



(51) International Patent Classification:
H04R 25/00 (2006.01) *H04R 25/02* (2006.01)

(21) International Application Number:
PCT/SG2009/000095

(22) International Filing Date:
18 March 2009 (18.03.2009)

(25) Filing Language: English

(26) Publication Language: English

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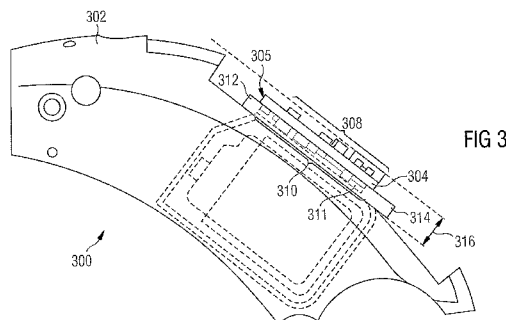
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(81) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: BASE FOR HEARING AID CIRCUITRY



(57) Abstract: Embodiments relate to a base (306) for mounting a circuit board assembly (304) in a behind-the-ear hearing aid (300). The base may include a cored region (311) and one or more support ribs (312). At least one of the support ribs (312) has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region (311). The cored region (311) and the support ribs (312) comprise elastomeric material.

DESCRIPTION**BASE FOR HEARING AID CIRCUITRY**

Embodiments relate to a base for mounting a circuit board assembly in a behind-the-ear hearing aid.

A hearing aid is usually fitted in or behind the ear of a user to amplify sound for the user. A hearing aid usually includes a hearing aid housing containing a microphone for collecting sound waves, a signal processing circuit (also referred to as a speech processing circuit) for processing the collected sound waves, and a loudspeaker (which may also be referred to as a receiver in the field of hearing aids). To provide power for the microphone, the signal processing circuit, and the loudspeaker, the hearing aid usually includes a battery chamber housing, also referred to as a battery door, coupled to the hearing aid housing.

Fig. 1 shows a partial cross-sectional view of a conventional behind-the-ear (BTE) hearing aid 100. The hearing aid 100 includes a hearing aid housing 102, a circuit board assembly 104 coupled to the hearing aid housing 102 via two plastic ribs 106 and 107. The circuit board 104 includes upward-facing components 108 and downward-facing components 110. The hearing aid housing 102 may also accommodate a microphone (not shown) and a loudspeaker (not shown).

The plastic ribs 106 and 107 must provide a minimum clearance between the hearing aid housing 102 and components 108 and 110 of the circuit board assembly 104 to prevent vibration or shocks from damaging components 108 and 110. If the circuit board assembly 104 includes a mounted or tact switch (not shown), the plastic ribs 106 and 107 also support circuit board assembly 104 to withstand downward actuation force.

Additional plastic ribs (not shown) are also needed to enclose the receiver compartment to avoid or reduce acoustic

leakage. These features take up additional space in the BTE hearing aid housing, resulting in a profile 112.

It is desired to decrease the profile of hearing aid housing 102 without compromising on support and protection of the components 108 and 110 and acoustical leakage.

An embodiment of the invention provides a behind-the-ear hearing aid that includes an elastomeric base for mounting a circuit board assembly in the hearing aid. The BTE further includes a circuit board assembly attached to the base, a microphone, a loudspeaker, and a hearing aid housing. The hearing aid housing includes a receiving portion adapted to receive the base.

In some embodiments, the base includes a cored region and one or more support ribs. In some embodiments, at least one of the one or more support ribs has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region

In some embodiments, the base includes an overlap seal configured to physically couple with the receiving portion. In some embodiments, the circuit board assembly is attached to the base with an adhesive.

Some embodiments of the invention provide a base including a cored region and one or more support ribs. At least one of the support ribs has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region. The cored region and the one or more support ribs are elastomeric material.

In some embodiments, the elastomeric material comprises natural rubber. In some embodiments, the elastomeric material comprises synthetic rubber. In some embodiments, the elastomeric material comprises silicone rubber.

In some embodiments, one or more support ribs comprises two substantially parallel support rails. In some embodiments, the two substantially parallel rails extend the length of a circuit board of the circuit board assembly. In some embodiments, the two substantially parallel rails extend the width of a circuit board of the circuit board assembly.

In some embodiments, the one or more support ribs define a rectangular cored region. In some embodiments, the one or more support ribs define a cored region comprising a mold of one or more components mounted on the circuit board assembly.

In some embodiments, the circuit board comprises a printed circuit board. In some embodiments, the base includes an overlap seal configured to physically couple with a receiving portion of a hearing aid.

Some embodiments of the invention provide a method for mounting a circuit board assembly in a BTE hearing aid. The method includes providing a base comprising an elastomeric material, mounting the circuit board assembly onto the base, and mounting the base onto a receiving portion of a hearing aid housing.

In some embodiments, a base is provided which includes a cored region and two or more support ribs. At least one of the support ribs has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region. Mounting the circuit board assembly onto the base includes mounting a component of the circuit board assembly between the two or more support rib of the base.

In some embodiments, a base is provided which includes an overlap seal. Mounting the base onto the receiving portion of the hearing aid housing includes physically coupling the overlap seal with the receiving portion to form a seal between the base and the hearing aid housing. The coupling

includes physically coupling at least one rib of the overlap seal between at least two sidewalls of the hearing aid housing.

In some embodiments, grease is applied to at least one rib of the overlap seal.

The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the following description, various embodiments of the invention are described with reference to the following drawings, in which:

Figure 1 shows a partial cross-sectional view of a conventional BTE hearing aid;

Figure 2 shows a side view of a BTE hearing aid, a base for mounting a circuit board assembly, and a circuit board according to an embodiment;

Figure 3 shows a partial cross-sectional view of a BTE hearing aid with a base for mounting a circuit board assembly according to an embodiment;

Figure 4 shows a top view of a base for mounting a circuit board assembly according to an embodiment;

Figure 5 shows a bottom view of a base for mounting a circuit board assembly according to an embodiment;

Figure 6 shows a cross sectional view of a base for mounting a circuit board assembly according to an embodiment;

Figures 7-9 show a sequence of installing a base for mounting a circuit board assembly in a BTE hearing aid according to an embodiment;

Figure 10 shows a side view of a BTE hearing aid, a base for mounting a circuit board assembly, and a circuit board according to an embodiment;

Figure 11 shows a side view of a BTE hearing aid, a base for mounting a circuit board assembly, and a circuit board according to an embodiment; and

Figure 12 shows a side view of a BTE hearing aid, a base for mounting a circuit board assembly, and a circuit board according to an embodiment.

FIG. 2 shows a partial cross-sectional view of a BTE hearing aid with a base for mounting a circuit board assembly according to an embodiment. The hearing aid 200 includes a hearing aid housing 202, a circuit board assembly 204, and a base 212. The hearing aid housing includes receiving portion 234. The circuit board assembly 204 includes a circuit board 206, upward-facing components 208, and downward-facing components 210. In some embodiments, the circuit board 206 is a printed circuit board. In some embodiments, the circuit board assembly 204 includes only upward-facing components 208 or downward-facing components 210.

The base 212 is made of elastomeric material. Examples of elastomeric material include, but are not limited to, natural rubber, synthetic rubber, and thermoplastic elastomers. In some embodiments, the base 212 is made of silicone rubber. The base includes a cored region 214, support ribs 216, 218, 220, and 222, and overlap seal 232.

The support ribs 216, 218, 220, and 222 may have a height equal or greater than a maximum protrusion from the circuit board assembly 204 towards the cored region of a component mounted on the circuit board assembly 204. For example, support ribs 216 and 218 may have a height equal or greater

than a tallest component 224 of the downward-facing components 210.

In some embodiments, support ribs may be of differing heights and widths. For example, support ribs 216 and 218 may be of a height greater than the tallest component 224 and support ribs 220 and 222 may be height equal to the tallest component 224. In some embodiments, support ribs may be a singular rectangular, circular, or other shaped rib of equal height and width.

In some embodiments, the cored region 214 is defined by the support ribs 216, 218, 220, and 222. In some embodiments, the cored region 214 is as wide as the edges of the widest set downward-facing components 210. For example, the cored region 214 may be as wide as the distance between the extreme left edge of component 226 and the extreme right edge of component 224. In other embodiments, the cored region 214 is as wide as circuit board 206. For example, the cored region 214 may be as wide as the distance between the extreme left wall 228 and the extreme right wall 230 of the circuit board 206. Similarly, the cored region 214 may be as long as the longest set downward-facing components 210 or be as long as the circuit board 206.

Thus, the cored region 214 may correspond to the area around the edge of the circuit board assembly 204 that is unpopulated, e.g., an area that contains no components. The cored region 214 may also correspond to the area of the circuit board 206, or a combination of the area of the circuit board 206 and the edge of the circuit board assembly that is unpopulated. For example, the width of the cored region 214 may equal the width of the circuit board 206 and the length of the cored region 214 may equal the edge of the circuit board assembly 204 that is unpopulated.

The cored region 214, being made of elastomeric material, acts as a cushion to provide stability during drops and

shocks administered to the hearing aid 200. In addition, because the cored region 214 accepts downward-facing components in at least a portion of its depth, a low profile is possible as below seen in FIG. 3.

Moreover, because the base 212 is comprised of elastomeric material, circuit board assembly 204 may be incorporated into features where flexibility is desired. For example, a push-button operation may incorporate base 212 and circuit board assembly 204 in operating a feature of BTE headphone 200.

FIG. 3 shows a partial cross-sectional view of a BTE hearing aid with a base for mounting a circuit board assembly according to an embodiment. The hearing aid 300 includes a hearing aid housing 302 and a circuit board assembly 304 supported by a base 306. In some embodiments, a circuit board 305 is a printed circuit board. Upward-facing components 308 and downward-facing components 310 are mounted on the circuit board 305.

A base 306 includes a cored region 311, support ribs 312 and 314. In comparison to the profile 112 of FIG. 1, profile 316 is shallower because circuit board assembly 304 is mounted considerably closer to hearing aid housing 302 than the respective circuit board assembly 104 in FIG. 1. A lower profile, among other things, reduces overall size for a BTE hearing aid and increases comfort when worn by users.

FIG. 4 shows a top view of a base for mounting a circuit board assembly according to an embodiment. A base 400 includes support ribs 402, 404, 406, and 408, a cored region 410, and an overlap seal 412. In this embodiment, support ribs 404 and 408 equal the height maximum height of a component protrusion from a bottom surface of a circuit board assembly towards the cored region 410. Support ribs 404 and 408 define the length of the cored region 410, wherein the cored region 410 is as long as the longest set downward-facing components of a circuit board assembly.

Support ribs 402 and 406 are of a height greater than the height maximum height of a component protrusion from a bottom surface of a circuit board assembly towards the cored region 410. Support ribs 402 and 406 partially define the width of the cored region 410, wherein the cored region 410 has a width substantially equal to a circuit board.

FIG. 5 shows a bottom view of a base for mounting a circuit board assembly according to an embodiment. A base 500 includes support ribs 502 and 506, a cored region 510, and an overlap seal 512. The overlap seal 512 is configured to physically couple with a receiving portion of a hearing aid housing and thus may take on a large variety of shapes and sizes. For example, the overlap seal 512 may be circular and/or may be composed of one or more ribs. In FIG. 5, overlap seal 512 is a rectangular rib. In some embodiments, a base may comprise a flat bottom surface and be mounted via a snug fit between the perimeter walls of the base 500 and a receiving portion of a hearing aid housing or, for example, an adhesive such as liquid or gel adhesive, epoxy, or a polymer functioning as an adhesive.

FIG. 6 shows cross sectional view of a base for mounting a circuit board assembly according to an embodiment. Hearing aid 600 includes hearing aid housing 602. Hearing aid housing 602 includes receiving portion 604. The receiving portion 604 includes side walls 606 and 608. A base 610 physically couples with the receiving portion 604 by a portion of overlap seal 612 snugly sliding in between side walls 606 and 608. The seal formed by the overlap seal 612 and receiving portion 604 minimizes acoustic leakage from within the hearing aid housing 602 and prevents water or other liquids from entering the hearing aid housing 602. Grease such as silicone grease or similar greases may also be applied to the overlap seal 612 to further enhance acoustical and liquid sealing performance.

FIGS. 7-9 show a sequence of installing a base for mounting a circuit board assembly in a BTE hearing aid according to an embodiment. In FIG. 7, a hearing aid 700 includes a hearing aid housing 702. The hearing aid housing 702 includes a receiving portion 726, which accommodates a base 712. A circuit board assembly 704 is shown above the base 712. The circuit board assembly 704 includes a circuit board 706, upward-facing components 708, and downward-facing components 710. The base 712 includes support ribs 714, 716, 718, and 720, a cored region 722, and an overlap seal 724.

In FIG. 8, the overlap seal 724 of base 712 is inserted into receiving portion (not shown) of hearing aid housing 702 to produce a snug fit between the overlap seal 724 and the sidewalls (not shown) of the receiving portion (not shown).

In FIG. 9, circuit board 706 is inserted between support ribs 714 and 716 and, at the same time, the downward-facing components 710 are inserted between support ribs 718 and 720. The support ribs 714, 716, 718, and 720 may have a height equal or greater than a maximum protrusion from the circuit board assembly 204 towards the cored region of a component mounted on the circuit board assembly 204.

In some embodiments, the cored region 722 is defined by the support ribs 714, 716, 718, and 720. In some embodiments, the cored region 722 is as wide as the edges of the widest set downward-facing components 710. In other embodiments, the cored region 722 is as wide as circuit board 706. Similarly, cored region 722 may be as long as the longest set downward-facing components of downward-facing components 710 or be as long as the circuit board 706.

In FIG. 10, a hearing aid 1000 includes a hearing aid housing 1002. The hearing aid housing 1002 includes a receiving portion 1028, which accommodates a base 1012. In some embodiments, the receiving portion 1028 physically couples with the perimeter sidewalls of the base 1012 to achieve a

snug fit. A circuit board assembly 1004 is shown above the base 1012. The circuit board assembly 1004 includes a circuit board 1006 and upward-facing components 1008. The base 1012 includes support ribs 1014, 1016, 1018, and 1020, and a cored region 1022.

In this embodiment, support ribs 1014, 1016, 1018, and 1020 may be of any height because cored region 1022 accommodates circuit board 1006 of circuit board assembly 1004, which has no downward-facing components. In this embodiment, the cored region 1022 defined by support ribs 1014, 1016, 1018, and 1020 is substantially the same area of circuit board 1006. Thus, support ribs 1014, 1016, 1018, and 1020 surround and fit snugly with the perimeter walls 1024 and 1026 (as well as the other two walls not shown) of circuit board 1006. In some embodiments, a base may have no support ribs and a circuit board assembly may be attached to the base with an adhesive. The adhesive may comprise a liquid or gel adhesive, epoxy, or a polymer functioning as an adhesive.

In FIG. 11, a hearing aid 1100 includes a hearing aid housing 1102. The hearing aid housing 1102 includes a receiving portion 1128, which accommodates base 1112. In some embodiments, the receiving portion 1128 physically couples with the sidewalls of the base 1112 to achieve a snug fit. A circuit board assembly 1104 is shown above the base 1112. The circuit board assembly 1104 includes a circuit board 1106, upward-facing components 1108, and downward-facing components 1110. The base 1112 includes support ribs 1114, 1116, 1118, and 1120, and a cored region 1122.

In this embodiment, support ribs 1114, 1116, 1118, and 1120 may be of any height because support ribs 1114, 1116, 1118, and 1120 fit snugly with the outer perimeter of the downward-facing components 1110 of the circuit board assembly 1104. In this embodiment, the cored region 1122 defined by support ribs 1114, 1116, 1118, and 1120 is substantially the same area corresponding to the circuit board 1106 area populated

by the downward facing components 1110. In some embodiments, support ribs and cored region may form a mold corresponding to downward-facing components of a circuit board assembly.

In FIG. 12, a hearing aid 1200 includes a hearing aid housing 1202. The hearing aid housing 1202 includes a receiving portion 1228, which accommodates base 1212. In some embodiments, the receiving portion 1228 physically couples with the sidewalls of the base 1212 to achieve a snug fit. A circuit board assembly 1204 is shown above the base 1212. The circuit board assembly 1204 includes a circuit board 1206, upward-facing components 1208, and downward-facing components 1210. The base 1212 includes support ribs 1214 and 1218 and a cored region 1222.

In this embodiment, two support ribs, support ribs 1214 and 1218, may fit snugly with the outer perimeter of the downward-facing components 1210 of the circuit board assembly 1204 or with the two corresponding perimeter walls of circuit board 206. In this embodiment, the cored region 1222 is defined by support ribs 1214 and 1218 and the length of the base 1212. In some embodiments, two support ribs may reside on the front and back of a base. In some embodiments, a base may have no support ribs and a circuit board assembly may be attached to the base with an adhesive. The adhesive may comprise a liquid or gel adhesive, epoxy, or a polymer functioning as an adhesive.

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 behind-the-ear hearing aid, the hearing aid comprising:

a base for mounting a circuit board assembly in the hearing aid, the base comprising elastomeric material;

the circuit board assembly, the circuit board assembly attached to the base;

a microphone;

a loudspeaker; and

a hearing aid housing, the hearing aid housing comprising a receiving portion, the receiving portion adapted to receive the base.

2. The hearing aid of claim 1, wherein the base further comprises:

a cored region; and

one or more support ribs.

3. The hearing aid of claim 2, wherein at least one of the one or more support ribs has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region

4. The hearing aid of claim 1, wherein the base further comprises an overlap seal, the overlap seal configured to physically couple with the receiving portion.

5. The hearing aid of claim 1, wherein the circuit board assembly is attached to the base with an adhesive.

6. A base for mounting a circuit board assembly in a behind-the-ear hearing aid, the base comprising:

a cored region; and

one or more support ribs, at least one of which has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region, wherein the cored region and the one or more support ribs comprise elastomeric material.

7. The base of claim 6, wherein the elastomeric material comprises natural rubber.

8. The base of claim 6, wherein the elastomeric material comprises synthetic rubber.

9. The base of claim 8, wherein the elastomeric material comprises silicone rubber.

10. The base of claim 6, wherein the one or more support ribs comprises two substantially parallel support rails.

11. The base of claim 10, wherein the two substantially parallel rails extend the length of a circuit board of the circuit board assembly.

12. The base of claim 10, wherein the two substantially parallel rails extend the width of a circuit board of the circuit board assembly.

13. The base of claim 6, wherein the one or more support ribs define a rectangular cored region.

14. The base of claim 6, wherein the one or more support ribs define a cored region comprising a mold of one or more components mounted on the circuit board assembly.

15. The base of claim 6, wherein the circuit board comprises a printed circuit board.

16. The base of claim 6, wherein the base further comprises an overlap seal, the overlap seal configured to physically couple with a receiving portion of a hearing aid.

17. A method for mounting a circuit board assembly in a behind-the-ear hearing aid, the method comprising:

providing a base, the base comprising an elastomeric material;

mounting the circuit board assembly onto the base; and

mounting the base onto a receiving portion of a hearing aid housing.

18. The method of claim 17, wherein providing the base comprises providing the base comprising:

a cored region;

two or more support ribs, at least one of which has a height equal or greater than a maximum height of a component protrusion from a bottom surface of the circuit board assembly towards the cored region; and

wherein mounting the circuit board assembly onto the base comprises mounting a component of the circuit board assembly between the two or more support rib of the base.

19. The method of claim 17, wherein providing the base comprises providing the base comprising an overlap seal; and

wherein mounting the base onto the receiving portion of the hearing aid housing comprises physically coupling the overlap seal with the receiving portion to form a seal between the base and the hearing aid housing, the coupling including: physically coupling at least one rib of the overlap seal between at least two sidewalls of the hearing aid housing.

20. The method of claim 19, further comprising:
applying grease to the at least one rib of the overlap seal.

FIG 1

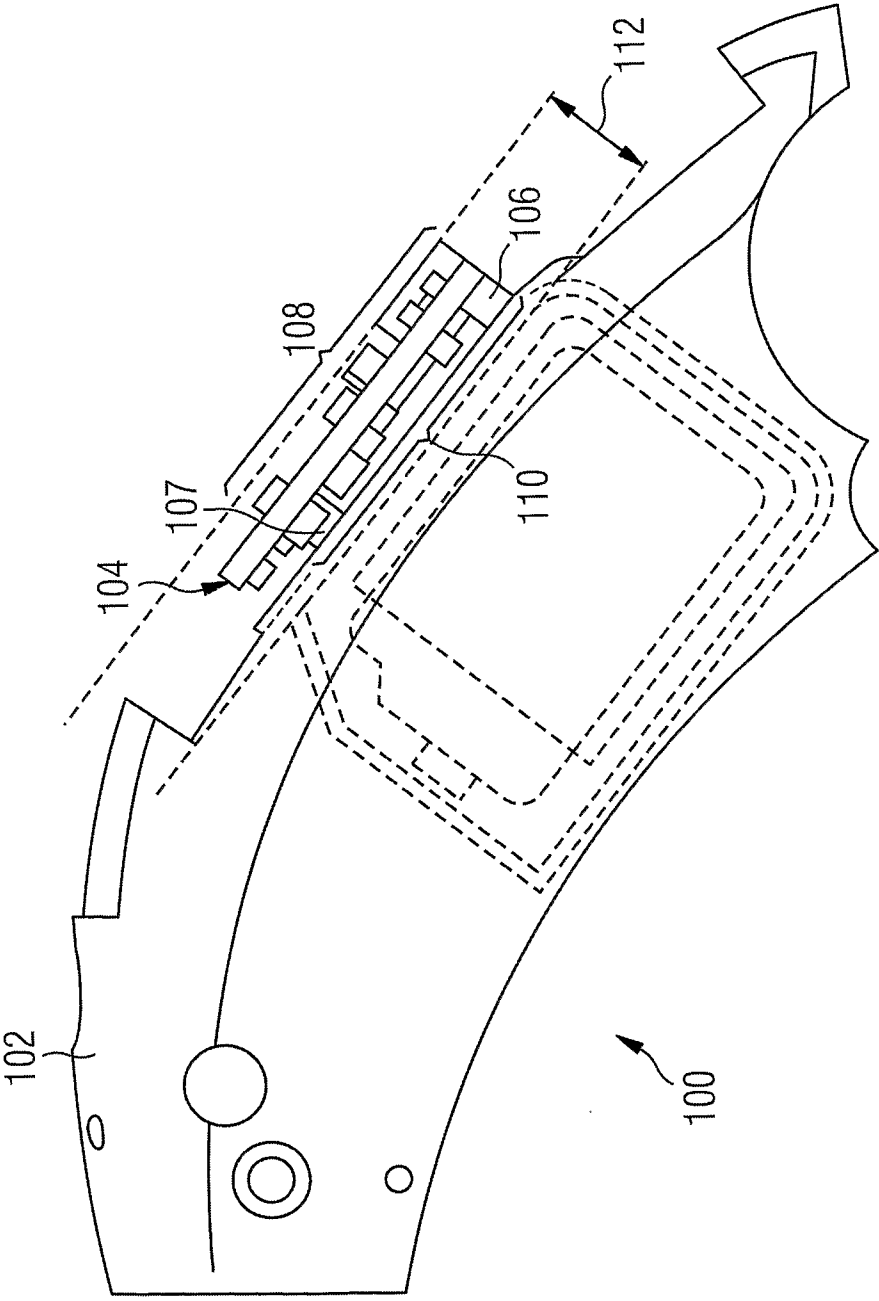


FIG 2

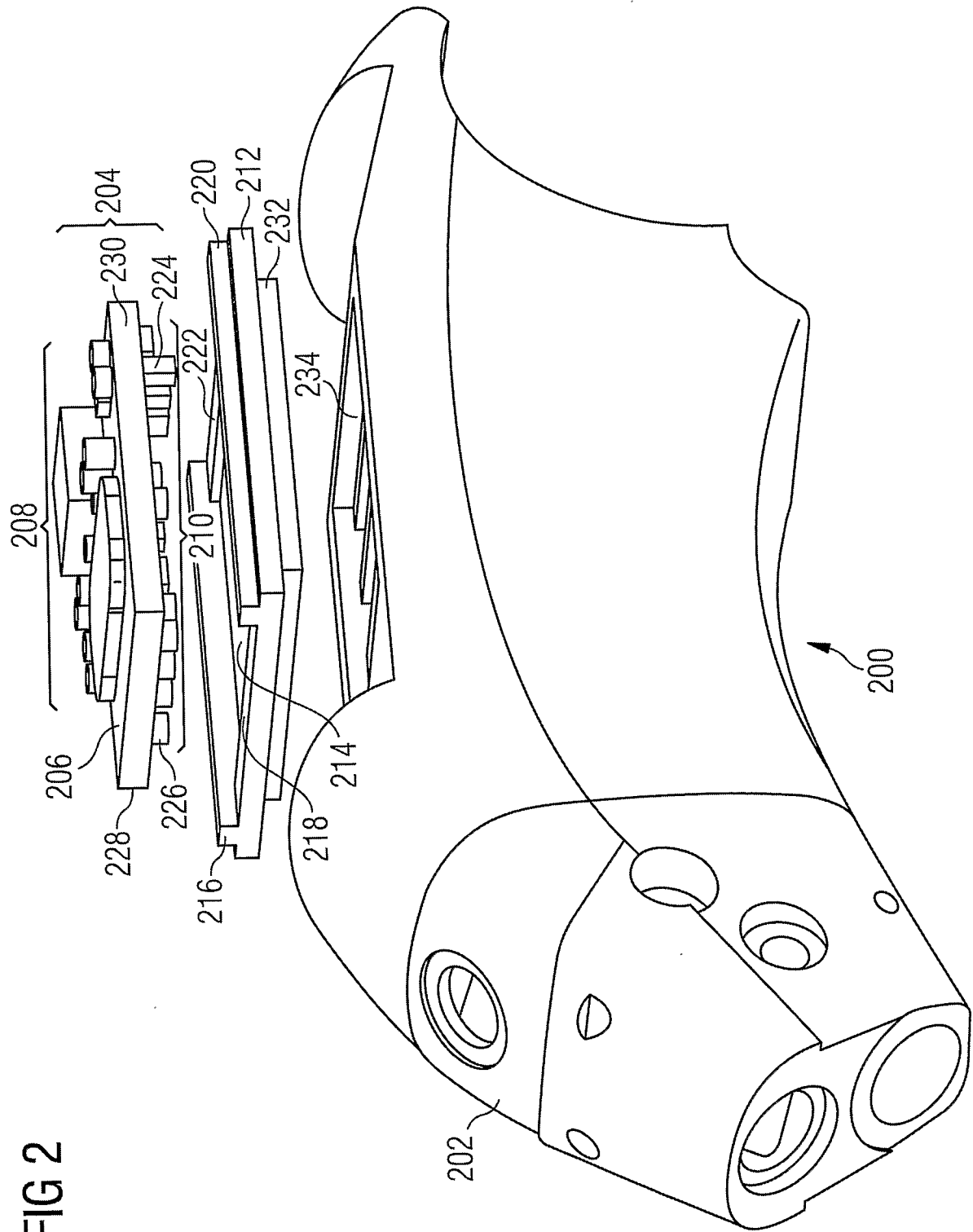
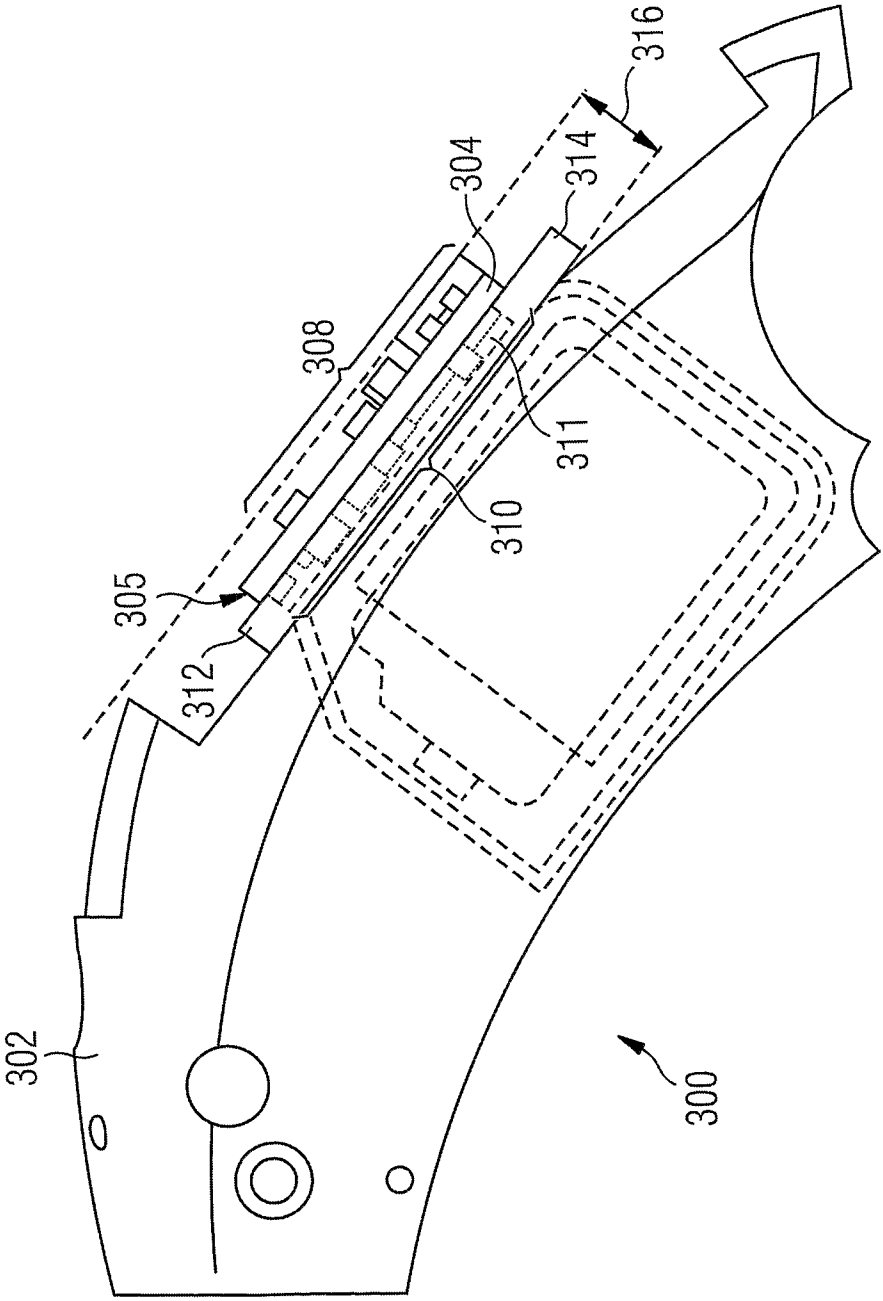
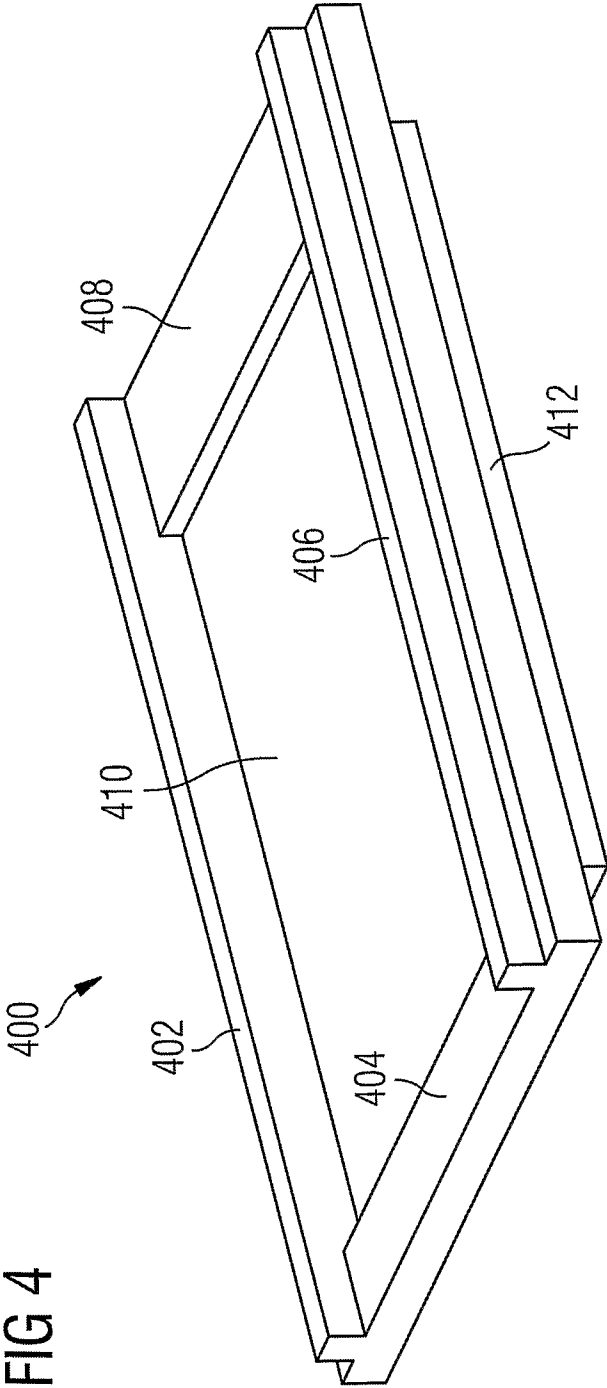
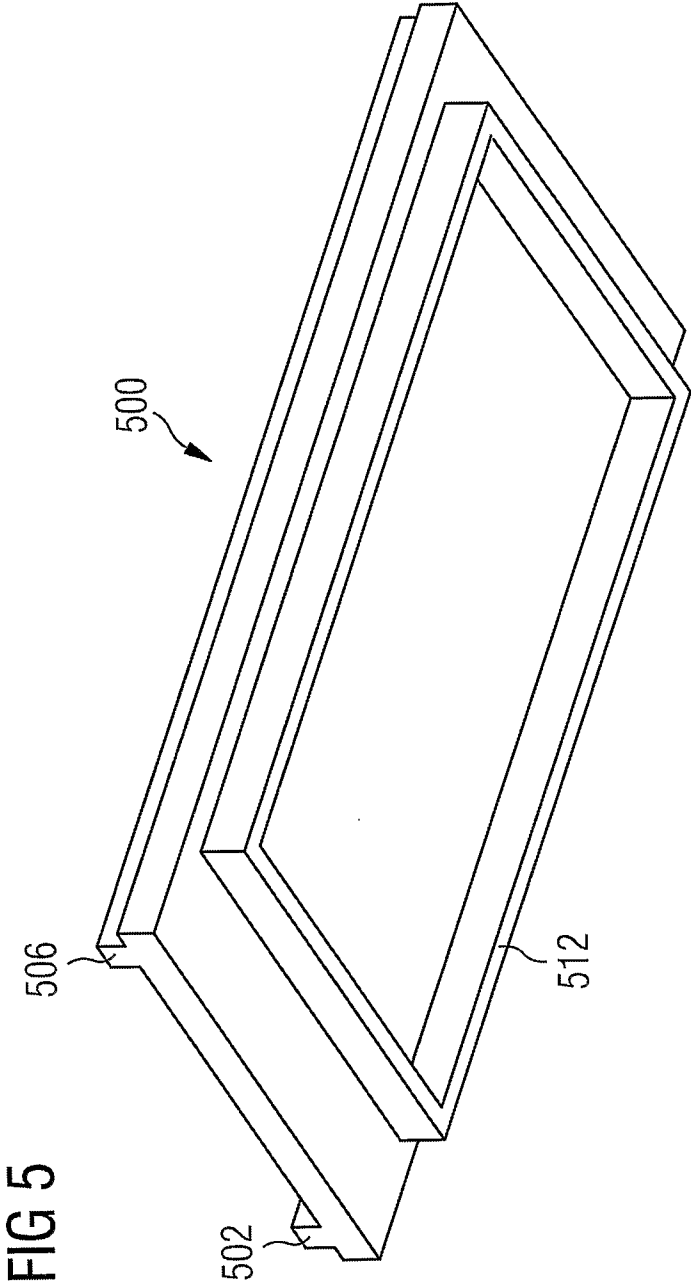


FIG 3







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FIG 6

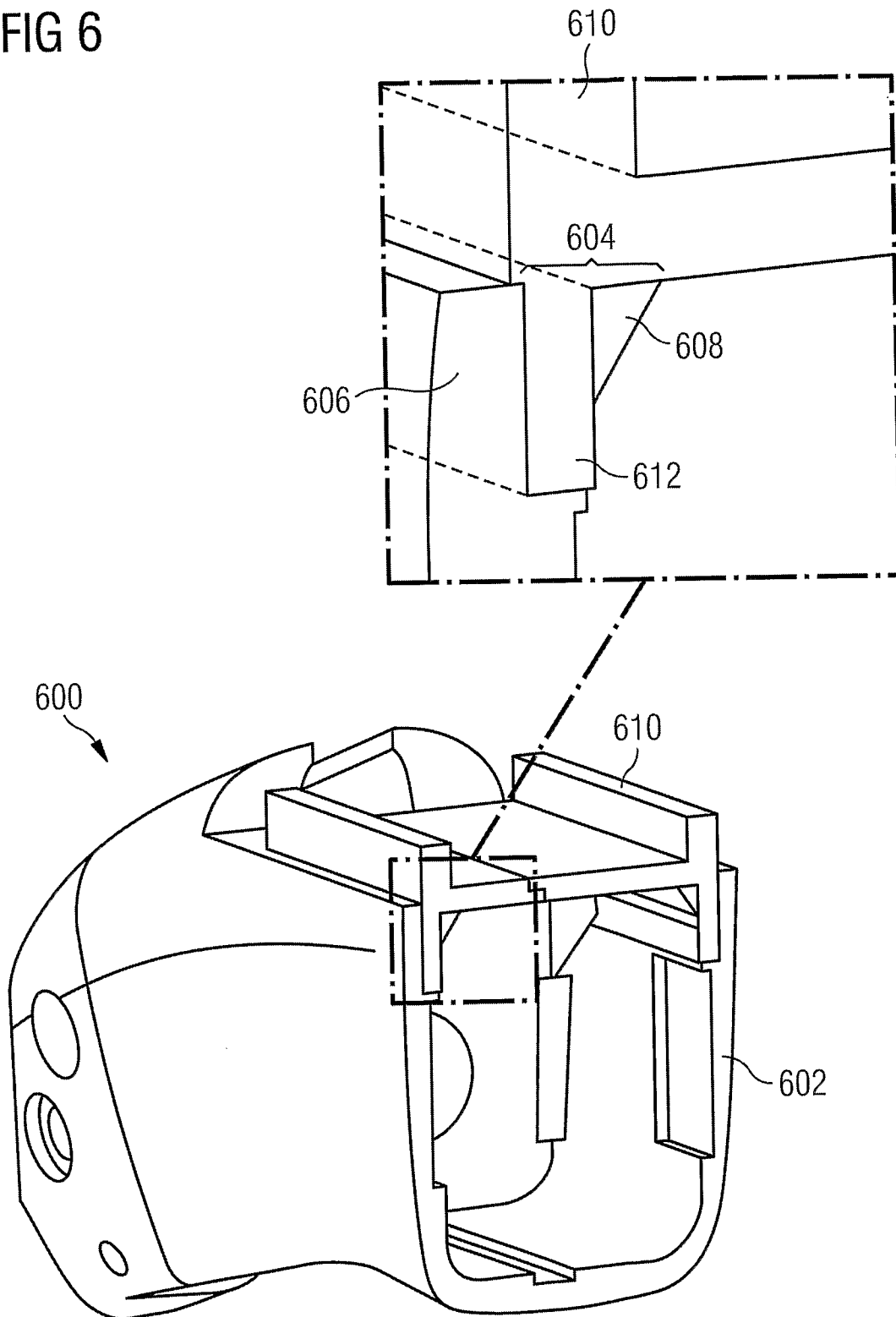
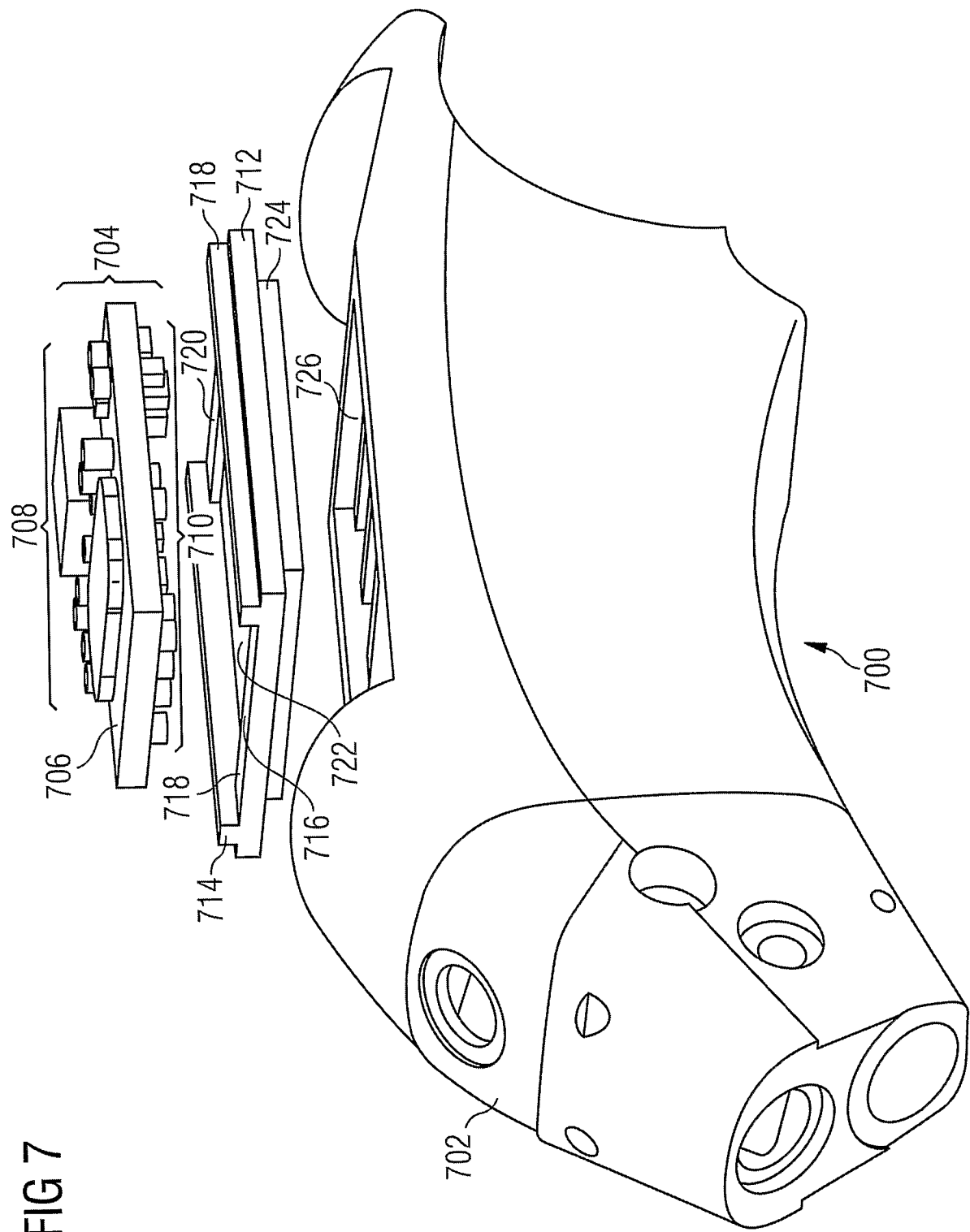
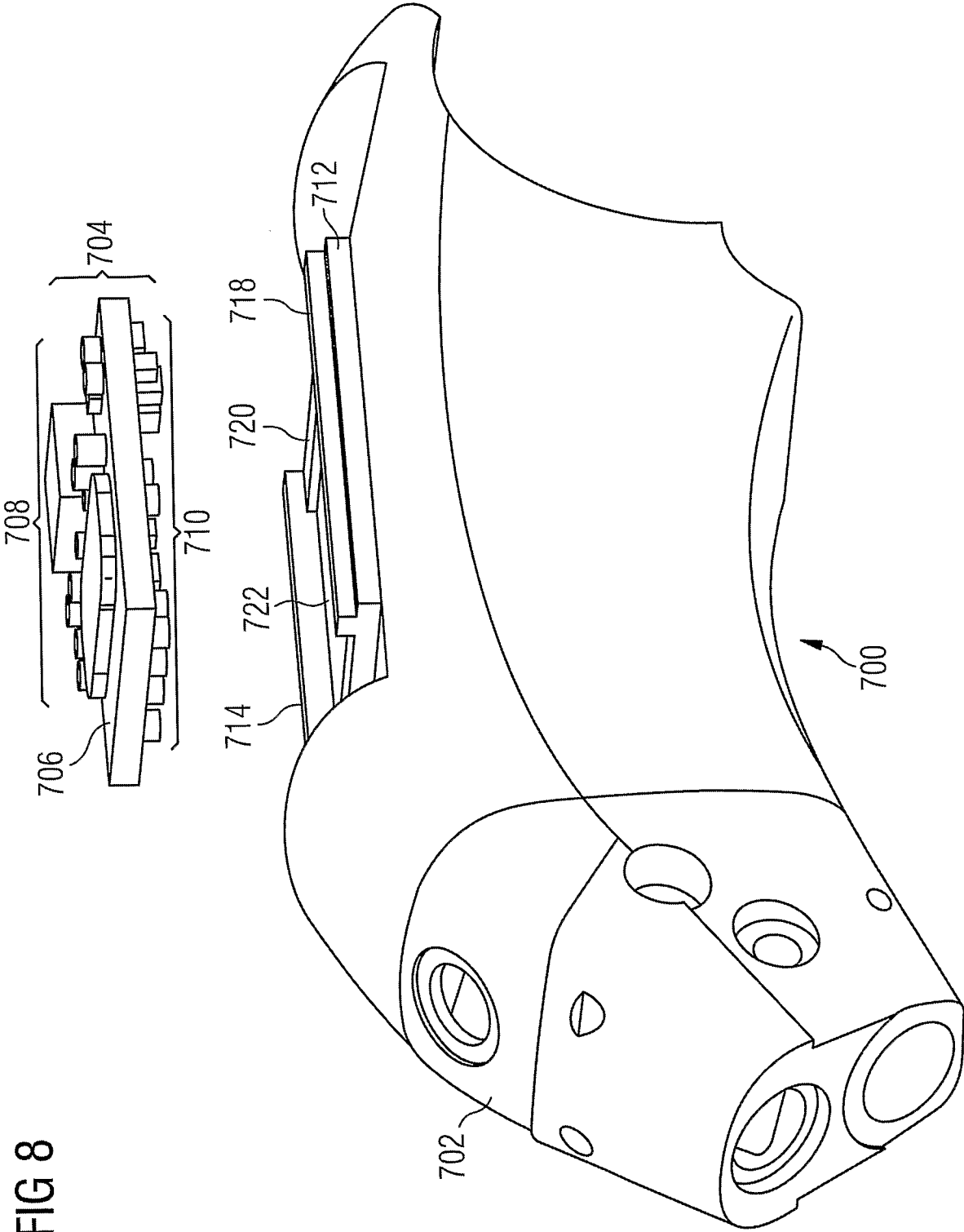
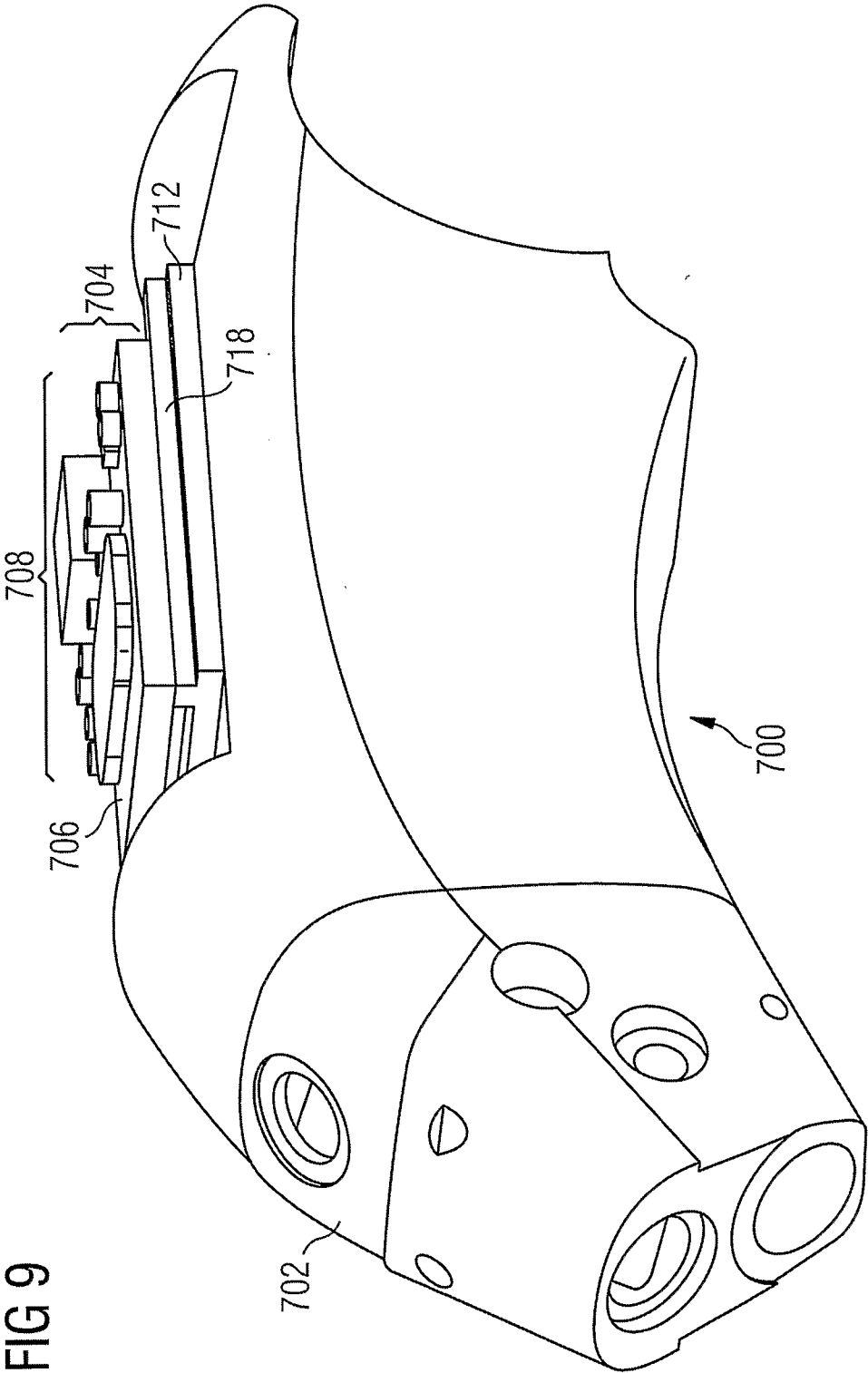
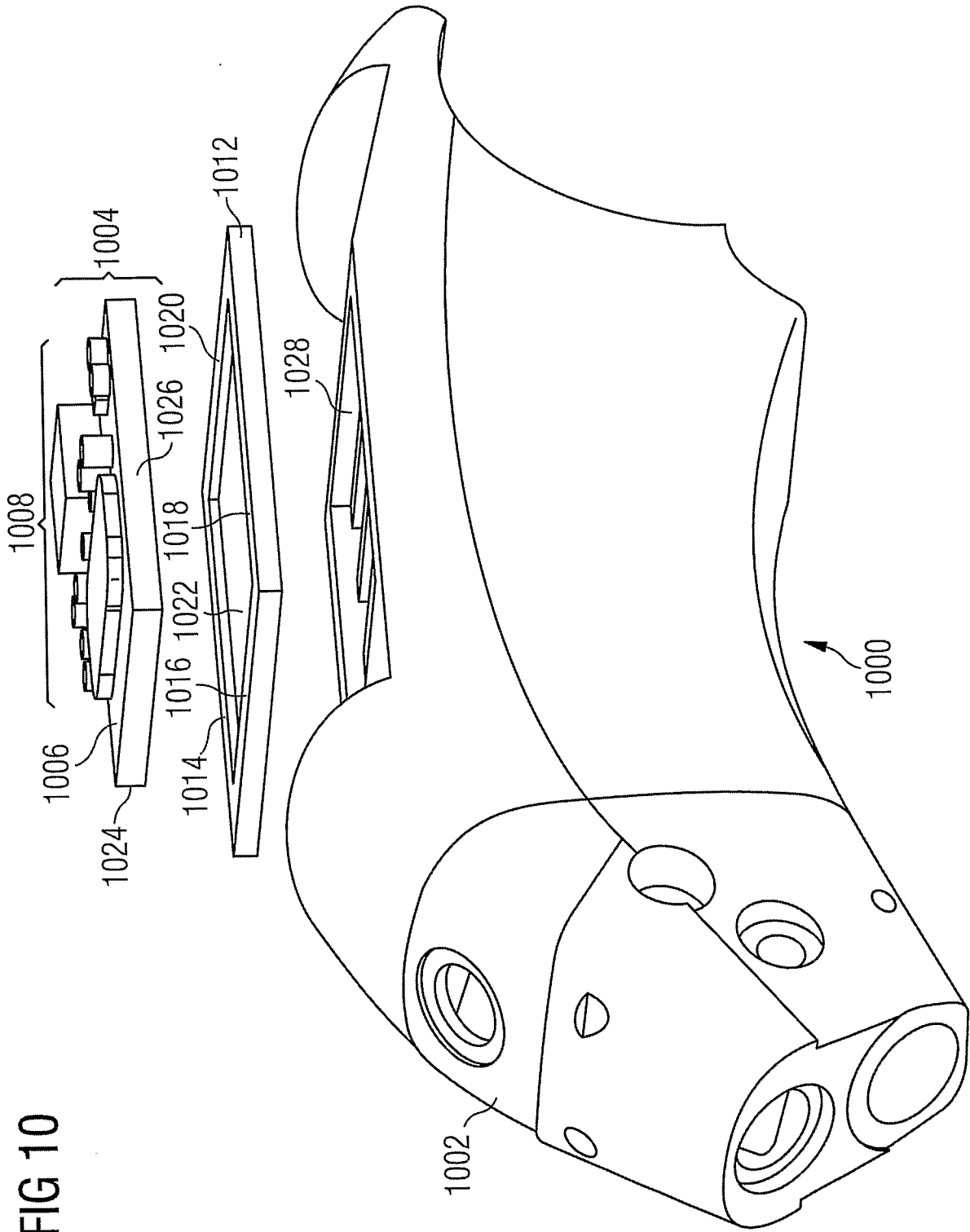


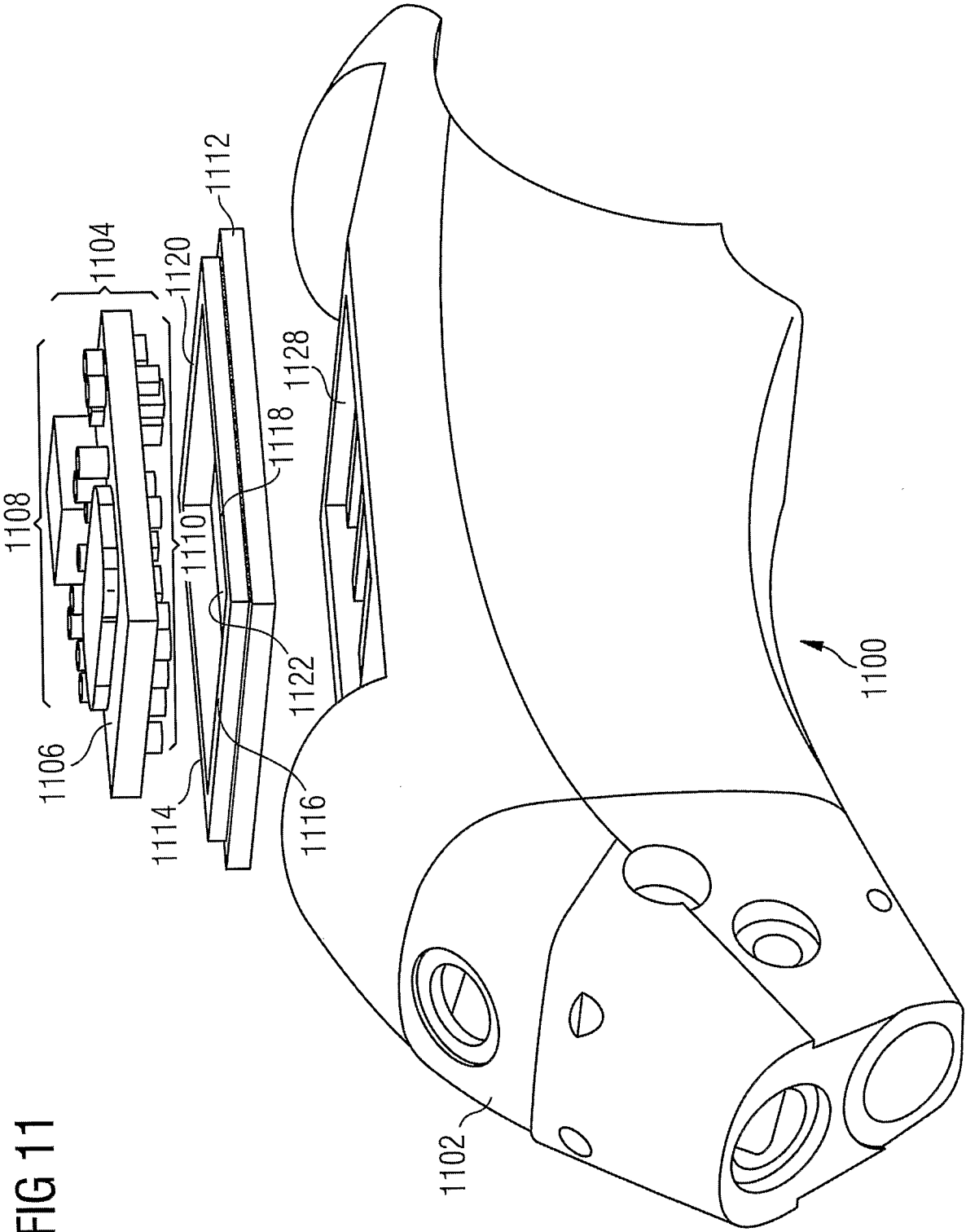
FIG 7

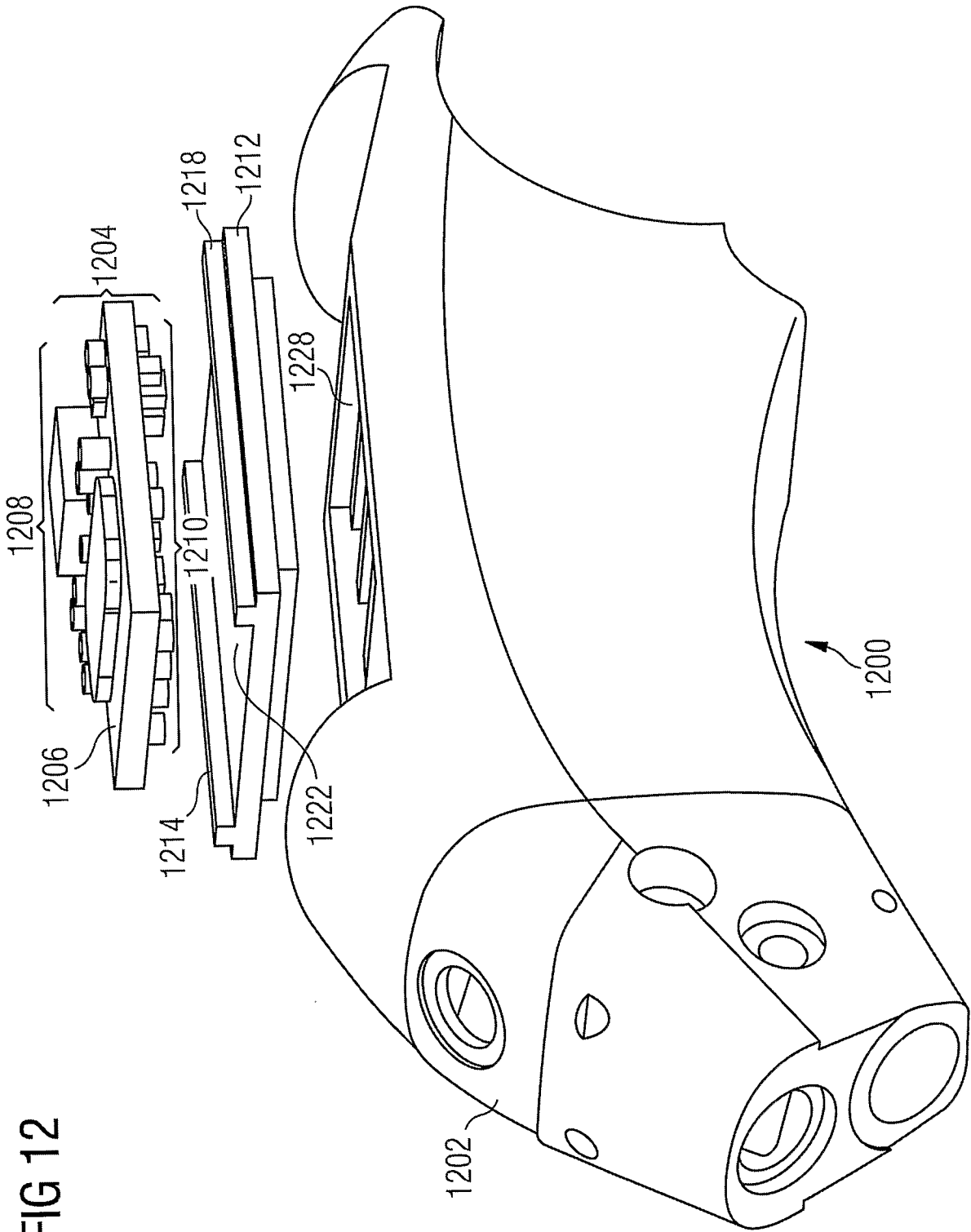












INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 2009/000095

A. CLASSIFICATION OF SUBJECT MATTER

IPC⁸: **H04R 25/00** (2006.01); **H04R 25/02** (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; H04R 25/02

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	US 2005/226448 A1 (Portmann) 13 October 2005 (13.10.2005) <i>Abstract; claims 1,4, and 6; Fig.4</i> --	1, 6, 17
A	EP 1278220 A2 (Jorgensen et al.) 22 January 2003 (22.01.2003) <i>Abstract; claim 1</i> --	1, 6, 17
A	DE 3921551 (Mueller, Thiel) 3 January 1991 (03.01.1991) <i>Abstract; claims 1 and 7</i> ----	1, 6, 17

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

* Special categories of cited documents:

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Date of the actual completion of the international search
15 June 2009 (15.06.2009)Date of mailing of the international search report
3 July 2009 (03.07.2009)Name and mailing address of the ISA/ AT
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Dresdner Straße 87, A-1200 ViennaAuthorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SG 2009/000095

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