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Canadian Intellectual Property Office

CA 3096994 A1 2019/10/17

(21) 3 096 994

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2019/04/15
(87) Date publication PCT/PCT Publication Date: 2019/10/17
(85) Entrée phase nationale/National Entry: 2020/10/13
(86) N° demande PCT/PCT Application No.: US 2019/027557
(87) N° publication PCT/PCT Publication No.: 2019/200409
(30) Priorités/Priorities: 2018/04/14 (US62/657,744); 2018/08/08 (US62/716,066); 2019/01/15 (US62/792,573)

(51) Cl.Int./Int.Cl. *A42B 3/04* (2006.01), *A42B 1/22* (2006.01), *A42B 3/06* (2006.01), *A42B 3/10* (2006.01), *A42B 3/12* (2006.01), *A42B 3/14* (2006.01), *A42B 3/32* (2006.01)

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(54) Titre : ENSEMBLE CASQUE REGLABLE
(54) Title: ADJUSTABLE HELMET ASSEMBLY

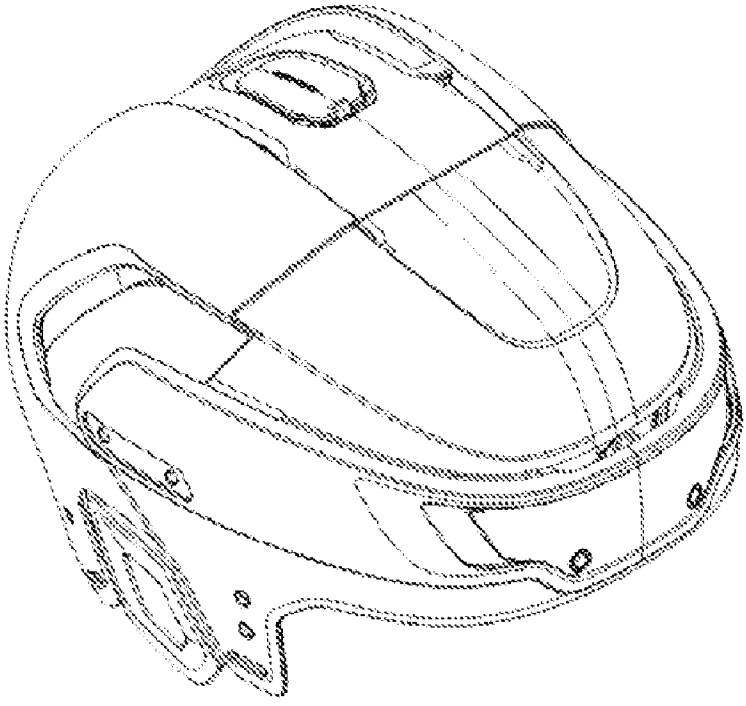

FIG. 38A

(57) Abrégé/Abstract:
The adjustable helmet assembly disclosed within in comprises a front shell, a back shell and a locking mechanism. The locking mechanism allows sliding movement of the front shell relative to the back shell for adjustment to a desired length for a specific

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(57) Abrégé(suite)/Abstract(continued):
wearer. The locking mechanism is movable from an unlocked position allowing the front shell to move relative to the back shell, and a locked position prohibiting the front shell to move relative to the back shell. The locking mechanism may be a clamp or lever function, and/or a cam function. Accordingly, the adjustable helmet may further comprise crumple zones to further reduce and/or dissipate impact forces.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 October 2019 (17.10.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/200409 A1

(51) International Patent Classification:
A42B 3/04 (2006.01) *A42B 3/12* (2006.01)
A42B 1/22 (2006.01) *A42B 3/14* (2006.01)
A42B 3/06 (2006.01) *A42B 3/32* (2006.01)
A42B 3/10 (2006.01)

(21) International Application Number:
PCT/US2019/027557

(22) International Filing Date:
15 April 2019 (15.04.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

62/657,744	14 April 2018 (14.04.2018)	US
62/716,066	08 August 2018 (08.08.2018)	US
62/792,573	15 January 2019 (15.01.2019)	US

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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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: ADJUSTABLE HELMET ASSEMBLY

(57) Abstract: The adjustable helmet assembly disclosed within in comprises a front shell, a back shell and a locking mechanism. The locking mechanism allows sliding movement of the front shell relative to the back shell for adjustment to a desired length for a specific wearer. The locking mechanism is movable from an unlocked position allowing the front shell to move relative to the back shell, and a locked position prohibiting the front shell to move relative to the back shell. The locking mechanism may be a clamp or lever function, and/or a cam function. Accordingly, the adjustable helmet may further comprise crumple zones to further reduce and/or dissipate impact forces.

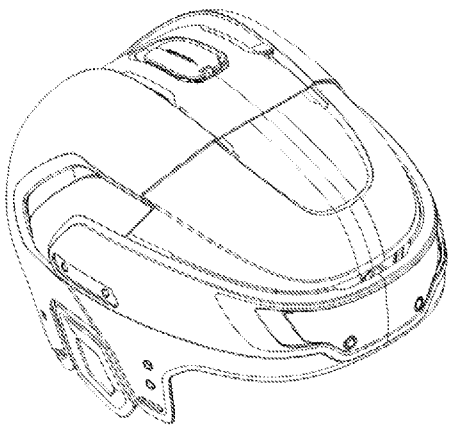

FIG. 38A

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ADJUSTABLE HELMET ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Appl. Serial No. 62/657,744 entitled "Collapsible Helmet Impact Zones," filed April 14, 2018, U.S. Provisional Patent Appl. Serial No. 62/716,066 entitled "No Tool Adjustable Helmet System," filed August 08, 2018 and U.S. Provisional Patent Appl. Serial No. 62/792,573 entitled "No Tool Adjustable Helmet System, filed January 15, 2019, which all the disclosures are incorporated by reference herein in its entireties.

TECHNICAL FIELD

[0002] The present invention relates to an adjustable helmet system assembly and a method for fitting the adjustable helmet system assembly to a wearer's head. The adjustable helmet system assembly includes a locking mechanism that allows the front shell to be movable or slidable to a rear shell to adjust to a desired length. Furthermore, the adjustable helmet system assembly may incorporate crumple zones or crumple features that allow the adjustable helmet system assembly to undergo structural changes in a pre-determined fashion so that the structural changes are recoverable but yet provide protection.

BACKGROUND OF THE INVENTION

[0003] Adjustable helmets have been known in the art for years, and used in different applications such as sports, firefighting, construction work, and the military. In particular, many of these adjustable helmets allow the wearer to adjust the helmet size to fit a particular head. For example, helmet adjustment mechanisms have consisted of a stud and notch or a headband with a rack and pinion adjusting mechanism, and/or by loosening and tightening screws.

[0004] Although, these and other conventional adjustment mechanisms have worked well, they have failed in a number of areas. For instance, loosening and tightening screws increase the length of adjustment time, require that the user carries tools and do not allow the helmet wearer to adjust the size of the helmet while wearing the helmet and/or adjust the helmet quickly. Accordingly, the helmet wearer must remove the helmet, adjust the helmet, and retry the helmet size multiple times before a proper fit can be established.

[0005] Also, in many other adjustable helmet designs, the adjustment does not allow the comfort liner padding to be properly fitted to the head of the user. Comfort liner padding assemblies are usually provided in standard sizes (e.g., small to xlarge) and are affixed to the helmet. The comfort liner padding assemblies are not adjustable, these variances create significant difficulties in having the helmet sized

correctly with the comfort liner pad system. The comfort liner pad system may be improperly positioned, too large or too small preventing or decreasing the safety of its intended function.

[0006] Furthermore, the previous adjustable helmet designs are usually manufactured from rigid or substantially rigid polymers. These rigid polymers do not perform as intended because they lack the ability absorb a significant amount of energy after an impact and/or manufacturers tend to increase the relative thickness of the material. Using such materials or increased thicknesses, allows the impact force to be transferred to the wearer's head, thus causing severe traumatic brain injuries or result in adding unnecessary weight/imbalance resulting in disproportionate measurements for optimal muscle control. Accordingly, the impact force can also be transferred to other portions of the helmet, potentially causing premature disengagement of the helmet shells and exposing the wearer to further traumatic brain injuries.

BRIEF SUMMARY OF THE INVENTION

[0007] It is therefore an object of the present invention to provide an adjustable helmet system with improved locking mechanisms and crumple zones that can overcome some of the disadvantages of the previous helmet designs. The adjustable helmet system offers a two-piece helmet that allows adjustment of the helmet quickly and efficiently without the need for tools, allow the impact mitigation layers and/or comfort liners pad systems to be easily disconnected and/or adjusted within the helmet, and/or provide for controlled localized deflection and/or deformation through the incorporation of structural features that promote the absorption of energy from an impact resulting in reduced forces experienced by the wearer and other portions of the helmet.

[0008] Another practical advantage with this adjustable helmet system that also improves safety by enabling a better customizing to fit different head shapes such as oval, oblong and round, not just adapt to sizes. Parents will be able to customize the helmets as their children grow, thus avoiding the understandable but dangerous habit of buying large so that the child will 'grow into it'. A frontal fall in a helmet that is too large, forces the helmet backwards and can force the back of the helmet into the neck at the base of the skull, at the anatomical area of the brain stem, with tragic results often worse than if a helmet had not been worn at all.

[0009] In one embodiment, the adjustable helmet system may comprise a locking system. The adjustable helmet system comprises a first (or front) shell; a second (or back) shell, the second shell being slidably attached to the first shell; a locking mechanism, the locking mechanism being movable between a first unlocked position which allows the first and second shells to slide relative to each other and a second locked position which inhibits the first and second shells from sliding relative to each other.

[00010] In one embodiment, an adjustable helmet system may comprise a helmet clamp locking mechanism assembly. The adjustable helmet system may comprise a front shell, a back shell, and a

clamp locking assembly. The clamp locking assembly will facilitate easy no-tool detachment and securement by using a lever function. To adjust a representative helmet, the user may lift the clamp body allowing the clamp post to place a downward compressive force against the clamp tongue thereby releasing the front and back shells to move relative to each other. Conversely, to secure or lock the clamp locking assembly, the user will push the clamp body down within the cavity allowing the base plate coupled to the clamp post to place an upward compressive force to sandwich the front and back shells and prevent movement and have the plurality of teeth engage with the plurality of recesses. Alternatively, the helmet may further comprise helmet alignment guides. The helmet alignment guides may be strategically placed onto the helmet and can be placed within any region of the helmet, including frontal, ridge (or top), and/or the sides (right or left). The helmet alignment guides will help align the front and back shells in the proper position during adjustment.

[00011] In one embodiment, the adjustable helmet system may comprise a clamp locking mechanism assembly that may be modular and coupled to any commercially available helmet (retrofitting a commercially available helmet). The clamp locking mechanism assembly may comprise at least one of a clamp housing, a clamp body, clamp post, a base plate, a clamp tongue and/or any combination thereof. The clamp housing has a top surface and a bottom surface, at least a portion of the top surface having a cavity extending from the top surface towards the bottom surface, the cavity sized and configured to receive the clamp body, the cavity having an aperture, the aperture extends through the top surface to the bottom surface, the aperture is sized and configured to receive a clamp post, the clamp post is pivotally coupled to the clamp body; the clamp housing bottom surface having a plurality of teeth, the plurality of teeth extending outwardly from the bottom surface, the plurality of teeth sized and configured to fit within a plurality of recesses on a clamp tongue. The clamp tongue having a first surface and a second surface, at least a portion of the first surface including the plurality recesses, the plurality of recesses sized and configured to receive the clamp housing plurality of teeth, the clamp tongue having a channel, the channel extends through the first surface to the second surface, the channel sized and configured to receive the clamp post; the clamp post coupled to a base plate.

[00012] In another embodiment, the adjustable helmet system may comprise a clamp locking mechanism that may be integrated within a helmet. The adjustable helmet system comprises a helmet and a clamp locking mechanism assembly. The clamp locking mechanism assembly may comprise at least one of a clamp housing, a clamp body, clamp post, a base plate, a clamp tongue, a spring and/or any combination thereof. The helmet having a front shell, and a back shell, at least a portion of the front or back shell having one or more alignment guides; the front or back shell may have a clamp tongue, the clamp tongue having a longitudinal length that extends outward from the front or back shell, the clamp tongue having a first surface and a second surface, at least a portion of the first surface including a

plurality recesses, the plurality of recesses sized and configured to receive a plurality of teeth, the clamp tongue having a channel, the channel extends through the first surface to the second surface, the channel sized and configured to receive the clamp post; the clamp post coupled to the base plate; at least a portion of the back or front shell having first surface and a second surface, the front or back shell first surface having a shell recess, the shell recess being sized and configured to fit a clamp housing, the shell recess having an shell aperture extends there through, the shell aperture being sized and configured to receive the clamp post; at least a portion of the front or back shell second surface having a plurality of teeth, the plurality of teeth sized and configured to fit within the plurality of recesses. The clamp housing has a top surface and a bottom surface, at least a portion of the top surface having a cavity extending from the top surface towards the bottom surface, the cavity sized and configured to receive the clamp body, the cavity having an aperture, the aperture extends through the top surface to the bottom surface, the aperture is sized and configured to receive a clamp post, the clamp post is pivotally coupled to the clamp body.

[00013] In another embodiment, the adjustable helmet system may comprise an alternate embodiment of a clamp locking mechanism that may be integrated within a helmet. The adjustable helmet system may comprise a front shell (or first shell), and back shell (or second shell), and a locking mechanism. The locking mechanism including a clamp assembly, a plurality of teeth, at least a portion of the plurality of teeth sized and configured to fit within a portion of a plurality of recesses, the plurality of teeth disposed on the first or second shell, a plurality recesses, at least a portion of the plurality of recesses are sized and configured to receive the plurality of teeth, the plurality of recesses disposed on the first or second shell, the clamp assembly being movable between a unlocked position that allows the plurality of teeth and the plurality of recesses to disengage and allow the first and second shells to slide relative to each other, and a locked position that allows a portion of the plurality of teeth and a portion of the plurality of recesses to engage that inhibits the first and second shells from sliding relative to each other.

[00014] In another embodiment, the adjustable helmet system may comprise crumple zones. The adjustable helmet system may comprise a first shell, a second shell, the second shell being slidably attached to the first shell, a locking mechanism, and/or at least one opening. The locking mechanism being movable between an unlocked position which allows the first and second shells to slide relative to each other and a locked position which prohibits the first and second shells from sliding relative to each other. The at least one opening placed adjacent to, in proximity to or within impact zones of the first or second shells resulting in local deformation and reducing the translation of impact forces from a portion of the first shell and/or second shells. The impact zones are zones of a wearer's head that may see higher than normal frequency of impacts and/or magnitude of impacts. The impact zones are within the occipital region, temporal region, parietal region, orbit region, the frontal region, the mandible (front, right and/or

left side) region, the maxilla region, the nasal region, zygomatic region, the ethmoid region, the lacrimal region, the sphenoid region and/or any combination thereof.

[00015] In another embodiment, the adjustable helmet system may further comprise at least one impact mitigation layer. The adjustable helmet system may comprise a front shell (or first shell), a back shell (or second shell), a locking mechanism, and at least one impact mitigation layer. The at least one impact mitigation layer may include one or more impact structures. The impact structures may comprise at least a portion of liner pod assemblies, at least a portion of filaments, at least a portion of laterally supported filaments (LSFs), at least a portion of auxetic structures, TPU (not shown), inflatable bladders (not shown), shock bonnets (not shown), at least one foam layer (not shown), at least a portion of air bladders, and/or any combination thereof. The front shell and/or back shell may have an external surface and an internal surface, the at least one impact mitigation layer may be coupled to the internal surface of the front and/or back shells. Coupling may be fixed or removably coupled.

[00016] In another embodiment, the adjustable helmet system may further comprise at least one supplemental layer. The adjustable helmet system may comprise a front shell (or first shell), a back shell (or second shell), a locking mechanism, at least one impact mitigation layer and at least one supplemental layer. The front shell and/or back shells may have an external surface and an internal surface, the supplemental layer may be positioned proximate to the impact mitigation layer and/or may be positioned proximate to the internal surface of the front and/or back shells. The supplemental layer may include a plurality of liner pod assemblies or comfort liners that are desirably positioned around various locations of the wearer's head, covering much of the area inner surface of the helmet. The liner pod assemblies may include a pod and a connection mechanism. Such plurality of liner pod assemblies may be positioned within and/or proximate to one or more of the following regions: a frontal assembly (or front), an occipital assembly (or lower-back), a mid-back assembly, a parietal assembly (or midline), and a temporal assembly (right and/or left sides), and/or any combination(s) thereof. At least a portion of the liner pod assemblies may be removably coupled to the helmet and/or any combination thereof to increase energy absorption, mitigation of linear or angular impact forces, enhance fit and comfort.

[00017] In another embodiment, the adjustable helmet system may comprise a cam locking mechanism assembly. The cam locking assembly will facilitate easy no-tool detachment and securement by using a rotational function. To adjust a representative helmet, the user may rotate the cam body counter-clock position to allowing the cam post to place a downward compressive force against the clamp tongue thereby releasing the front and back shells to move relative to each other. Conversely, to secure or lock the cam locking assembly, the user will rotate the cam body to a clock-wise position to lift the base plate that coupled to the clamp post and place an upward compressive force to sandwich the front and back shells and prevent movement and have the plurality of teeth engage with the plurality of recesses.

Alternatively, the helmet may further comprise helmet alignment guides. The helmet alignment guides may be strategically placed onto the helmet and can be placed within any region of the helmet, including frontal, ridge (or top), and/or the sides (right or left). The helmet alignment guides will help align the front and back shells in the proper position during adjustment.

[00018] In one exemplary embodiment, at least one commercially available (CA) may be retrofitted to have one or more crumple zones. The at least one CA helmet may comprise one or more protrusions that may be modified or replaced with impact mitigation structures or impact mitigation features to create a crumple zone. The one or more protrusion may be modified with impact mitigation features that allow the collapsibility, compressibility and/or impact absorption, the impact mitigation features comprising a plurality of perforations, the plurality of perforations may include a variety of different shapes and/or configurations to enhance collapsibility, compressibility and/or impact absorption. Such shapes and/or configurations may include relief cuts, slits, holes, openings, herringbone shape, zig-zag shapes, chevron shapes, auxetic shapes, reentrant shapes, and/or any combination thereof. In another exemplary embodiment, the one or more protrusion may incorporate at least one impact mitigation structure over the shell protrusions. Additionally, the one or more shell protrusions may be replaced with at least one impact mitigation structure. The at least one CA helmet shell protrusions may have at least one impact mitigation structure disposed within a cavity of the one or more protrusions. Alternatively, the at least one impact mitigation structure can be positioned between the at least two protrusions.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[00019] FIGS. 1A-1F depicts various views of one embodiment of an adjustable helmet assembly;

[00020] FIG. 1G depicts an exploded view of one embodiment of an adjustable helmet assembly of FIGS. 1A-1F;

[00021] FIGS. 2A-2J depict various various views of an alternate embodiment of an adjustable helmet assembly;

[00022] FIGS. 3A-3F depict various views of one embodiment of an adjustable helmet first or front shell;

[00023] FIGS. 4A-4F depict various views of one embodiment of an adjustable helmet second or back shell;

[00024] FIGS. 5A-5G depict various views of an alternate embodiment of an adjustable helmet;

[00025] FIGS. 6A-6H depict various views of an alternate embodiment of a clamp locking mechanism assembly;

[00026] FIGS. 6I-6J depict an exploded isometric and side view of one embodiment of a clamp locking mechanism assembly of FIGS. 6A-6H;

[00027] FIGS. 7A-7H depict various views of one embodiment of the clamp housing;

[00028] FIGS. 8A-8H depict various views of one embodiment of a clamp body;

[00029] FIGS. 9A-9H depict various views of one embodiment of a clamp post;

[00030] FIGS. 10A-10H depict various views of one embodiment of a clamp tongue;

[00031] FIGS. 11A-11H depict various views of one embodiment of a cam locking mechanism assembly;

[00032] FIGS. 11I-11J depict various exploded views of the cam locking mechanism assembly of FIGS. 11A-11H;

[00033] FIGS. 12A-12H depict various views of one embodiment of a cam tongue;

[00034] FIGS. 13A-13H depict various views of one embodiment of the cam housing;

[00035] FIGS. 14A-14H depict various views of one embodiment of a cam post;

[00036] FIGS. 15A-15H depict various views of one embodiment of a cam body;

[00037] FIGS. 16A-16F depict various views of an alternate embodiment of a clamp body;

[00038] FIGS. 17A-17D depict various views and magnified views of a method to open and close a clamp locking assembly;

[00039] FIGS. 18A-18D depict various magnified views of a method to open and close a clamp locking assembly with engagement features;

[00040] FIGS. 19A-19E depict various views of one embodiment of an ear protection;

[00041] FIGS. 20A-20I depict various views of different embodiments of crumple zones on an adjustable helmet;

[00042] FIGS. 21A-21F depict various views of different embodiments of commercially available helmets without crumple zones and locations of the at least one shell protrusions;

[00043] FIGS. 22A-22B illustrate an alternate embodiment of a commercially available (CA) helmet without crumple zones;

[00044] FIG. 23 depict one embodiment of a CA helmet with at least one impact mitigation feature;

[00045] FIGS. 24A-24F depict various embodiments of impact mitigation features shape and configurations;

[00046] FIG. 25 depicts one embodiment of a CA helmet having impact mitigation structure over a shell protrusion;

[00047] FIGS. 26A-26B depicts one embodiment of a CA helmet having an impact mitigation structure replacing the shell protrusion;

[00048] FIG. 27 depicts one embodiment of a CA helmet having an impact mitigation structure disposed within the shell protrusion;

[00049] FIGS. 28A-28D depict one embodiment of an impact mitigation structure comprising filaments;

[00050] FIGS. 29A-29C depict one embodiment of an impact mitigation structure comprising laterally supported filaments;

[00051] FIGS. 30A-30C depict one embodiment of an impact mitigation structure comprising an array of laterally supported filaments on a flexible layer;

[00052] FIGS. 31A-31B depict one embodiment of an impact mitigation structure comprising auxetic structures;

[00053] FIG. 32A-32C depict various embodiments of at least one impact mitigation pads;

[00054] FIGS. 33A-33D depict various views of one embodiment of one or more liner pod assemblies;

[00055] FIGS. 34A-34B depict various bottom isometric views of an alternate embodiment of one or more liner pod assemblies;

[00056] FIGS. 35A-35D depict various views of one embodiment of a liner pod assembly;

[00057] FIGS. 36A-36C depict various views of one embodiment of a connection mechanism for a liner pod assembly.

[00058] FIGS. 38A-38G depict various view of an alternate embodiment of an adjustable helmet;

[00059] FIGS. 38H-38I depict a cross-sectional view and an exploded cross-sectional view of the alternate embodiment of the adjustable helmet of FIGS. 38A-38G;

[00060] FIGS. 39A-39H depict various views of an alternate embodiment of an adjustable helmet first or front shell;

[00061] FIGS. 40A-40G depict various views of an alternate embodiment of an adjustable helmet second or back shell;

[00062] FIGS. 41A-41G depict various views of an alternate embodiment of a clamp body;

[00063] FIGS. 42A-42H depict various views of an alternate embodiment of a clamp post;

[00064] FIGS. 43A-43F depict various views of an alternate embodiment of an ear protection;

[00065] FIGS. 44A-44F depict various views of one embodiment of an ear loop.

[00066] FIGS. 45 depicts a cross-sectional front view of the helmet and impact mitigation layer;

[00067] FIGS. 46A-46B depict a side and cross-sectional view of one embodiment of a supplemental layer; and

[00068] FIGS. 47A-47C depict various views of one embodiment of a ridge or crown foam pad.

DETAILED DESCRIPTION OF THE INVENTION

[00069] The various improved locking mechanisms provided herein are depicted with respect to hockey, but it should be understood that the various devices and systems may be suitable for use in protecting players in various other athletic sports, as well as law enforcement, military and/or informal training session uses. For example, the embodiments of the present invention may be suitable for use by individuals engaged in athletic activities such as baseball, bowling, boxing, cricket, cycling, motorcycling, golf, hockey, lacrosse, soccer, rowing, rugby, running, skating, skateboarding, skiing, snowboarding, surfing, swimming, table tennis, tennis, or volleyball, or during training sessions related thereto.

[00070] Accordingly, the adjustable helmet system with improved locking mechanisms provide significant benefits that can overcome some of the disadvantages of the previous adjustable helmet designs. The adjustable helmet system offers a two-piece shelled helmet that allows adjustment and/or locking of the helmet quickly and efficiently without the need for tools, it allows the locking and/or unlocking of the helmet with one handed function, it can allow for the impact mitigation layers and/or comfort liners pad systems to be easily disconnected and/or adjusted within the helmet, and/or provide for localized deflection through the incorporation of structural features that promote the absorption of energy from the impact in more predictable ways. The adjustability is key should the players or wearers decide to improve their impact protection during play, and exchange at least a portion of the impact mitigation layer and/or at least a portion of the supplemental layer based on the frequency or severity of impact. Then, the adjustable helmet system may be properly adjusted to accommodate the comfort and sizing of the specific wearer.

[00071] Adjustable Helmet Assembly

[00072] FIGS. 1A-1F depicts various views of one embodiment of an adjustable helmet assembly 101. FIG. 1G depicts an exploded isometric view of the adjustable helmet assembly 101. The adjustable helmet assembly 101 comprises an adjustable helmet system 102, and an impact mitigation layer 103. The adjustable helmet assembly may further comprise at least one inner shell 104, a supplemental layer 105, an ear protection 106, an ear loop 107, a visor 108, a chinstrap (not shown) and/or any combination thereof.

[00073] In one exemplary embodiment, the adjustable helmet assembly 101 comprises an adjustable helmet system 102, an impact mitigation layer 103, an inner shell 104. The adjustable helmet assembly 101 may further comprise a supplemental layer 105. The impact mitigation layer 103 nests within the adjustable helmet system 102, and the impact mitigation layer 103 disposed between the adjustable helmet system 102 and the inner shell 104. The supplemental layer 105 nests within the inner

shell 104, where an exterior surface of the supplemental layer 105 is adjacent to an interior surface of the inner shell 104.

[00074] Adjustable Helmet System

[00075] FIGS. 2A-2J depict various views of different embodiments of an adjustable helmet system 201. In one embodiment, the adjustable helmet system 201 may comprise a front shell (or first shell) 206, a back shell (or second shell) 202 and a locking mechanism 208. The locking mechanism may comprise a clamp lock mechanism and/or a cam lock mechanism. The locking mechanism 208 further comprising a clamp tongue 214, a clamp body 213 and a clamp recess 215. The first 206 and/or second shell 202 may be slidably connected, slidably coupled and/or rotatably coupled together via the locking and unlocking of the locking mechanism 208. More specifically, the locking mechanism 208 being movable between an unlocked position which allows the first 206 and second shells 202 to slide relative to each other and a locked position which prohibits the first 206 and second shells 202 from sliding relative to each other. The adjustable helmet system 201 may further comprise additional features, including helmet alignment guides 203, a side plate 204, ear protection 204, a front plate 207, a center plate 209, one or more openings 210, one or more crumple zones 211, one or more securement holes 212 and/or any combination thereof.

[00076] The locking mechanism 208 may be a modular assembly and/or integrated within the first 206 and/or second 202 shells. In one embodiment, the locking mechanism comprises a clamp assembly, a plurality of teeth, at least a portion of the plurality of teeth sized and configured to fit within a portion of a plurality of recesses, the plurality of teeth disposed on the first or second shell, a plurality of recesses, at least a portion of the plurality of recesses are sized and configured to receive the plurality of teeth, the plurality of recesses disposed on the first or second shell, the clamp assembly being movable between an unlocked position that allows the plurality of teeth and the plurality of recesses to disengage and allows the first and second shells to slide relative to each other, and a locked position that allows the a portion of the plurality of teeth and a portion of the plurality of recesses to engage and inhibits the first and second shells from sliding relative to each other.

[00077] The first 206 and/or second shell 202 may be manufactured from a relatively rigid material, such as polyethylene, nylon, polycarbonate materials, acrylonitrile Butadiene Styrene (ABS), polyester resin with fiberglass, thermosetting plastics, and/or any other rigid thermoplastic materials. Alternately, the first and/or second shell may be manufactured from a relatively deformable material, such as polyurethane and/or high-density polyethylene, where such material allows local deformation upon impact. FIGS. 5A-5G and FIGS. 38A-38I depict various views of an alternate embodiments of an adjustable helmet.

[00078] FIGS. 3A-3F depict various views of one embodiment of a first shell or front shell 301. The first shell 301 may comprise a top portion 303, a front portion 302, and/or side portions 304 (e.g., right and left sides). The front portion 302 is positioned within the frontal region of a wearer's head and may extend towards the rear or back of the wearer's head, covering at least portions of top portion 303 or the crown region and/or the right and left temporal regions of the wearer's head or the side portions 304, where the edge is at or immediately adjacent to the wearer's eyebrows. The front portion 302 may comprise a front plate 307 and securement holes 306 to secure the front plate 307 to the front portion 302. The front plate 307 may be utilized as aesthetic feature and/or a logo may be disposed onto the front plate. Alternatively, the front plate 307 may comprise at least a portion of an impact mitigation structure as disclosed herein. The impact mitigation structure may be affixed to the first shell 301 and the front plate 307 may be affixed to the impact mitigation structure and/or the first shell 301. The front plate 307 may have securement holes 306 and/or other features to affix the front plate 307 to the first shell 301. The securement holes 306 and/or features may comprise rivets, screws, snaps, Velcro, adhesive, press fit, and/or any combination thereof. The first shell 301 may further comprise a plurality of openings 305, where the openings may provide for ventilation and/or give rise to one or more crumple zones 310. The one or more openings 305, the one or more openings 305 being elongated and having a width and a length, the length being at least two times larger than the width. The one or more openings 305 may comprise one or more tabs (not shown) that span the width of the one or more openings 305. FIGS. 39A-39H depict various views of an alternate embodiment of a first or front shell.

[00079] The top portion 303 of the first or front shell 301 may be positioned on a portion of a central ridge of a wearer's head and covering a portion of the parietal region of a wearers head as shown as FIG. 3C-3D. The top portion 303 of the first or front shell 301 may comprise a central plate 308, one or more openings 305 and a portion of the lock mechanism, the central plate 308 having a perimeter edge 311, the perimeter edge 311 sits below the perimeter edge 312 of the top portion 303, leaving an indentation or recessed area disposed within the top portion 303. The top portion 303 may further comprise one or more openings 305, the one or more openings 305 being elongated and having a width and a length, the length being at least two times larger than the width. The one or more openings 305 may further comprise one or more tabs (not shown) that spans the width of the one or more openings 305. Additionally, the central plate 308 includes a clamp tongue 313. The clamp tongue 313 may be positioned adjacent or proximate to the central plate 308 of the first or front shell. The clamp tongue 313 being a longitudinal member having a first end and a second end, the first end affixed to the central plate 308, and the second end extending away from the central plate 308 of the top portion 303 of the first or front shell 301 on a substantially similar planar surface or on the same plane as the central plate 308. Substantially similar may include an offset plane having a range of minus 20 to plus 20 degrees difference

(or a 0.25 in to 2 in below the planar surface of the central plate 308) from the co-planar surface of the top portion 303 and/or the co-planar surface of the central plate 308 of the first or front shell 301. The clamp tongue 313 having a top surface 317, a bottom surface 316 and a first channel 314. The clamp tongue top surface 317 having a plurality of a plurality recesses 315 disposed onto the top surface 317, at least a portion of the plurality of recesses 315 are sized and configured to receive a portion of a plurality of teeth 413 (see FIG. 4D) and/or are sized and configured to engage a portion of a plurality of teeth 413, the first channel 314 sized and configured to receive a clamp post 420 (see FIG. 4F). FIGS. 39E-39F depict various views of an alternate embodiment of a top portion of a first or front shell.

[00080] The side portions 304 of the first or front shell 301 may be positioned within or near the temporal regions of the wearer, covering the right and left sides of the wearer and/or at least a portion of the wearer's mandible as shown in FIG. 3E-3F. The side portions 304 may comprise at least one side plate (not shown), at least one side plate recess 318, one or more securement holes 306, one or more openings 305 and/or any combination thereof. The side plate being disposed within the side plate recess 318, and the securement holes 306 secure the side plate within the side plate recess 318. The side portion 304 may further comprise or more openings 305, the one or more openings 305 being elongated and having a width and a length, the length being at least two times larger than the width. The top portion 303 may further comprise one or more tabs (not shown) that couple the central plate 308 to the top portion 303. The one or more tabs (not shown) may span the width of the one or more openings 318. The first shell side portions 304 may further comprise an ear cover. The ear cover may comprise a portion of the shell that extends proximate to the wearer's ear for protection. The ear cover may include holes for further securement of a chin strap (not shown). In another embodiment, the first shell side portion may further comprise a side plate recess 318 and/or a side plate (not shown). The side plate recess 318 may be disposed on a portion of the first shell side portion 304, the side plate recess 318 may be sized and configured to receive the side plate. The side plate may be sized and configured to fit within the side plate recess 318. Alternatively, the side plate may be affixed to a portion of the first shell side portion 304. The side plate may be utilized as aesthetic feature and/or a logo may be disposed onto the side plate. Alternatively, the side plate may comprise at least a portion of an impact mitigation structure as disclosed herein, the impact structure may be disposed within the side plate recess 318, and the side plate positioned over the impact structure. The side plate may have securement features to affix the side plate to the first shell 301. The securement features may comprise rivets, screws, snaps, Velcro, adhesive, press fit and/or any combination thereof. FIGS. 39G-39H depict various views of an alternate embodiment of a side portion of a first or front shell.

[00081] FIG. 3F depicts a cross-sectional view of one embodiment of a side portion 304 of the first shell 301. The first shell 301 may further comprise one or more alignment protrusions 319 that

longitudinally extends perpendicular or substantially perpendicular from an interior or exterior surface of the side portion 304. Such one or more alignment protrusions 319 may be sized and configured to fit within one or more alignment protrusion channels 403. The alignment protrusions 319 are inserted within the one or more alignment protrusion channels 403 (see FIG. 4E) to allow the first shell 301 and the back shell 401 to mate and facilitate the proper alignment to slidably connect at a fixed distance. The one or more alignment protrusions 319 may be molded directly onto the first shell 301 and/or the one or more alignment protrusions 319 may be affixed by a separate structure. The separate structure may comprise a base, and the one or more protrusions perpendicularly extending upwards from the base, the base being coupled to the first shell 301. The slidable fixed distance may range from 1 mm to 40 mm. The alignment protrusion channels 403 having a width and length, the length of the alignment protrusion channel 403 being a range from 1 mm to 40 mm. The first shell 301 side portion 304 may further comprise a plurality of openings 305, where the openings may provide for ventilation and/or give rise to one or more crumple zones. The one or more openings 305 being elongated and having a width and a length, the length being at least two times larger than the width. The side portion 304 may further comprise one or more tabs (not shown), the one or more tabs (not shown) may span the width of the one or more openings 305. FIG. 39H depicts a cross-sectional view of an alternate embodiment of a side portion of the first shell.

[00082] FIGS. 4A-4F depict various views of one embodiment of a second shell, back shell or rear shell 401. The second shell 401 may comprise a back portion 408, a top portion 411 and/or a side portion 419. In one embodiment, the second shell 401 may comprise a portion of the lock mechanism 404, one or more openings 402 giving rise to one or more crumple zones 407, a central plate 406, and one or more alignment protrusion channels 403, and/or any combination thereof. More specifically, FIG. 4B illustrates a back view of one embodiment of a back portion 408 of the second or back shell 401. The back portion 408 may of the second or back shell 401 may comprise a central plate 406, the central plate 406 having a perimeter edge 409, the perimeter edge 409 sits below the perimeter edge 410 of the back portion 408 of the second or back shell 401, leaving an indentation, depressed or recessed area disposed within the back portion 408 of the second or back shell 401. The central plate 406 may extend from the lower occipital region (or lower back) up towards the mid-back region and to the top portion 411 of the second or back shell 401. The back portion 408 may further comprise one or more tabs 405 that couple the central plate 406 to the back portion 408 of the second or back shell 401. FIGS. 40A-40G depict various views of an alternate embodiment of a second or back shell, and specifically, FIGS. 40C-40D depict a front and back view of an alternate embodiment of a back portion of a second or back shell.

[00083] FIGS. 4C-4D illustrate the top and bottom view of one embodiment of a top portion 411 of the second or back shell 401. The top portion 411 of the second or back shell 401 covering at least a

portion of the crown region of the head and extends towards a portion the back portion that covers the occipital and/or the temporal region of the head. The top portion 411 of the second or back shell 401 may comprise a central plate 406 and a portion of the lock mechanism 404, the central plate 406 having a perimeter edge 409, the perimeter edge 409 sits below the perimeter edge 410 of the top portion 411, leaving an indentation or recessed area disposed within the top portion 411 of the second or back shell 401. The top portion 411 may further comprise one or more tabs 412 that couple the central plate 406 to the top portion 411 of the second or back shell 401. Additionally, the central plate 406 includes a portion of a lock mechanism 404, the lock mechanism comprising a plurality of teeth 414. The central plate 406 may further comprise a central plate external surface 417 and a central plate internal surface 418, the central plate external surface 417 having a recess 413, the recess extending from the central plate external surface 417 towards the central plate internal surface 418. The recess 413 further comprising a recess external surface 412 and a recess internal surface 415. The recess internal surface 415 comprising a plurality of teeth 414, the plurality of teeth 414 perpendicularly extending away from the recess internal surface 415. The plurality of teeth 414 having different cross-sectional shapes and configurations, the shapes and configurations of the plurality of teeth 414 to be sized to fit within a portion of the plurality of recesses 315 of the clamp tongue 313. FIGS. 40C-40D depict a top and bottom view an alternate embodiment of a top portion of a second or back shell.

[00084] Furthermore, the recess external surface 415 of the top portion 411 of the second or back shell 401 may further comprise a clamp post 420. The clamp post 420 being a solid or hollow longitudinal member that perpendicularly extends from the recess external surface 415. The clamp post 420 being a longitudinal member having a diameter, a height, a first end and a second end. The first or second end being coupled to the recess external surface 415, and the first or second having a planar surface, the planar surface abutting or mating within a planar surface of the clamp body. The recess 413 comprising a cross-sectional shape and a height 421. The recess 413 cross-sectional shape is configured to match or substantially match the clamp body (not shown) of the locking mechanism 404. The recess height 421 being equal to a clamp body width to provide a flush surface, or the recess height being greater than the clamp body width to allow the clamp body to be slightly recessed. Accordingly, the top portion 411 of the second or back shell 401 comprises one or more openings 402 giving rise to one or more crumple zones 407. FIGS. 40E-40F depict a top and bottom view an alternate embodiment of a top portion of a second or back shell.

[00085] The side portions 419 of the second or back shell 401 may be positioned within or near the temporal regions of the wearer, covering the right and left sides of the wearer and/or at least a portion of the wearer's mandible as shown in FIG. 4E-4F. The side portions 410 of the second or back shell 401 may comprise one or more alignment protrusion channels 403, one or more openings 402 that gives rise

to one or more crumple zones 407, and/or any combination thereof. The one or more alignment protrusion channels 403 may be molded directly onto the second shell 401 and/or the one or more alignment protrusion channels 403 may be affixed by a separate structure 3703 as shown in FIGS. 37A-37B. The separate structure 3703 may comprise a base 3704, and the one or more protrusion channels 3705 extending through the base 3704, the base 3704 being coupled to the second shell 3702, allowing the protrusions 318 (see FIG. 3F) to be inserted into the one or more protrusion channels 3705 for controlled sliding and controlled distance. The second shell side portions 419 may further comprise a portion of the ear cover. The ear cover may comprise a portion of the shell that extends proximate to the wearer's ear for protection. The ear cover may include holes for further securement of a chin strap (not shown). The alignment protrusions 319 (see FIG. 3F) are inserted within the one or more alignment protrusion channels 403 to allow the first shell 301 and the back shell 401 to mate and facilitate the proper alignment to slidably connect at a fixed distance. The slidable fixed distance may range from 1 mm to 40 mm. The alignment protrusion channels 403 having a width and length, the length of the alignment protrusion channel 403 being a range from 1 mm to 40 mm. The second shell 401 side portion 419 may further comprise a plurality of openings 402, where the openings may provide for ventilation and/or give rise to one or more crumple zones 407. FIG. 40G depicts a side view of alternate embodiment of a side portion of a second or back shell.

[00086] Alternatively, the protrusion alignment channels or the alignment guides 403 and the alignment protrusions 319 may be switched. For example, the protrusion alignment channels 403 may be disposed on the first shell 301 rather than the second shell 401. Accordingly, the alignment protrusions 319 may be disposed on the second shell 401 rather than the first shell 301. The helmet alignment guides or alignment protrusion channels may be strategically placed onto or within any region of the helmet, including frontal, ridge (or top), and/or the sides (right or left). The helmet alignment guides will help align the front and back shells in the proper position during adjustment. The helmet alignment guides comprise alignment protrusions and alignment guide channels. The alignment protrusions may be disposed onto a least a portion of the first or second shell, the alignment protrusions being sized and configured to fit within the alignment guide channels. The alignment guide channels may be disposed onto a least a portion of the first or second shell, the alignment guide channels having a translation length, the translation length minimizing the total adjustment size of the helmet. The alignment guide channels being sized and configured to receive the alignment protrusions. Once the alignment protrusions mate with the alignment guide channels, the helmet may only be adjusted to the designed translation length. The translation length may be anywhere from 0 inches to 6 inches.

[00087] Locking Mechanism Assemblies

[00088] In one embodiment, an adjustable helmet system may comprise a locking mechanism, the locking mechanism being a clamp locking mechanism assembly 601 (see FIGS. 6A-6B, FIGS. 17A-17D, FIGS. 18A-18D, and FIG. 38I) or a cam locking mechanism assembly 1101 (see FIGS. 11A-11J). The locking mechanism may be integrated within a portion of the front or back shells and/or be modular, which the modularity allows the locking mechanism to be retrofitted to commercially available helmets. The locking mechanism being movable between a first unlocked position which allows the first (or front) and second (or back) shells to slide relative to each other and a second locked position which inhibits the first and second shells from sliding relative to each other.

[00089] FIGS. 6A-6H, FIGS. 17A-17B and FIGS. 38I depict various views of an alternate embodiment of a clamp locking mechanism assembly. More specifically, FIGS. 6A-6H depicts one embodiment of a clamp locking mechanism assembly 601 that comprises at least one clamp lock subassembly 603 and a clamp tongue 602. The clamp locking assembly 601 will facilitate easy no-tool detachment and securement by using a lever function and may require only a one-handed operation. For example, FIGS. 17A-17D illustrate an example of a method to adjust a representative adjustable helmet assembly 1701. The user or wearer may lift the clamp body 1705 allowing the clamp post 1705 to place a downward compressive force against a portion of the first or second shells 1702, 1703 thereby releasing the first and/or second shells 1702, 1703 to move relative to each other. Conversely, to secure or lock the clamp locking assembly 1703, the user or wearer will push the clamp body down 1705 within the cavity allowing the base plate 1707 coupled to the clamp post 1707 to place an upward compressive force to sandwich the at least a portion of the first and second shells 1702, 1703 and/or the clamp tongue 1708 and have the plurality of teeth engage with the plurality of recesses to prevent or inhibit movement of the first and second shells 1702, 1703. FIGS. 17A-B and FIG. 38I illustrate cross-sectional views of an alternate embodiment of a clamp locking mechanism assembly.

[00090] FIGS. 6I-6J illustrate an exploded isometric view of a clamp locking mechanism 601. The clamp locking mechanism assembly 601 may comprise at least one clamp lock subassembly 603 and a clamp tongue 602. The clamp lock subassembly 603 comprises at least one of a clamp housing 608, a clamp body 607, clamp post 604, and/or a base plate 609. The clamp lock subassembly 603 may further comprise a spring (not shown). Alternatively, FIGS. 38I illustrate an exploded side view of a clamp locking mechanism assembly 3801. The clamp locking mechanism assembly 3801 comprises a clamp body 507, a plurality of teeth 3804, a plurality of recesses (not shown), and a clamp post 3805. The plurality of recesses being disposed an external surface of a clamp tongue 3803.

[00091] FIGS. 7A-7H depict various views of one embodiment of a clamp housing 701. The clamp housing 701 comprises a clamp housing recess 703 and a plurality of teeth 708. The clamp

housing 701 having a top surface 702 and a bottom surface 709, at least a portion of the top surface having a clamp housing recess 703 or cavity extending from the top surface 702 below the bottom surface 709, the cavity or clamp housing recess 703 sized and configured to receive the clamp body 607 (as shown in FIGS. 6I-6J), the cavity or champ housing recess 703 having an aperture 704, the aperture 704 extends through the clamp housing recess top surface 705 to the clamp housing recess bottom surface 707, the aperture 704 having a width, the width matches or substantially matches a width of a clamp post 604 (as shown in FIGS. 6I-6J). The clamp housing recess bottom surface 707 of the clamp housing 701 having a plurality of teeth 708, the plurality of teeth 708 perpendicularly extending outwardly from the clamp housing bottom surface 707, the plurality of teeth 708 sized and configured to fit within a portion of a plurality of recesses 1002 on a clamp tongue 1001 (see FIGS. 10A-10H). Alternatively, the clamp housing 701 and the clamp tongue 1001 (see FIGS. 10A-10H) may reverse some of the engagement features. The clamp housing recess bottom surface 707 may alternatively comprise a plurality of recesses that are sized and configured to receive a plurality of teeth. Furthermore, the clamp housing recess 703 having a clamp recess height (not shown), the clamp recess height is equal to or greater than a clamp body height 807 (see FIG. 8E). The clamp housing 701 may be affixed to the first or second shell and/or it may be integrated within the first or second shell. Desirably, should the clamp housing 701 be integrated within the first or second shell, the clamp housing 701 would be a recessed surface disposed onto an external surface of the first or second shell.

[00092] FIGS. 8A-8H and 9A-9G depict various views of one embodiment of a clamp body 801 and a clamp post 901. The clamp body 801 comprises a lever portion 805, at least one finger tab 805, a at least one base portion 804, an aperture 803, and/or any combination thereof. The clamp body 801 is sized and configured to fit within and/or disposed within the clamp housing cavity or the clamp housing recess 703 (see FIG. 7B). The at least one finger tab 805 extends longitudinally from the lever portion 805, the longitudinal extension is on a plane that is parallel and/or substantially parallel to the lever portion 805. The at least one base 804 having a base channel 806 that extends perpendicularly through the at least one base 804. The base channel 806 having a base channel width 808 that matches or substantially matches the clamp post width top portion 906 of the clamp post top portion 902. The clamp body further comprising a clamp body aperture 803, the clamp body aperture 803 aligns with the clamp post aperture 904 or is concentric with the clamp post aperture 904. The clamp post 901 being pivotally connected to the clamp body 801 allowing for a lever action or function.

[00093] FIGS. 16A-16F and FIGS. 41A-41G depict various views of an alternate embodiment for a clamp body. More specifically, FIGS. 41A-41G depict a clamp body 4101, the clamp body 4101 comprises a lever portion 4102, a base 4103, at least one aperture 4104, and at least one channel 4108. The clamp body 4101 is sized and configured to fit within and/or disposed within the clamp housing

cavity or the clamp housing recess 703 (see FIG. 7B). The lever portion 4102 of the clamp body 4101 having a plurality struts that form a matrix or a framework to provide support to the clamp body 4101 and to resist compression or other impacts. Each of the plurality struts are an elongated column. A first plurality of struts are positioned longitudinally along an axis of the clamp body 4101, and a second plurality of struts are positioned perpendicular to the longitudinal axis of the clamp body 4101. The at least one base 4103 having a base channel 4105 that extends perpendicularly through the at least one base 4103. The at least one base 4103 extending perpendicularly below the lever portion 4102. The base channel 4105 having a base channel width 4106 that matches or substantially matches the clamp post width 4206 first end 4204 of the clamp post top portion 4202. The clamp body further comprising a clamp body aperture 4104, the clamp body aperture 4104 aligns with the clamp post aperture 4209 or is concentric with the clamp post aperture 4209. The clamp post 4201 being pivotally connected to the clamp body 4101 allowing for a lever action or function.

[00094] FIGS. 9A-9G illustrates various views of one embodiment of a clamp post 901. The clamp post 901 comprising a clamp post top portion 902 and a clamp post bottom portion 903. The clamp post top portion 902 and the clamp post bottom portion 903 having a cross-sectional shape. The cross-sectional shape is circular, and/or it may be hollow. Other cross-sectional shapes may be contemplated, including square and rectangular. The clamp post having a T-shape, where the clamp post top portion 902 is perpendicular to the clamp post bottom portion 903 forming the T-shape. The clamp post 901 having an end with a planar surface 905, the planar surface abuts or is coupled to the base plate (not shown).

[00095] FIGS. 42A-42H illustrates various views of an alternate embodiment of a clamp post 4201. The clamp post 4201 comprising a clamp post top portion 4102 and a clamp post bottom portion 4203. The clamp post top portion 4202 and the clamp post bottom portion 4203 having a cross-sectional shape. The clamp post top portion 4202 cross-sectional shape is generally rectangular. The clamp post top portion 4202 extends perpendicular to the base 4203. The clamp post top portion 4202 having a first end 4204 and a second end 4205, the second end 4205 coupled to the clamp post bottom portion 4203. The first end 4204 having a cylindrical shape, the first end 4204 having a width 4206. The width 4206 of the first end 4204 of the clamp post top portion 4202 that matches or substantially matches the base channel 4105 of the clamp body 4101 (see FIGS. 41A- 41G). The clamp post bottom portion 5203 cross-sectional shape is rectangular or generally rectangular, but other shapes may be contemplated, including square, circular or triangular. The clamp post bottom portion 5203 having a first surface 4207 and a second surface 4208, the second surface 4208 having a plurality of ribs 4209 extending along at least a portion of the length of the clamp post bottom portion 4203. The plurality of ribs 4209 extending parallel or perpendicularly below the second surface 4208. The first surface 4207 abuts and/or mates with at least

a portion of the first surface 1004 or second surface 1005 of the clamp tongue 1001 (see FIGS. 10A-10H or 38I) and/or the bottom surface of a clamp tongue.

[00096] FIG. 10A-10H depicts various views of an alternate embodiment of a clamp tongue 1001. The clamp tongue 1001 having a longitudinal body, at least a portion of the longitudinal body angled obliquely between a range of 1 degree to 60 degrees. The clamp tongue having a first surface 1004 and a second surface 1005, at least a portion of the first surface 1004 or second surface 1005 including a plurality recesses 1002, the plurality of recesses 1002 sized and configured to receive a portion of the clamp housing plurality of teeth 703 (see FIG. 7A), the clamp tongue 1001 further comprising a clamp tongue channel 1003, the clamp tongue channel 1003 extends through the first surface 1004 to the second surface 1005, the clamp tongue channel 1003 having a clamp channel width 1006, the clamp channel width 1006 being sized and configured to receive the clamp post bottom portion 903 (see FIGS. 9A-9G) and/or the clamp channel width 1006 matching or substantially matching the clamp post bottom portion width and/or cross-sectional shape. The clamp channel 1003 having a channel length 1007, the channel length 1007 allowing clamp post 901 to translate axially, the translation distance being 1 mm to 25 mm. The clamp post coupled to a base plate.

[00097] Alternatively, the clamp housing 701 (see FIG. 7A-7H) and the clamp tongue 1001 (see FIGS. 10A-10H) may reverse some of the engagement features. The clamp housing recess bottom surface 707 may alternatively comprise a plurality of recesses that are sized and configured to receive a plurality of teeth. Furthermore, the clamp housing recess 703 having a clamp recess height (not shown), the clamp recess height is equal to or greater than a clamp body height 807 (see FIG. 8E). The clamp housing 701 may be affixed to the first or second shell, and/or the clamp tongue 1001 may be affixed to the first or second shell. The clamp tongue 1001 having a first surface 1004, a second surface 1005 and a clamp channel 1003. The clamp tongue first surface 100 having a plurality of a plurality teeth 703 disposed onto the first surface 1004, at least a portion of the plurality of recesses 1002 disposed on the clamp housing 701 are sized and configured to receive a portion of a plurality of teeth 703, the clamp channel 1003 sized and configured to receive a clamp post 901.

[00098] FIGS. 11A-11H depicts various views of one embodiment of a cam locking mechanism assembly 1101. The adjustable helmet system may comprise a first shell, a second shell and a locking mechanism assembly, the locking mechanism assembly comprises a cam locking mechanism 1101. The cam locking mechanism 1101 may comprise a cam tongue 1102 and a cam locking subassembly 1103. The cam locking assembly 1101 will facilitate easy no-tool detachment and securement by using a rotation action and may require only a one-handed operation. To adjust a representative helmet, the user or wearer may rotate the cam body allowing the cam post to place a downward compressive force against a portion of the first or second shells thereby releasing the first and/or second shells to move relative to

each other. Conversely, to secure or lock the cam locking assembly, the user or wearer will rotate the cam body in the opposite direction allowing the base plate coupled to the cam post to place an upward compressive force to sandwich the at least a portion of the first and second shells and prevent or inhibit movement and have the plurality of teeth engage with the plurality of recesses.

[00099] FIGS. 11I-11J depict an exploded isometric and side view of one embodiment of a cam lock mechanism 1101. The cam lock mechanism 1101 comprises a cam tongue 1102 and a cam locking subassembly 1103. The cam locking subassembly 1103 comprises a cam housing 1104, a cam post 1105, a base plate 1107, a cam body 1106, and/or any combination thereof.

[000100] FIGS. 12A-12H depict various views of one embodiment of a cam tongue 1201. The cam tongue 1201 having a longitudinal body, at least a portion of the longitudinal body having an arched shape or a generally arched shape. The cam tongue 1201 having a first surface 1202 and a second surface 1203, at least a portion of the first surface 1202 or second surface 1203 including a plurality recesses 1204, the plurality of recesses 1204 sized and configured to receive a portion of the cam housing plurality of teeth 1303 (see FIG. 13A), the cam tongue 1201 further comprising a clamp tongue channel 1205, the cam tongue channel 1205 extends through the first surface 1202 to the second surface 1203, the cam tongue channel 1205 having a cam channel width 1206, the cam channel width 1206 being sized and configured to receive the cam post top portion 1402 (see FIGS. 14A-14G) and/or the cam channel width 1206 matching or substantially matching the cam post top portion width and/or cross-sectional shape. The cam channel 1203 having a channel length 1207, the channel length 1207 allowing cam post 1401 to translate axially, the translation distance being 1 mm to 25 mm. The cam post coupled to a base plate. The cam tongue 1201 may be positioned and/or coupled on the top portion of the front or back shell, and extend longitudinally away from the top portion of the front or back shell.

[000101] Alternatively, the cam tongue 1201 and/or the front or back shells may reverse some of the engagement features. The cam tongue 1201 having a first surface 1202 and a second surface 1203, at least a portion of the first surface 1202 including the plurality teeth, the plurality of teeth sized and configured to fit within a plurality of recesses with a front or back shell top portion second surface, the cam tongue having a channel 1203, the channel 1203 extends through the first surface 1202 to the second surface, the channel 1203 sized and configured to receive the cam post 1401; the channel having a length, the length allowing cam post 1401 to translate along an axis.

[000102] FIGS. 13G-13H depict various views of one embodiment of a cam housing 1301. The cam housing 1301 comprises a clamp housing recess 1302 and a plurality of teeth 1203. The cam housing 1301 having a top surface 1304 and a bottom surface 1305, at least a portion of the top surface 1304 having a cam housing recess 1302 or cavity starting from the top surface 1304 and extending below the bottom surface 1305, the cavity or cam housing recess 1302 sized and configured to receive the cam

body 1501 (as shown in FIGS. 15A-15H), the cavity or cam housing recess 1302 having an aperture 1306, the aperture 1306 extends through the cam housing recess top surface 1307 to the cam housing recess bottom surface 1308, the aperture 1306 having a width, the width matches or substantially matches a width of a cam post top portion 1402 (as shown in FIGS. 14A-14H). The cam housing recess bottom surface 1308 of the cam housing 1301 having a plurality of teeth 1303, the plurality of teeth 1303 perpendicularly extending outwardly from the cam housing bottom surface 1308, the plurality of teeth 1303 sized and configured to fit within a portion of a plurality of recesses 1002 on a cam tongue 1301 (see FIGS. 10A-10H).

[000103] Alternatively, the cam housing 1301 and the camp tongue 1201 (see FIGS. 12A-12H) may reverse some of the engagement features. The cam housing recess bottom surface 1308 may alternatively comprise a plurality of recesses 1204 (see FIG. 12A-12H) that are sized and configured to receive a plurality of teeth 1303. Furthermore, the cam housing recess 1302 having a cam recess height (not shown), the cam recess height is equal to or greater than a cam body height 1507 (see FIG. 15F). The cam housing 1301 may be affixed to the first or second shell.

[000104] FIGS. 14A-14H depict various views of one embodiment of a cam post 1401. The cam post 1401 comprising a cam post top portion 1402 and a cam post bottom portion 1403. The cam post top portion 1402 having a cam post top portion cross-sectional shape. The cam post top portion cross-sectional shape includes circular, and/or it may be hollow. Other cross-sectional shapes may be contemplated, including square and rectangular. The cam post top portion 1402 may have a channel 1404 that extends from the first end 1405 of the cam post top portion 1402 towards a portion of the second end 1406 of the cam post top portion 1402. At least a portion of the channel 1404 may be chamfered. The cam post having a T-shape, where the cam post top portion 1402 is a longitudinal member that perpendicularly extends upward from the cam post bottom portion 1403 forming the T-shape. The cam post second end 1406 having an end with a planar surface, the planar surface abuts or is coupled to the cam post bottom portion 1403.

[000105] FIGS. 15A-15H depict various views of one embodiment of a cam body 1501. The cam body 1501 comprises a first portion 1502, a second portion 1503, an aperture 1504, and/or any combination thereof. The cam body 1501 is sized and configured to fit within and/or disposed within the cam housing cavity or the clamp housing recess 1302 (see FIG. 13B). The first portion abuts or mates with the cam housing top surface 1307. The second portion 1503 having a longitudinal member that extends perpendicularly first portion 1502. The second portion 1503 may further comprise a top surface, the top surface having a recess 1506 disposed within. The second portion 1503 may further comprise ribs 1504, the ribs 1504 having a generally triangular shape. Other shapes may be contemplated, including square or rectangle. The ribs 1504 are intended to allow the wearer to have sufficient surface area to hold

the cam body 1501 and rotate. The aperture 1504 having a width that matches or substantially matches the cam post width top portion 1402 of the cam post 1401. The cam post 1501 being inserted to the cam body 1401 allowing for a rotation action or function.

[000106] In another embodiment, the adjustable helmet system may have an alternate embodiment of an integrated locking mechanism. The adjustable helmet comprises a first shell, the first shell having an external surface and an internal surface; a second shell, the second shell being slidably attached to the first shell, the second shell an external surface and an internal surface; and a locking mechanism, the locking mechanism including: a clamp tongue, clamp tongue extending away from the first or second shell, the clamp tongue having a plurality of a plurality recesses, at least a portion of the plurality of recesses are sized and configured to receive a portion of a plurality of teeth; a plurality of teeth, at least a portion of the plurality of teeth sized and configured to fit within a portion of the plurality of recesses, the plurality of teeth disposed on a portion of the first or second shell internal surfaces; and a clamp assembly, the clamp assembly being movable between a unlocked position that disengages the portion of the plurality of teeth from the portion of the plurality of recesses and allow the first and second shells to slide relative to each other, and a locked position that allows the a portion of the plurality of teeth and a portion of the plurality of recesses to engage that inhibits the first and second shells from sliding relative to each other. The adjustable helmet may further comprise a cavity, the cavity being sized and configured to receive the clamp assembly, the cavity being disposed within the first or second shells, the clamp assembly having a top surface and a bottom surface, the clamp assembly top surface being flush or substantially flush with the external surface of the first or second shell.

[000107] In another embodiment, the adjustable helmet system may have an alternate embodiment of an integrated locking mechanism. An adjustable helmet comprising: a first shell, the first shell having an external surface and an internal surface; a second shell, the second shell being slidably attached to the first shell, the second shell an external surface and an internal surface; and a locking mechanism, the locking mechanism including; and a clamp assembly, the clamp assembly having a clamp body, the clamp post, and a base plate; a clamp tongue, clamp tongue extending away from the first or second shell, the clamp tongue having a top surface, a bottom surface and a first channel, the clamp tongue top surface having a plurality of a plurality recesses, at least a portion of the plurality of recesses are sized and configured to receive a portion of a plurality of teeth, the channel sized and configured to receive the clamp post; a plurality of teeth, the plurality of teeth disposed on a portion of the first or second shell internal surface, at least a portion of the plurality of teeth sized and configured to fit within a portion of the plurality of recesses, the first or second shell internal surface further including a second channel, the second channel sized and configured to receive the clamp post; a cavity, the cavity being sized and configured to receive the clamp assembly, the cavity being disposed within the first or second shells

external surface, the clamp assembly having a top surface and a bottom surface, the clamp assembly top surface being flush or substantially flush with the external surface of the first or second shell, the cavity having an aperture, the aperture sized and configured to receive the clamp post; the base plate coupled to the clamp post, the base plate abuts the bottom surface of the clamp tongue; a clamp assembly, the clamp assembly being movable between a locked position and an unlocked position, the locked position places tension on the clamp post and the base plate to compress the clamp tongue allowing a portion of the plurality of teeth and a portion of the plurality of recesses on the clamp tongue to engage and inhibit the first and second shells from sliding relative to each other, the unlocked position places compression on the clamp post and the base plate to release the clamp tongue allowing the portion of the plurality of teeth and the portion of the plurality of recesses of the clamp tongue to disengage, and allow the first and second shells to slide relative to each other.

[000108] Ear Protection and Other Accessories

[000109] FIGS. 1A-1G and 19 depict different embodiments of adjustable helmet assemblies that include ear protection 1901. In one embodiment, adjustable helmet system may further comprise ear protection 1901. The ear protection 1901 may comprise a base 1905 and an ear frame 1902. The base 1905 may have an exterior surface 1907 and an interior surface 1906. The ear frame 1902 having a shape that relatively matches or substantially matches or matches the wearer's ear. The ear frame 1902 may extend perpendicularly away from the base 1905 exterior surface 1907 to have a slight protrusion. The ear frame 1902 may include a recessed perimeter 1903, where the recessed perimeter 1903 may relatively matches or substantially matches or matches the wearer's ear, and the wearer's ear may be seated or abut against the recessed perimeter 1903. The ear frame 1902 may further comprise an aperture 1908 therethrough, the aperture 1908 is sized and configured to substantially match or reasonably match around a wearer's ear canal to allow sound to easily penetrate and pass through. At least a portion of the ear protection 1901 is coupled to a first shell, and at least a portion of the ear protection 1901 is coupled to a second shell. Alternatively, the ear protection 1901 may be coupled to the first or second shell. Ear protectors may general offer protection around the temporal region of the wearer's head. FIGS. 43A-43F depict various views of an alternate embodiment of an ear protection.

[000110] FIGS. 1A-1G and FIG. 44A-44F depict an exploded view of an adjustable helmet assembly that comprises an ear loop. In one embodiment, the adjustable helmet system may further comprise an ear loop 4401. The ear loop 4401 may comprise a frame that extends away from the edge of the helmet downwards away from the ear towards the jaw and/or mandible region of the wearer's head to overlap a portion of the jaw and/or mandible region. The ear loop 4401 may follow the contours of the jaw and/or mandible region of the wearer's head. Such ear loop 4401 comprises a first member 4402 and a second member 4403, the first 4402 and second 4403 member having a length, the length being average

or median jaw length. The first member 4402 may be coupled to the first or second shell (not shown), the second member 4403 may be coupled to the first or second shell (not shown). Each of the first member 4402 and the second member 4403 having first end and a second end. Each of the first member 4402 and the second member 4403 first end 4404, 4405 having a connecting structure 4406, the connecting structure 4406 having a square or rectangle cross-sectional shape, the connecting structure 4406 have a width greater than the first member 4402 and the second member 4403 width. Furthermore, the second ends of the first member 4402 and the second member 4403 being coupled together. The ear loop 4401 may be fixed, and/or removably connected. The ear loop 4401 is generally U-shaped. The ear loop may further comprise a pad. The pad may comprise at least one foam layer. The pad may further comprise an impact mitigation structure.

[000111] FIGS. 1A-1G depict an exploded view of an adjustable helmet assembly that further comprises a chin strap. Such chin strap may allow the wearer's head to be secured to the helmet to prevent premature dislodgement of the helmet during impact. The chin strap may be removably coupled to the first and/or second shells. The chin strap may further comprise a pad. The pad may comprise at least one foam layer. The pad may further comprise an impact mitigation structure.

[000112] FIGS. 1A-1G depict an exploded view of an adjustable helmet assembly that further comprises a visor. Such visor may be affixed to the first and/or second shell to protect players from glare or eye injuries. Furthermore, the visor may comprise protective coatings, such as scratch-resistance, UV coating, anti-glare coating, and/or any combination thereof.

[000113] Openings and Crumple Zones

[000114] In one exemplary embodiment, the adjustable helmet assembly may comprise one or more openings that gives rise to one or more crumple zones. Crumple zones are areas of the adjustable helmet assembly that are designed to deform in a controlled manner during an impact. The specifically designed crumple zones would absorb some of the impact force and redistribute the impact force before its transmitted to the wearer. More specifically, there's a given amount of force present during any impact, and the forces are determined by the acceleration and the mass of the wearer or the objects causing the impacts. Therefore, in order for the crumple zones to absorb and redistribute the impact force, it may do this by slowing down the acceleration or by extending the distance over which the adjustable helmet's kinetic energy is transferred out (into potential or thermal energy). The acceleration may be slowed by creating one or more crumple zones around the perimeter of the adjustable helmet, which the crumple zones would take the initial impact, slowing down acceleration by a few tenths of a second to create a drastic reduction in the force involved during an impact. Accordingly, crumple zones may be manufactured and integrated directly into the adjustable helmet and/or be commercially available (CA) helmet may be retrofitted with crumple zones.

[000115] FIGS. 20A-20I depict one various views of alternate embodiments of an adjustable helmet 2001 with integrated crumple zones. In one embodiment, the adjustable helmet 2001 may comprise one or more openings 2002, 2003 that may be disposed onto a front shell 2004 and/or a back shell 2005. Such one or more openings 2002, 2003 may align with the front shell 2004 and/or a back shell 2005. Such one or more openings 2002, 2003 may an elongated cross-sectional shape, such that each of the one or more openings 2002, 2003 have a length and a width. The length and/or the width of the one or more openings 2002, 2003 may allow particular regions and/or localized regions of the adjustable helmet 2001 to bend, deflect and/or collapse as shown in FIGS. 20D-20I. The width may be a range between 0.0625 inches to 2 inches, and the length may have a range between 0.25 inches to 5 inches. The elongated cross-sectional shape of the one or more openings 2002, 2003 may follow the contours of helmet. For example, in one embodiment, a unilateral or bilateral lateral force 2010 may impact the adjustable helmet 2001 leading to a localized bending and/or deflecting 2011 one or both sides of the adjustable helmet 2001 as shown in FIGS. 20D-20E. In another embodiment, a normal or axial force 2012 may impact the adjustable helmet 2001 leading to a localized bending, deflecting, collapse and/or buckling 2013 of the specific regions of the adjustable helmet 2001 as shown in FIGS. 20F-20G. Accordingly, in another embodiment, an oblique force 2014 may impact the adjustable helmet 2001 leading to a localized bending, deflecting, collapse and/or buckling 2015 of the specific regions of the adjustable helmet 2001 as shown in FIGS. 20H-20I.

[000116] The at least one opening 2002, 2003 placed adjacent to, in proximity to or within impact zones and/or crumple zones of the first shell 2004 or second shells 2005 resulting in absorption of the energy from the impact by controlled local deformation and/or reducing the impact forces transferred to the head of the wearer. The impact zones are zones of a wearer's head that may see higher than normal frequency of impacts and/or magnitude of impacts. The impact zones are within the occipital region (lower and mid), temporal region (right and left side), parietal region, orbit region, the frontal region, the mandible (front, right and/or left side) region, the maxilla region, the nasal region, zygomatic region, the ethmoid region, the lacrimal region, the sphenoid region, crown region or top ridge, raised eyebrow region and/or any combination thereof. In addition, the at least one opening may provide ventilation allowing air to circulate around the head of the wearer. The at least one opening may be positioned in plane tangent to the helmet circumference, in a plane perpendicular or substantially perpendicular to the helmet circumference, or in an oblique plane to the helmet plane, in a plane parallel to helmet plane, and/or any combination thereof.

[000117] Furthermore, the one or more openings 2002, 2003 may have one or more tabs 2006 disposed within the one or more openings 2002, 2003 to further absorb the impact forces. The one or more tabs 2006 couple the center plate 2007 to the top portion 2008 of the front shell 2004 and/or the

back shell 2005. The one or more tabs 2006 may be desirably used to provide a controlled deformation and/or buckling. The one or more tabs 2006 may span the width of the one or more openings 2002, 2003. The one or more tabs 2006 may have a length, width and depth, as well as a cross-sectional shape that facilitates a controlled deformation response by providing some relative resistance. Such cross-sectional shape can vary, and includes square, rectangle, triangle, hexagon, dome or arched cross-sectional shape, and/or any combination thereof. The desired cross-sectional shape would improve on the specific deformation properties that are expected for the adjustable helmet design. The length, width and/or depth of the one or more tabs 2006 may vary to obtain the ideal tab structure that can provide such controlled deformation, and still allow return to its original configuration. Alternatively, different protrusions 2009 may be positioned within the center plate 2007 and/or other locations on the adjustable helmet 2001 that may also further facilitate impact absorption.

[000118] FIGS. 22A-22B, 23, 24A-24F, 25, 26A-26B and 27 depict various views of alternate embodiments of helmets with retrofitted crumple zones. Various types of traditional commercially available (CA) helmets 2101 have very pronounced shell features that are purely aesthetic. Many of these features contain shell protrusions 2102 on the outer helmet layer or shell as shown in FIGS. 21A-21F, where the shell protrusions 2102 may have an empty cavity that faces internally towards the wearer's head and protrude outwardly away from the exterior surface of the outer shell. The CA helmets 2101 may have at least one shell protrusion 2102 with empty cavities are in various regional locations that are configured in varying sizes and shapes throughout the helmet outer layer structure.

[000119] Furthermore, the shell protrusions 2102 provide many disadvantages to the player that decides to wear such a CA helmet 2101. The disadvantages provide (1) additional unnecessary weight to the CA helmet; (2) The shell protrusions have cavities that is considered unused real estate; (3) the shell protrusions do not provide any impact protection (see FIG. 2B); and (4) the impact will be directly transferred to the players head potentially at the same acceleration as the impact, and not properly distributed over a wide an area as possible to reduce the deformation and severity of impact (see FIG. 2B).

[000120] As a result, the present invention overcomes many of the disadvantages observed with current CA helmets 2101. The present invention relates to various methods, devices and systems to retrofit CA helmets to leverage the existing shell protrusions and its cavities to improve impact performance of the CA helmet 2101. Impact performance may be improved by modifying or retrofitting the shell protrusions 2102 with impact mitigation structures and/or impact mitigation features to create crumple zones.

[000121] By leveraging at least one shell protrusion 2102 on the CA helmet 2101, the at least one shell protrusion 2102 may be deformable, bendable, deflectable, collapsible or compressible or buckle,

behaving similarly to "crumple zones." The at least one shell protrusion 2102 may be designed with impact mitigation structures and/or impact mitigation features to essentially convert the at least one shell protrusion to a crumple zone. The crumple zones will be defined as at least one shell protrusion that is converted into an impact structural area located in various regions on the CA helmet that facilitate the management of incident forces on the helmet during play, thus enhancing protection from the localized impact directly to the player's head in a predictable manner. Furthermore, such crumple zones can collapse, deform and/or compress in a predictable way to absorb much of the impact kinetic energy by reducing the initial impact force and redistribute the impact force before it reaches the player's head.

[000122] FIGS. 22A-22B depict cross-sectional views of one embodiment of a traditional CA helmet 2201 with protrusions. The CA helmet 2201 may comprise an outer shell or outer layer 2202, the outer layer having an outer surface 2207 and an inner surface 2208, a shell protrusion 2203 that extends outwardly from the outer surface 2207 of the outer layer 2202. The shell protrusion 2203 may have a cavity 2204 disposed within, the cavity 2204 may face towards the head of the wearer 2206. The shell protrusion 2203 does not contain any features, cross-sectional shape or other material changes that would provide or lead to a crumple zone. A force 2209 may impact the CA helmet 2201 causing the rigid protrusion 2203 to transmit the force directly to the wearers head 2206, leading to increased concussions and/or other brain injuries.2

[000123] FIG. 23 depicts a cross-sectional view of one embodiment of CA helmet 2301 that comprises a shell protrusion 2302 with impact mitigation features 2303 to create one or more crumple zones. The CA helmet 2301 may comprise an outer layer 2302, an impact mitigation layer 2304 and/or at least one protrusion 2302. The at least one CA helmet shell protrusion 2302 may be modified with impact mitigation features 2303 that allow the deformation, collapsibility, compressibility, buckling and/or impact absorption desired for the particular wearer, the wearer's position, and/or the wearer's sport or occupation. The impact mitigation features 2304 may comprise a plurality of perforations, the plurality of perforations extending therethrough from the outer surface of the outer shell protrusion 2302 through to the inner surface of the outer shell protrusion 2302, thus creating a through-hole perforation. The plurality of perforations may be symmetrically aligned or be offset.

[000124] The plurality of perforations may include a variety of different shapes and/or configurations to enhance deformation, collapsibility, compressibility, buckling and/or impact absorption as shown in FIGS. 24A-24F. Such shapes and/or configurations may include relief cuts, slits, holes, openings, polygons 2401, 2042, herringbone shape 2406, zig-zag shapes 2404, chevron shapes 2405, auxetic shapes (not shown), reentrant shapes 2403, and/or any combination thereof. It should be understood that any shape and configuration can be contemplated as long as the impact mitigation feature facilitates or improves impact performance.

[000125] FIG. 25 depicts a cross-sectional view of an alternate embodiment of a CA helmet retrofitted with a crumple zone. The CA helmet 2501 may comprise an outer layer 2502, an impact mitigation layer 2505, at least one shell protrusion 2503, and an impact mitigation structure 2504. The at least one CA helmet shell protrusion 2503 may incorporate at least one impact mitigation structure 2504 over the shell protrusions 2503. The at least one impact mitigation structure 2504 can be affixed to the outer surface of the shell protrusion 2503. Affixation may be a removable affixation or a permanent affixation. Affixation may use various methods known in the art, including press-fit, friction-fit, snaps, Velcro, magnets, adhesives, molding, sintering, welding, cam locks, screws and bolts, dovetail, interlocking protrusions (e.g. LEGOs), over molding and/or any combination thereof. Each of these coupling mechanisms may utilize existing features of a CA helmet or may require minor modifications with penetration through at least one of the CA helmet outer layer, CA helmet inner layer, the CA impact absorbing layer, and/or any combination thereof.

[000126] FIGS. 26A-26B depicts a cross-sectional view of an alternate embodiment of CA helmet retrofitted with a crumple zone. The CA helmet 2601 may comprise an outer layer 2602, an impact mitigation layer 2605, at least one shell protrusion 2603, and an impact mitigation structure 2604. The at least one CA helmet shell protrusion 2603 may be replaced with at least one impact mitigation structure 2604. The at least one impact mitigation structure 2604 may match or substantially match the shape of the at least one shell protrusion 2603. The at least one CA helmet shell protrusion 2603 may be removed with methods known in the art leaving an opening or empty space (FIG. 26A). The at least one impact mitigation structure 2604 may mimic the shape and/or configuration of the existing, removed shell protrusion 2603 or redesigned to desired custom shape & configuration. The at least one impact mitigation structure 2604 may be disposed within the opening and/or over the opening and affixed to the CA helmet. The affixation may be a removable affixation or a permanent affixation. Affixation may use various methods known in the art, including press-fit, friction-fit, snaps, Velcro, magnets, adhesives, molding, sintering, welding, cam locks, screws and bolts, dovetail, interlocking protrusions (e.g. LEGOs), over molding and/or any combination thereof. Each of these coupling mechanisms may utilize existing features of a CA helmet or may require minor modifications with penetration through at least one of the CA helmet outer layer, CA helmet inner layer, the CA impact absorbing layer, and/or any combination thereof.

[000127] FIG. 27 depicts a cross-sectional view of an alternate embodiment of CA helmet retrofitted with a crumple zone. The CA helmet 2701 may comprise an outer layer 2702, an impact mitigation layer 2705, at least one shell protrusion 2703, and an impact mitigation structure 2704. The at least one CA helmet shell protrusions 2703 may have at least one impact mitigation structure 2704 disposed within the cavity of the shell protrusion 2703. The at least one impact mitigation structure 2704

may mimic the shape and/or configuration of the existing shell protrusion 2603 and may partially fill the cavity. The at least one CA helmet impact mitigation layer 2705 may be removed to access the CA helmet shell protrusion cavity. The at least one impact mitigation structure may be affixed to the shell protrusion cavity. Affixation may be a removable affixation or a permanent affixation. Affixation may use various methods known in the art, including press-fit, friction-fit, snaps, Velcro, magnets, adhesives, molding, sintering, welding, cam locks, screws and bolts, dovetail, interlocking protrusions (e.g. LEGOs), over molding and/or any combination thereof. Each of these coupling mechanisms may utilize existing features of a CA helmet or may require minor modifications with penetration through at least one of the CA helmet outer layer, CA helmet inner layer, the CA impact absorbing layer, and/or any combination thereof.

[000128] FIG. 45 depict a cross-sectional front view of a helmet with crumple zones. An helmet 4501 comprising an impact mitigation layer; the impact mitigation layer having a first portion 4504 and a second portion 4505; and an outer shell, the outer shell having a first region 4502 and a second region 4503, at least a portion of the outer shell first region 4502 being in contact with the impact mitigation layer first portion 4502, the outer shell second region 4503 being in contact with the impact mitigation layer second portion 4505, at least a portion of the outer shell first region 4502 being offset from a portion of the outer shell second region 4503, at least a portion of the outer shell second region 4503 being independently deflectable relative to at least a portion of the outer shell first region 4502 as shown in FIGS. 20A-20I. The outer shell comprises a front shell and a back shell. The offset comprises at least one or more openings, and/or one or more tabs. Alternatively, the one or more tabs may be disposed with the one or more openings, the one or more tabs span the width of the one or more openings.

[000129] Impact Mitigation Layer and Impact Mitigation Structures

[000130] In another embodiment, the adjustable helmet system assembly may further comprise an impact mitigation layer. The adjustable helmet system includes a helmet, a locking mechanism, and/or an impact mitigation layer. The helmet may comprise a front shell (or first shell) and a back shell (or second shell), the first or second shell having an external surface and an internal surface. The locking mechanism, being movable between a first unlocked position which allows the first and second shells to slide relative to each other and a second locked position which inhibits the first and second shells from sliding relative to each other. The impact mitigation layer may comprise at least one impact mitigation structure. The impact mitigation layer may further comprise a force distribution layer, the force distribution layer being a relatively rigid or rigid material. The impact mitigation structure may comprise a first portion and a second portion. The first portion and second portion may comprise the same impact mitigation structure or different impact mitigation structures. The impact mitigation layer may be coupled to a first and/or second shell internal surface. Coupling may occur in different regions within the first or second shell and

the coupling may comprise heat staking, gluing, mechanical mounting, Velcro, and/or any combination thereof. The impact mitigation structures may comprise at least a portion of filaments (FIGS. 28A-28D), at least a portion of laterally supported filaments (LSFs) (FIGS. 29A-29C and 30A-30C), at least a portion of auxetic structures (FIGS. 31A-31B), at least a portion of liner pod assemblies (FIGS. 34A-34B and 35A-35B), TPU (not shown), undulating structures (FIGS. 24D-24F), inflatable bladders (not shown), shock bonnets (not shown), at least one foam layer, and/or any combination thereof.

[000131] Furthermore, as disclosed herein, any CA helmet with at least one shell protrusion may be leveraged to create or enhance impact protection by converting the at least one shell protrusion into crumple zones or impact zones. The at least one shell protrusion may be converted into a crumple zone or impact zone by incorporating impact mitigation features or impact mitigation structures that allow the collapsibility, compressibility and/or impact absorption. The impact mitigation structures may comprise at least a portion of filaments (FIGS. 28A-28D), at least a portion of laterally supported filaments (LSFs) (FIGS. 29A-29C and 30A-30C), at least a portion of auxetic structures (FIGS. 31A-31B), at least a portion of liner pod assemblies (FIGS. 34A-34B and 35A-35B), TPU (not shown), undulating structures (FIGS. 24D-24F), inflatable bladders (not shown), shock bonnets (not shown), at least one foam layer, and/or any combination thereof.

[000132] In one embodiment, the impact mitigating structures can comprise at least a portion of filaments. FIGS. 28A-28D depicts that at least a portion of filaments may be thin, longitudinally extending members or be shaped and configured to deform non-linearly in response to an impact force. The non-linear deformation behavior is expected to provide improved protection against high-impact forces, and/or oblique forces. The non-linear deformation behavior is described by at least a portion of the filaments stress-strain profile. The non-linear stress-strain profile illustrates that there can be an initial rapid increase in force (region I) followed by a change in slope that may be flat, decreasing or increasing slope (region II), followed by a third region with a different slope (region III).

[000101] In another embodiment, the at least a portion of the filaments may comprise filaments that buckle in response to an incident force, where buckling may be characterized by a localized, sudden failure of the filament structure subjected to high compressive stress, where the actual compressive stress at the point of failure is less than the ultimate compressive stress that the material is capable of withstanding. Furthermore, the at least a portion of the filaments may be configured to deform elastically, allowing the at least a portion of the filaments to substantially return to their initial configuration once the external force is removed. The at least a portion of filaments may extend between two surfaces, the at least a portion of filaments having at least one end coupled to the outer layer and/or the inner layer.

[000133] In another embodiment, the impact mitigating structures can comprise at least a portion of a plurality of filaments that are interconnected by laterally positioned walls or sheets in a polygonal

configuration, otherwise known as laterally supported filaments (LSF). FIGS. 29A-29C illustrate at least a portion of the LSF structures 2901, where the filaments 2902 are arranged in a hexagonal pattern interconnected by laterally positioned walls 2903. Alternatively, other polygonal structures and/or configurations known in the art may be contemplated, such as triangular, square, pentagonal, hexagonal, septagonal, octagonal, and/or any combination thereof. A plurality of sheets or lateral walls 2903 can be secured between adjacent pairs of filaments 2902 with each filament having a pair of lateral walls attached thereto. Alternatively, each of the plurality of filaments 2902 may comprise a lateral wall 2903 extending outwardly therefrom to at least one adjacent filament 2902. In the disclosed embodiment, the lateral walls 2903 can be oriented approximately 120 degrees apart about the filament axis, with each lateral wall extending substantially along the longitudinal length of the filament 2902. Accordingly, the orientation of the lateral walls 2903 may be asymmetric, which at least one lateral wall 2903 may be oriented approximately 75 to 135 degrees apart about the filament axis. The shape, wall thickness or diameter, height, and configuration of the lateral walls 2903 and/or filaments 2902 may vary as shown in FIGS. 29A-29C to "tune" or "tailor" the structures to a desired performance. For example, one embodiment of a hexagonal structure may have a tapered configuration as shown in FIG. 29A. The hexagonal structure can have a top surface 2905 and a bottom surface 2904, with the bottom surface 2904 perimeter (and/or bottom surface thickness/diameter of the individual elements) that may be larger than the corresponding top surface 2905 perimeter (and/or individual element thickness/diameter). In another example, the hexagonal structure can have an upper ridge 2906 as shown in FIG. 29C. The upper ridge 2906 can also facilitate connection to another structure, such as an inner surface of a helmet, an item of protective clothing, and/or a mechanical connection (e.g., a grommet or plug having an enlarged tip that is desirably slightly larger than the opening in the upper ridge of the hexagonal element).

[000134] Furthermore, the polygonal or hexagonal structures 3001 may be manufactured as individual structures or in a patterned array (see FIGS. 30A-30C). The individual structures 3001 can be manufactured using an extrusion, investment casting or injection molding process. Also, they may have the same shape and configuration with repeating symmetrical arrangement or asymmetrical arrangement and/or different shape and configurations with repeating symmetrical arrangement or asymmetrical arrangement.

[000135] Conversely, the polygonal or hexagonal structures 3001 may be manufactured directly into a patterned array that is affixed to at least one base membrane 3002. The base membrane may be manufactured with a polymeric or foam material. The polymeric or foam material may be flexible and/or elastic to allows it to be easily bent, twisted or flexed to conform to complex surfaces. Alternatively, the polymeric and/or foam material may be substantially rigid. The manufacturing of each patterned array of polygonal or hexagonal structures 3001 may include extrusion, investment casting or injection molding

process. The base membrane with the polygonal or hexagonal structures may be affixed directly to at least a portion of the base or the entirety. Affixing each pattered array of polygonal or hexagonal structures 3001 may be arranged in continuous or segmented arrays. Also, the polygonal or hexagonal structures 3001 may have the same shape and configuration with repeating symmetrical arrangement or asymmetrical arrangement and/or different shape and configurations with repeating symmetrical arrangement or asymmetrical arrangement.

[000136] In another embodiment, the impact mitigation structure may comprise at least a portion of auxetic structures 3101 as shown in FIGS. 31A-31B. The auxetic structures 3101 may include a plurality of interconnected members forming an array of reentrant shapes 3102. The auxetic structures 3101 may be affixed to a base membrane or directly onto an outer shell. Such auxetic structures 3101 may be coupled or affixed to the shell protrusion as a continuous layer or in segmented arrays 3103. The term "auxetic" generally refers to a material or structure that has a negative Poisson ratio, when stretched, auxetic materials or structures become thicker (as opposed to thinner) in a direction perpendicular to the applied force. Such auxetic structures can result in high energy absorption and/or fracture resistance. In particular, when a force is applied to the auxetic material or structure, the impact can cause it to expand (or contract) in one direction, resulting in associated expansion (or contraction) in a perpendicular direction. It should be recognized that those skilled in the art could utilize auxetic structures 3101 to include differently shaped segments or other structural members and different shaped voids. For example, FIG. 31B illustrates an amplified view of one embodiment of an auxetic structure that is "bone" or "ribbon" shaped with radiused or arced re-entrant shapes.

[000137] In another embodiment, the impact mitigation layer may further comprise at least one foam layer or a portion of a foam layer. The at least one foam layer can include polymeric foams, quantum foam, polyethylene foam, polyurethane foam (foam rubber), XPS foam, polystyrene, phenolic, memory foam (traditional, open cell, or gel), impact absorbing foam (e.g., VN600),), Ethylene Vinyl Acetate foam (EVA), Ariaprene foam, latex rubber foam, convoluted foam ("egg create foam"), Evlon foam, impact hardening foam, 4.0 Custula comfort foam (open cell low density foam) and/or any combination thereof. The at least one foam layer may have an open-cell structure or closed-cell structure. The at least one foam layer can be further tailored to obtain specific characteristics, such as anti-static, breathable, conductive, hydrophilic, high-tensile, high-tear, controlled elongation, and/or any combination thereof. For example, FIGS. 47A-47B illustrates various views of a portion of a foam layer. The foam layer comprises a foam pad 4701. The foam pad 4701 may be positioned on the crown of the wearer's head and conform to the curvature of the wearer's head. The portion of a foam layer may have a length 4704 and a height 4703. The height 4703 may vary at a range between 0.5 inches to 2 inches. The length

4704 may vary from 2 inches to 6 inches. The foam pad 4702 may have a rectangular cross-section. The foam pad having a recess 4702 disposed on an external surface.

[000138] In another embodiment, the impact mitigation layer may further comprise at least one base layer. The at least one base layer may be a rigid and/or substantially rigid material. The at least one base layer may have a first surface and a second surface. At least a portion of an impact mitigation structure and/or a plurality of impact mitigation structures may be affixed to at least a portion of the at least one base layer first and/or second surface. Alternatively, at least one end of an impact mitigation structure and/or one end of a plurality of impact mitigation structures may be affixed to the at least one base layer first and/or second surface. Desirably, the at least one base layer may comprise two base layers, which the impact mitigation structure is disposed in between the two base layers.

[000139] FIGS. 32A-32C depict cross-sectional views of impact mitigation pads. In another embodiment, the impact mitigation layer may further comprise impact mitigation pads 3201, 3204, 3205. The one or more impact mitigation pads 3201, 3204, 3205 may comprise a first material layer 3202, a second material layer 3203, and an impact mitigation structure 3204. The first material layer 3202 and/or the second material layer 3203 may comprise a 2-way stretch material, a 4-way stretch material, and/or a foam layer. Additionally, the first material layer 3202 and/or the second material layer 3203 may further comprise a polymeric material, such as polypropylene, polyethylene, polyester, nylon, PVC, PTFE, and/or any combination thereof. It also may be desirable to have a plurality of individual impact mitigation pads. Furthermore, the first material 3202 and/or the second material layer 3203 may be breathable and wick away moisture easily from the skin while carrying out various sporting and athletic activities. For example, the covering may completely or continually cover an entire array of impact mitigating structures (not shown). Conversely, the covering may cover at least a portion of an entire array of impact mitigating structures. Furthermore, the covering may cover segmented arrays of impact mitigating structures or individual impact mitigating structures (not shown).

[000140] In one embodiment, the impact mitigating structures can comprise a least a portion of liner pod assemblies as shown in FIGS 33A-33D, 34A-34B, and 35A-35B. FIGS. 33A-33D depict various views of one embodiment of an impact mitigation pod assembly 3301. The one or more liner pod assemblies 3305 may include at least one individual pod (known as "pods" or "modular pods") and/or a connecting mechanism that is coupled to a base membrane layer 3306 and/or inner shell or inner layer 3303. If the one or more liner pod assemblies 3305 are assembled onto a base membrane layer 3306, they will be coupled to the base membrane 3306 in a flat configuration then flexed or bend to create a shape that conforms to a wearers head. The base membrane 3306 may be manufactured with a polymeric or foam material. The polymeric or foam material may be flexible and/or elastic to allows it to be easily bent, twisted or flexed to conform to complex surfaces. Alternatively, the polymeric and/or foam material

may be substantially rigid to provide a force distribution layer. The base membrane 3306 may comprise tabs 3302 that will be bent around the inner shell 3303 to couple the base membrane 3306 to the inner shell 3303. The one or more pod assemblies 3305 can be modular and removably coupled into any configuration within the helmet. Each of the one or more pod assemblies 3305 may be positioned proximate to an adjacent to the one or more pod assemblies 3305, such that the perimeter of each of the one or more pod assemblies 3305 may be parallel 3307 to the adjacent one or more pod assemblies 3305.

[000141] Furthermore, additional spaces 3308 may not be covered in case the wearer desires further attachment of additional one or more pod assemblies 3305 and allow easier flexing capabilities. Each of the liner pod assemblies 3305 may include easily removable connections (or removably connected) to couple to the helmet (e.g., first or second shells), the impact mitigation layer and/or various components thereof. Each of the one or more liner pod assemblies may be manufactured to accommodate and protect the desired region of the wearer's head. Such plurality of liner pod assemblies 3305 may include regions such as one or more of the following: a frontal assembly (or front), an occipital assembly (or lower-back), a mid-back assembly (right and/or left sides), a parietal assembly (or midline), and a temporal assembly (right and/or left sides), and/or any combination(s) thereof. Alternatively, each of the one or more liner pod assemblies 3305 may be positioned adjacent to another liner pod assembly and connected by a flexible coupling to create a single-piece pod layer. The single-piece pod layer can be folded and manipulated to conform to the curvature of the head.

[000142] Alternatively, the one or more pod assemblies 3403 may be coupled directly to the inner shell 3402. Each of the one or more liner pod assemblies 3403 may be manufactured to accommodate and protect the desired region of the wearer's head. Such plurality of liner pod assemblies 3403 may include regions such as one or more of the following: a frontal assembly (or front), an occipital assembly (or lower-back), a mid-back assembly (right and/or left sides), a parietal assembly (or midline), and a temporal assembly (right and/or left sides), and/or any combination(s) thereof.

[000143] FIGS. 35A-35B depict two alternative embodiments of a pod assemblies 3501, 3502. Each of pods assemblies 3501, 3502 comprise a pod body 3503 and a connection mechanism 3504. The pod body can comprise a generally triangular shaped body with rounded corners (an isosceles triangle, for example), although a variety of other shapes, including other shaped triangles, squares, pentagons, hexagons, septagons and/or octagon shapes, could be utilized in a variety of embodiments. In a similar manner, alternative shapes having rounded and/or sharp corners and/or edges may be utilized, as well as irregular and/or re-entrant shaped bodies, if desired.

[000144] In one exemplary embodiment, one or more liner pod assemblies can be provided in a series of sizes and/or thicknesses, such as the pods shown in FIG. 35A-35B, which depicts pods bodies of similar sizes but with varying thicknesses, from a first pod body having a ¼" thickness progressively up

to a fourth pod body with 1" or 1.25" or greater thickness. Desirably, the different thickness triangular pods bodies can be provided with similar external dimensions (i.e., height and/or width), with only the thickness differing to any substantial degree, allowing different thickness pods to be "mixed and matched" for use with a single helmet liner or other component, and/or other item of protective clothing.

[000145] The one or more liner assemblies may comprise at least one single foam layer construction. The connection mechanism 3504 is removably coupled or permanently coupled to the single foam layer pod. The single foam layer pod construction may further comprise one or more impact mitigation structures (not shown). The at least one foam layer can include polymeric foams, quantum foam, polyethylene foam, polyurethane foam (foam rubber), XPS foam, polystyrene, phenolic, memory foam (traditional, open cell, or gel), impact absorbing foam (e.g., VN600),), Ethylene Vinyl Acetate foam (EVA), Ariaprene foam, latex rubber foam, convoluted foam ("egg create foam"), Evlon foam, impact hardening foam, 4.0 Custula comfort foam (open cell low density foam) and/or any combination thereof. The at least one foam layer may have an open-cell structure or closed-cell structure. The at least one foam layer can be further tailored to obtain specific characteristics, such as anti-static, breathable, conductive, hydrophilic, high-tensile, high-tear, controlled elongation, and/or any combination thereof.

[000146] Alternatively, the one or more liner pods may comprise a multi-foam layer construction. the multilayer layer construction may include a single foam layer, an enclosure, and impact mitigation structure, and/or a second foam layer. Such multi-construction layers may allow the assembly to function as impact mitigation and comfort, thus, eliminating the need for an additional comfort liner. In another embodiment, the one or more liner pod assemblies may comprise a multi-layered pod construction and a connection mechanism. The multi-layered pod construction comprises two or more material layers. The two or more material layers may include at least one foam layer, a resilient and/or flexible fabric (e.g., a two-way or four-way stretch fabric) layer, a plastic layer (e.g., polycarbonate), and/or any combination thereof. More specifically, the multi-layered pod construction comprises a top layer, a first foam layer, a second foam layer, a bottom layer, and/or any combination thereof. Furthermore, the one or more liner pod assembly may further comprise an impact mitigation structure (not shown) or an impact distribution plate (not shown), and/or an impact mitigation structure and an impact distribution plate, where the impact mitigation structure and/or the impact distribution plate are disposed between the top layer and/or bottom layer. Each of the two or more layers may be different material layers and/or the same material layers. The at least one top layer and at least one bottom layer may be the same material, or they may be different materials. The at least one foam layer may be a one single layer, and/or it may be a plurality of foam layers (two or more).

[000147] Desirably, the one or more liner pod assemblies may be easily removable and interchangeable. For example, in order to increase the amount of protection on the left and/or right side

of the helmet, the wearer may simply replace one or more of the liner pods on the right side of the helmet with thicker or thinner liner pod assemblies to balance the width reduction, and ultimately have proper helmet adjustment to accommodate the exchange of liner pod assemblies. Alternatively, the player may choose an "oversized" comfort liner which may be slightly "too big" for the wearer, and then the wearer can replace the liner pod assemblies in one or more regions with thinner liner pod assemblies to "fit" the helmet more appropriately.

[000148] FIGS. 36A-36C depict various views of one embodiment of a connection mechanism 3602. The connection mechanism 3601 having a central body 3602, and at least one longitudinal extending member 3603. Each of the longitudinal extending members 3603 may be positioned symmetrically or asymmetrically around the perimeter of the central body 3602. Each of the longitudinal extending members 3603 extends parallel from a surface of the central body 3602. Each of the central bodies 3602 may comprise at least one fin 3603, that may be positioned around the perimeter of the central body 3602 either symmetrically or asymmetrically. The fins 3603 are sized and configured to fit within one or more cavities on the base membrane layer and/or the inner shell.

[000149] Inner Shell

[000150] In one embodiment, the adjustable helmet assembly may further comprise at least one inner shell, the inner shell being a force distribution layer. The inner shell being nested within the impact mitigation layer. The inner shell having an exterior surface and an interior surface. The at least one inner shell being a continuous shell that conforms and surrounds the head of the wearer. Alternatively, the at least one inner shell may have a two or more portions that align with the adjustable helmet system.

[000151] Accordingly, the at least one inner shell may be a rigid material. The at least one inner shell may be more rigid than the adjustable helmet system and/or more rigid than the impact mitigation layer. In some embodiments, the inner shell is five to 100 times stiffer or more rigid than the adjustable helmet system and/or the impact mitigation layer. The rigid material may comprise polycarbonate (PC). Alternatively, the inner shell comprises a relatively rigid material or relatively stiff material. The relatively rigid material may be stiff or rigid enough to withstand breakage or cracking, but flexible enough to deform slightly and distribute incident forces after an impact. The at least one inner shell may comprise a thermoplastic material. The thermoplastic materials may comprise polyurethane, polycarbonate, polypropylene, polyether block amide, and/or any combinations thereof.

[000152] Supplemental Layers

[000153] In another embodiment, the adjustable helmet assembly may further comprise one or more supplemental layers. The adjustable helmet system includes a front shell, a back shell, a locking mechanism, and/or one or more supplemental layers. The helmet may further comprise an impact mitigation layer. The helmet may comprise a front shell (or first shell) and a back shell (or second shell),

the first or second shell having an external surface and an internal surface. The locking mechanism being movable between a first unlocked position which allows the first and second shells to slide relative to each other and a second locked position which inhibits the first and second shells from sliding relative to each other. It may be desirous to supplement the impact mitigation layer with a one or more supplemental layers, and one or more supplemental layers may be positioned proximate to the impact mitigation layer and/or the supplemental layer may be positioned proximate to the front (or first) or back (or second) shells. In addition, the supplemental layer may be removably connected or coupled to the helmet and/or the impact mitigation layer for additional impact protection, comfort and fit for a user. The one or more supplemental layers may comprise one or more of the following: at least one foam layer, one or more liner pod assemblies, a one-piece pad assembly, a multi-piece pad construction, a polycarbonate layer and/or any combination thereof.

[000154] The supplemental layer may comprise of one or more liner pod assemblies as disclosed herein. The liner pod assemblies may be used as either a mitigation structure, supplemental layer and/or a combination thereof. The one or more liner pod assemblies may be positioned proximate to the mitigation structure and/or positioned proximate to the front and or back shells. Alternatively, the one or more liner pod assemblies may be coupled to the helmet, the impact mitigation layer, or both the helmet and the impact mitigation layer. Furthermore, the one or more liner pod assemblies may be coupled to a polycarbonate layer or a rigid polymer layer.

[000155] The one-piece supplemental layer may comprise a plurality of segmented pads that are coupled to the adjacent pad through a pivotal or flexible, elastic connection. Each of the plurality of pads may comprise a first layer, a second layer, and at least one foam layer. Each of the plurality of segmented pads are separated by gap. The foam layer is disposed between the first and second layer. The gap has a thickness, the thickness allowing substantial flexibility and/or a pivotal connection. Each of the plurality of pads may be placed in specific regions within the helmet, such as at least one frontal region (or front), an occipital region (or lower-back), a mid-back region, a parietal region (or midline), and a temporal region (right and/or left sides), and/or any combination(s) thereof. The first or second layer may comprise a two-way stretch fabric, four-way stretch fabric, Neoprene, Ducksan Power Net, thermoplastic polyurethane (TPU), any wicking material, any antimicrobial material, polycarbonate material and/or any combination thereof.

[000156] The at least one foam layer can include polymeric foams, quantum foam, polyethylene foam, polyurethane foam (foam rubber), XPS foam, polystyrene, phenolic, memory foam (traditional, open cell, or gel), impact absorbing foam (e.g., VN600), Ethylene Vinyl Acetate foam (EVA), Ariaprene foam, latex rubber foam, convoluted foam ("egg create foam"), Evlon foam, impact hardening foam, 4.0 Custula comfort foam (open cell low density foam) and/or any combination thereof. The at least one

foam layer may have an open-cell structure or closed-cell structure. The at least one foam layer can be further tailored to obtain specific characteristics, such as anti-static, breathable, conductive, hydrophilic, high-tensile, high-tear, controlled elongation, and/or any combination thereof. The at least one foam layer may comprise of segmented pieces and/or one continuous layer.

[000157] Alternatively, the supplemental layer may comprise a plurality of individual segmented pads providing for a multi-piece construction. Each of the plurality of individual pads may comprise a first layer, a second layer, and at least one foam layer. The foam layer is disposed between the first and second layer. Each of the plurality of individual pads may be placed in specific regions within the helmet, such as at least one frontal region (or front), an occipital region (or lower-back), a mid-back region, a parietal region (or midline), and a temporal region (right and/or left sides), and/or any combination(s) thereof. The first or second layer may comprise a two-way stretch fabric, four-way stretch fabric, Neoprene, Ducksan Power Net, thermoplastic polyurethane (TPU), any wicking material, any antimicrobial material, polycarbonate material and/or any combination thereof.

[000158] In another embodiment, the supplemental layer 4601 may comprise a plurality of segmented assemblies 4603 providing for a multi-piece construction as shown in FIGS. 46A-46B. Each of the segmented assemblies 4603 comprise one or more liner pod assemblies 4604 as disclosed in FIGS. 35A-35D, and/or one or more individual pads as disclosed in FIG. 32A-32C, each of the one or more liner pod assemblies 4604 and/or each the one or more individual pads coupled to a base layer 4605. The base layer 4605 may be a polymer, the polymer may be relatively rigid or a rigid material. Each of the plurality segmented assemblies 4603 may be placed in specific regions within the helmet, such as at least one frontal region (or front), an occipital region (or lower-back), a mid-back region, a parietal region (or midline), and a temporal region (right and/or left sides), and/or any combination(s) thereof.

[000159] Example Embodiments

[000160] 1. An adjustable helmet comprising:

[000161] A first shell;

[000162] A second shell, the second shell being slidably attached to the first shell,

[000163] A locking mechanism, the locking mechanism being movable between a first unlocked position which allows the first and second shells to slide relative to each other and a second locked position which inhibits the first and second shells from sliding relative to each other.

[000164] 2. An adjustable helmet comprising:

[000165] A first shell;

[000166] A second shell, the second shell being slidably attached to the first shell;

[000167] A locking mechanism, the locking mechanism being movable between an unlocked position which allows the first and second shells to slide relative to each other and a locked position which prohibits the first and second shells from sliding relative to each other.

[000168] At least one opening, the at least one opening placed adjacent to, in proximity to or within impact zones of the first or second shells, thereby absorbing the energy from an impact and reducing the transfer of the impact force to an adjacent portion of the first or second shell and/or to the wearer's head.

[000169] 3. The adjustable helmet of claim 2, wherein the impact zones are located within the occipital region, temporal region, parietal region, orbit region, the frontal region, the mandible (front, right and/or left side) region, the maxilla region, the nasal region, zygomatic region, the ethmoid region, the lacrimal region, the sphenoid region and/or any combination thereof.

[000170] 4. The adjustable helmet of claim 2, wherein the flexure and/or local deformation may occur laterally, perpendicular, oblique, normal to helmet plane, tangent to helmet plane, perpendicular to helmet plane, or parallel to helmet plane, and/or any combination thereof.

[000171] 5. The adjustable helmet of claim 2, the at least one opening may be positioned in plane tangent to the helmet circumference, in a plane perpendicular or substantially perpendicular to the helmet plane, or in an oblique plane to the helmet plane, in a plane parallel to helmet plane, and/or any combination thereof.

[000172] 6. An adjustable helmet comprising:

[000173] A first shell;

[000174] A second shell, the second shell being slidably attached to the first shell; and

[000175] A locking mechanism, the locking mechanism including:

[000176] a clamp assembly,

[000177] a plurality of teeth, at least a portion of the plurality of teeth sized and configured to fit within a portion of a plurality of recesses, the plurality of teeth disposed on the first or second shell,

[000178] a plurality of recesses, at least a portion of the plurality of recesses are sized and configured to receive the plurality of teeth, the plurality of recesses disposed on the first or second shell, the clamp assembly being movable between an unlocked position that allows the plurality of teeth and the plurality of recesses to disengage and allows the first and second shells to slide relative to each other, and a locked position that allows the a portion of the plurality of teeth and a portion of the plurality of recesses to engage and inhibits the first and second shells from sliding relative to each other.

[000179] 7. An adjustable helmet comprising:

[000180] A first shell;

[000181] A second shell, the second shell being slidably attached to the first shell; and

[000182] A locking mechanism, the locking mechanism including:

[000183] a clamp tongue, clamp tongue extending away from the first or second shell, the clamp tongue having a plurality recesses, at least a portion of the plurality of recesses are sized and configured to receive a portion of a plurality of teeth,

[000184] a plurality of teeth, at least a portion of the plurality of teeth sized and configured to fit within a portion of the plurality of recesses, the plurality of teeth disposed on a portion of the first or second shell,

[000185] a clamp assembly, the clamp assembly being movable between an unlocked position that disengages the portion of the plurality of teeth from the portion of the plurality of recesses and allows the first and second shells to slide relative to each other, and a locked position that allows a portion of the plurality of teeth and a portion of the plurality of recesses to engage and inhibits the first and second shells from sliding relative to each other.

[000186] 8. An adjustable helmet comprising:

[000187] A first shell, the first shell having an external surface and an internal surface;

[000188] A second shell, the second shell being slidably attached to the first shell, the second shell having an external surface and an internal surface; and

[000189] A locking mechanism, the locking mechanism including:

[000190] a clamp tongue, clamp tongue extending away from the first or second shell, the clamp tongue having a plurality of recesses, at least a portion of the plurality of recesses are sized and configured to receive a portion of a plurality of teeth,

[000191] a plurality of teeth, at least a portion of the plurality of teeth sized and configured to fit within a portion of the plurality of recesses, the plurality of teeth disposed on a portion of the first or second shell,

[000192] a clamp assembly, the clamp assembly being movable between an unlocked position that disengages the portion of the plurality of teeth from the portion of the plurality of recesses and allows the first and second shells to slide relative to each other, and a locked position that allows the a portion of the plurality of teeth and a portion of the plurality of recesses to engage and inhibits the first and second shells from sliding relative to each other.

[000193] a cavity, the cavity being sized and configured to receive the clamp assembly, the cavity being disposed within the first or second shells, the clamp assembly having a top surface and a bottom surface, the clamp assembly top surface being flush or substantially flush with the external surface of the first or second shell.

[000194] 9. An adjustable helmet comprising:

[000195] A first shell, the first shell having an external surface and an internal surface;

[000196] A second shell, the second shell being slidably attached to the first shell, the second shell an external surface and an internal surface; and

[000197] A locking mechanism, the locking mechanism including; and

[000198] a clamp assembly, the clamp assembly having a clamp body, the clamp post, and a base plate;

[000199] a clamp tongue, clamp tongue extending away from the first or second shell, the clamp tongue having a top surface, a bottom surface and a first channel, the clamp tongue top surface having a plurality of a plurality recesses, at least a portion of the plurality of recesses are sized and configured to receive a portion of a plurality of teeth, the channel sized and configured to receive the clamp post;

[000200] a plurality of teeth, the plurality of teeth disposed on a portion of the first or second shell internal surface, at least a portion of the plurality of teeth sized and configured to fit within a portion of the plurality of recesses, the first or second shell internal surface further including a second channel, the second channel sized and configured to receive the clamp post;

[000201] a cavity, the cavity being sized and configured to receive the clamp assembly, the cavity being disposed within the first or second shells external surface, the clamp assembly having a top surface and a bottom surface, the clamp assembly top surface being flush or substantially flush with the external surface of the first or second shell, the cavity having an aperture, the aperture sized and configured to receive the clamp post; the base plate coupled to the clamp post, the base plate abuts the bottom surface of the clamp tongue;

[000202] a clamp assembly, the clamp assembly being movable between a locked position and an unlocked position, the locked position places tension on the clamp post and the base plate to compress the clamp tongue allowing a portion of the plurality of teeth and a portion of the plurality of recesses on the clamp tongue to engage and inhibit the first and second shells from sliding relative to each other, the unlocked position places compression on the clamp post and the base plate to release the clamp tongue allowing the portion of the plurality of teeth and the portion of the plurality of recesses of the clamp tongue to disengage, and allow the first and second shells to slide relative to each other.

[000203] 10. The adjustable helmet of claim 1, 2, 5, 6, 7 or 8, wherein the adjustable helmet further comprises an impact mitigation layer.

[000204] 11. The adjustable helmet of claim 1, 2, 5, 6, 7 or 8, wherein the adjustable helmet further comprises a supplemental layer.

[000205] 12. The adjustable helmet of claim 1, 2, 5, 6, 7or 8, wherein the adjustable helmet further comprises ear protection.

[000206] 13. The adjustable helmet of claim 1, 2, 5, 6, 7 or 8, wherein the adjustable helmet further comprises a jaw frame.

[000207] 14. The adjustable helmet of claim 1, 2, 5, 6, 7 or 8, wherein the adjustable helmet further comprises a chin strap.

[000208] 15. The adjustable helmet of claim 10, wherein the supplemental layer is one or more liner pod assemblies.

[000209] 16. The adjustable helmet of claim 14, wherein the one or more liner pod assemblies are removably connected.

[000210] 17. An improved helmet, comprising:

[000211] a helmet, the helmet having an outer layer and a shell protrusion, the outer layer having an outer surface and an inner surface, the shell protrusion extending outwardly from the outer layer outer surface, and

[000212] at least one impact mitigation feature, the at least one impact mitigation feature being disposed onto the shell protrusion and extending therethrough;

[000213] 18. An improved helmet, comprising:

[000214] a helmet, the helmet having an outer layer and a shell protrusion, the outer layer having an outer surface and an inner surface, the shell protrusion extending outwardly from the outer layer outer surface, and

[000215] at least one impact mitigation structure, the at least one impact mitigation structure being disposed onto the shell protrusion;

[000216] 19. An improved helmet, comprising:

[000217] a helmet, the helmet having an outer layer and a shell protrusion, the outer layer having an outer surface and an inner surface, the shell protrusion extending outwardly from the outer layer outer surface, the shell protrusion having a cavity disposed within, and

[000218] at least one impact mitigation structure, the at least one impact mitigation structure being disposed within the cavity of the shell protrusion;

[000219] 20. An improved helmet, comprising:

[000220] a helmet, the helmet having an outer layer and a shell protrusion, the outer layer having an outer surface and an inner surface, the shell protrusion extending outwardly from the outer layer outer surface, the shell protrusion having a cavity disposed within, and

[000221] at least one impact mitigation structure, the at least one impact mitigation structure replacing the shell protrusion.

CLAIMS

I/we Claim:

1. An adjustable helmet comprising:

   a first shell, the first shell having a tongue, the tongue having a first end and a second end, the first or second end affixed to the first shell and the tongue extending away from the first shell, a portion of the tongue having a plurality of recesses;

   a second shell, the second shell having an external surface and an internal surface, the internal surface having a plurality of teeth, the plurality of teeth being sized and configured to engage within a portion of the plurality of recesses; and

   a locking mechanism, the locking mechanism being movable between an unlocked position that disengages the portion of the plurality of teeth from the portion of the plurality of recesses and allows the first and second shells to slide relative to each other, and a locked position that allows the a portion of the plurality of teeth and a portion of the plurality of recesses to engage and inhibits the first and second shells from sliding relative to each other.
2. The adjustable helmet of claim 1, wherein the adjustable helmet further comprises an impact mitigation layer.
3. The adjustable helmet of claim 2, wherein the impact mitigation layer comprises a plurality of laterally supported filament structures coupled to a base membrane.
4. The adjustable helmet of claim 1, wherein the adjustable helmet further comprises an impact mitigation layer and an inner shell.
5. The adjustable helmet of claim 1, wherein the adjustable helmet further comprises an impact mitigation layer, an inner shell and a supplemental layer.
6. The adjustable helmet of claim 5, wherein the supplemental layer comprises a plurality of pod assemblies.
7. An adjustable helmet comprising:

   a first shell;

   a second shell, the second shell being slidably attached to the first shell; and

   a locking mechanism, the locking mechanism comprises

      a plurality of recesses, the plurality of recesses being disposed on a portion of the first or second shell,

      a plurality of teeth, the plurality of teeth disposed on a portion of the first or second shell, at least a portion of the plurality of teeth sized and configured to engage with a portion of the plurality of recesses,

a clamp assembly, the clamp assembly being movable between an unlocked position that disengages the portion of the plurality of teeth from the portion of the plurality of recesses and allows the first and second shells to slide relative to each other, and a locked position that allows the portion of the plurality of teeth and the portion of the plurality of recesses to engage and inhibits the first and second shells from sliding relative to each other.

8. The adjustable helmet of claim 7, wherein the adjustable helmet further comprises an impact mitigation layer, the impact mitigation layer positioned adjacent to an inner surface of the first and second shells.
9. The adjustable helmet of claim 7, wherein the adjustable helmet further comprises an impact mitigation layer and an inner shell.
10. The adjustable helmet of claim 7, wherein the adjustable helmet further comprises an impact mitigation layer, an inner shell and a supplemental layer.
11. An impact mitigation helmet comprising:

an impact mitigation layer; the impact mitigation layer having a first portion and a second portion; and

an outer shell, the outer shell having a first region and a second region, at least a portion of the outer shell first region being in contact with the impact mitigation layer first portion, the outer shell second region being in contact with the impact mitigation layer second portion, at least a portion of the outer shell first region being offset from a portion of the outer shell second region, at least a portion of the outer shell second region being independently deflectable relative to at least a portion of the outer shell first region.

12. The adjustable helmet of claim 11, wherein the outer shell comprising a front shell and a back shell.
13. The adjustable helmet of claim 11, wherein the impact mitigation layer first portion is a foam pad and the impact mitigation layer second portion are a polygonal laterally supported filament structure.
14. The adjustable helmet of claim 11, wherein the offset comprises one or more elongated openings.
15. The adjustable helmet of claim 11, wherein the offset comprises one or more tabs.

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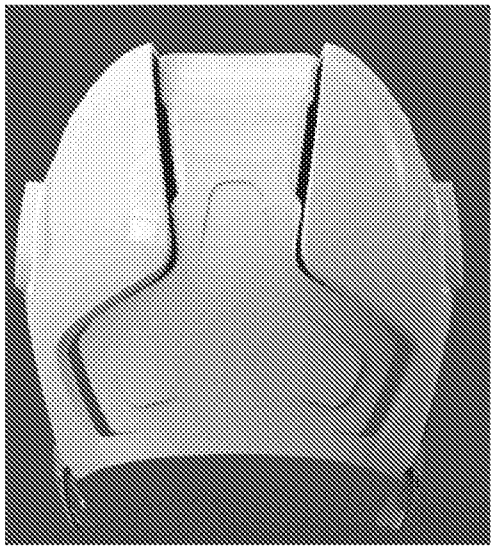
FIG. 1A FIG. 1B



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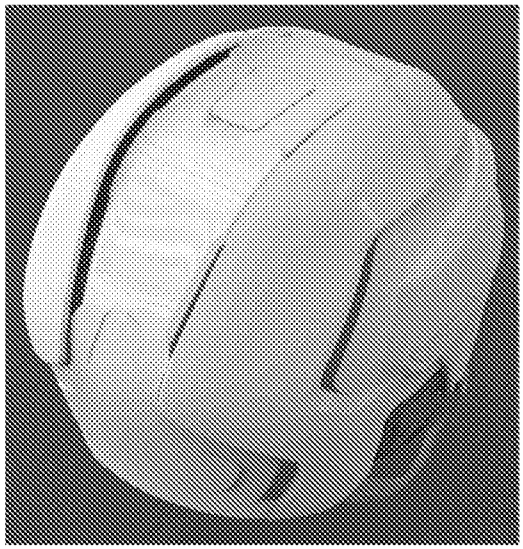
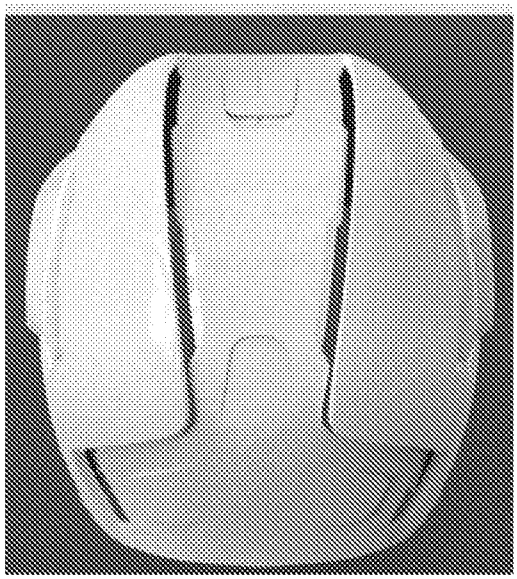


FIG. 1C FIG. 1D



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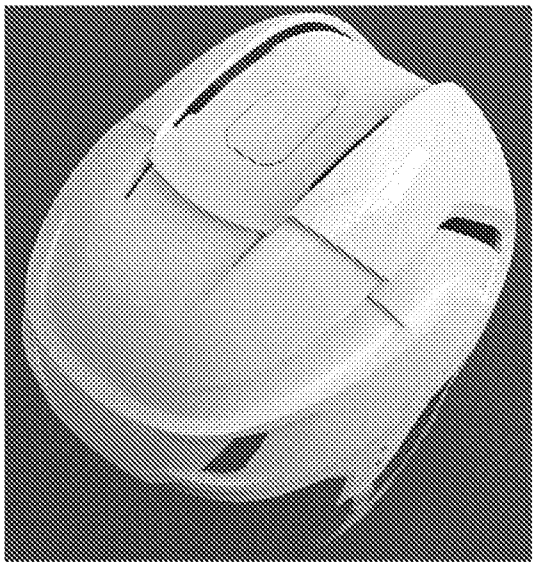

FIG. 1E FIG. 1F

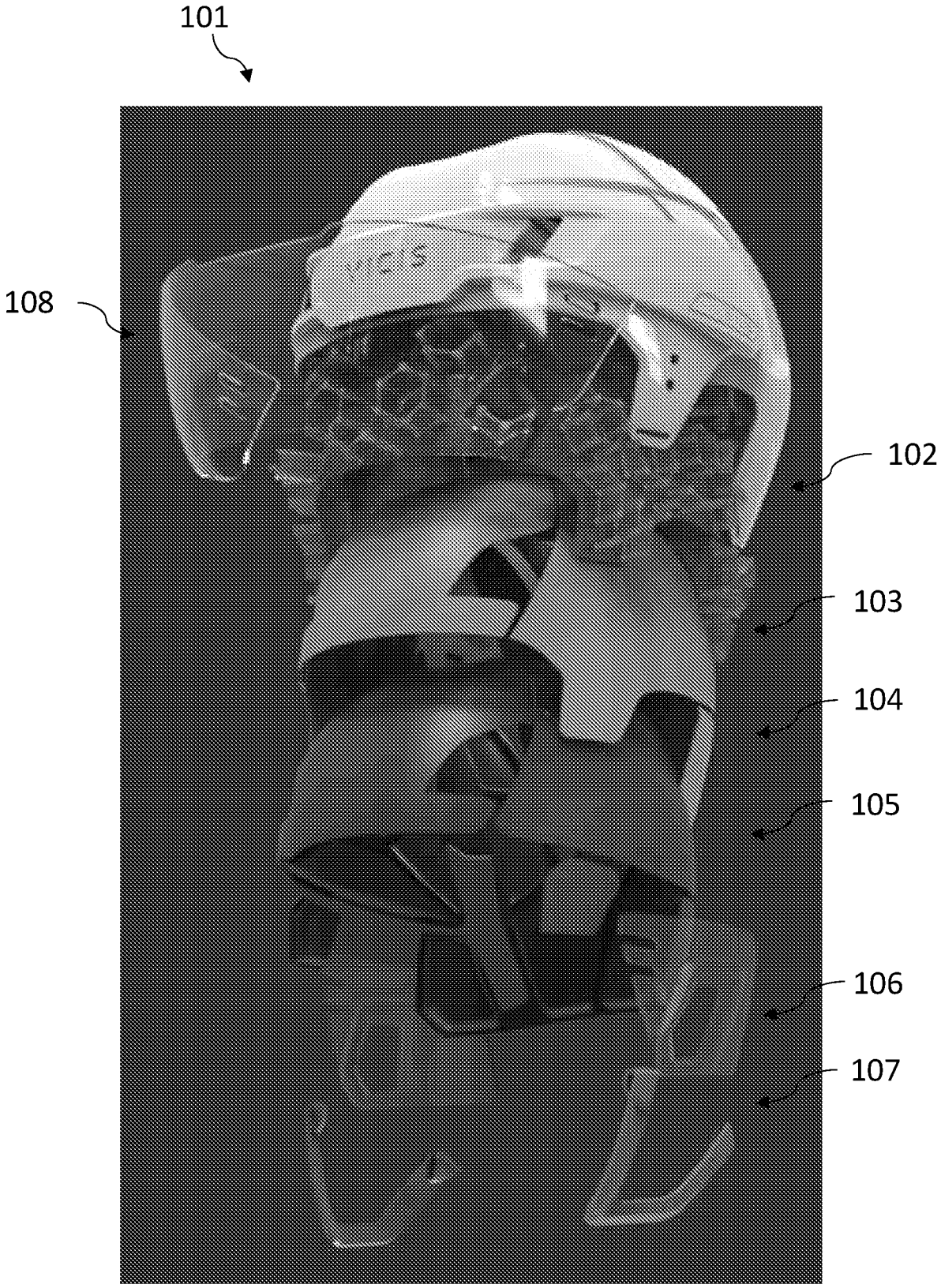

FIG. 1G

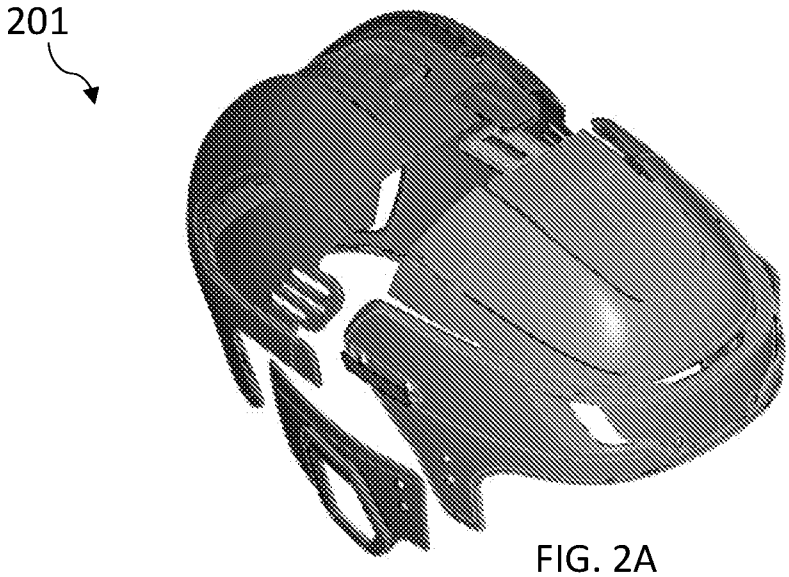

FIG. 2A

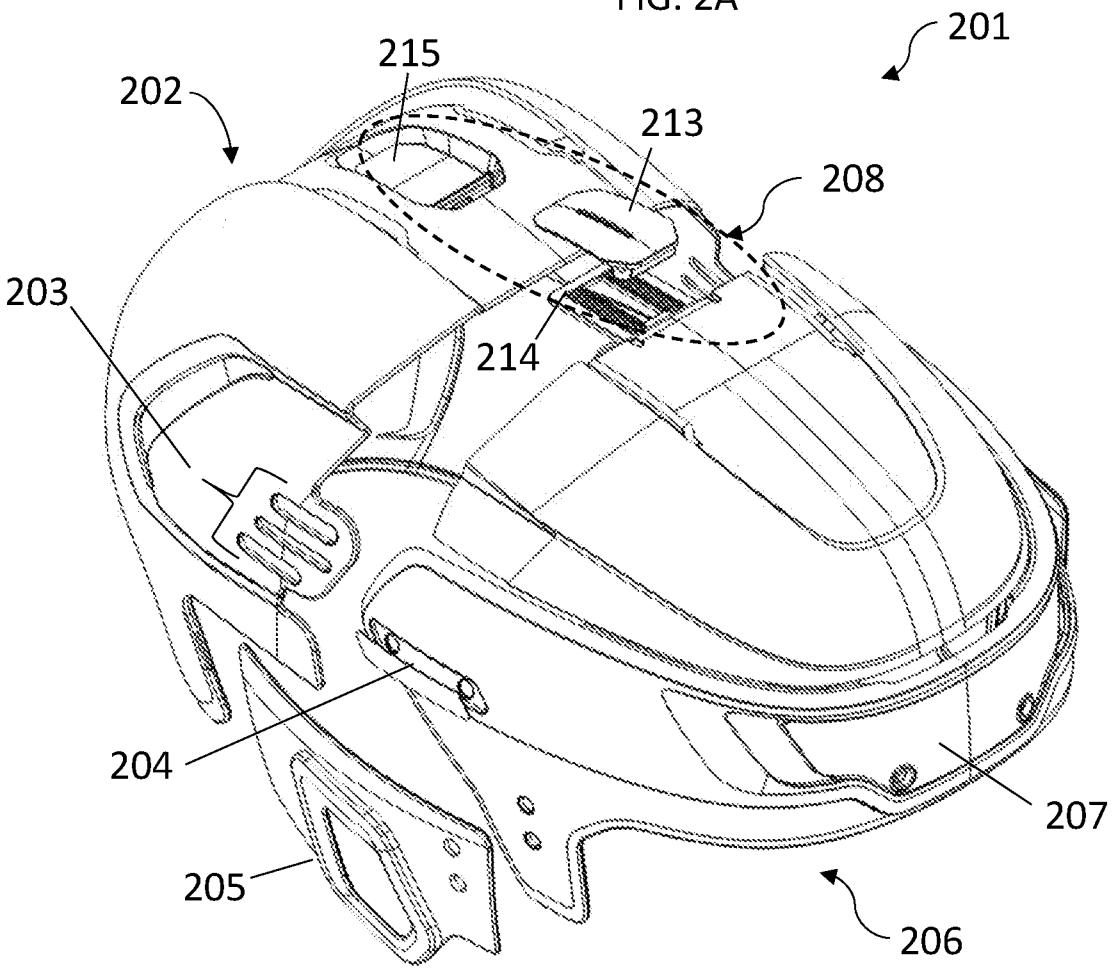

FIG. 2B

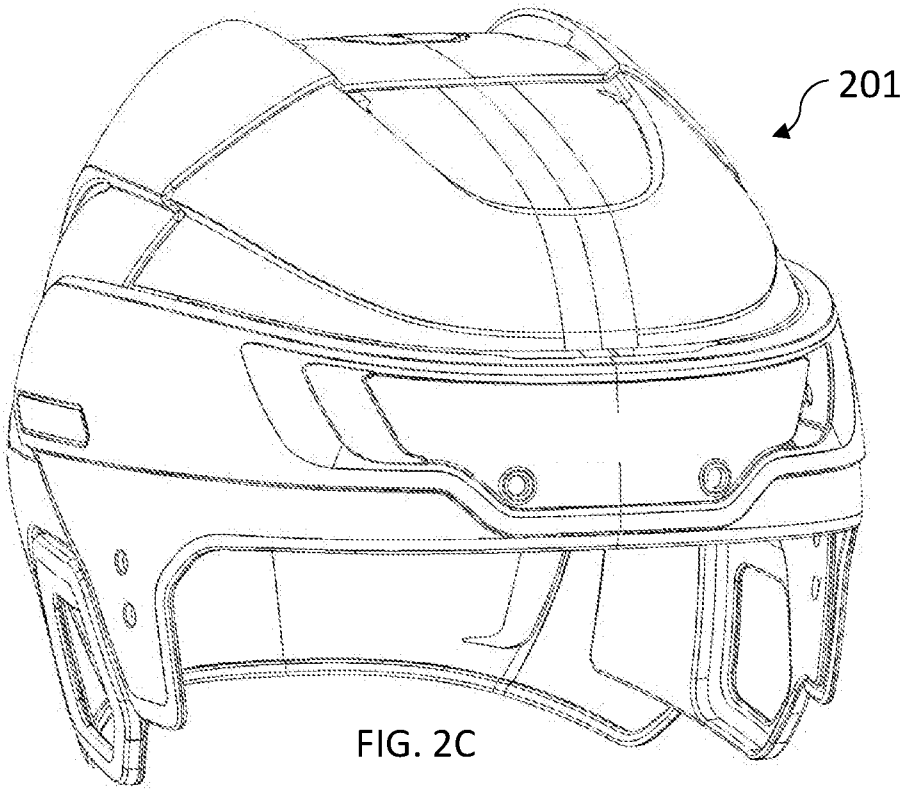

FIG. 2C

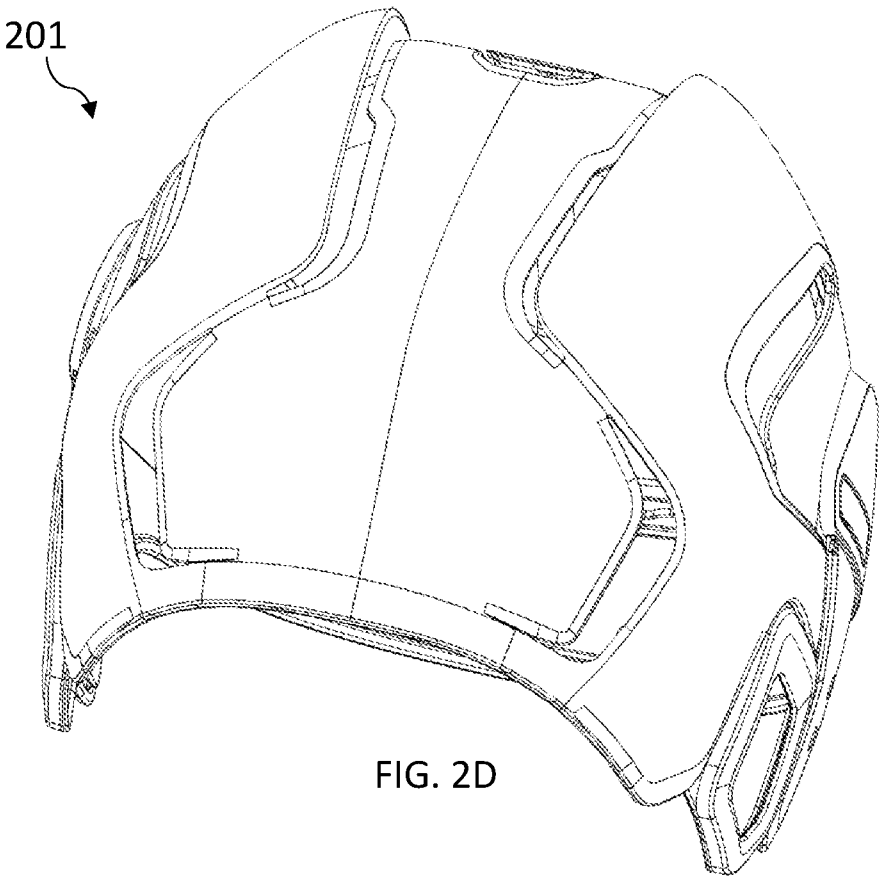

FIG. 2D

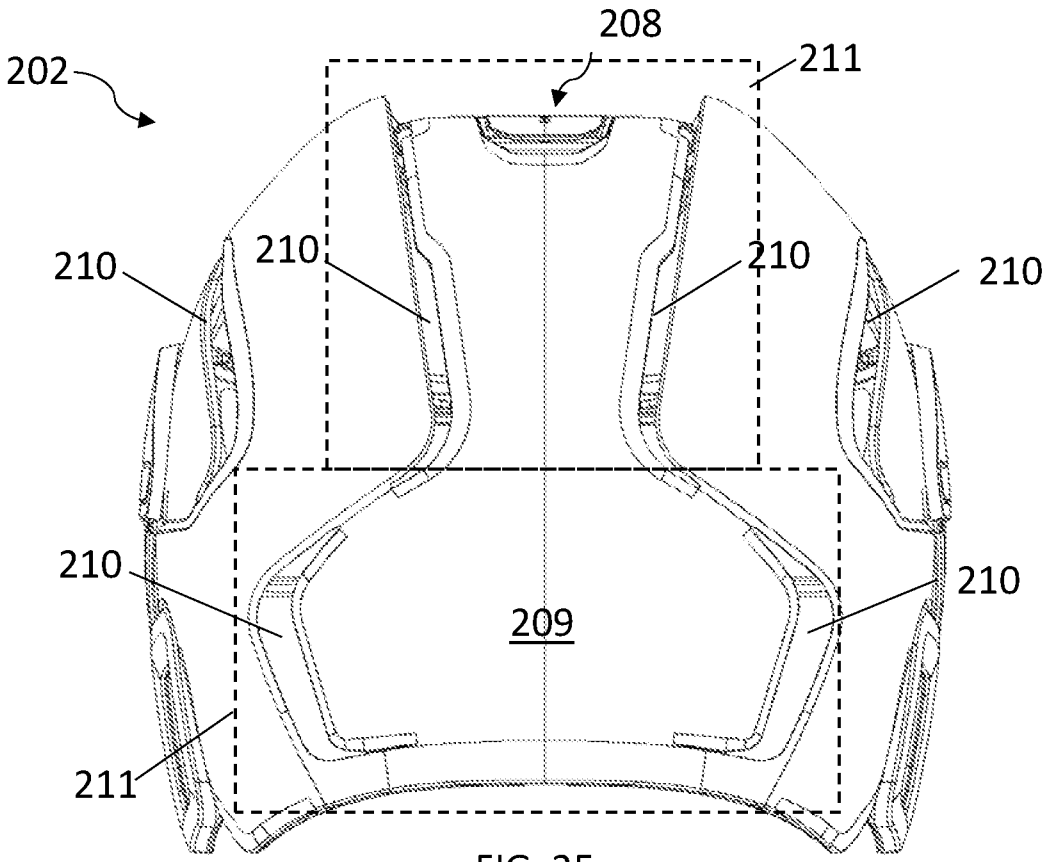
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FIG. 2E

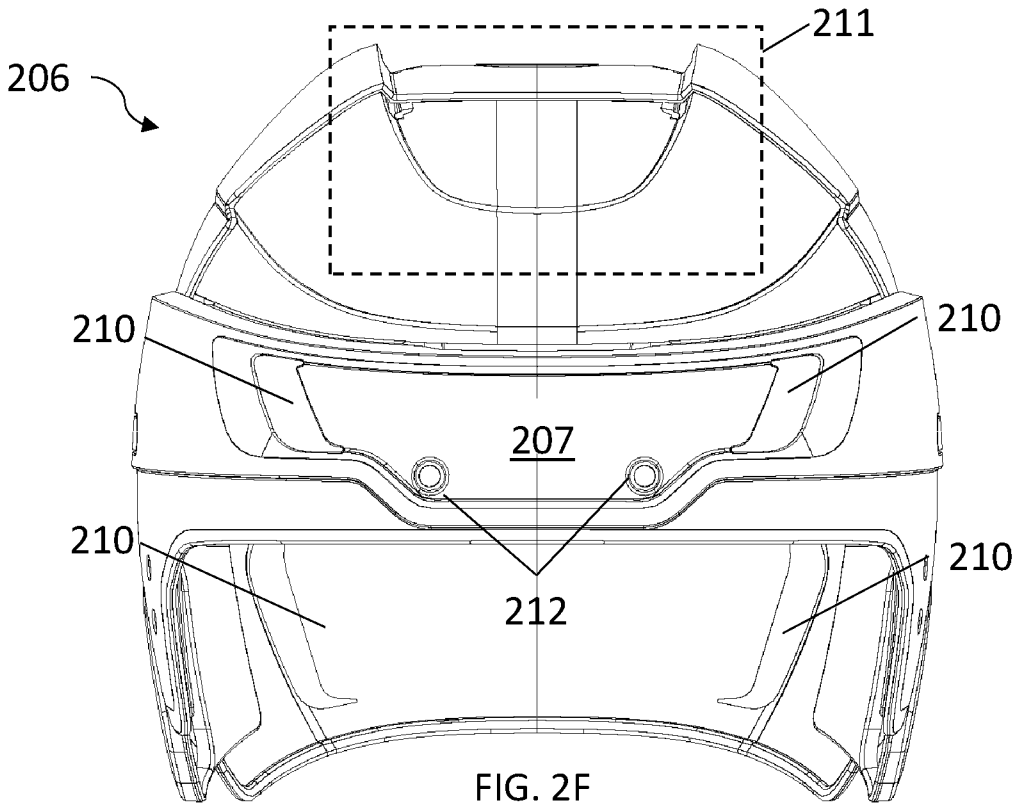
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FIG. 2F

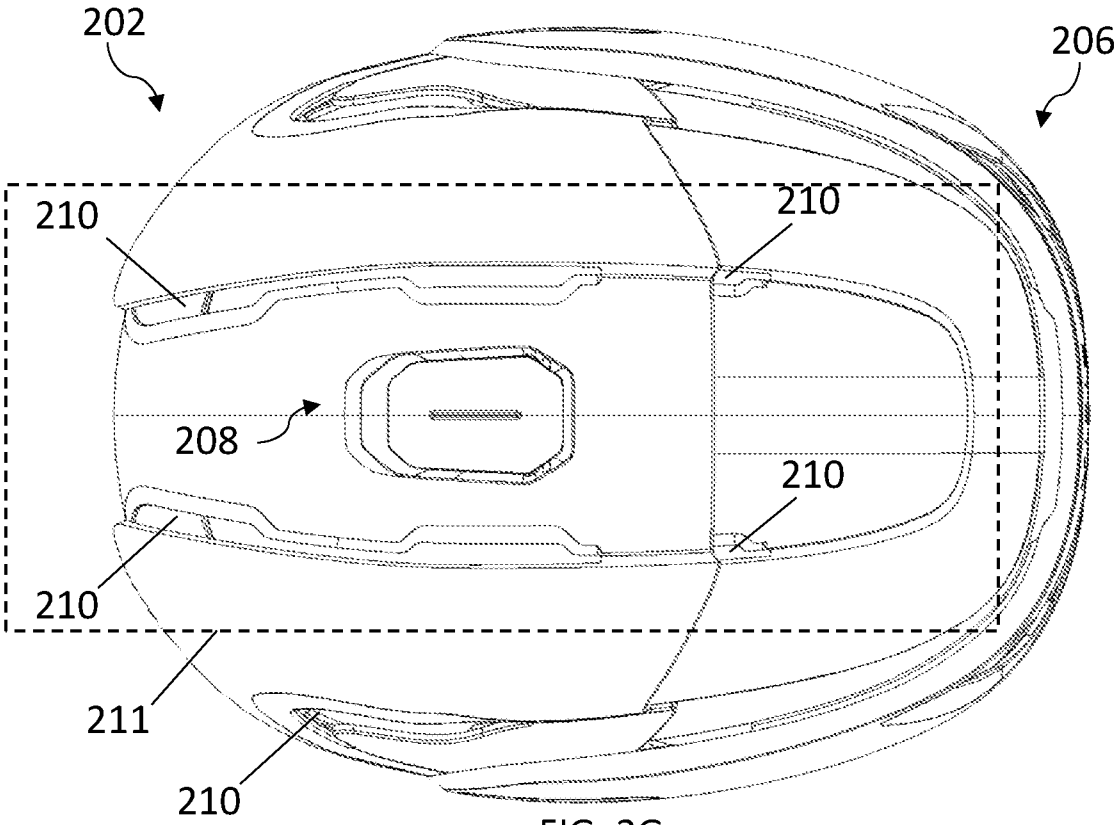

FIG. 2G

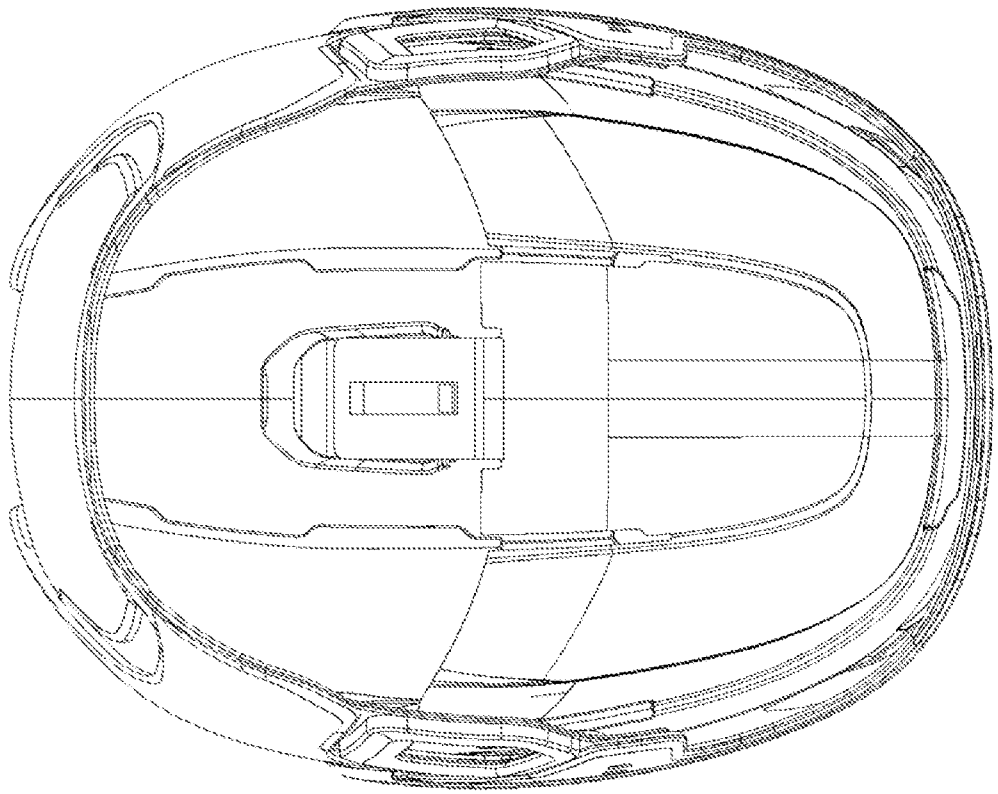

FIG. 2H

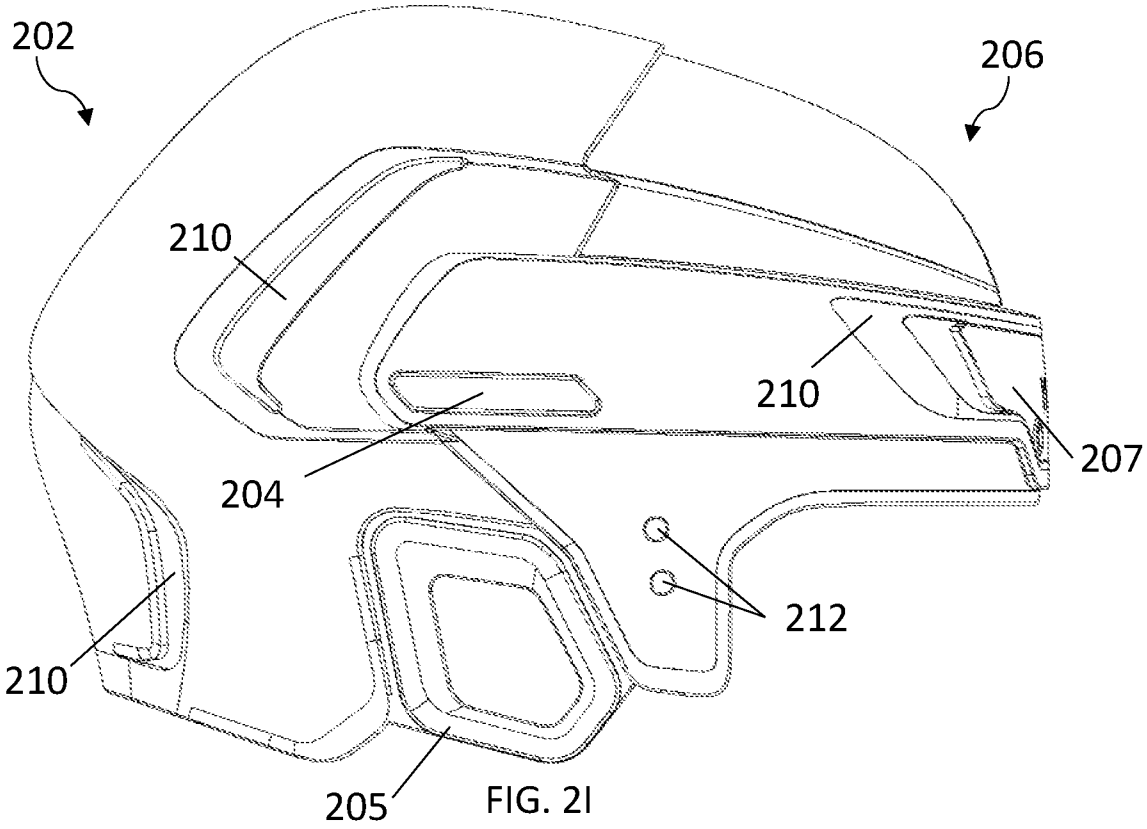

FIG. 2I

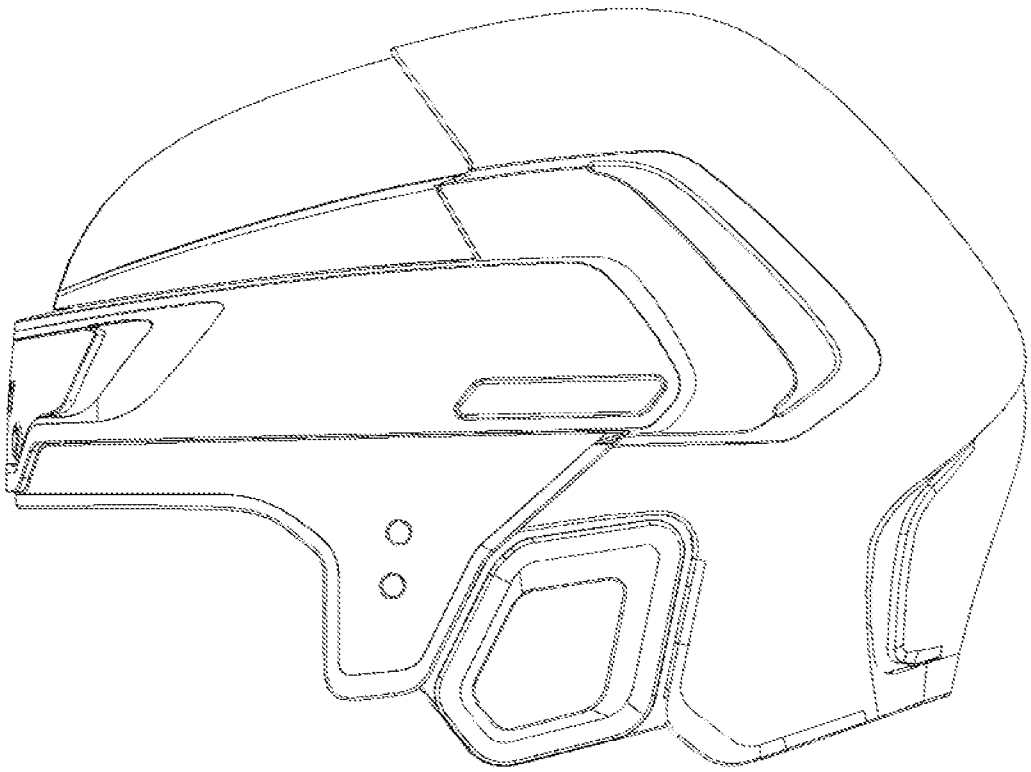

FIG. 2J

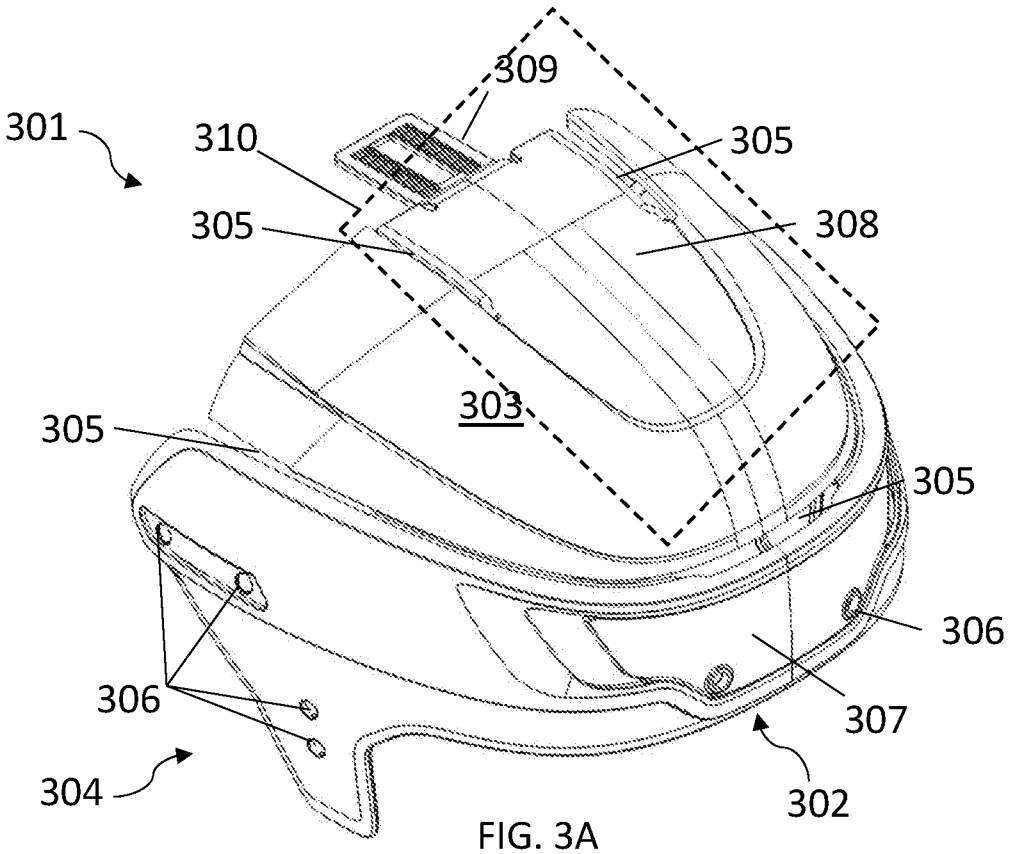
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FIG. 3A

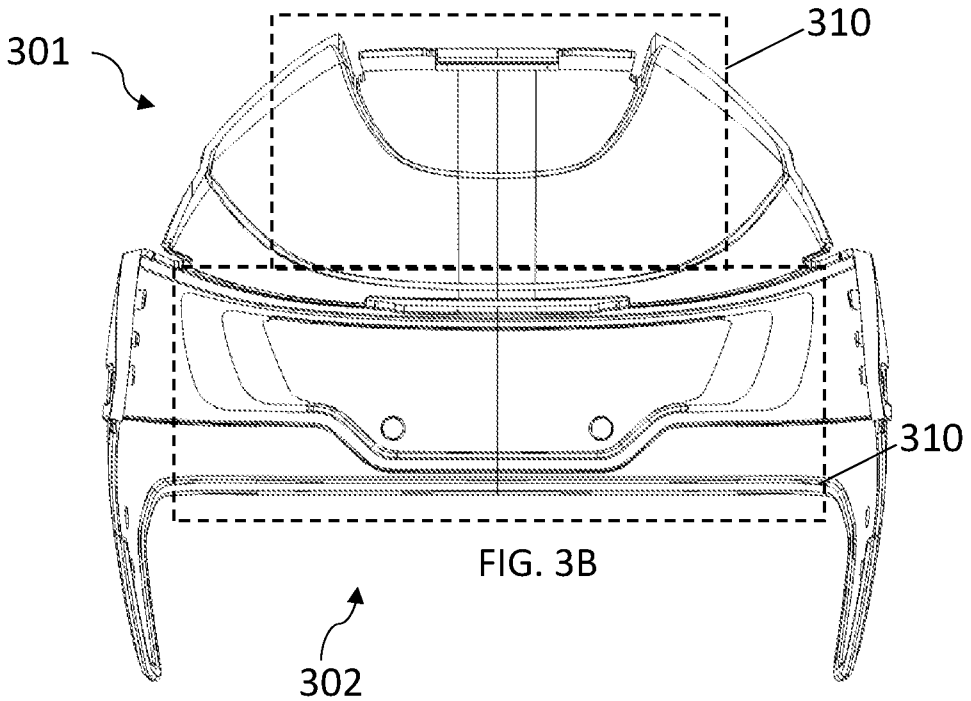
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FIG. 3B

FIG. 3C

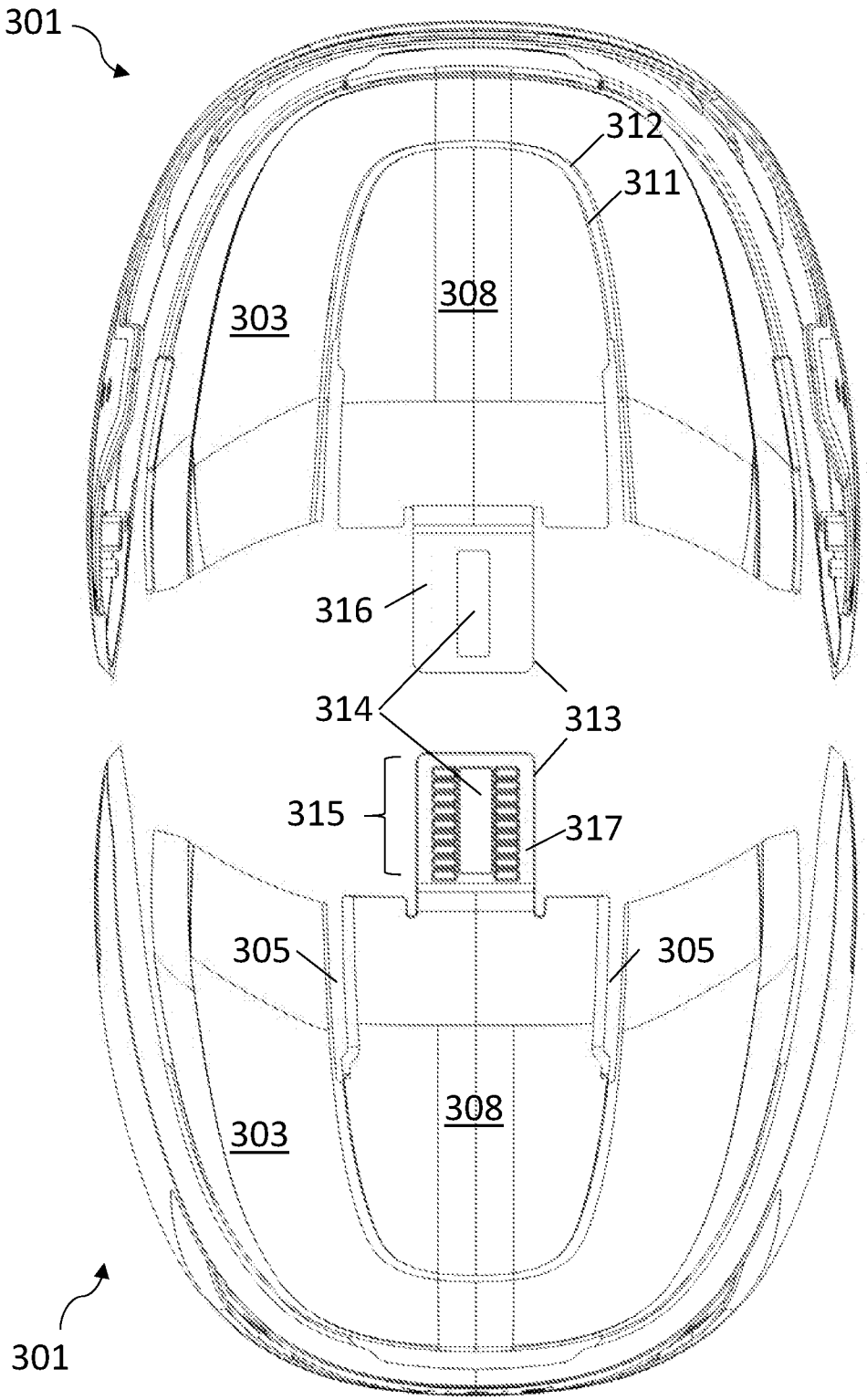

FIG. 3D

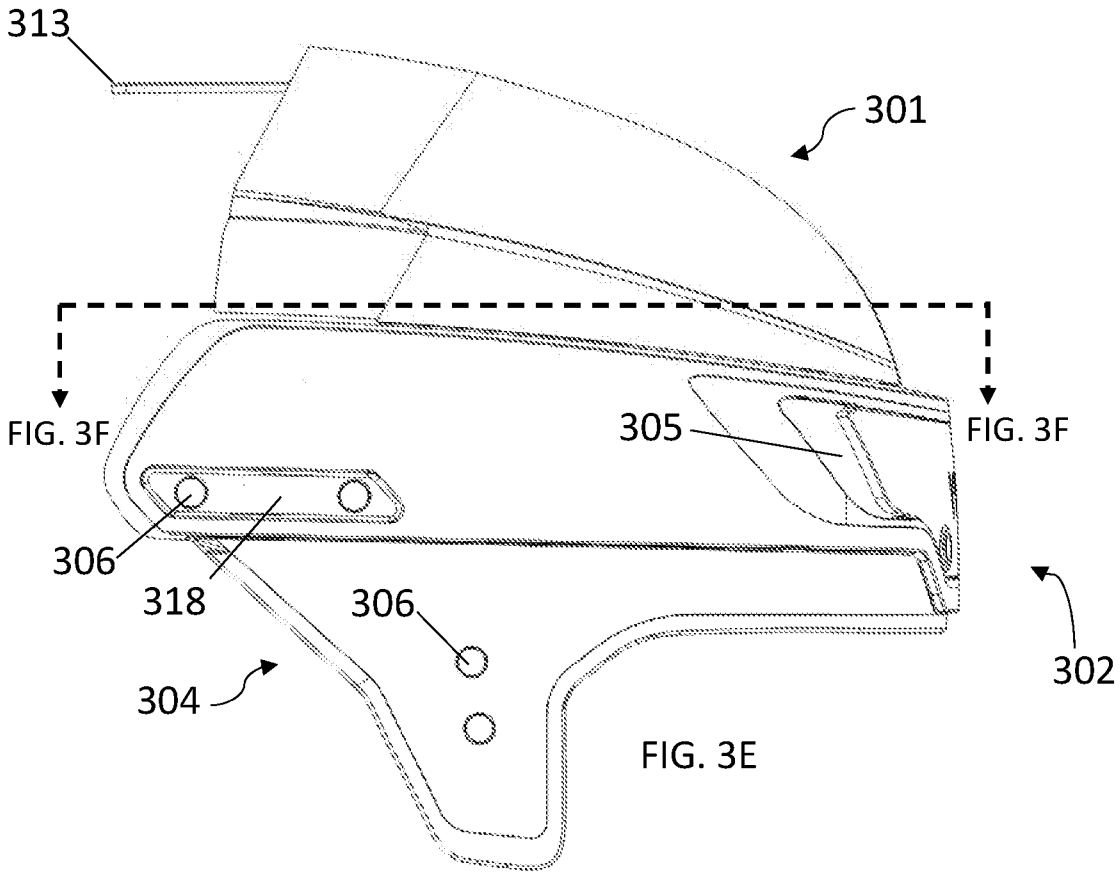
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FIG. 3F
FIG. 3F
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FIG. 3E

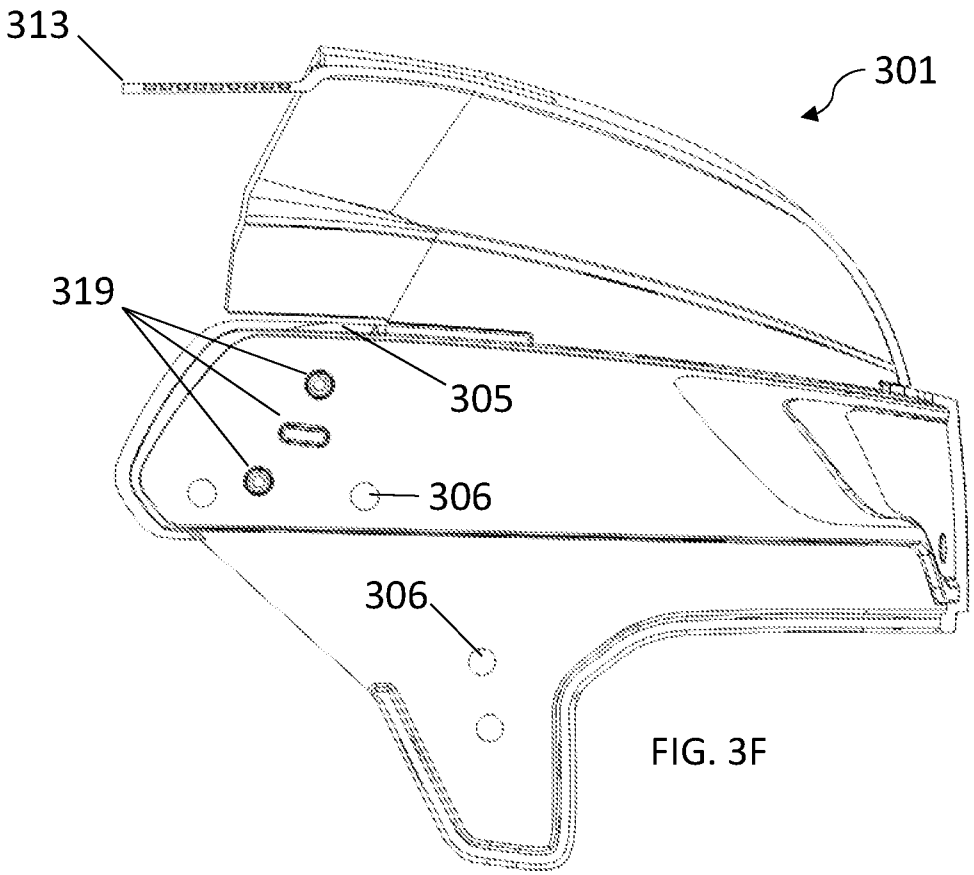
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FIG. 3F

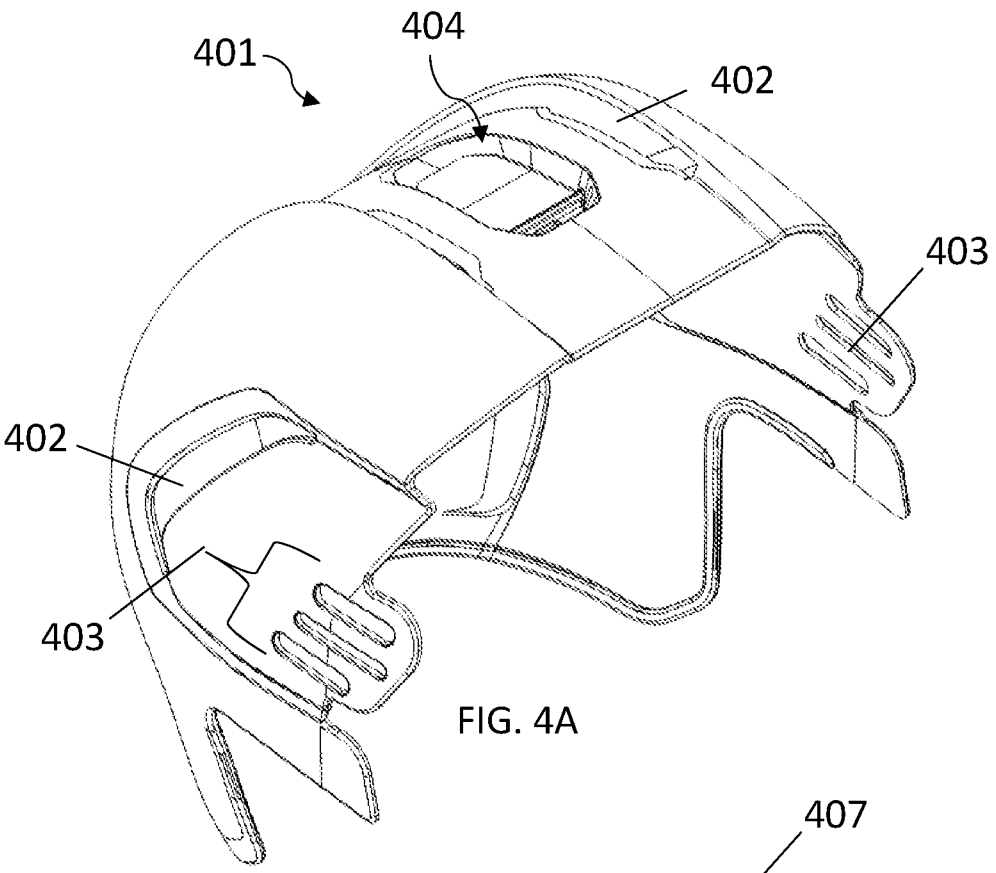

FIG. 4A

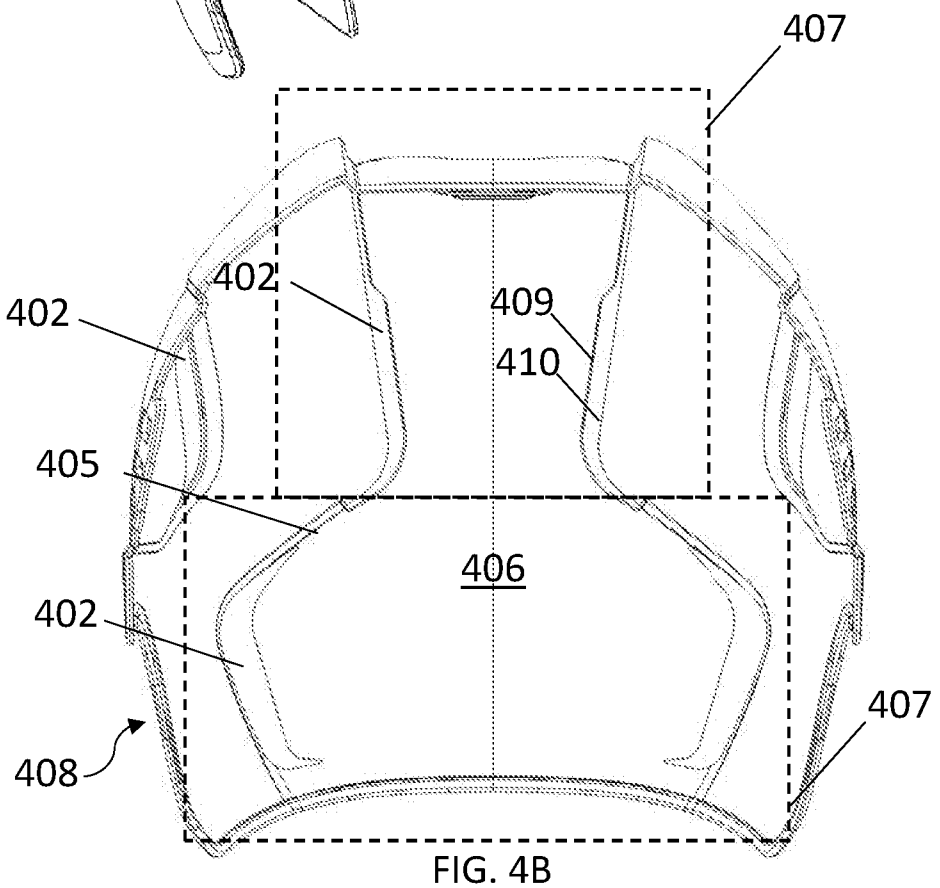

FIG. 4B

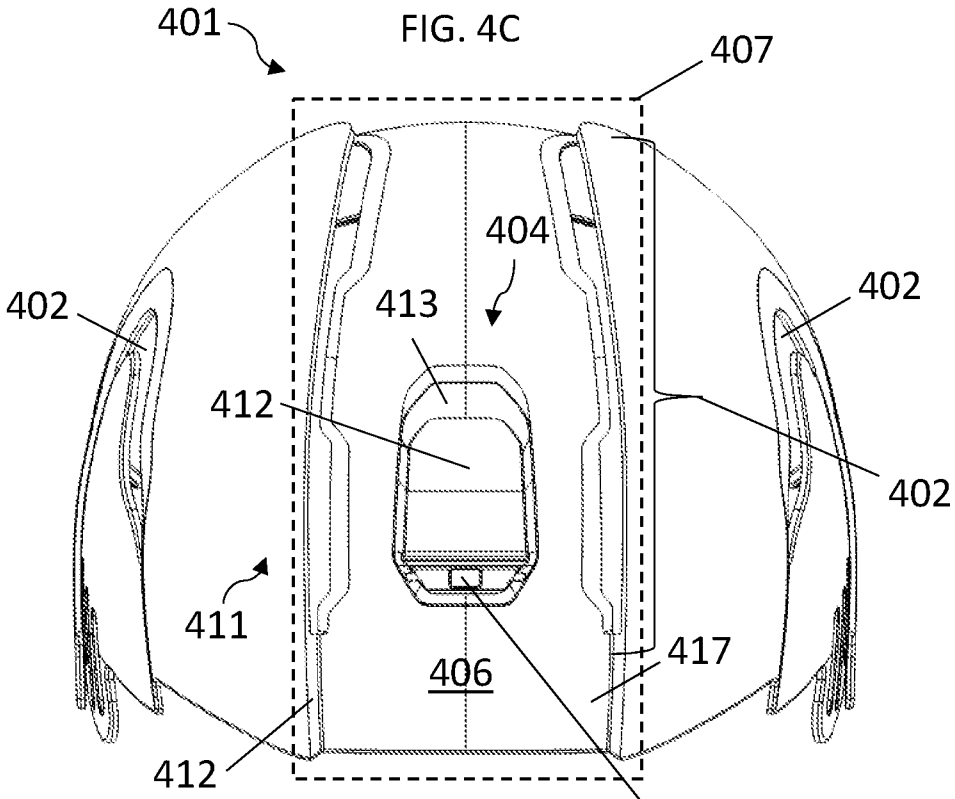
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FIG. 4C

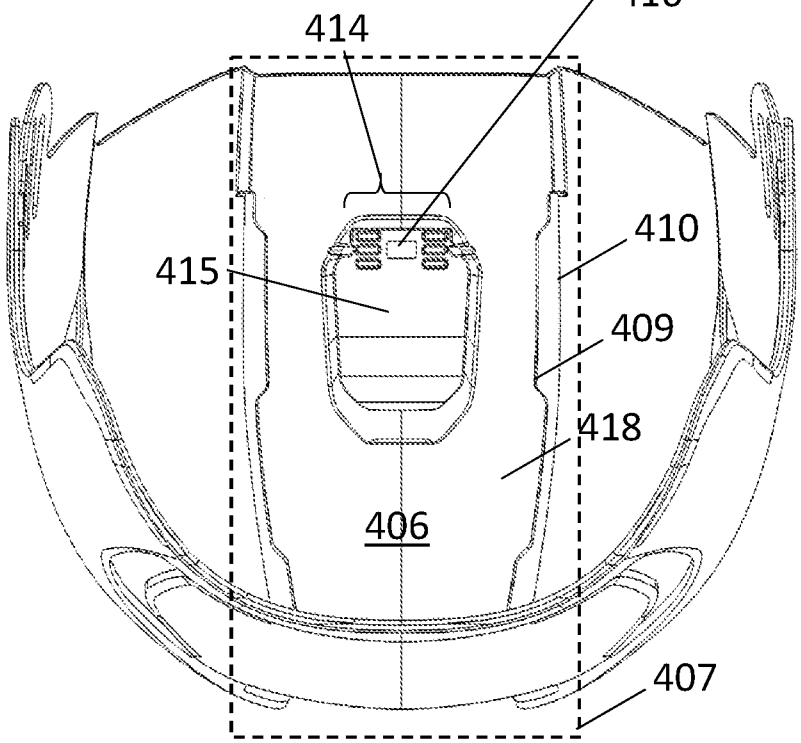
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FIG. 4D

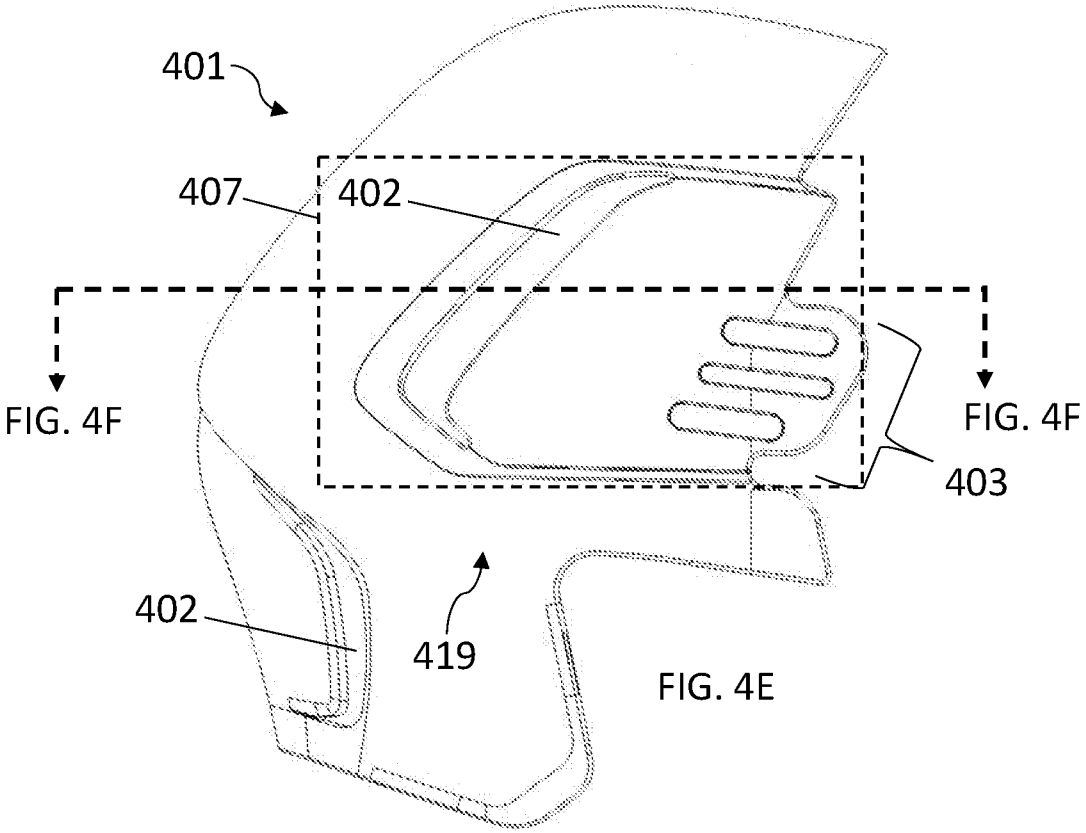


FIG. 4E

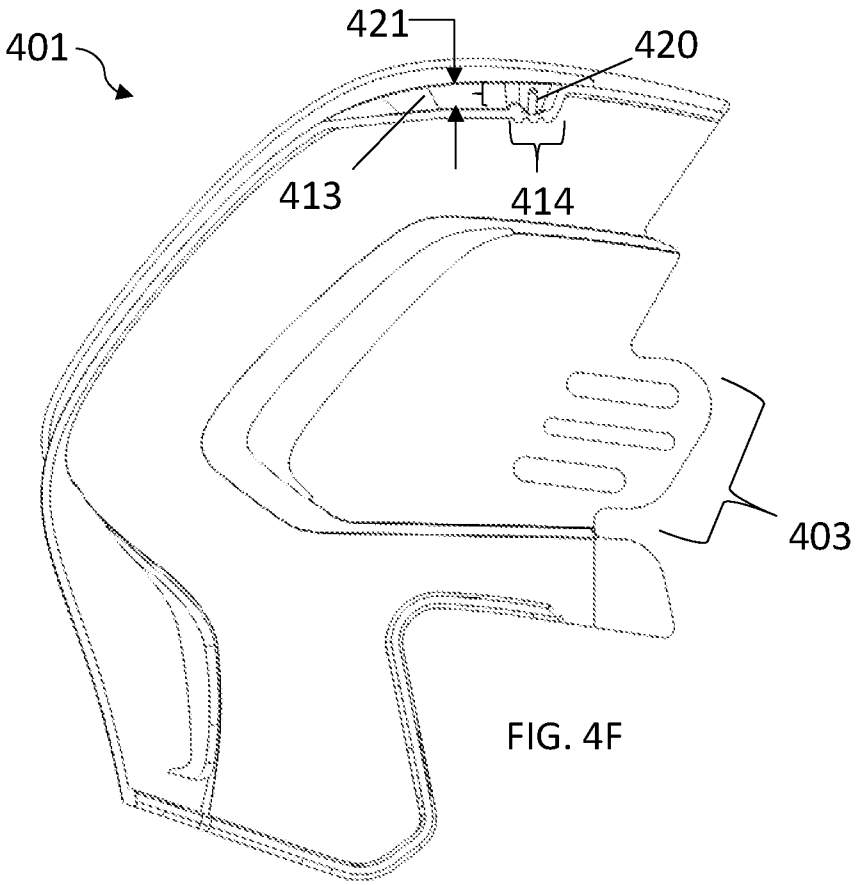


FIG. 4F

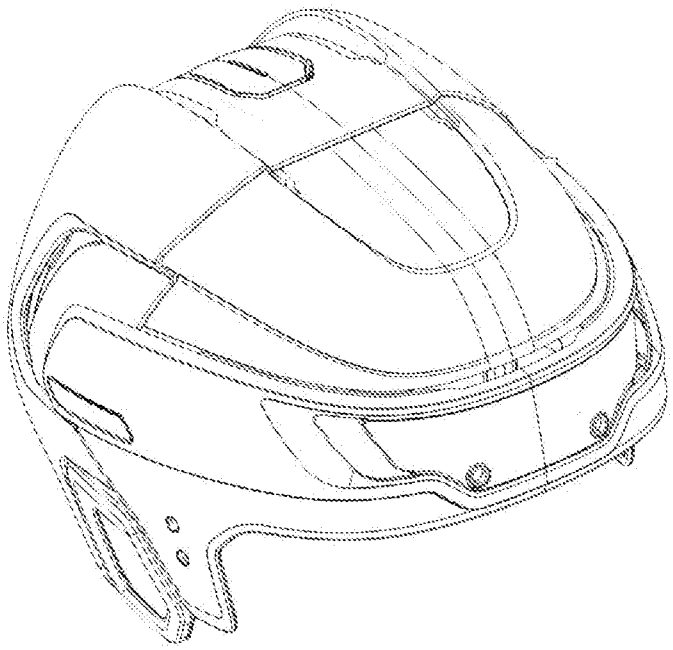


FIG. 5A

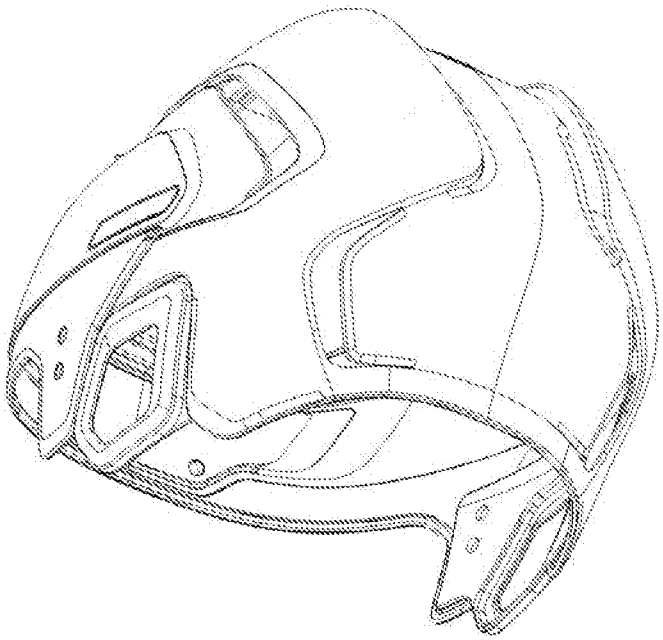


FIG. 5B

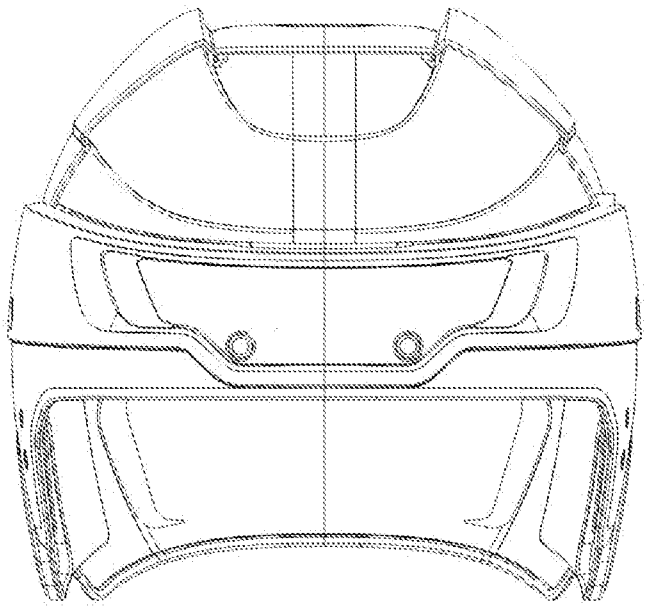


FIG. 5C

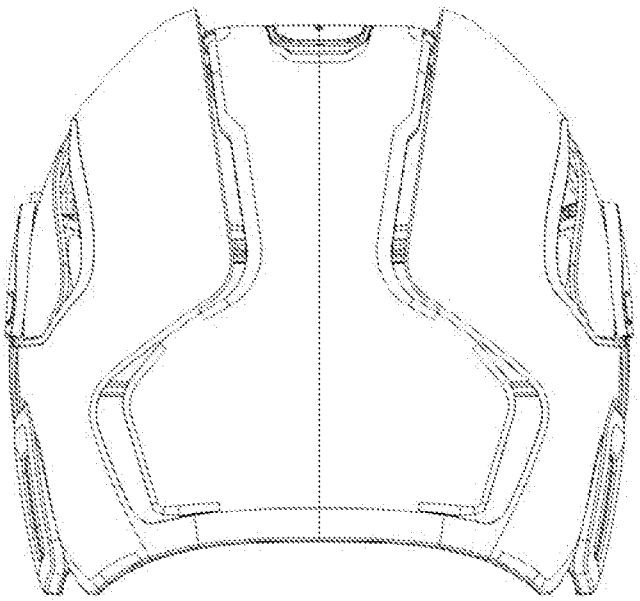


FIG. 5D

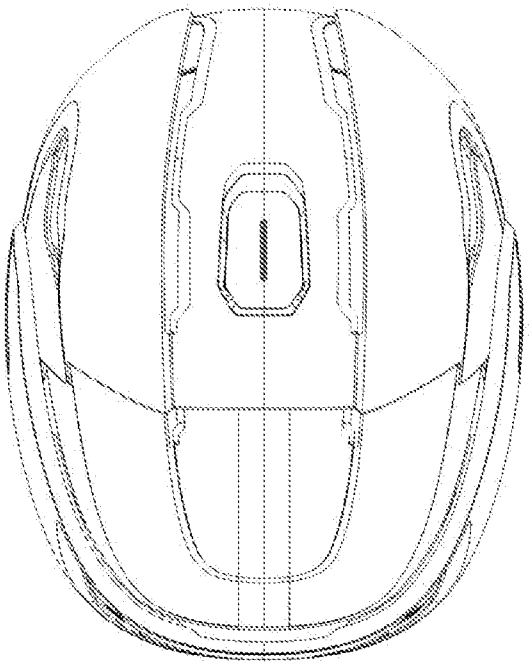
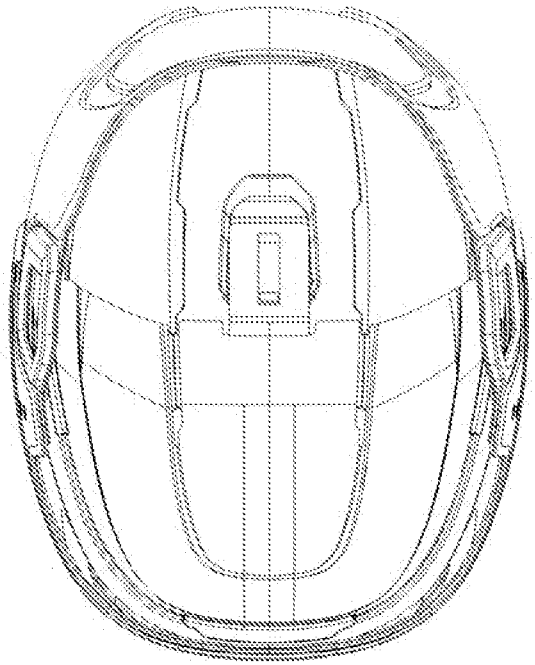


FIG. 5E



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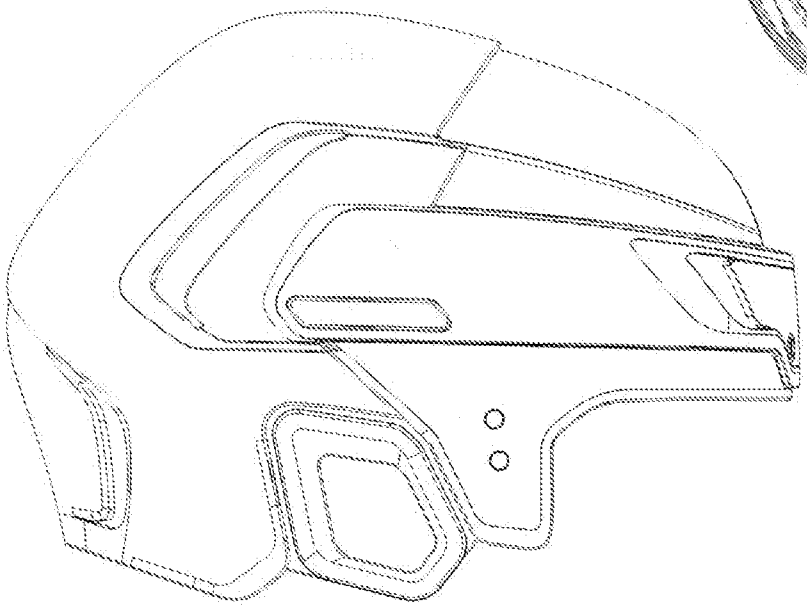


FIG. 5G

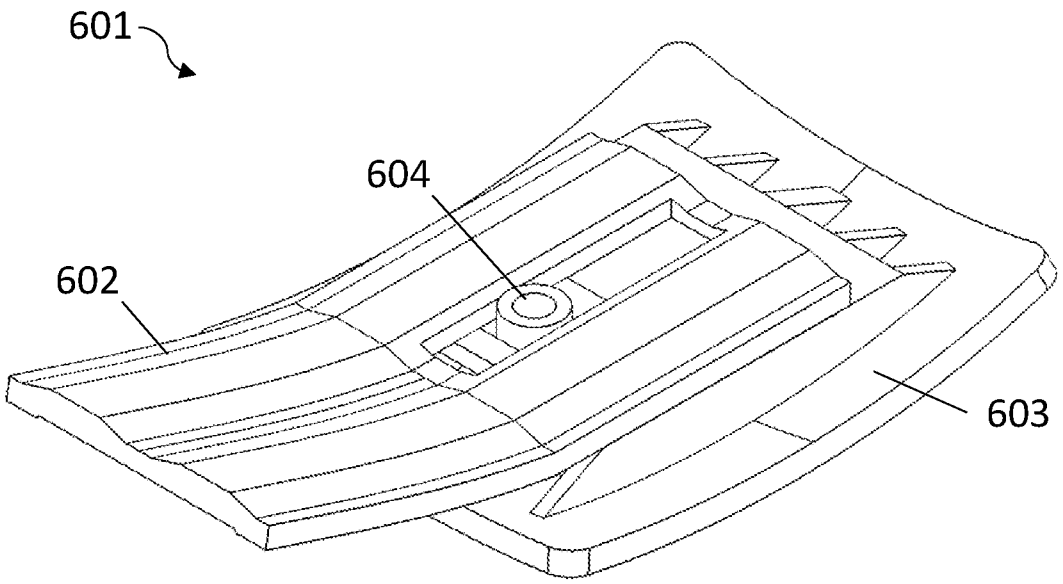


FIG. 6A

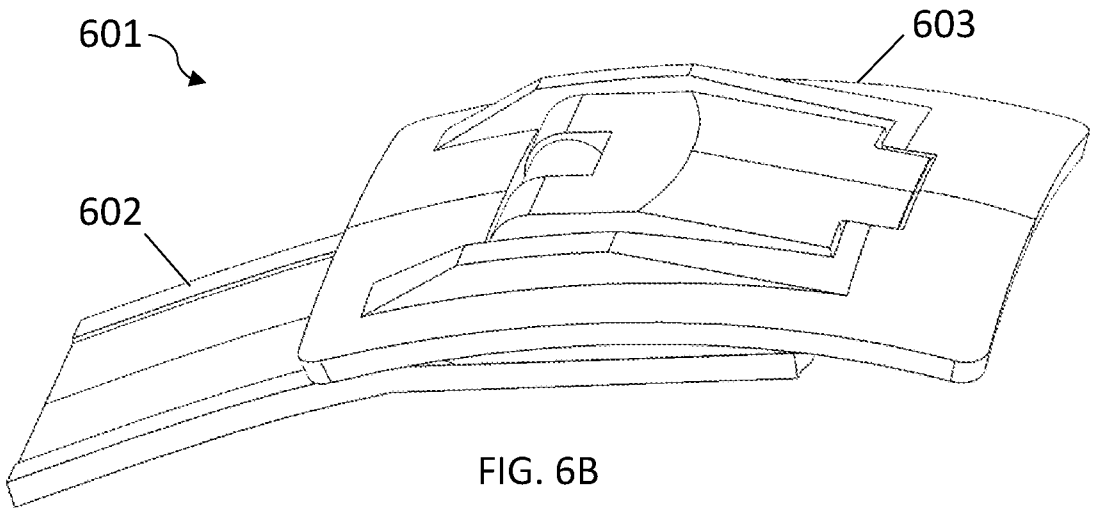


FIG. 6B

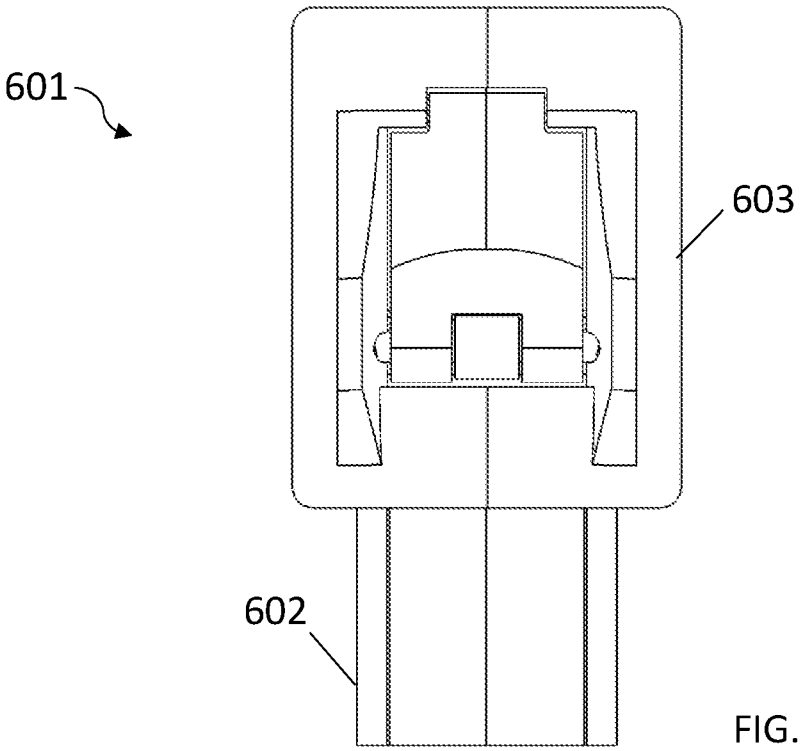


FIG. 6C

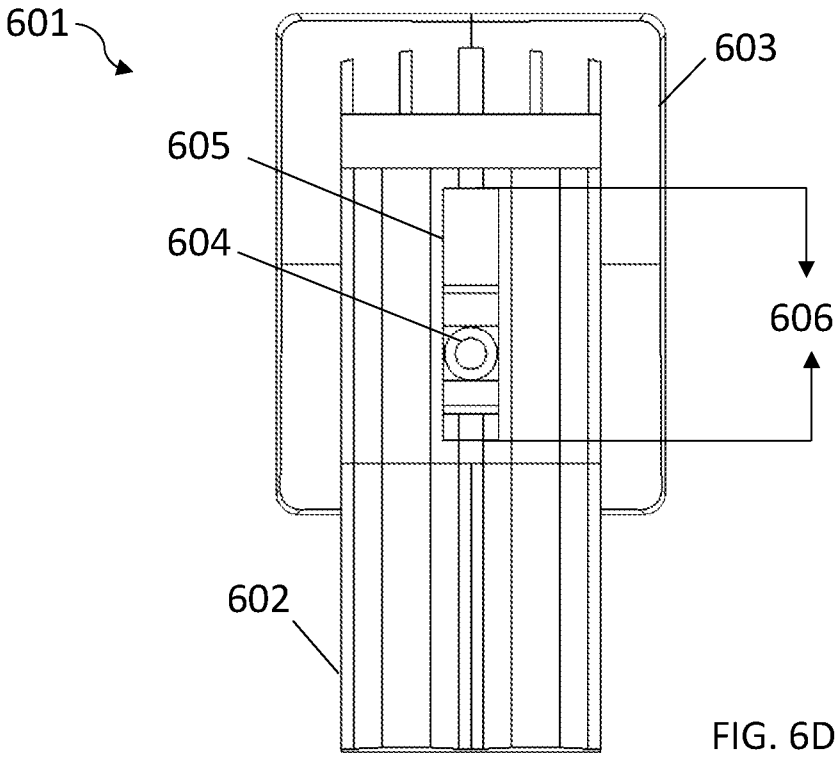


FIG. 6D

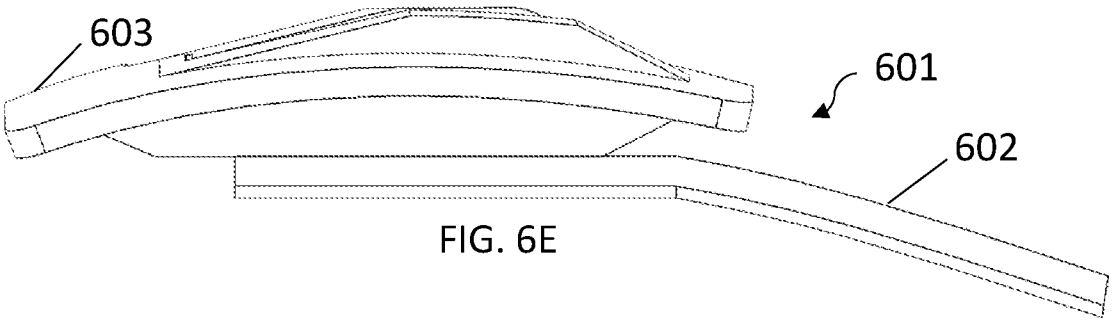


FIG. 6E

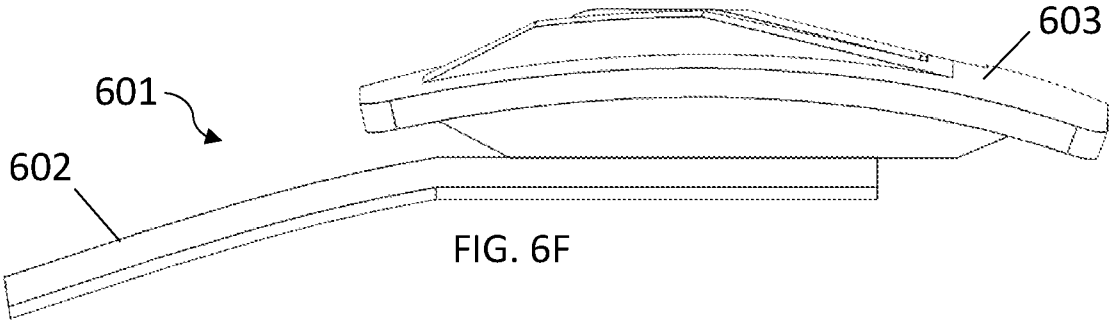


FIG. 6F

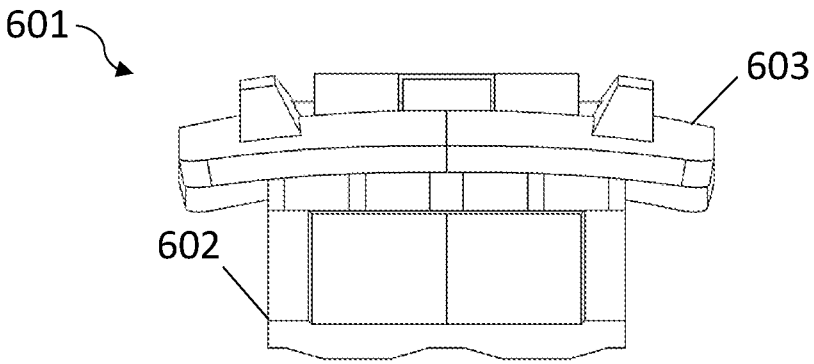


FIG. 6G

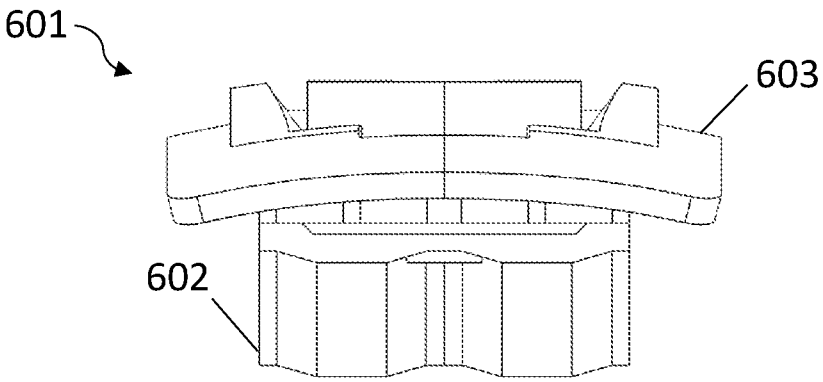


FIG. 6H

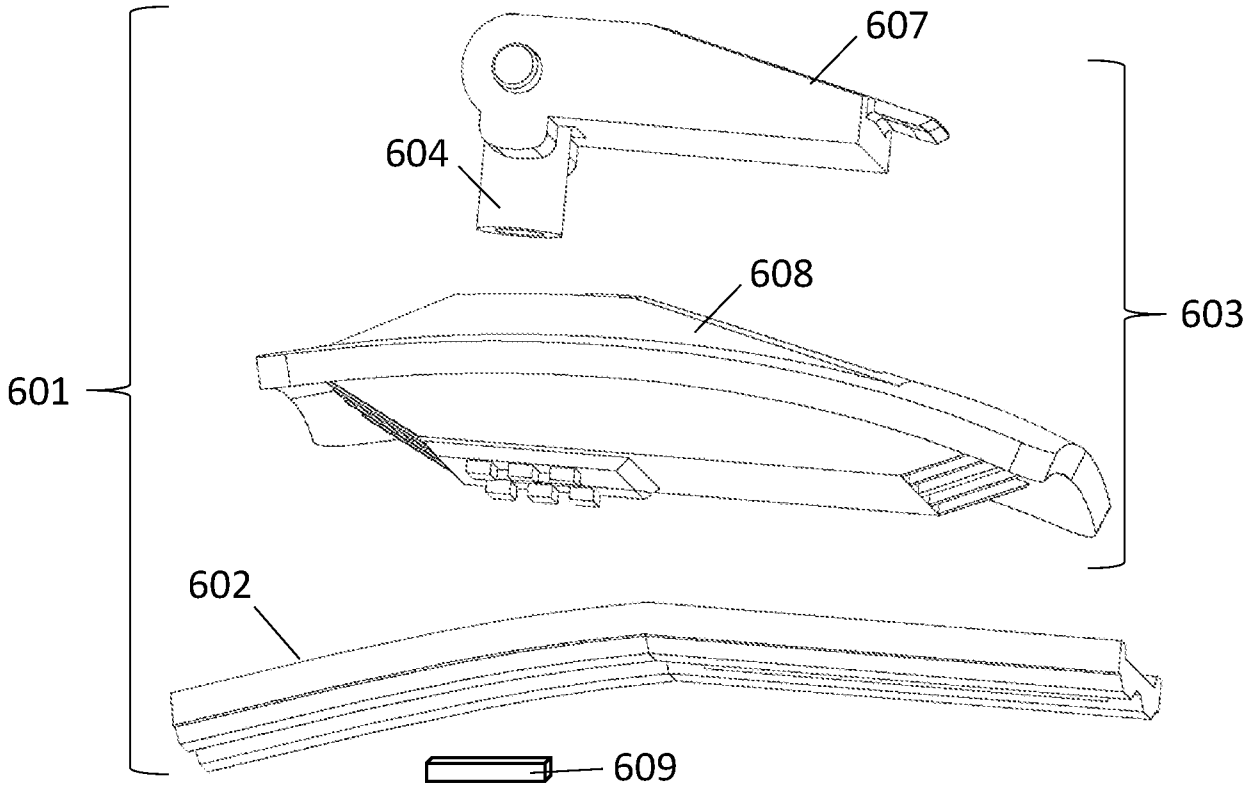


FIG. 6I

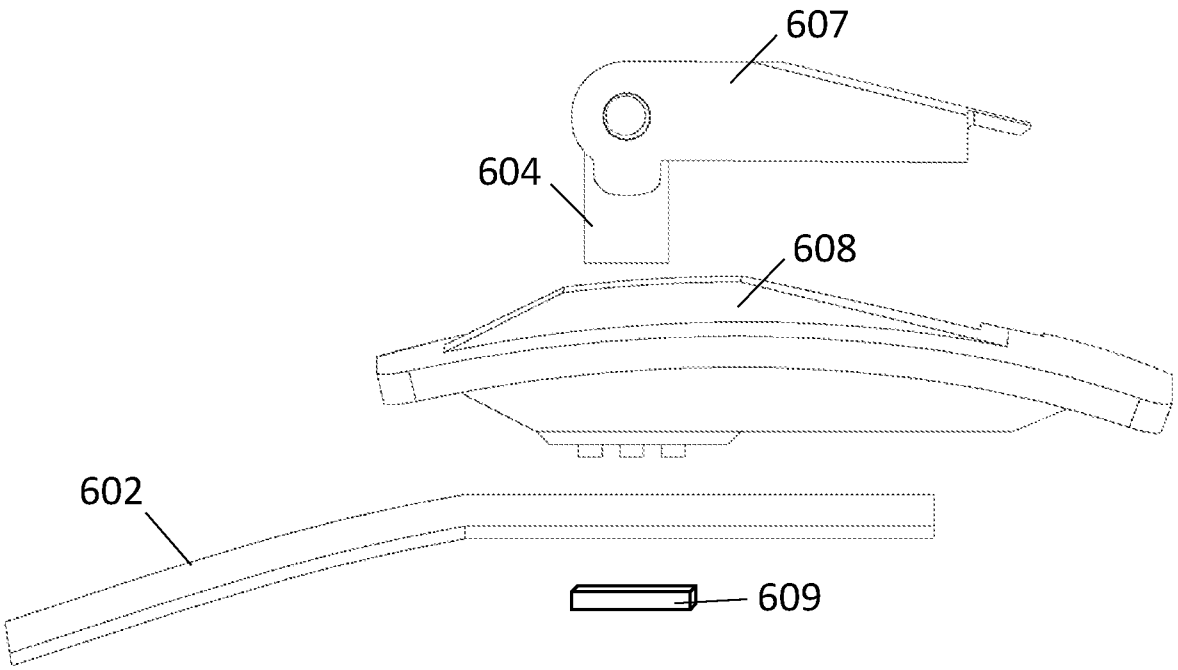


FIG. 6J

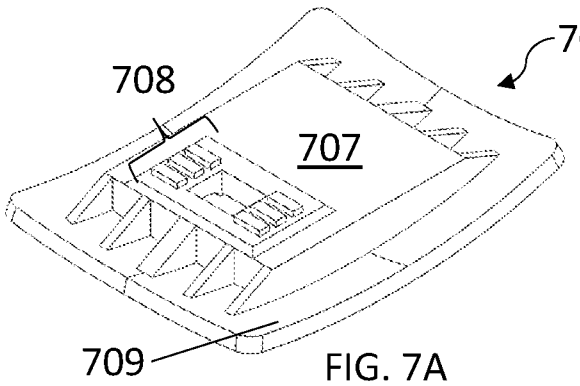


FIG. 7A

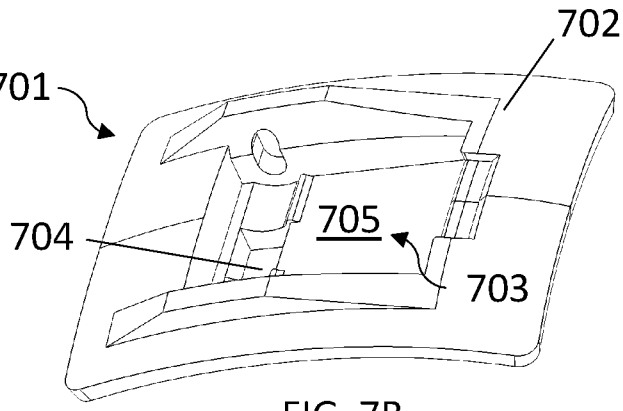


FIG. 7B

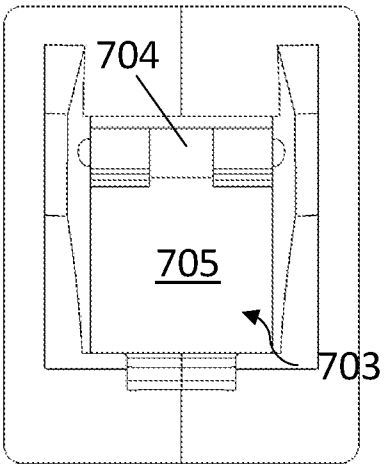


FIG. 7C

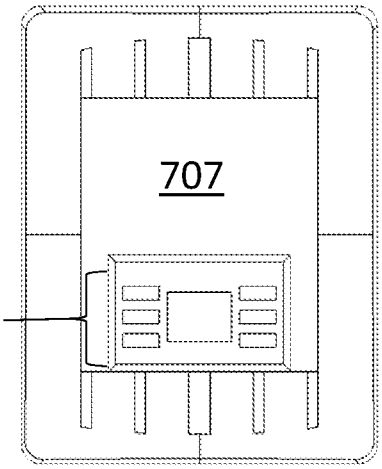


FIG. 7D

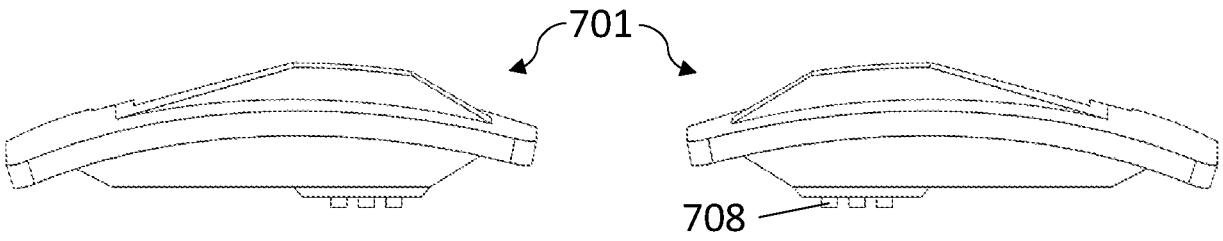


FIG. 7E

FIG. 7F

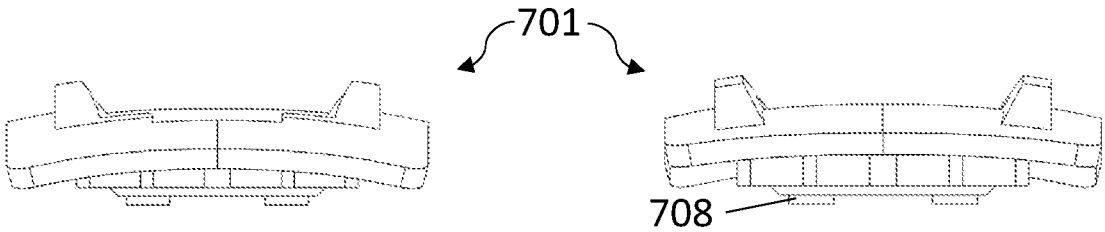


FIG. 7G

FIG. 7H

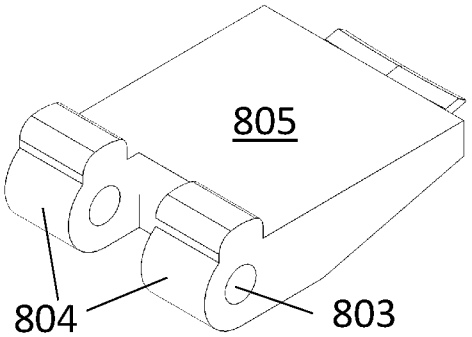


FIG. 8A

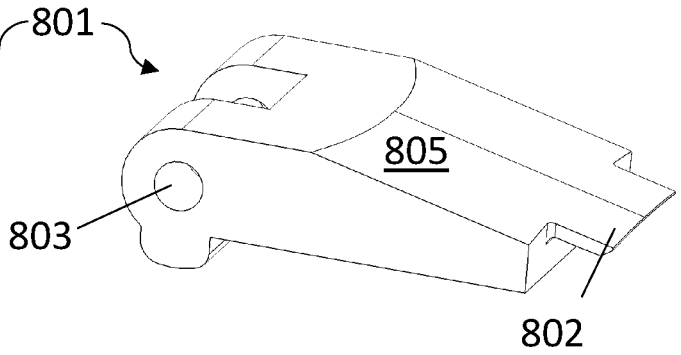


FIG. 8B

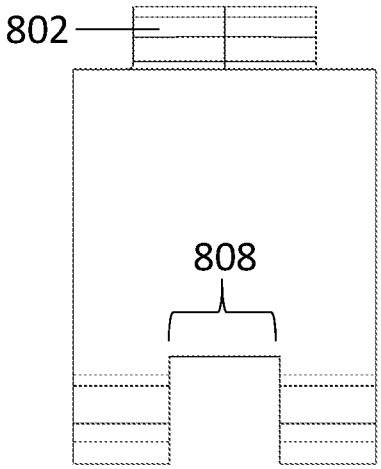


FIG. 8C

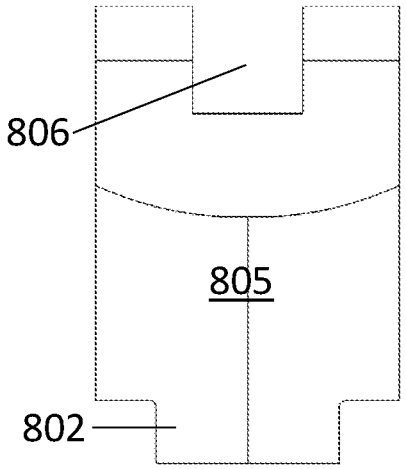


FIG. 8D

FIG. 8E

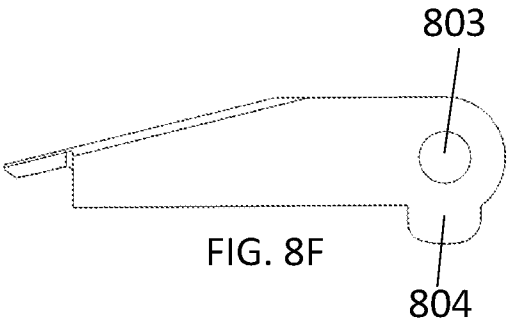


FIG. 8F

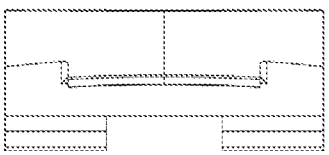


FIG. 8G

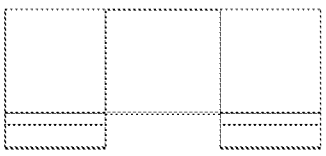


FIG. 8H

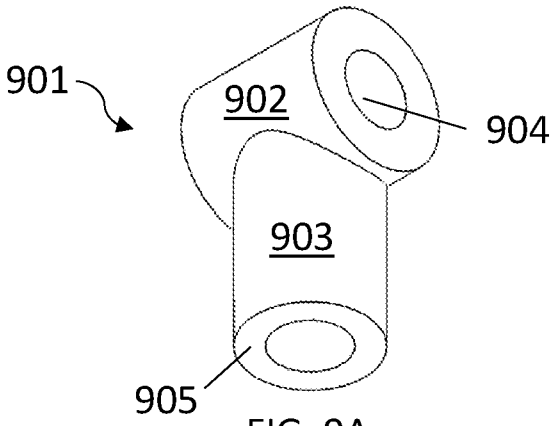


FIG. 9A

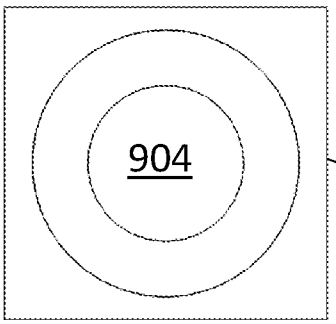


FIG. 9B

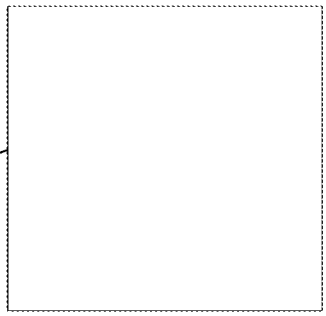


FIG. 9C

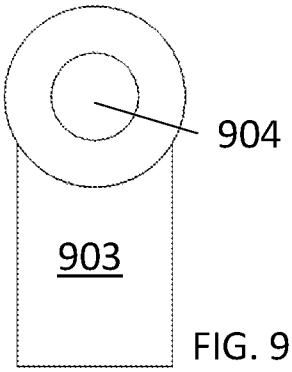


FIG. 9D

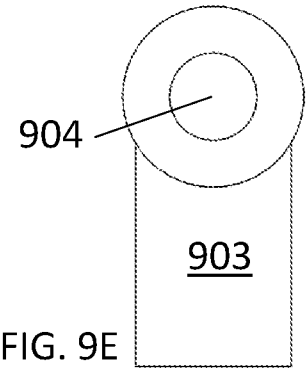


FIG. 9E

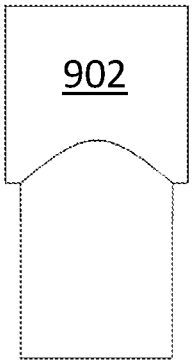


FIG. 9F

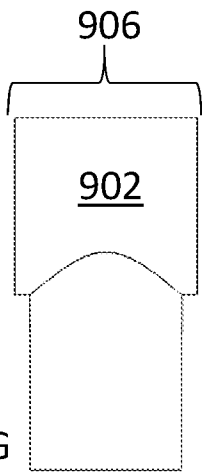


FIG. 9G

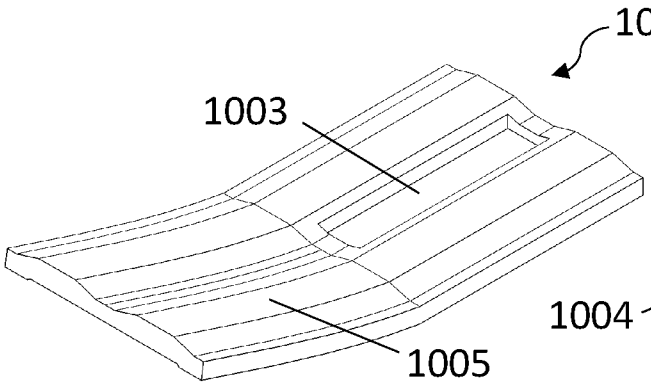


FIG. 10A

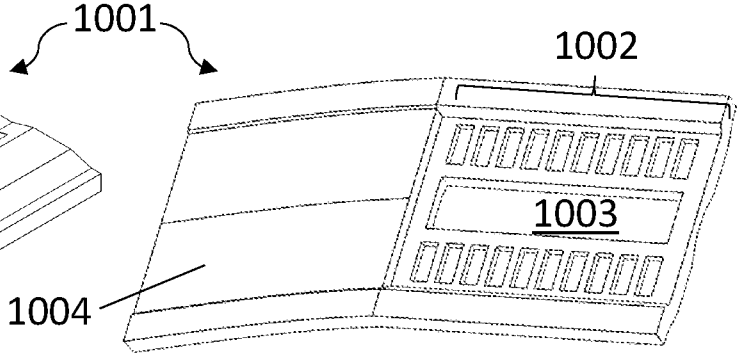


FIG. 10B

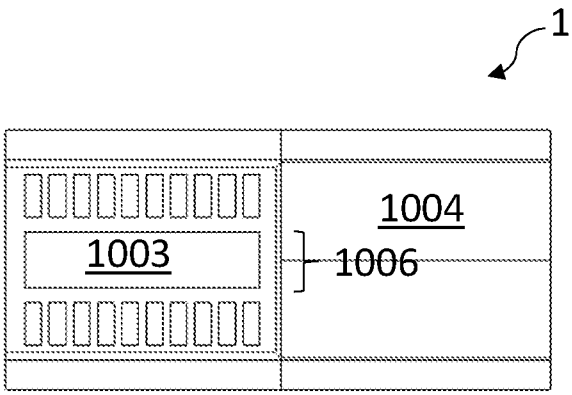


FIG. 10C

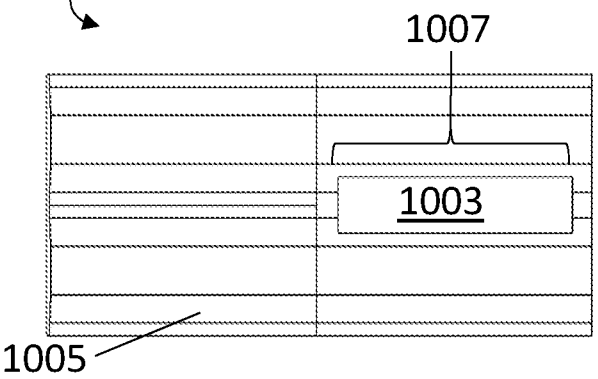


FIG. 10D

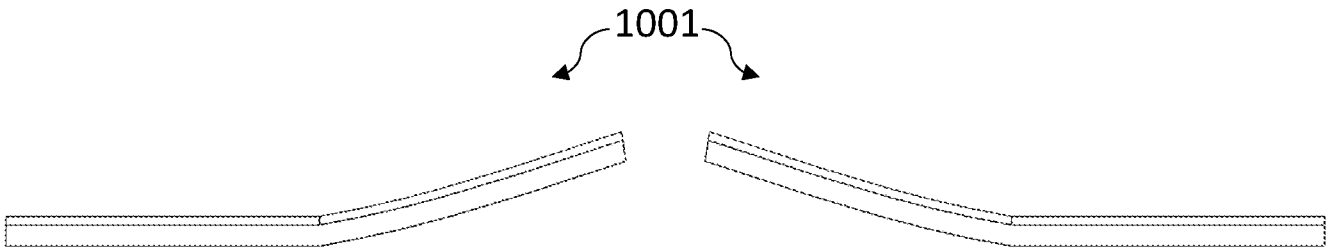


FIG. 10E

FIG. 10F

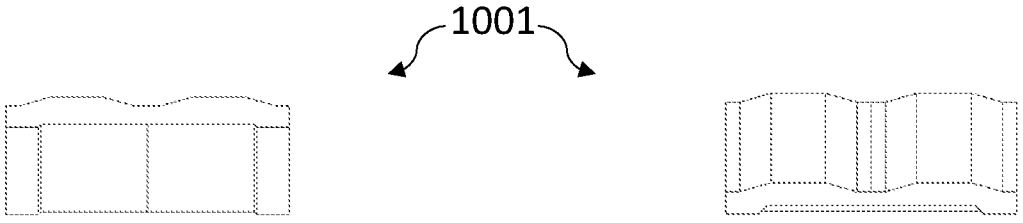


FIG. 10G

FIG. 10H

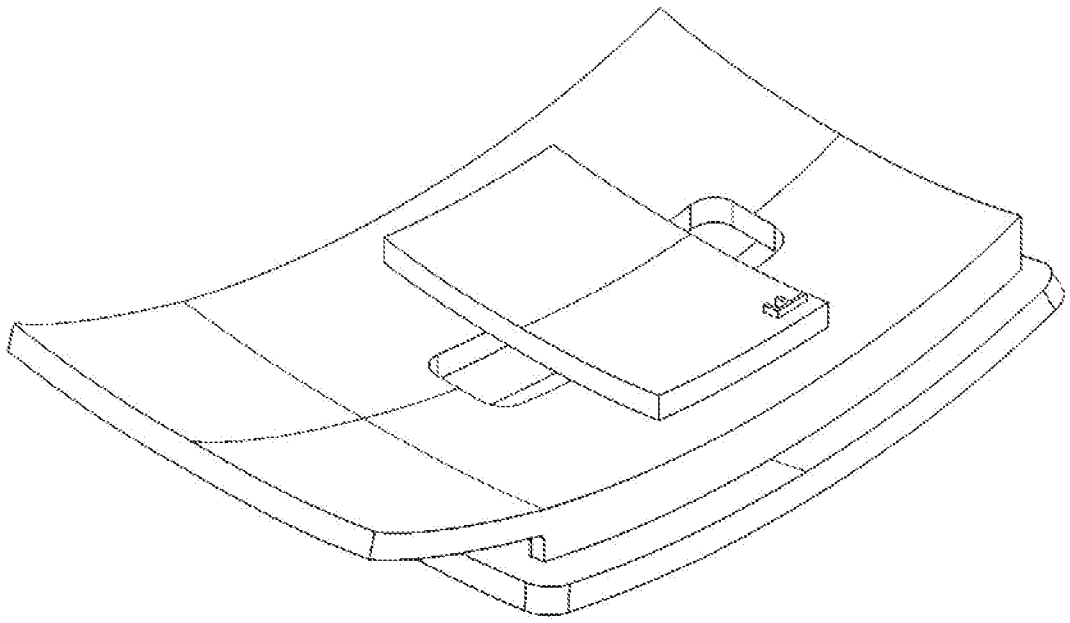


FIG. 11A

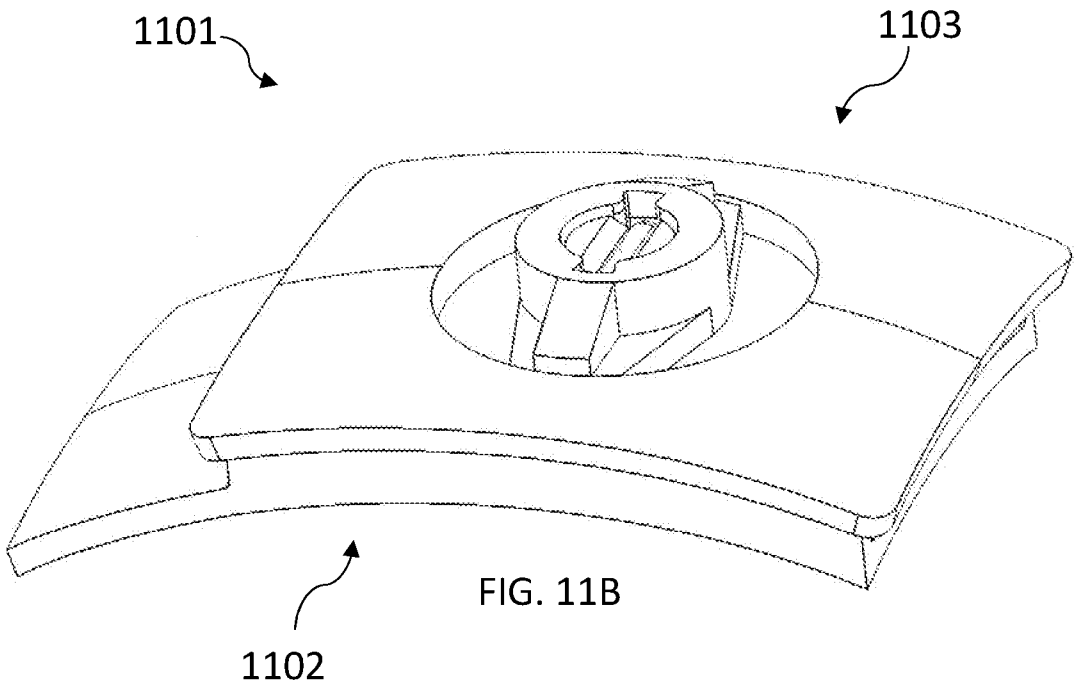


FIG. 11B

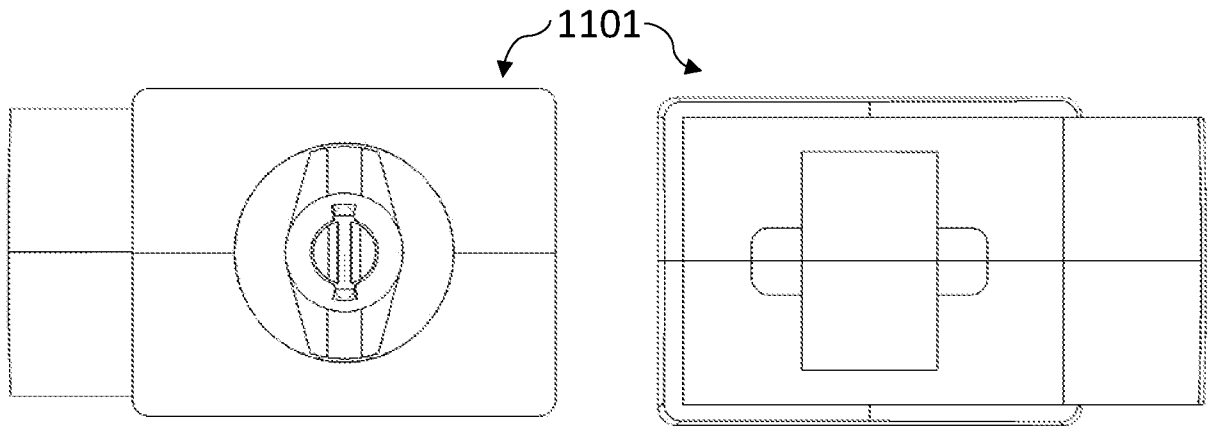


FIG. 11C FIG. 11D

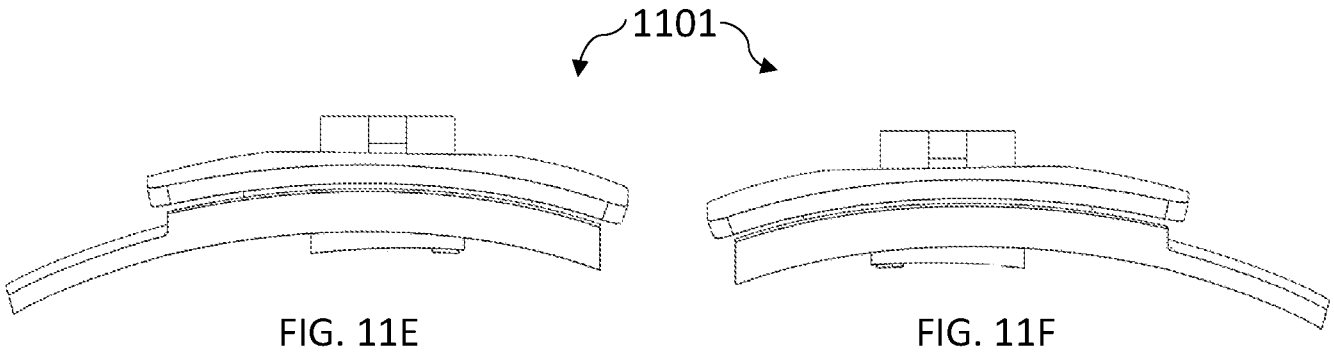


FIG. 11E FIG. 11F

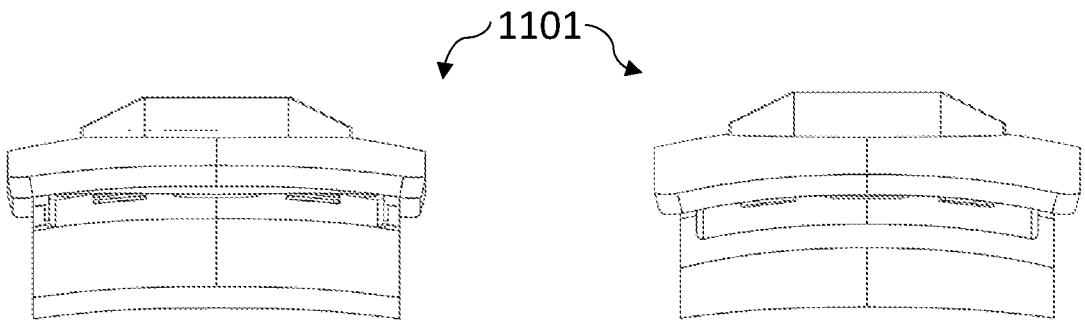


FIG. 11G FIG. 11H

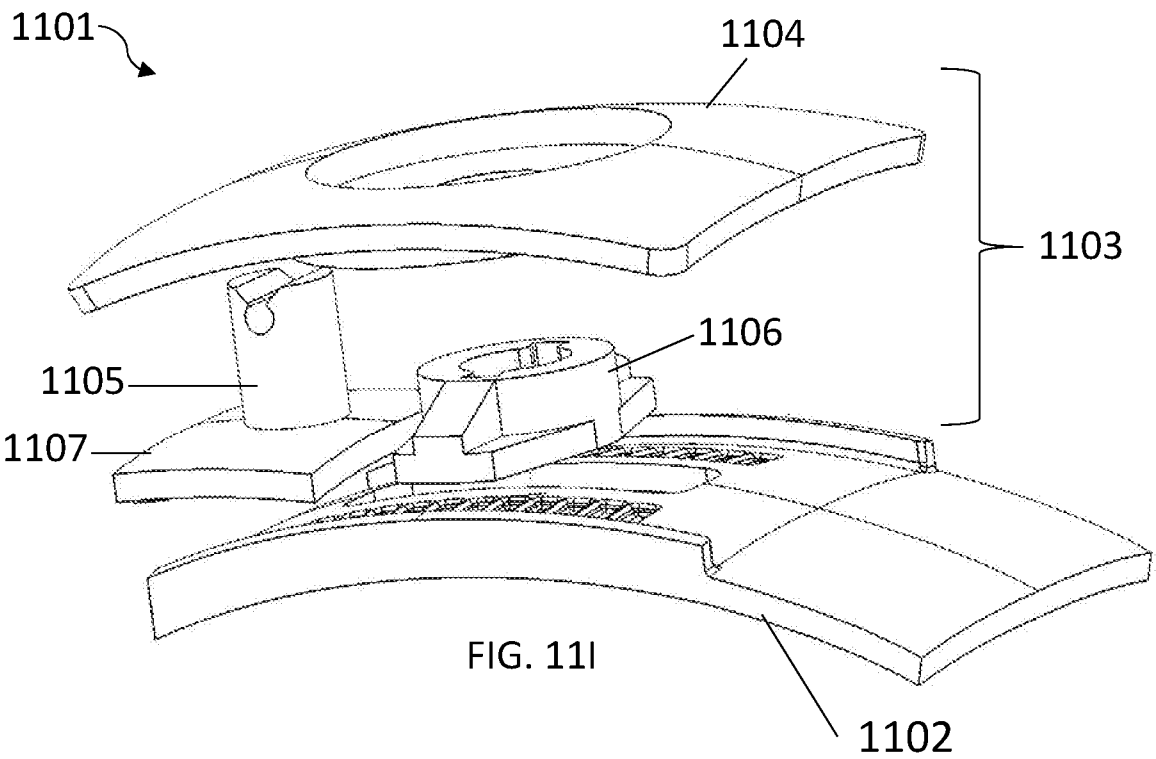


FIG. 11I

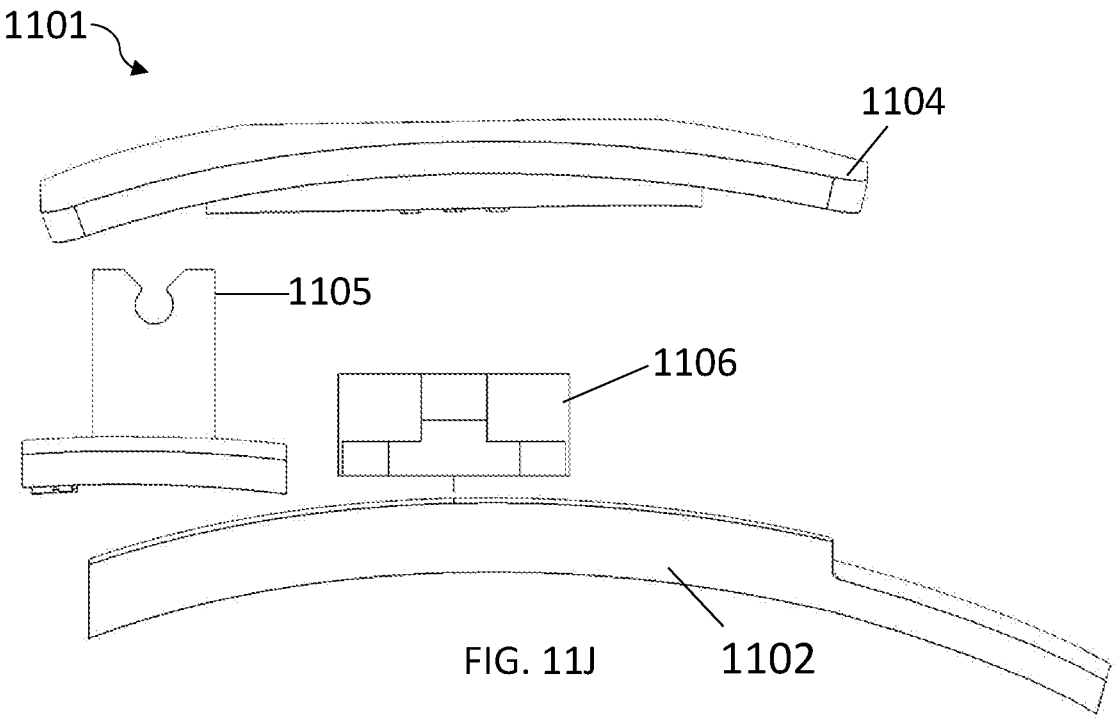


FIG. 11J

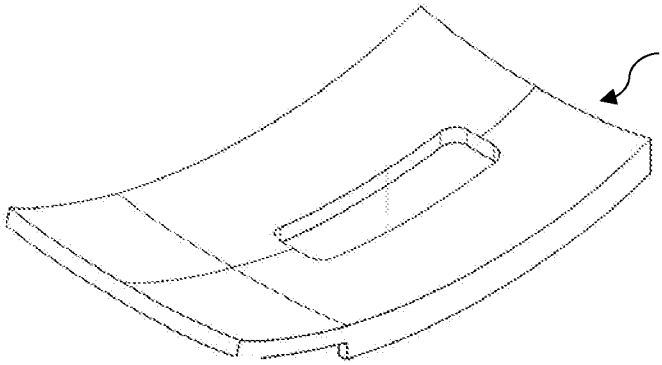


FIG. 12A

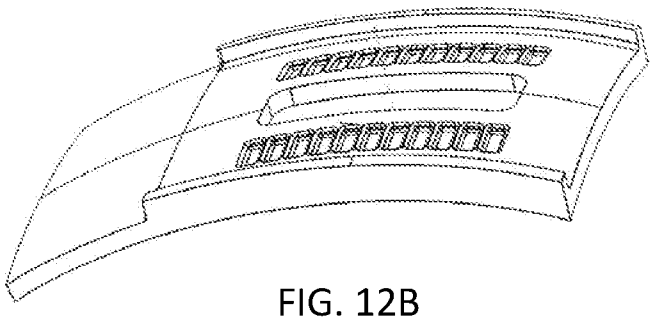


FIG. 12B

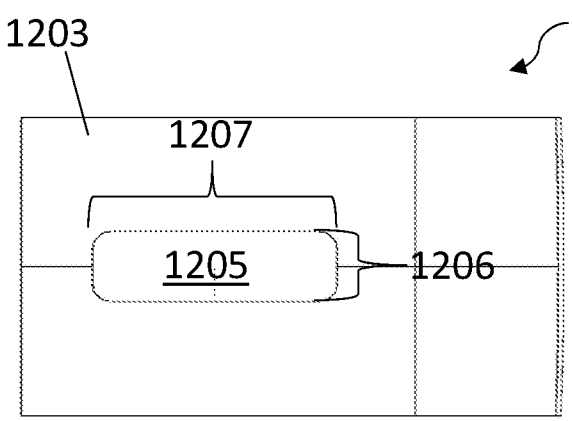


FIG. 12C

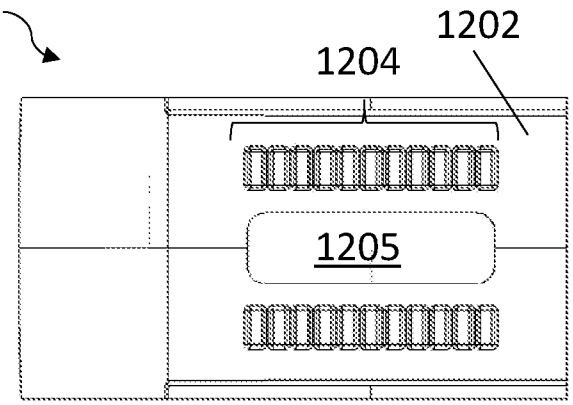


FIG. 12D

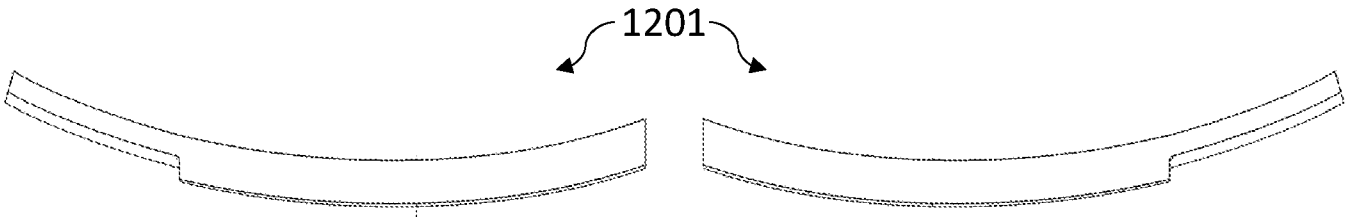


FIG. 12E

FIG. 12F

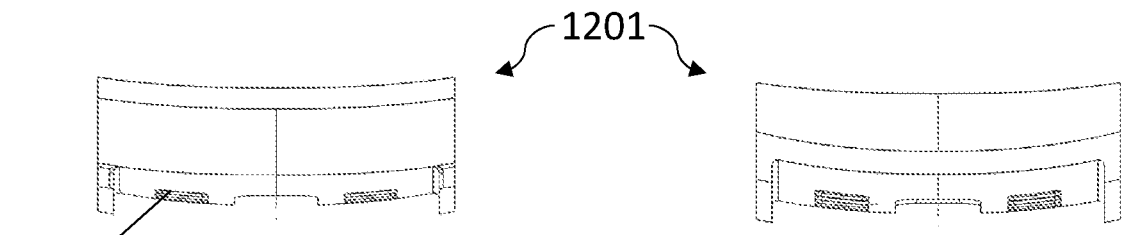


FIG. 12G

FIG. 12H

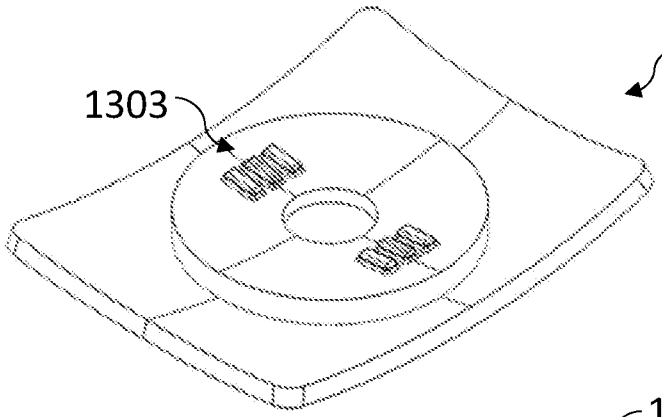


FIG. 13A

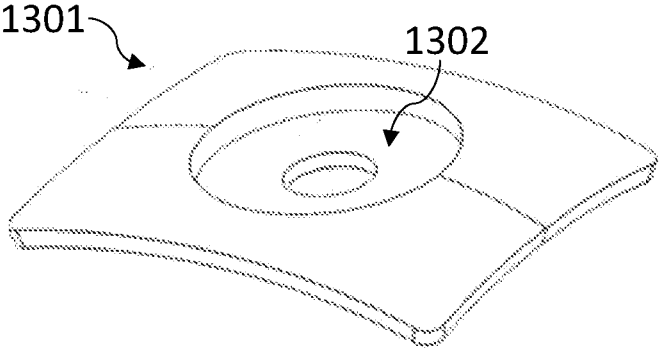


FIG. 13B

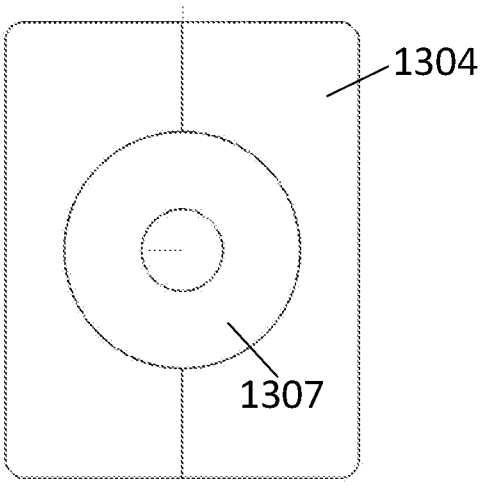


FIG. 13C

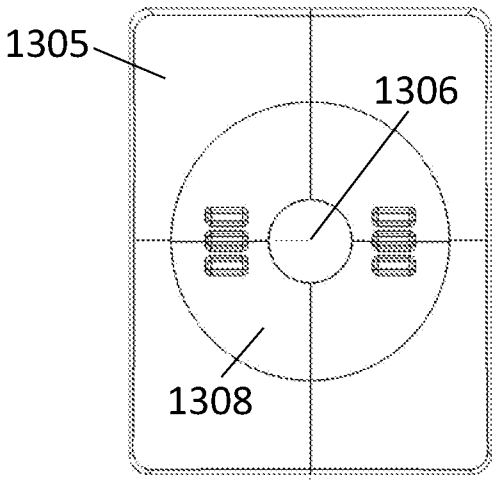


FIG. 13D

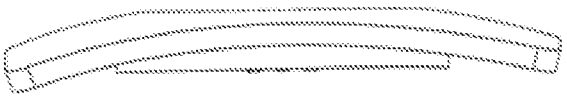


FIG. 13E

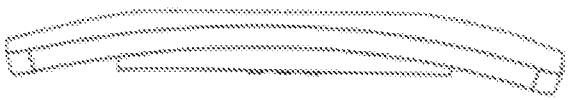


FIG. 13F

FIG. 13G

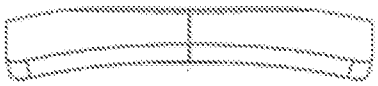


FIG. 13H

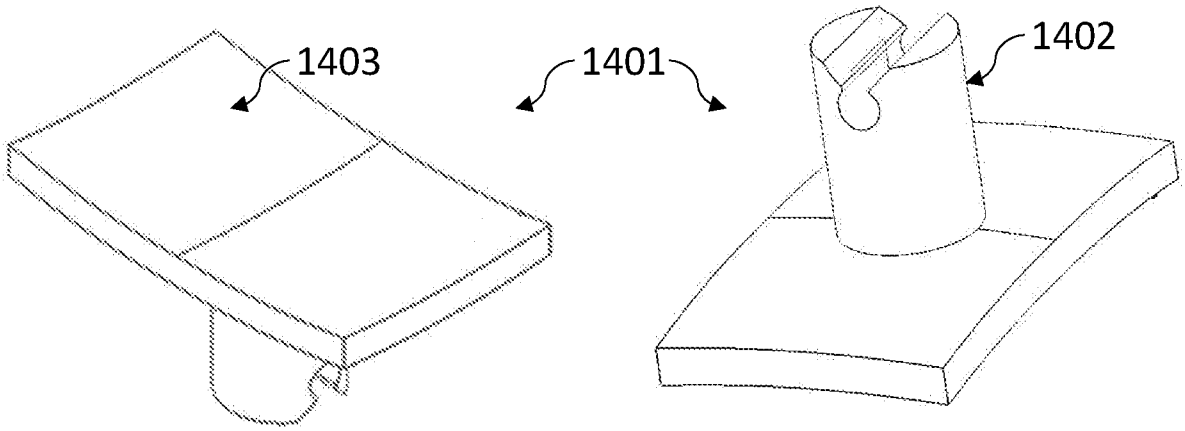


FIG. 14A FIG. 14B

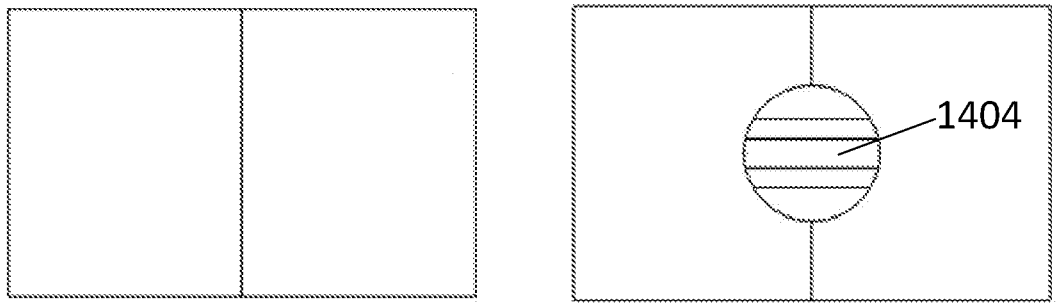


FIG. 14C FIG. 14D

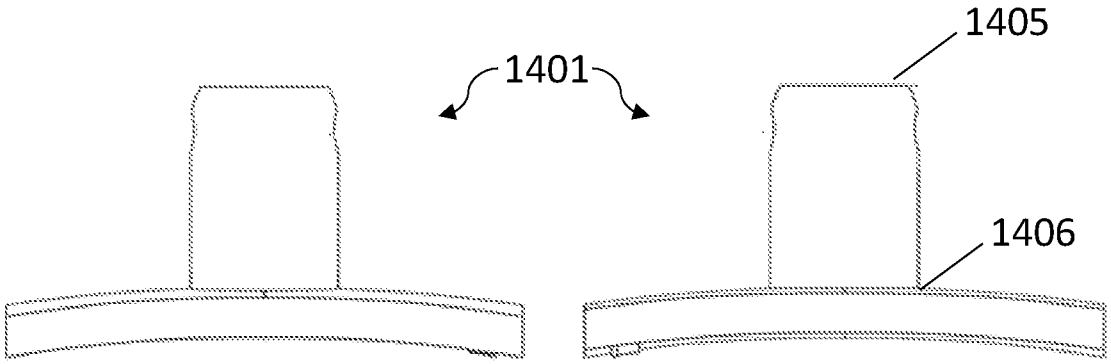


FIG. 14E FIG. 14F

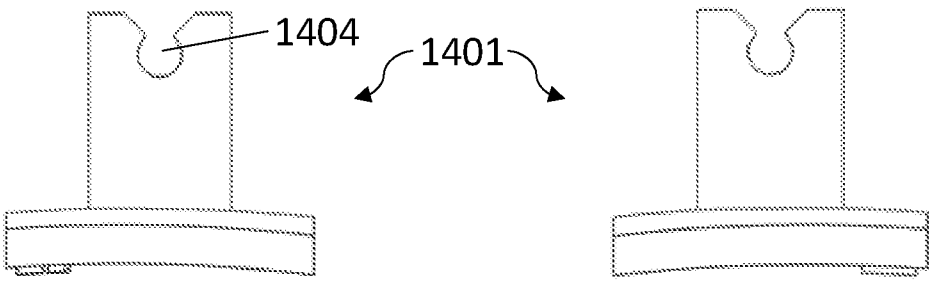


FIG. 14G FIG. 14H

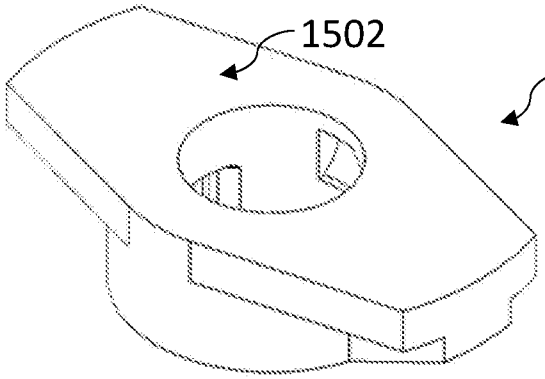


FIG. 15A

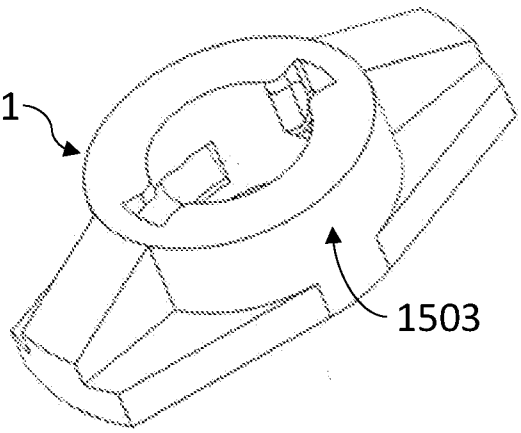


FIG. 15B

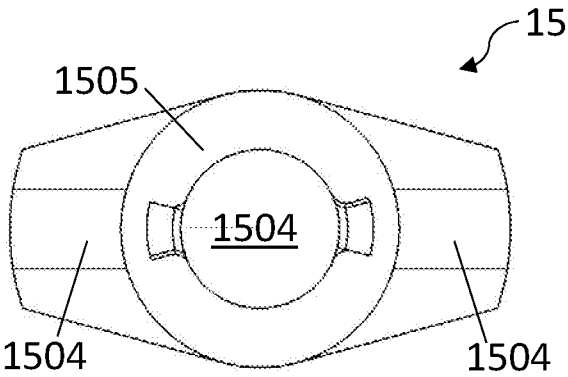


FIG. 15C

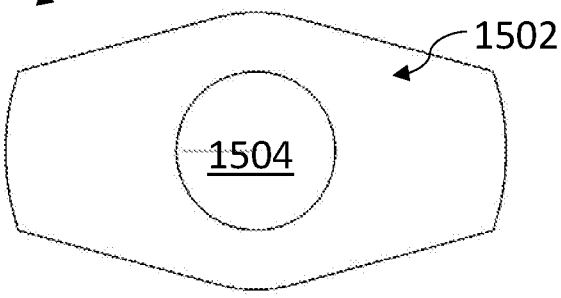


FIG. 15D

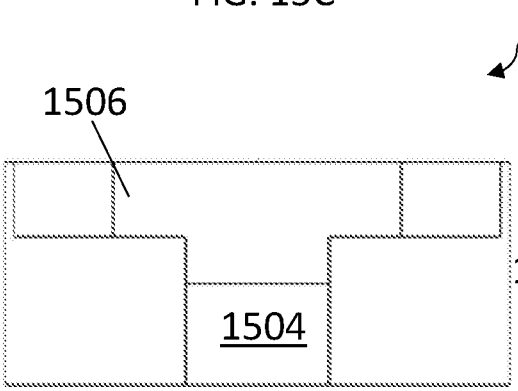


FIG. 15E

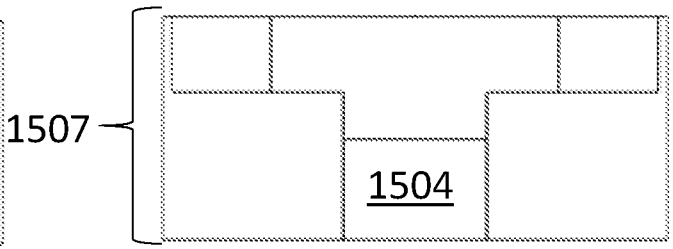


FIG. 15F

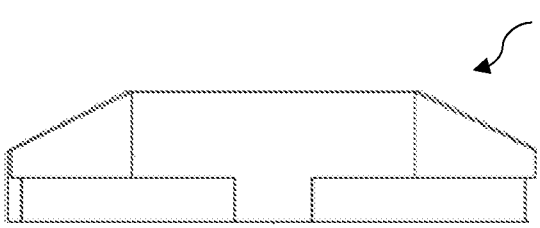


FIG. 15G

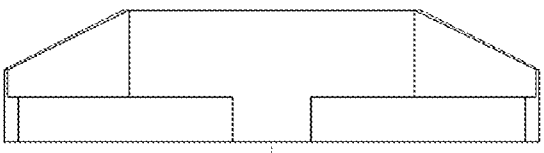


FIG. 15H

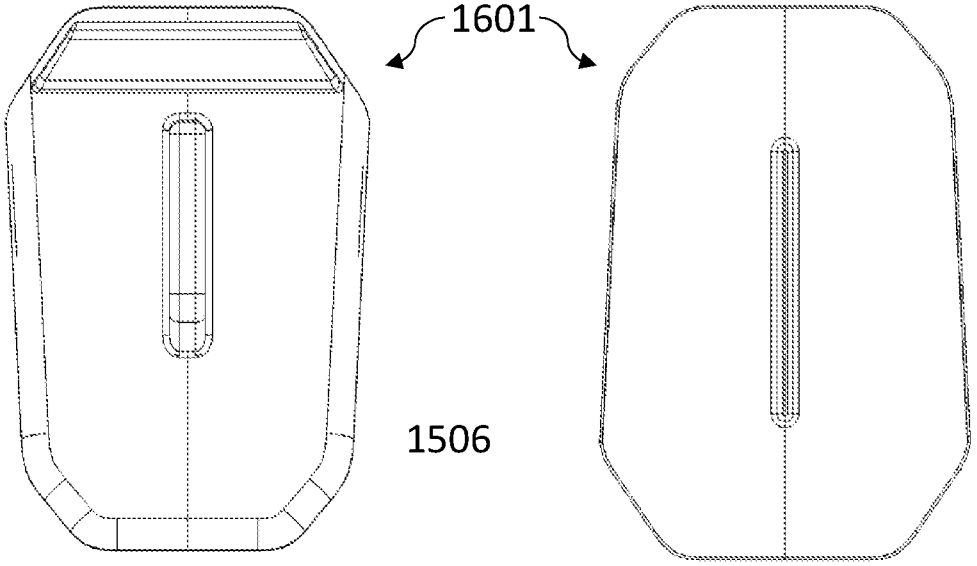


FIG. 16A FIG. 16B

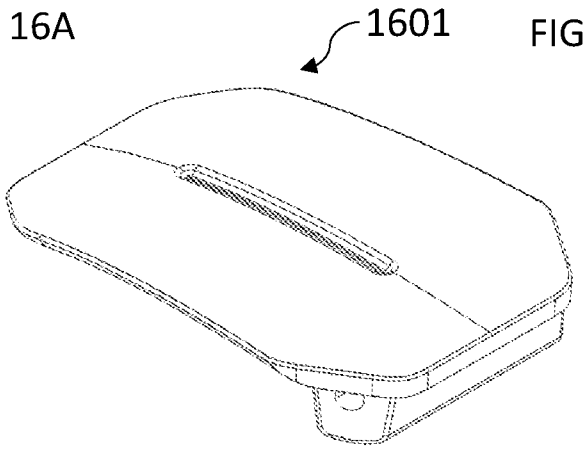


FIG. 16C

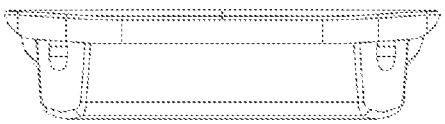


FIG. 16D

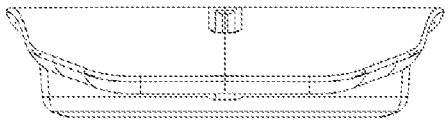


FIG. 16E

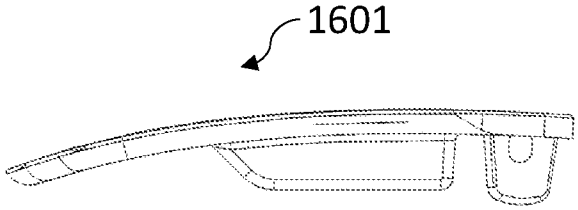


FIG. 16F

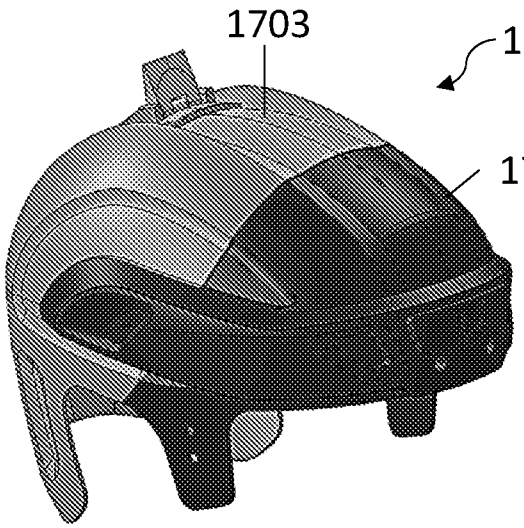


FIG. 17A

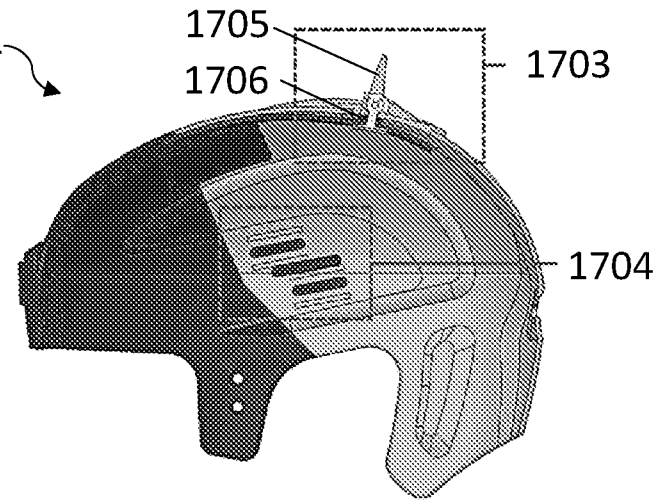
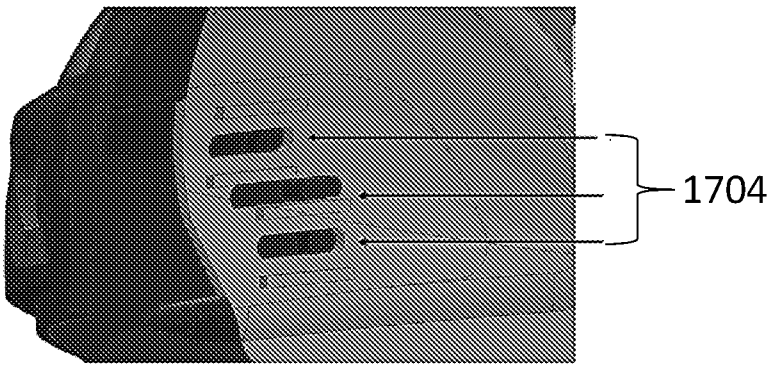


FIG. 17B



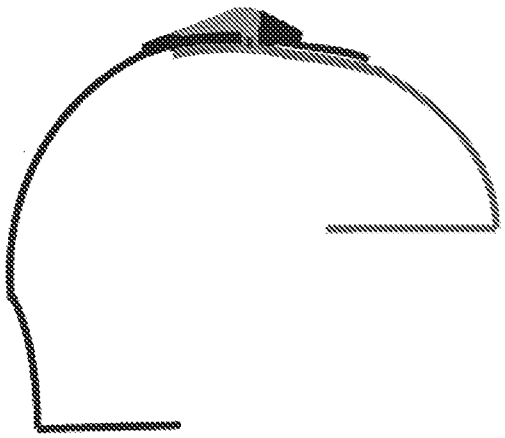


FIG. 17C

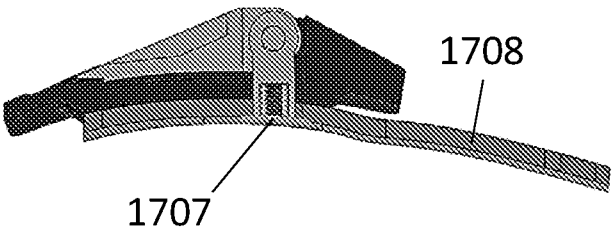


FIG. 17D

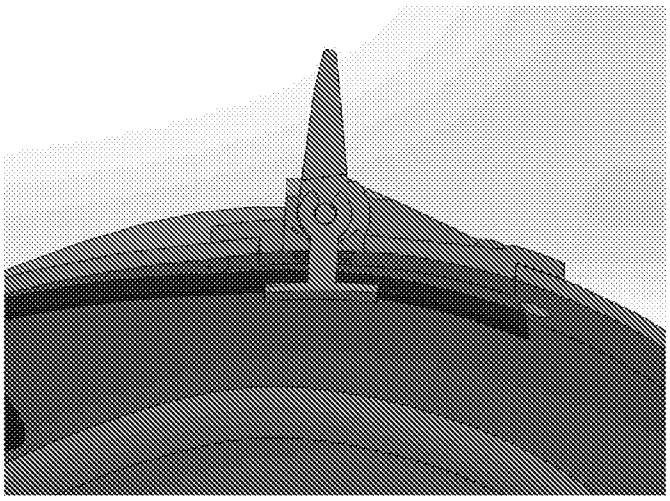


FIG. 18A

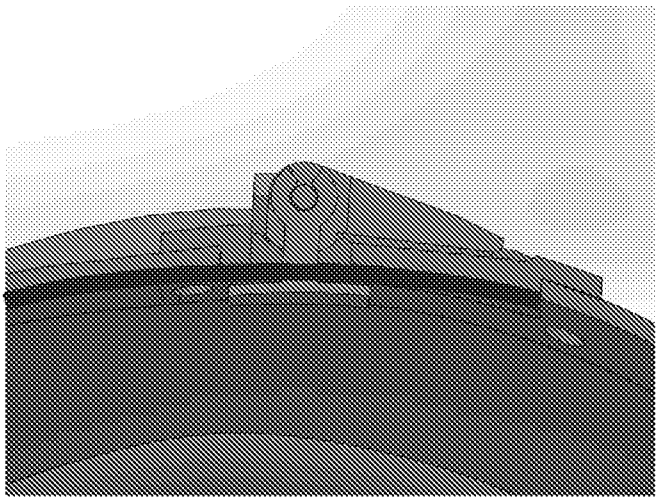


FIG. 18B

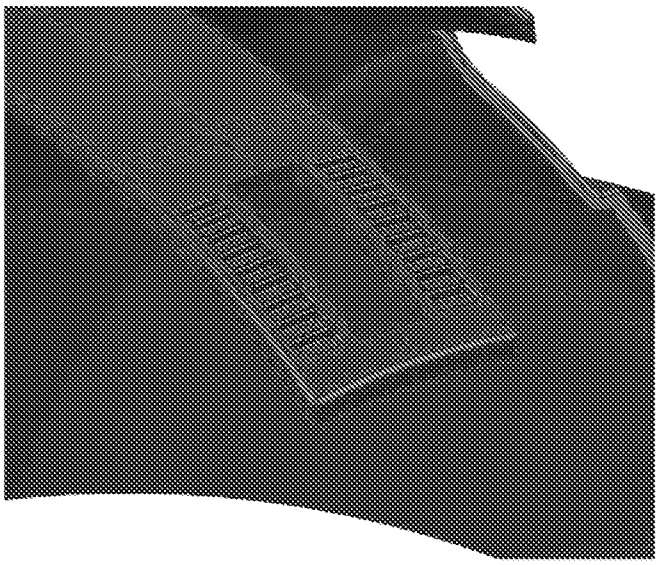


FIG. 18C

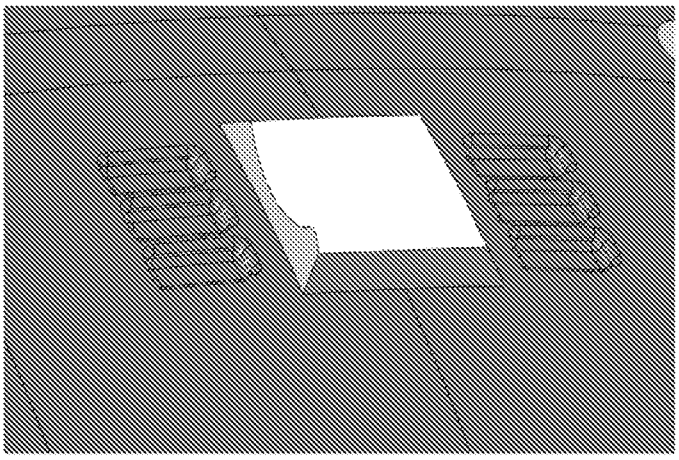


FIG. 18D

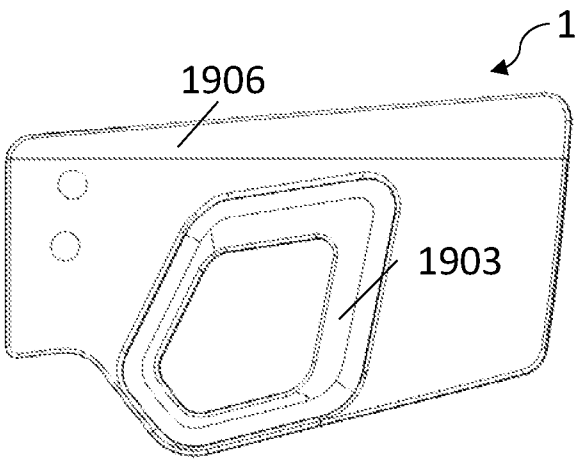


FIG. 19A

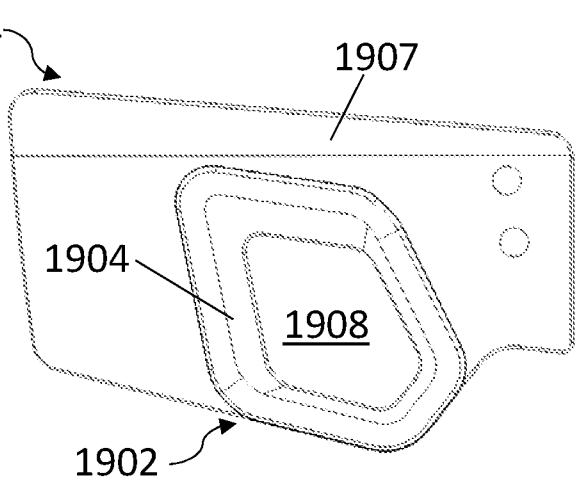


FIG. 19B

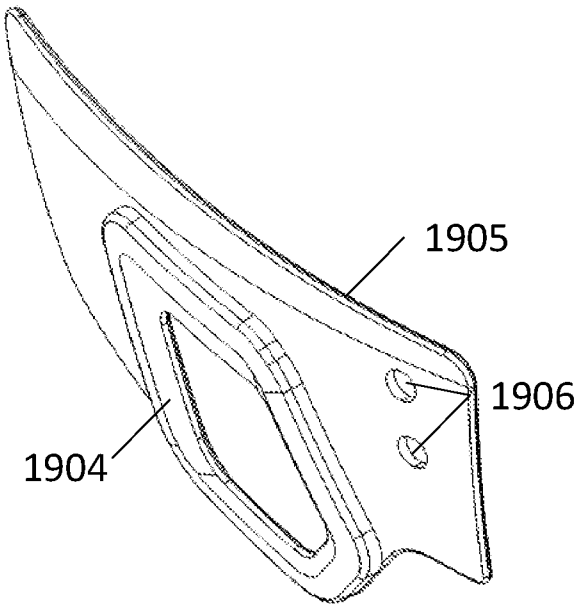


FIG. 19C

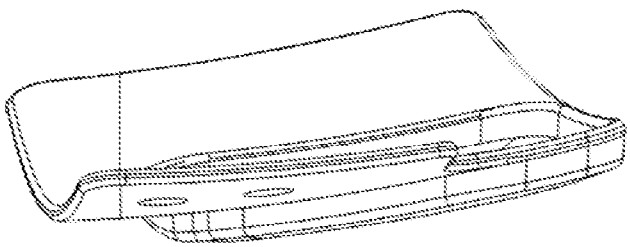


FIG. 19D

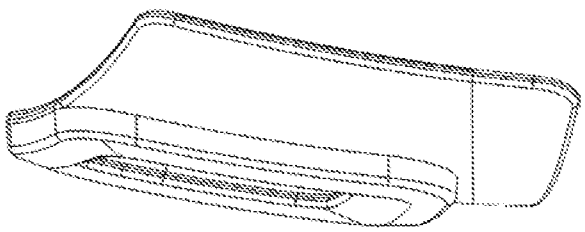


FIG. 19E

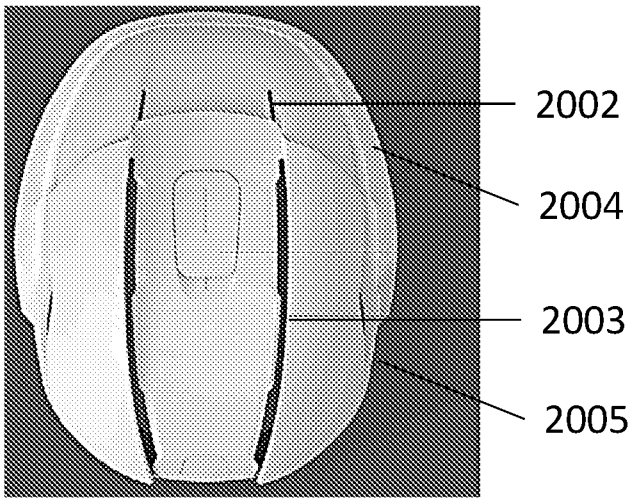


FIG. 20A

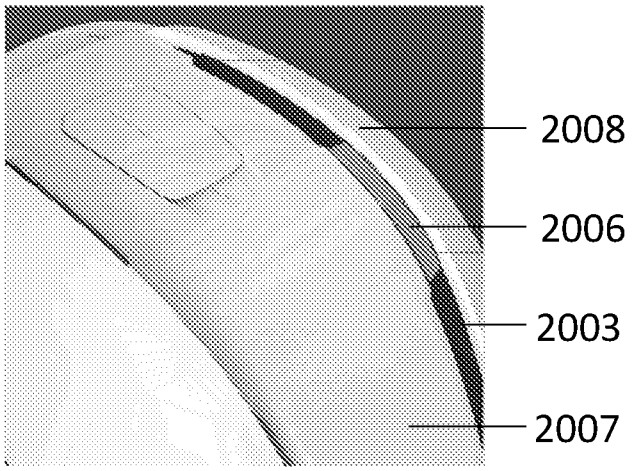


FIG. 20B

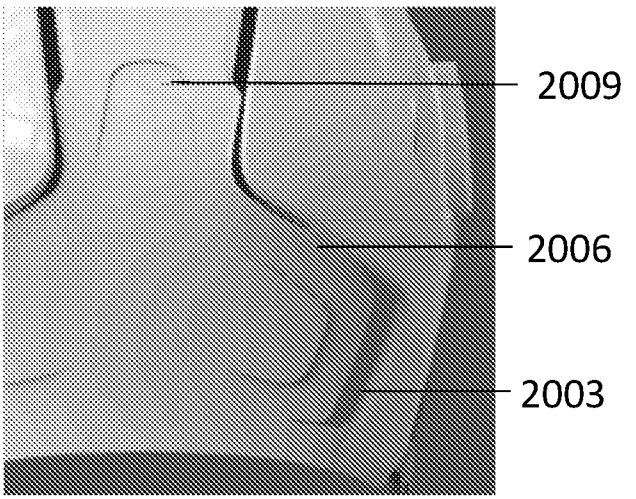


FIG. 20C

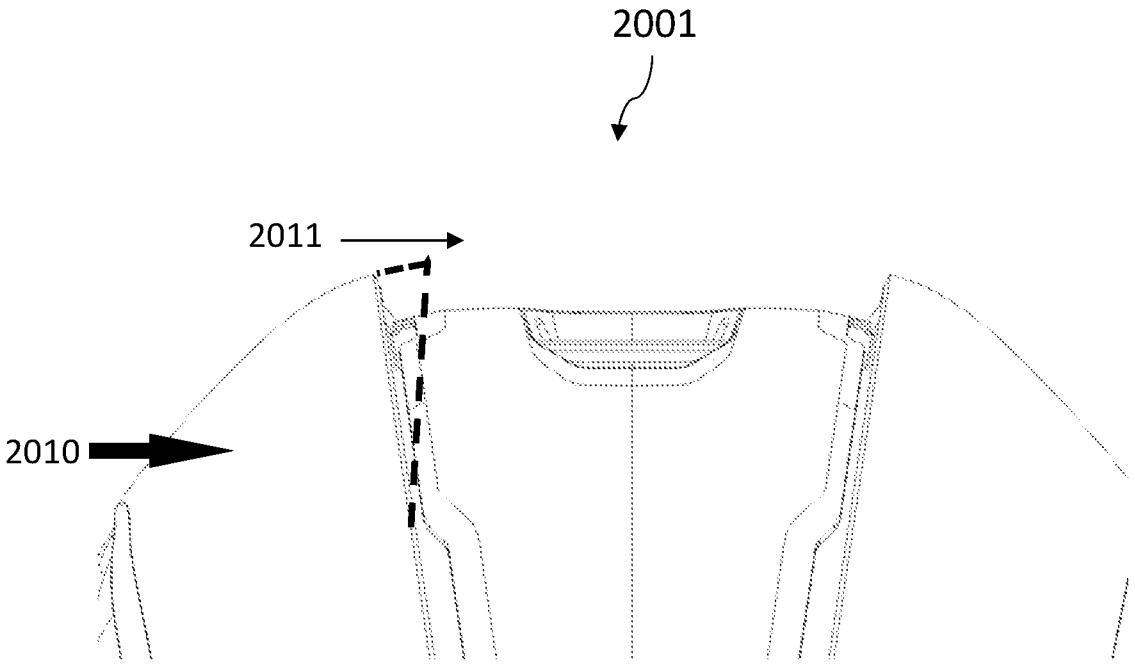


FIG. 20D

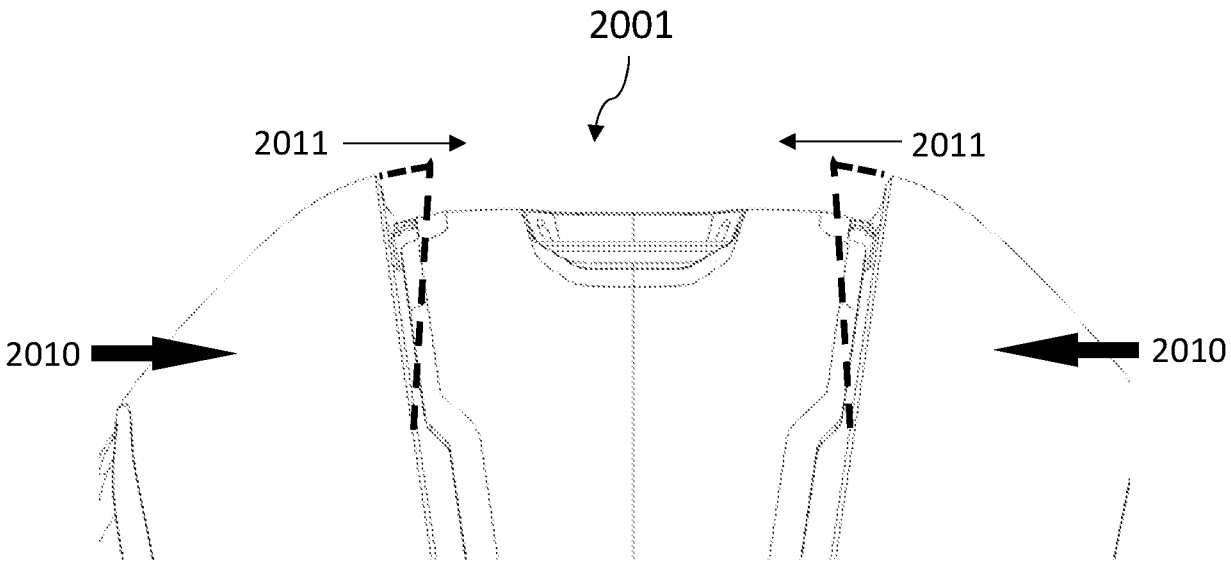


FIG. 20E

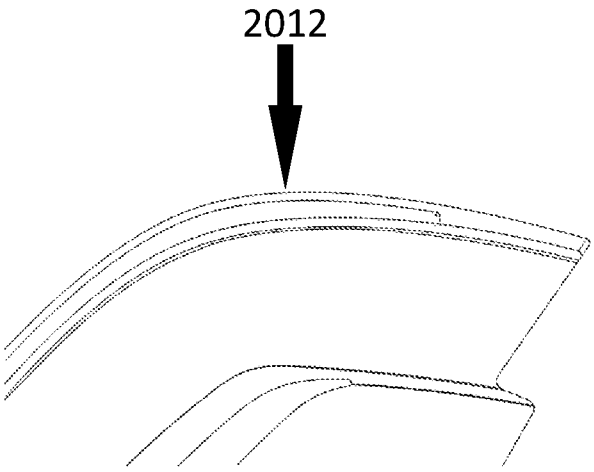


FIG. 20F

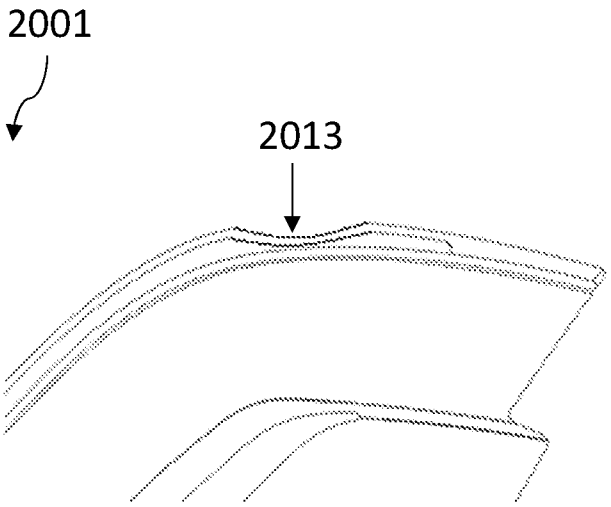


FIG. 20G

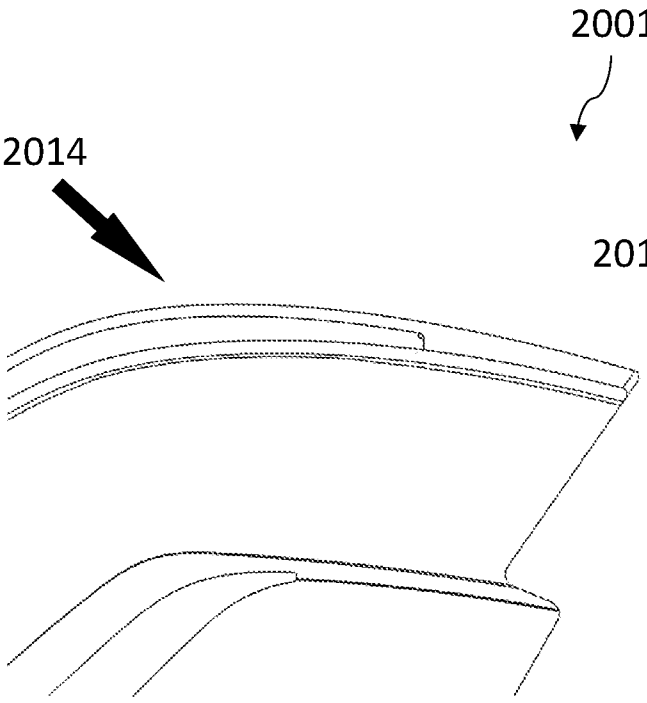


FIG. 20H

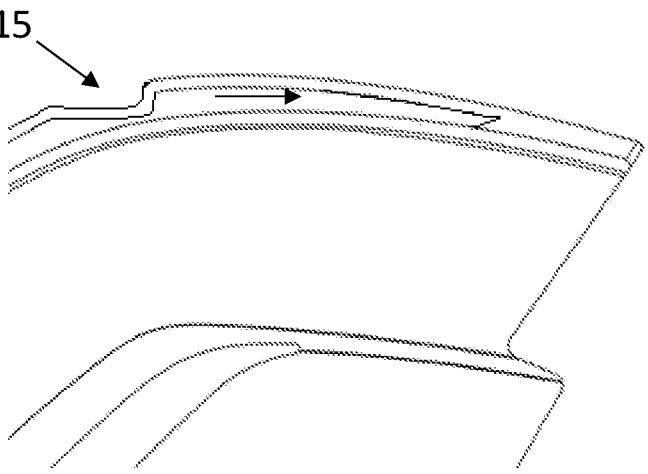


FIG. 20I

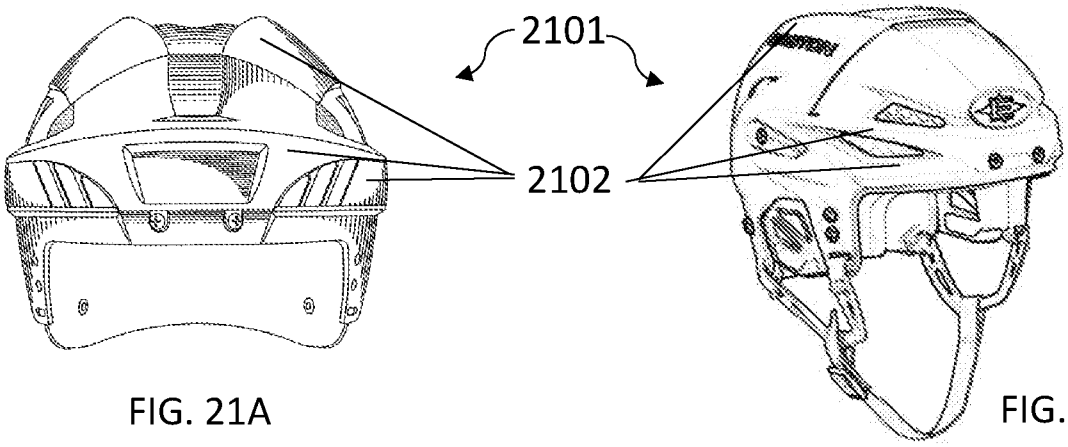


FIG. 21A FIG. 21B

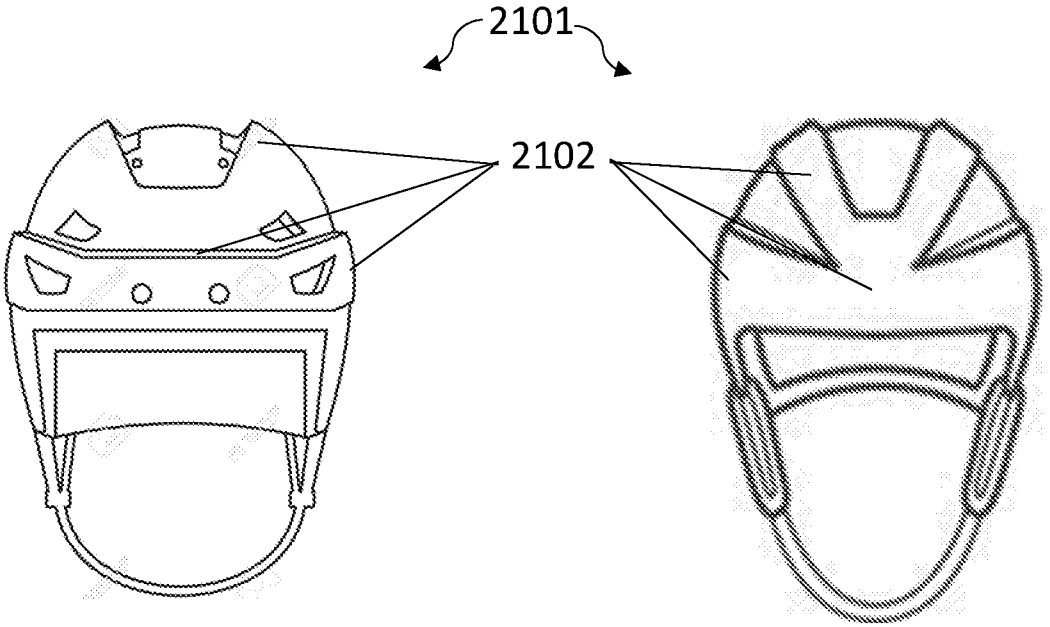


FIG. 21C FIG. 21D

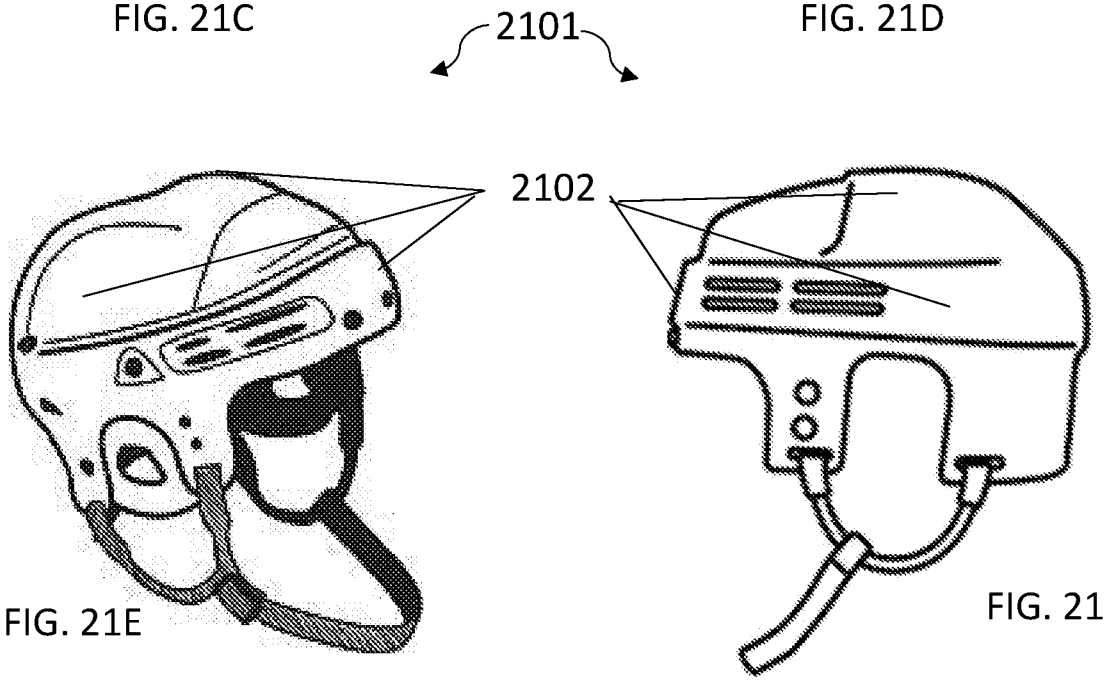


FIG. 21E FIG. 21F

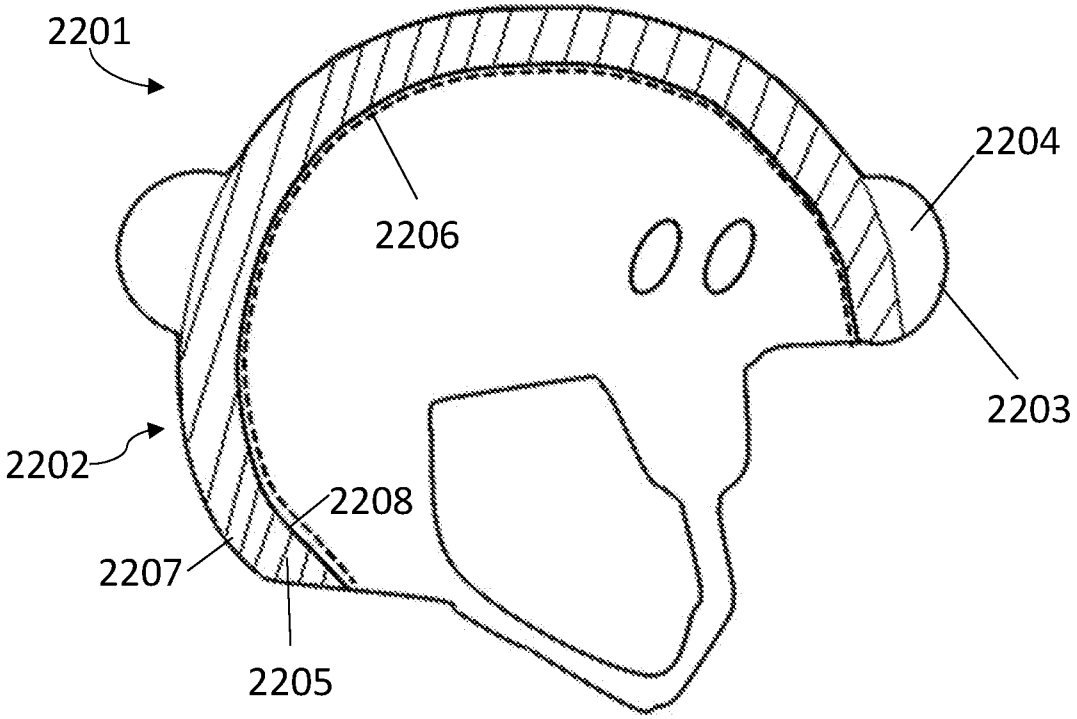


FIG. 22A

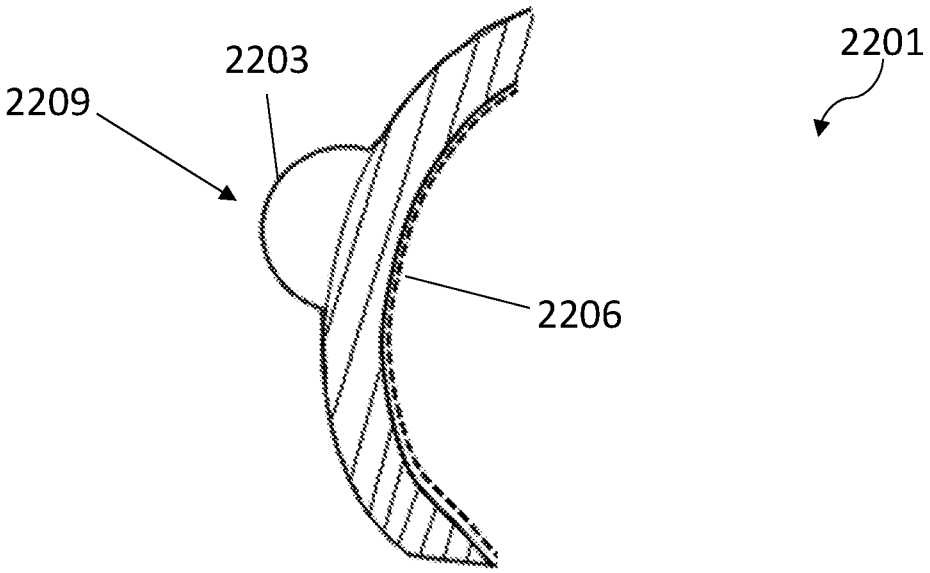


FIG. 22B

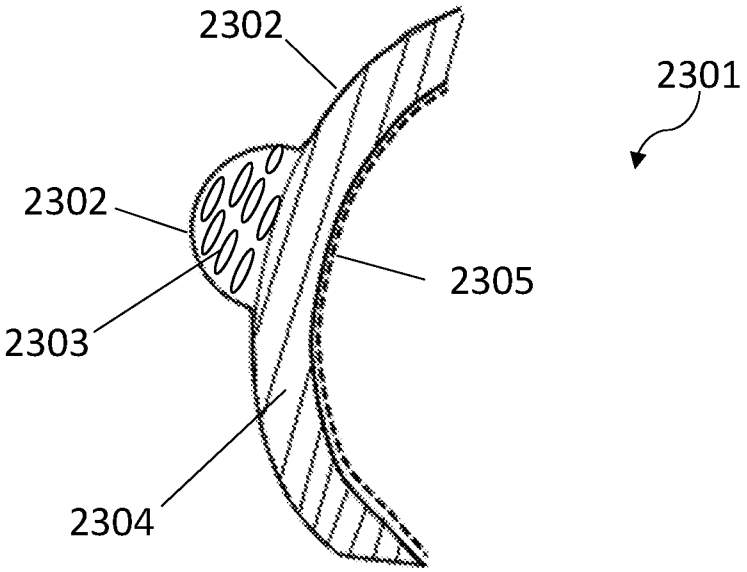


FIG. 23

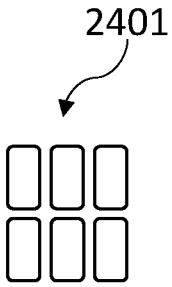


FIG. 24A

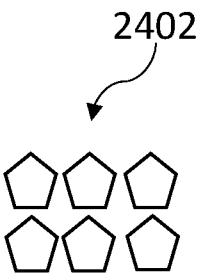


FIG. 24B

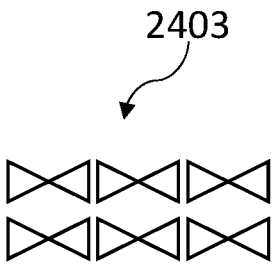


FIG. 24C

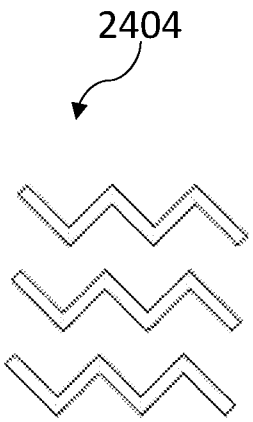


FIG. 24D

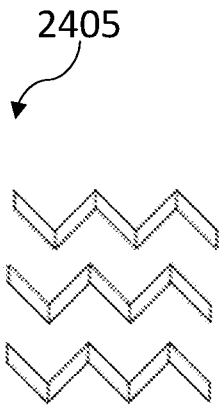


FIG. 24E

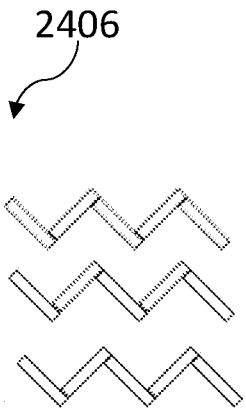


FIG. 24F

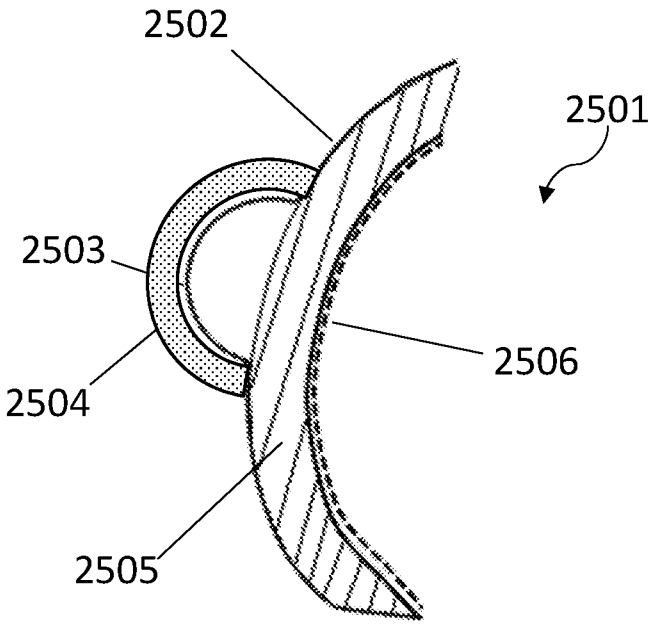


FIG. 25

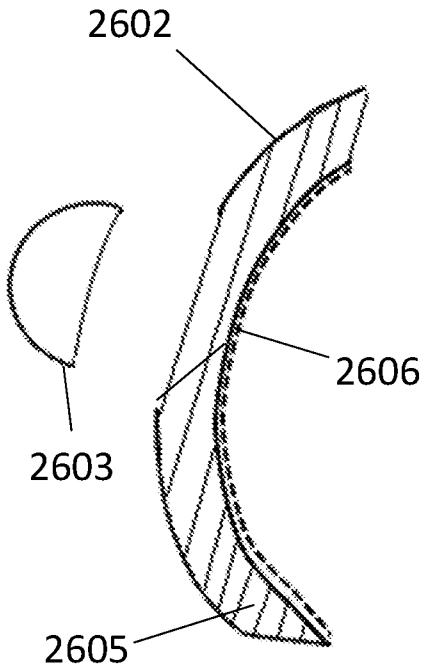


FIG. 26A

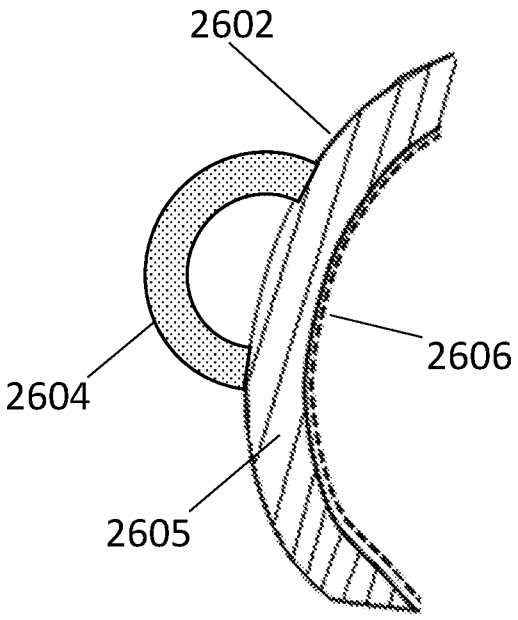


FIG. 26B

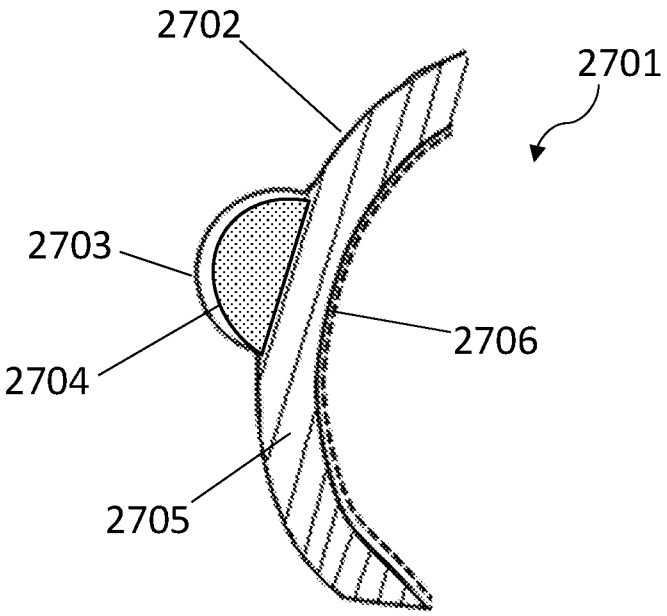


FIG. 27

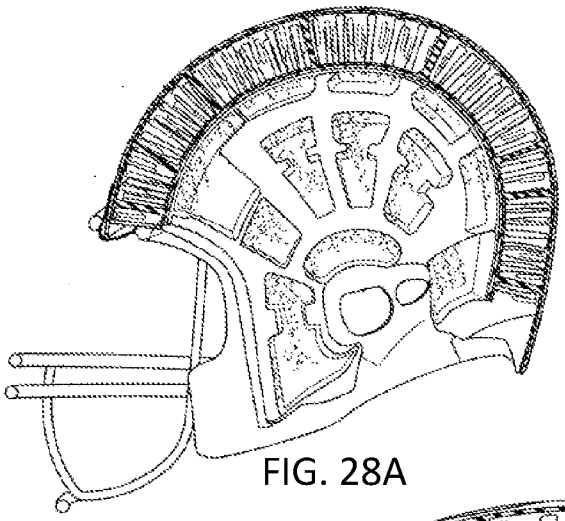


FIG. 28A

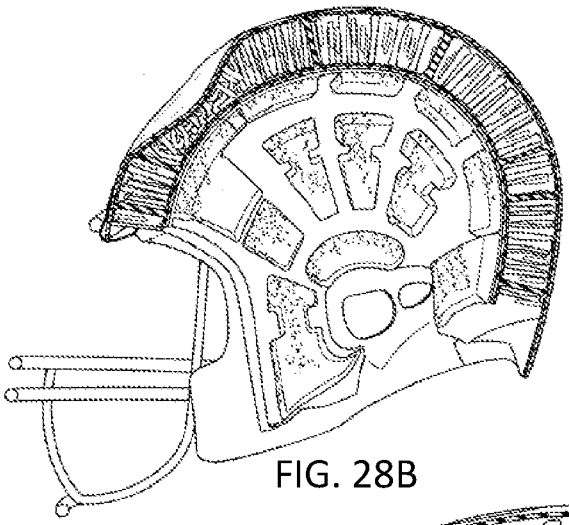


FIG. 28B

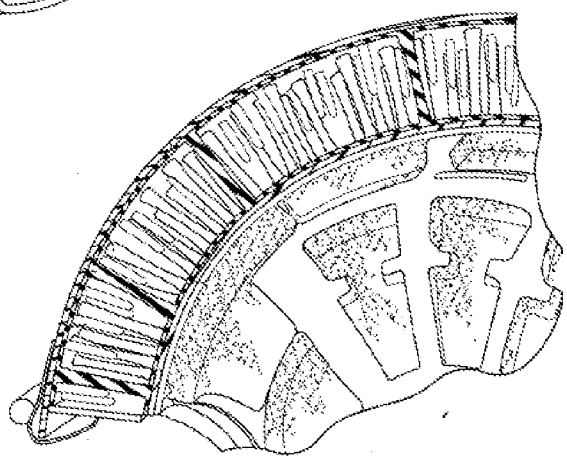


FIG. 28C

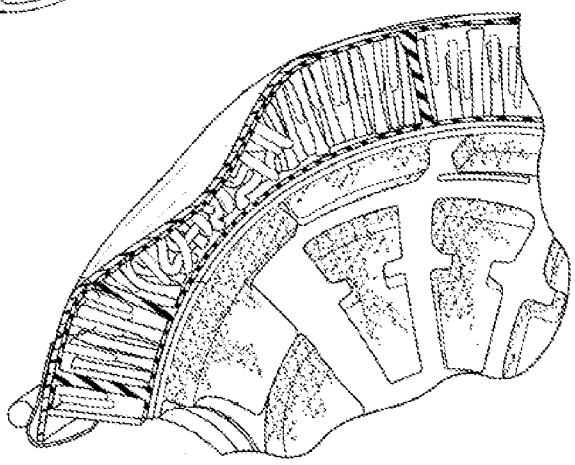


FIG. 28D

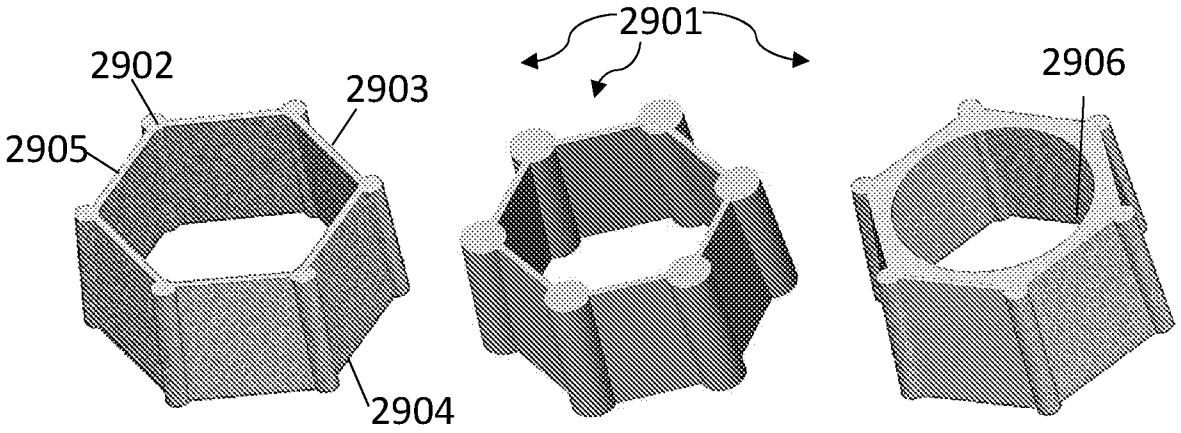


FIG. 29A FIG. 29B FIG. 29C

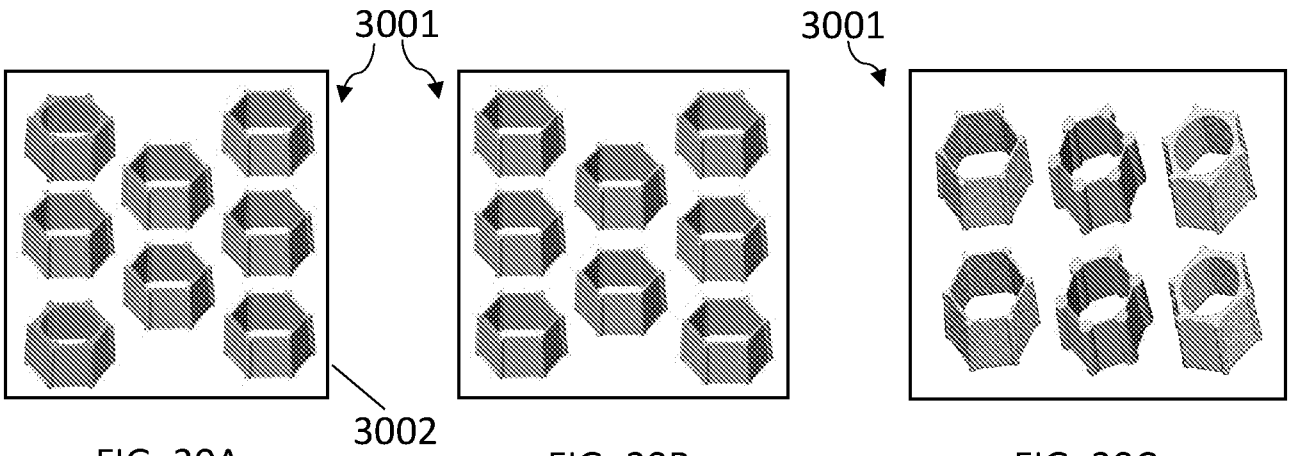


FIG. 30A FIG. 30B FIG. 30C

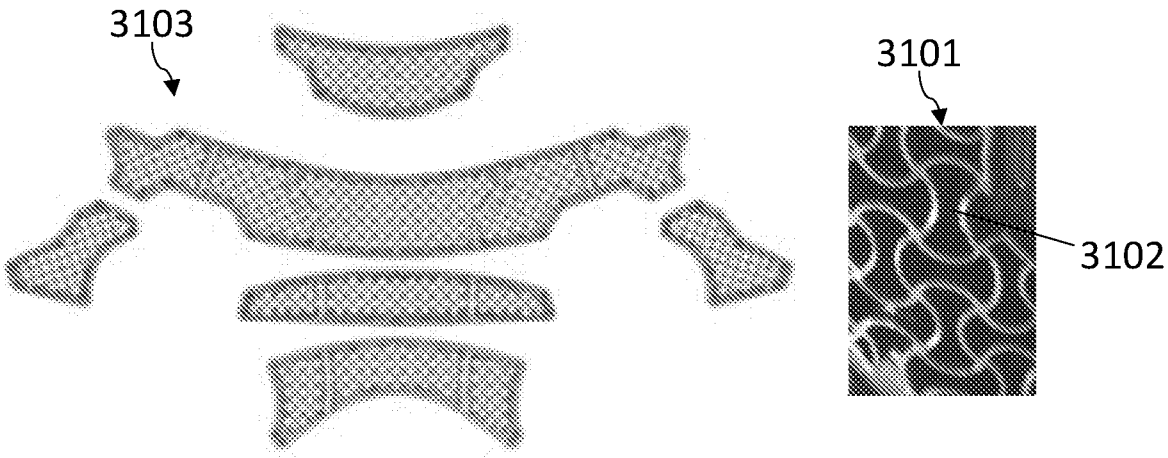


FIG. 31A FIG. 31B

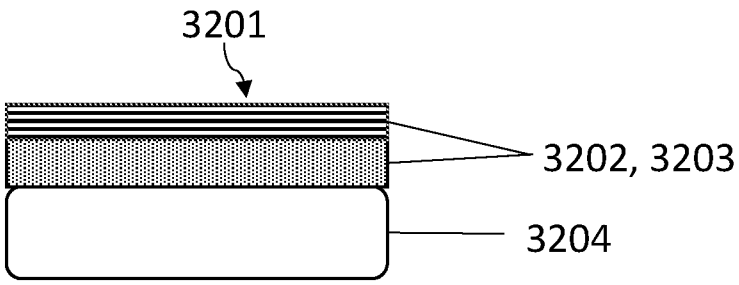


FIG. 32A

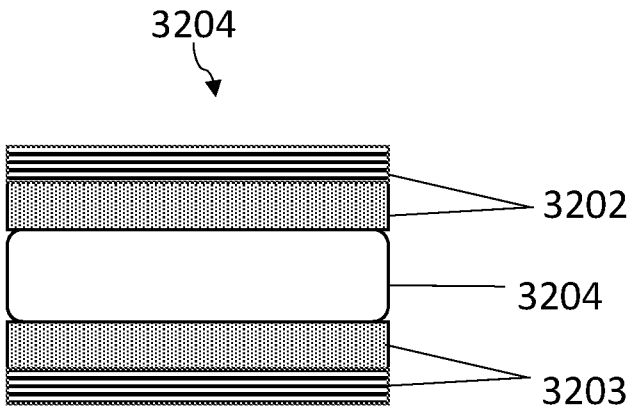


FIG. 32B

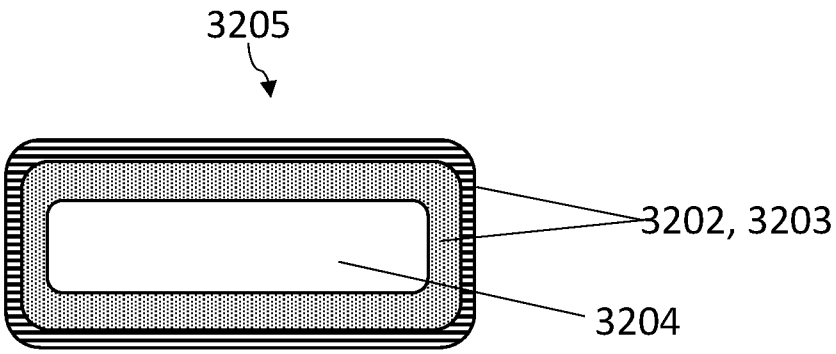


FIG. 32C

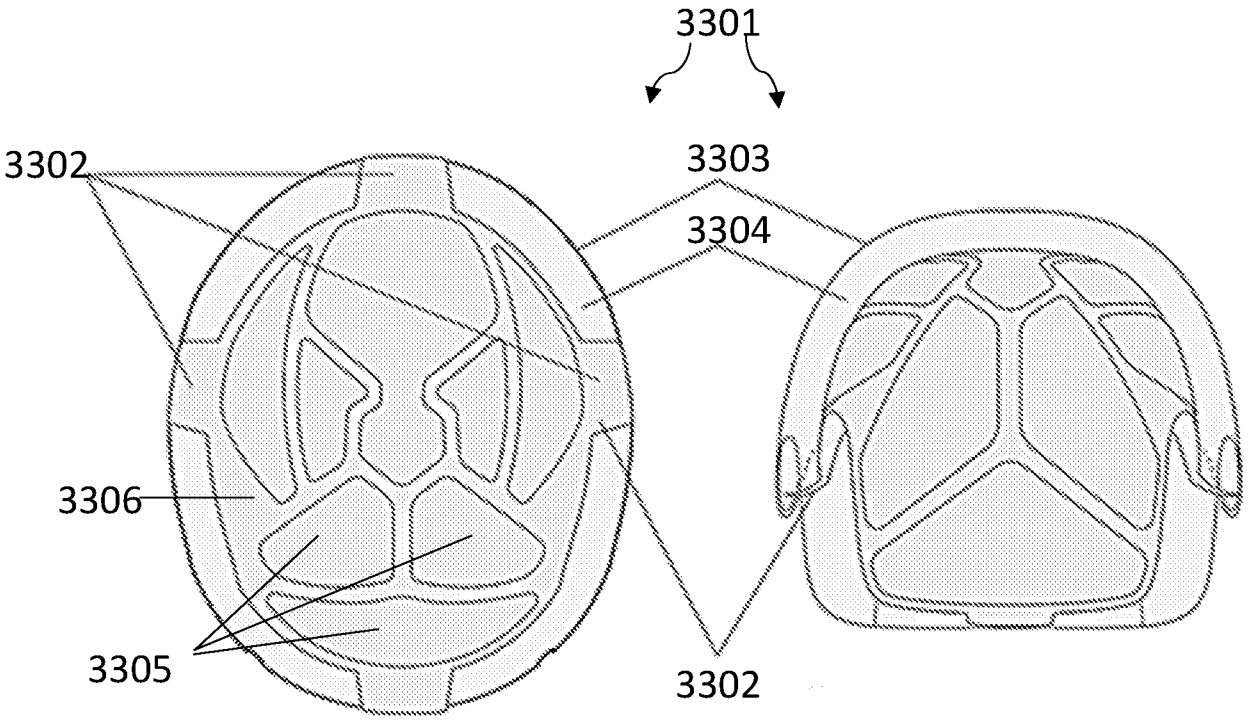
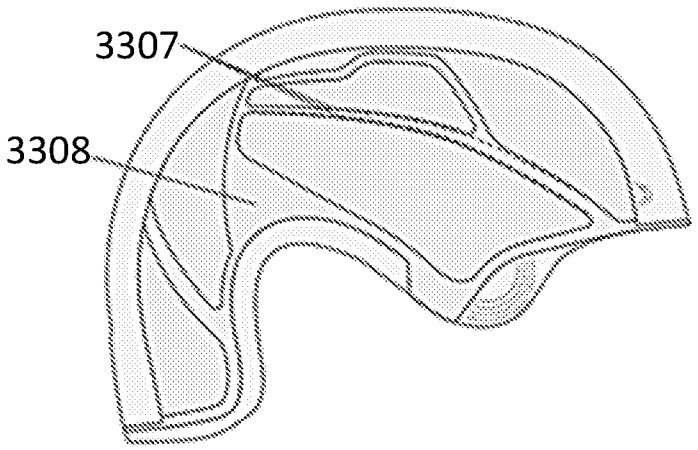


FIG. 33A

FIG. 33B



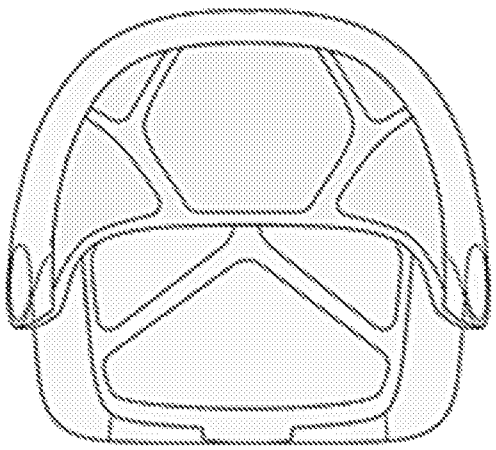


FIG. 33C

FIG. 33D

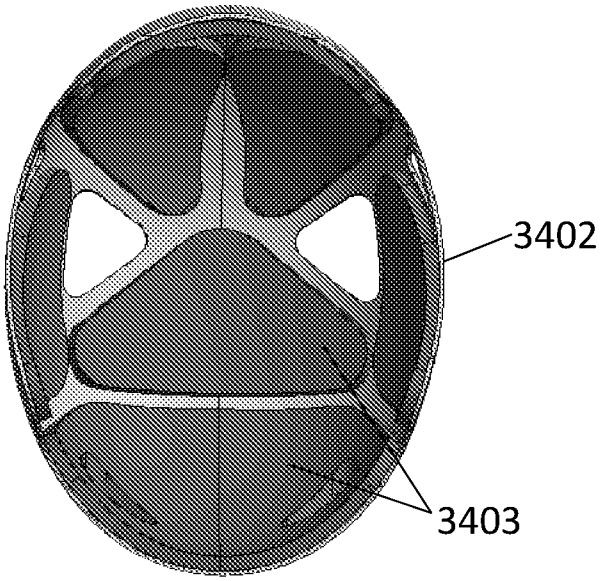


FIG. 34A

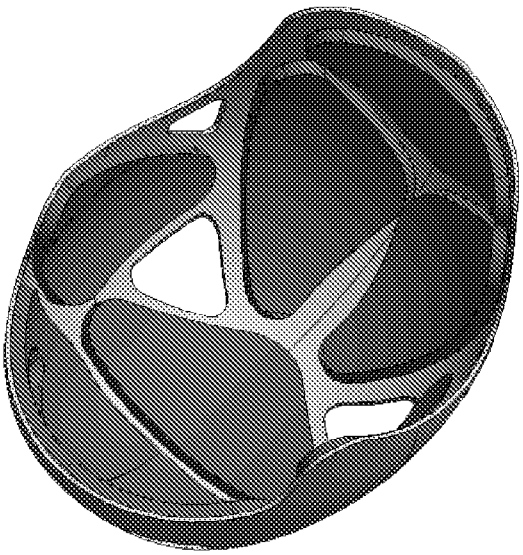


FIG. 34B

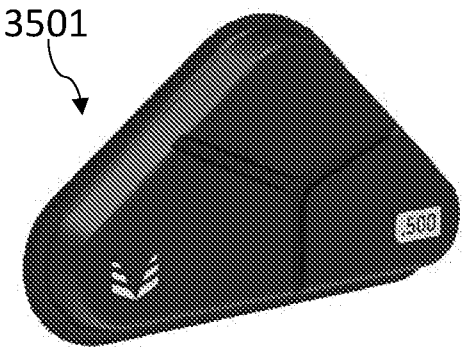


FIG. 35A

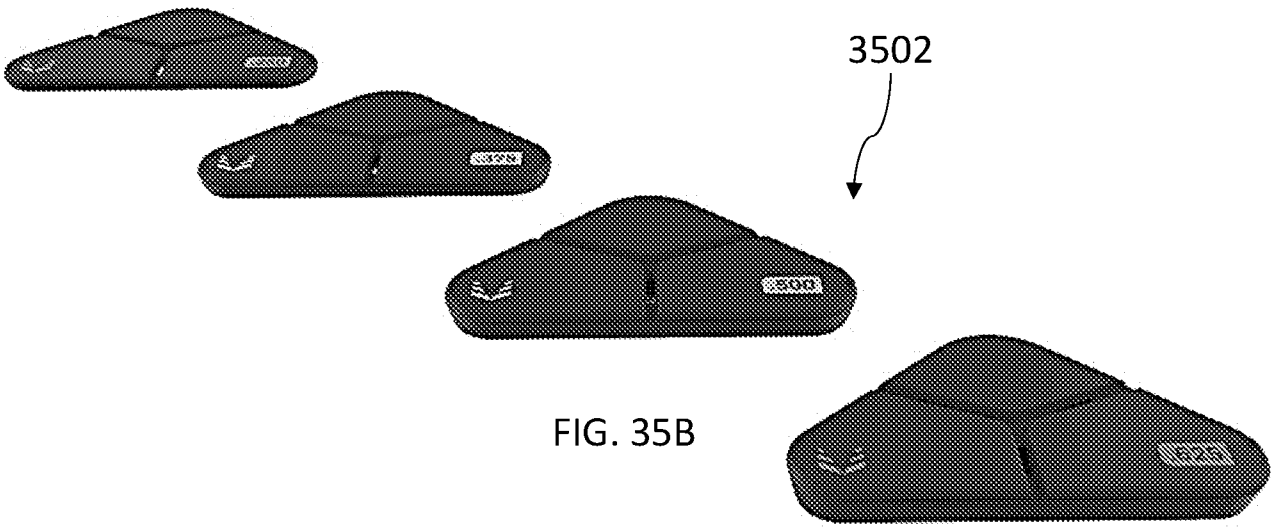


FIG. 35B

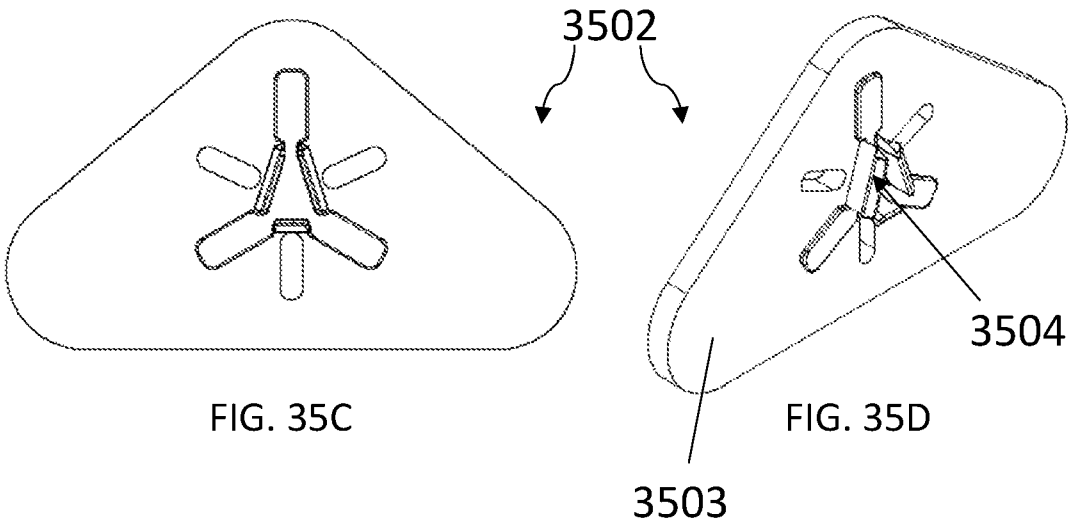


FIG. 35C FIG. 35D

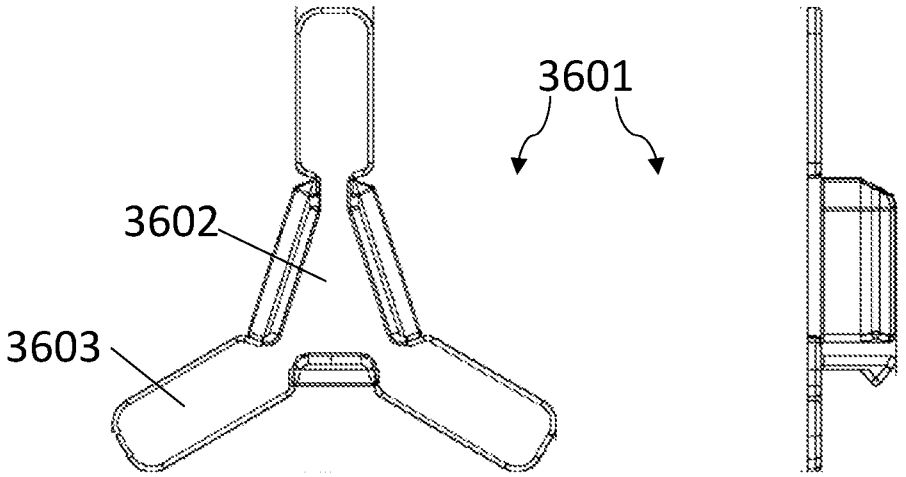


FIG. 36A FIG. 36B

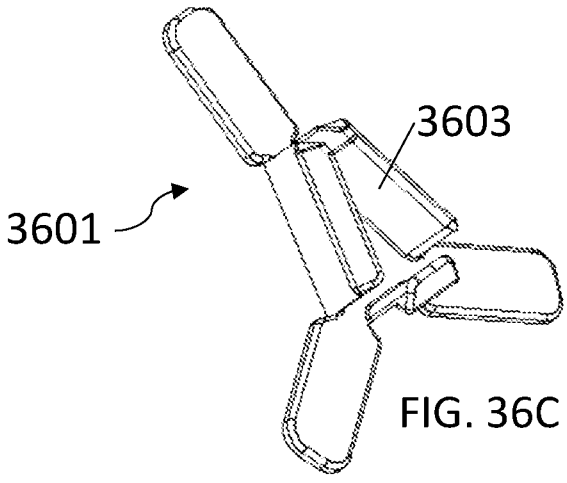


FIG. 36C

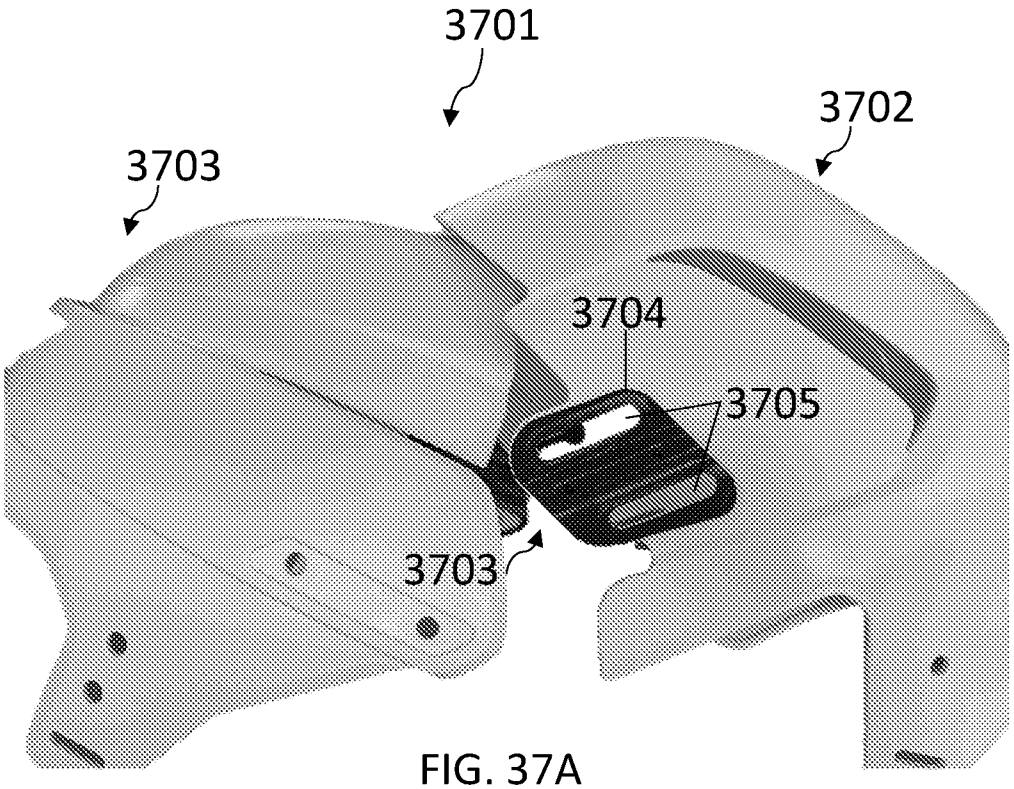


FIG. 37A

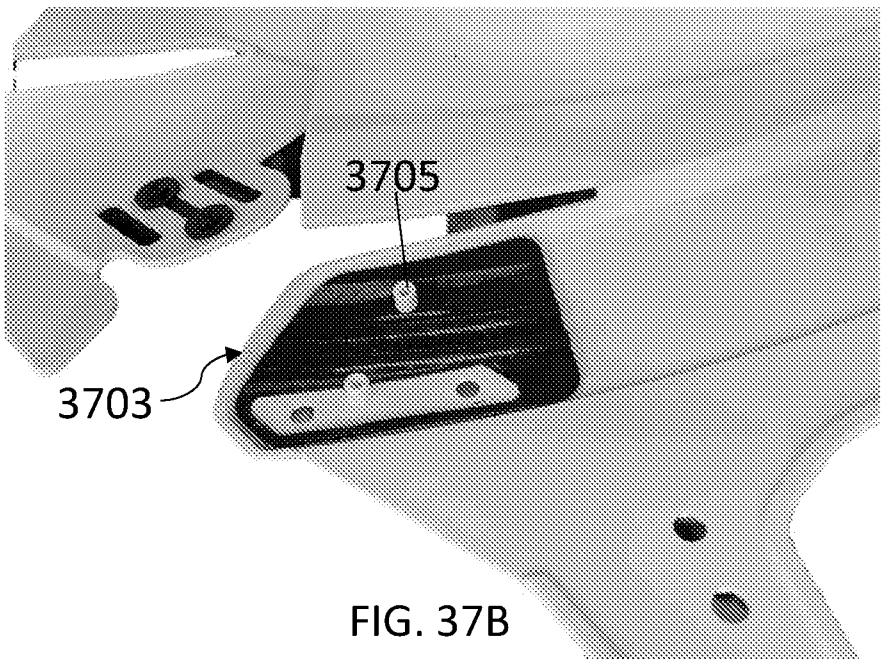


FIG. 37B

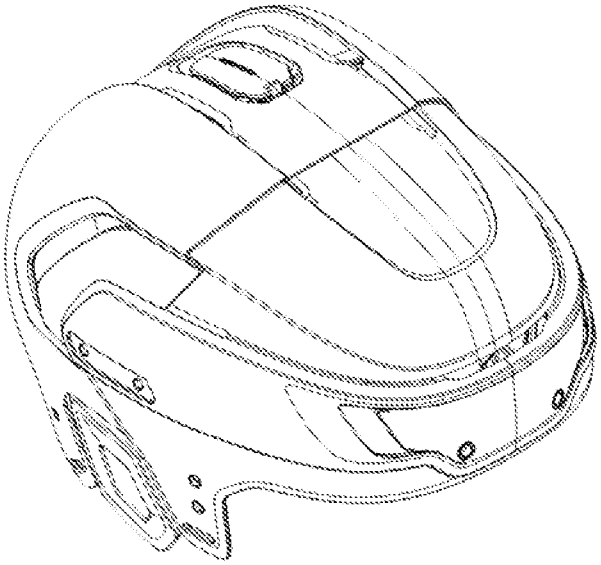


FIG. 38A

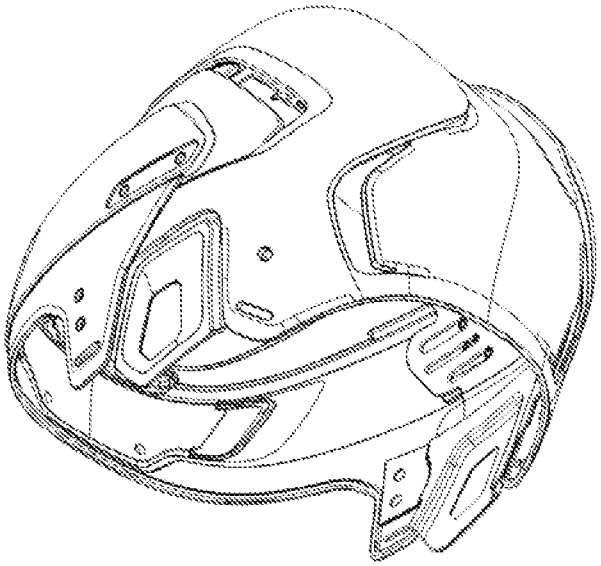


FIG. 38B

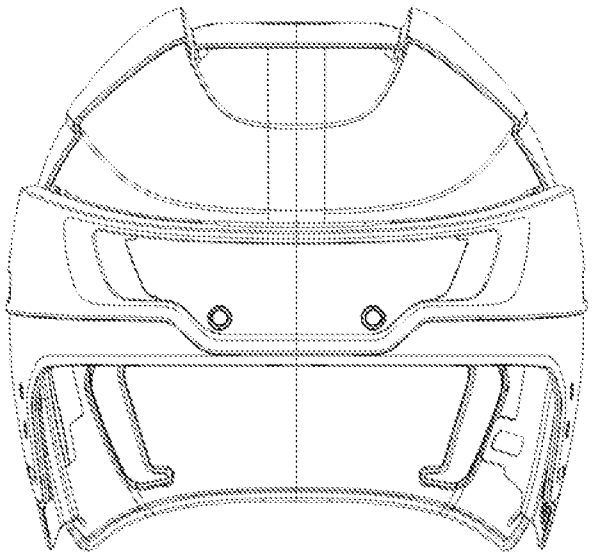


FIG. 38C

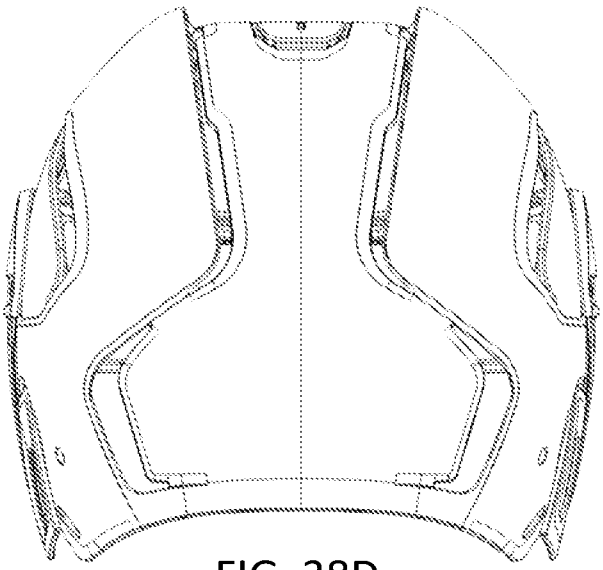


FIG. 38D

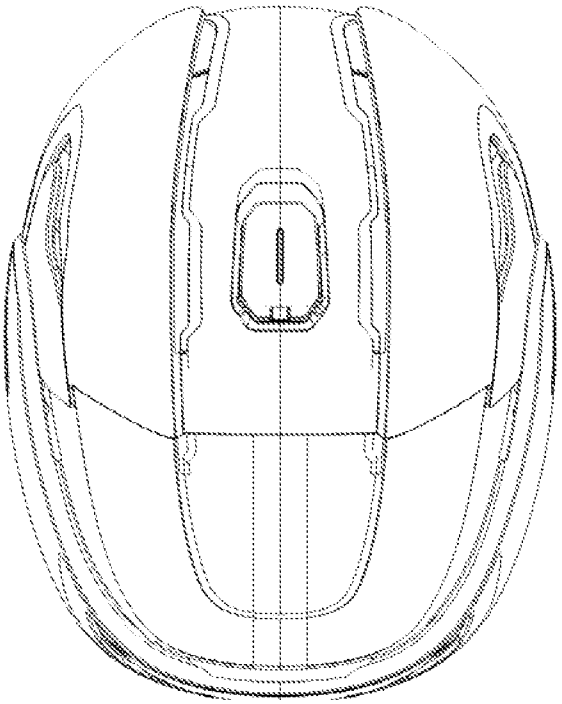


FIG. 38E

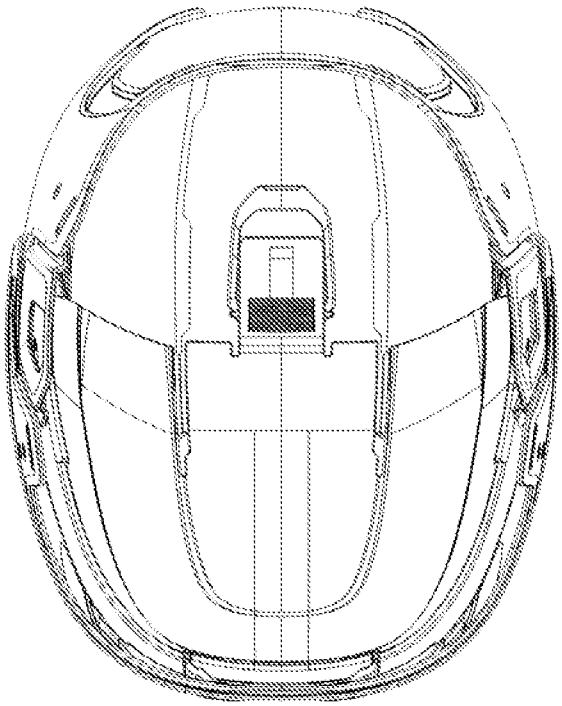


FIG. 38F

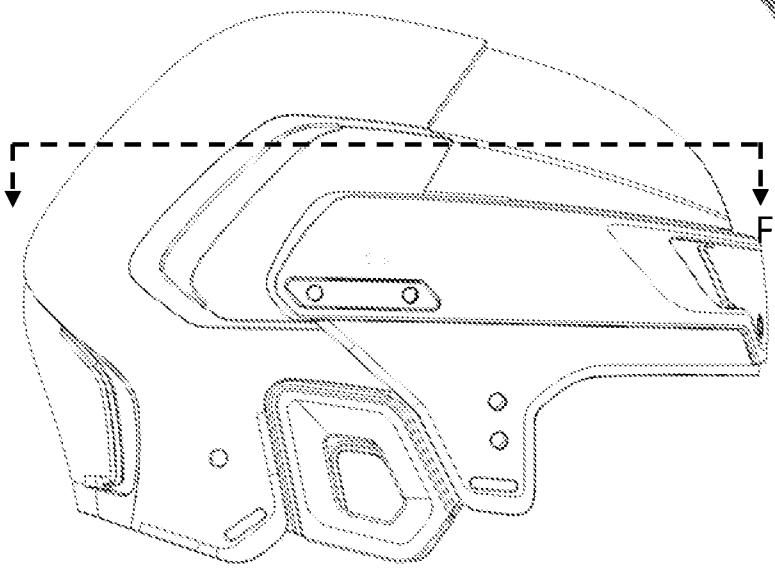


FIG. 38H

FIG. 38G

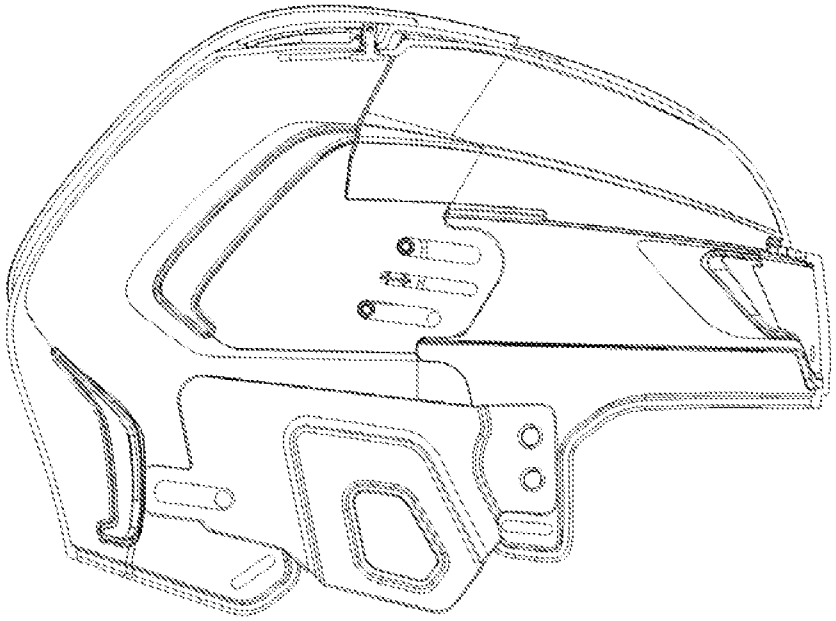


FIG. 38H

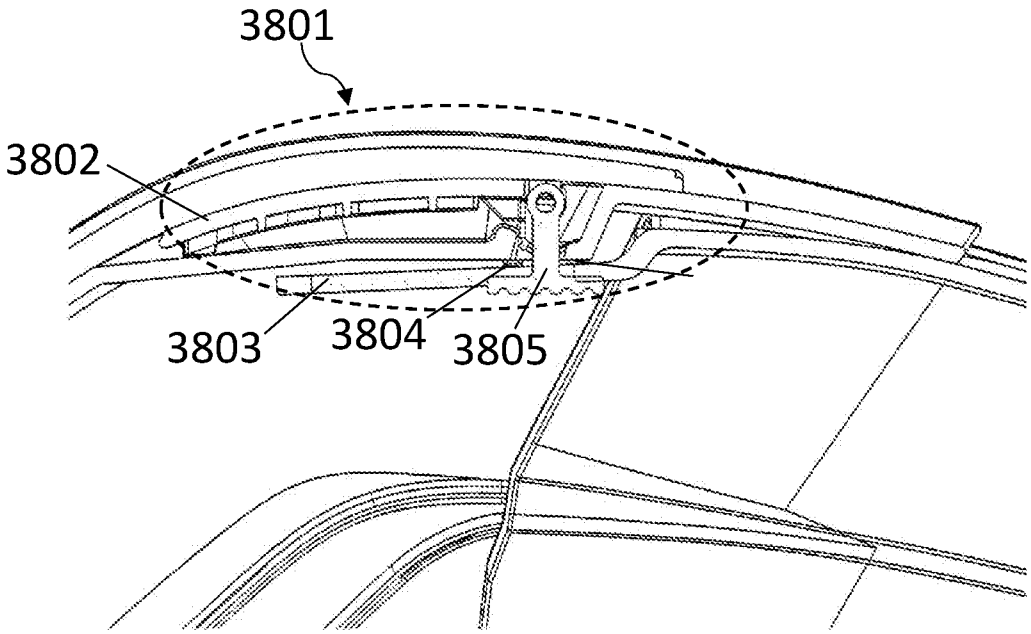


FIG. 38I

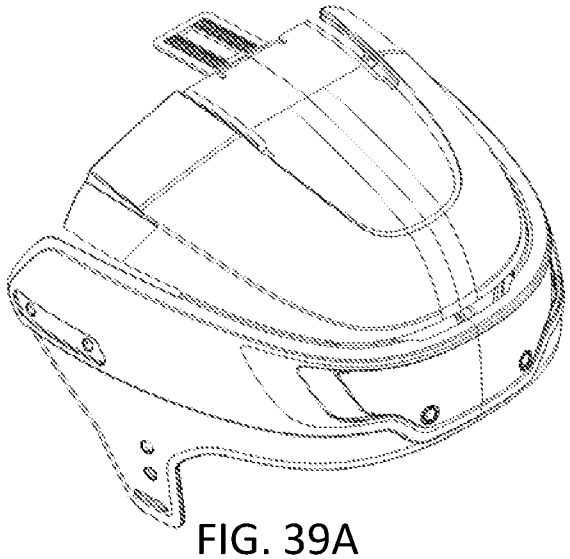


FIG. 39A

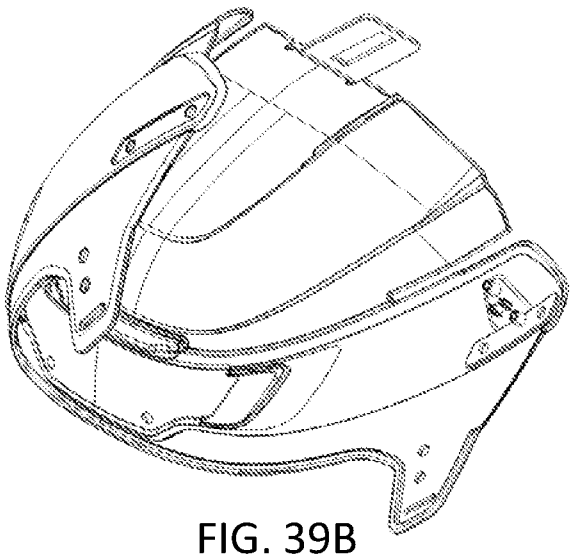


FIG. 39B

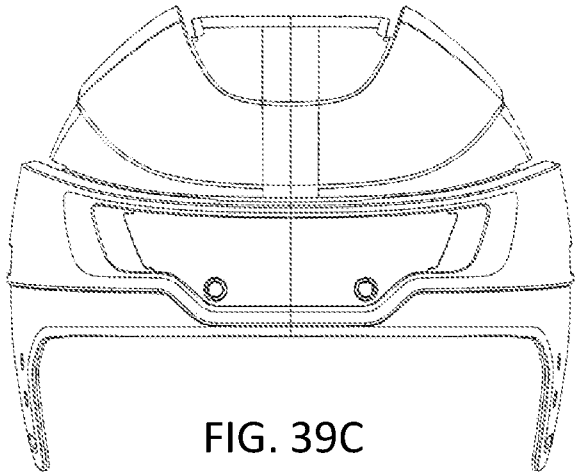


FIG. 39C

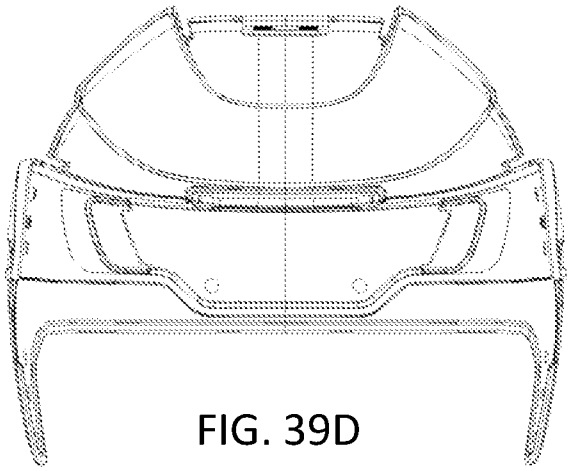


FIG. 39D

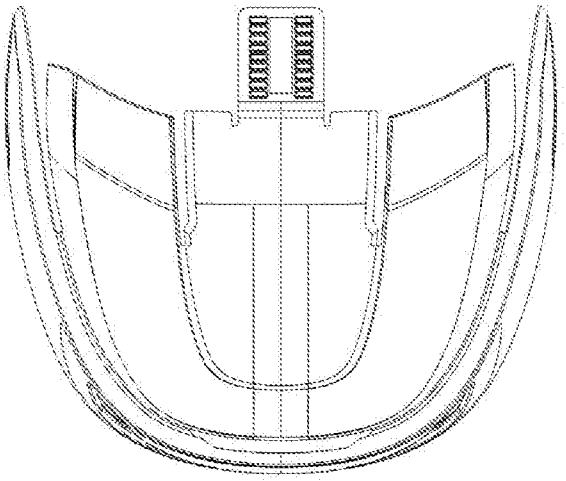


FIG. 39E

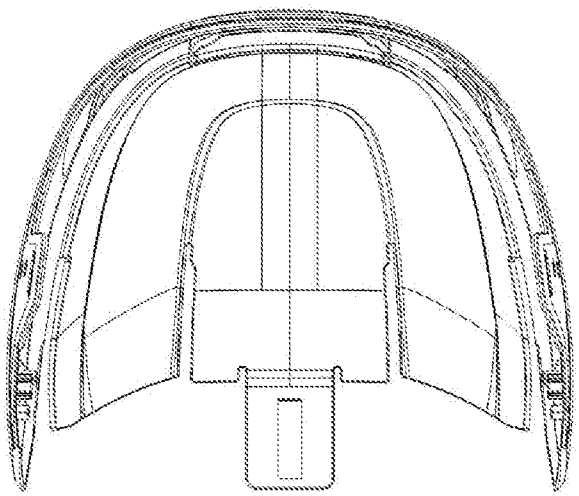


FIG. 39F

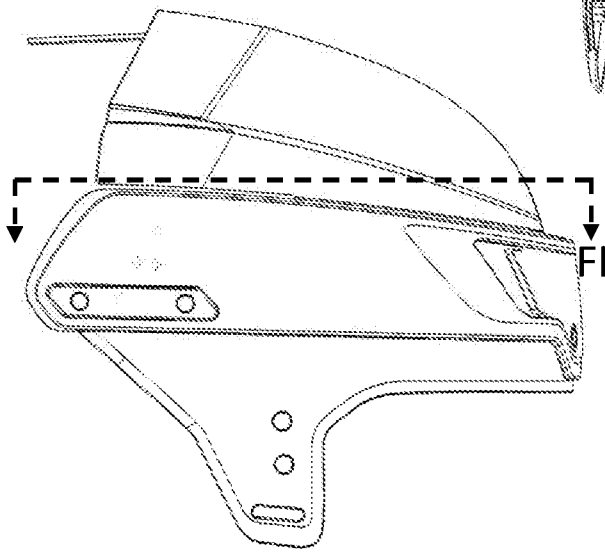


FIG. 39G

FIG. 39H

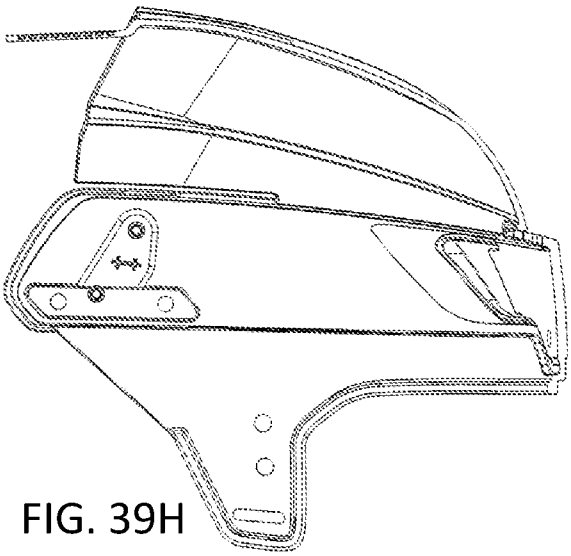


FIG. 39H

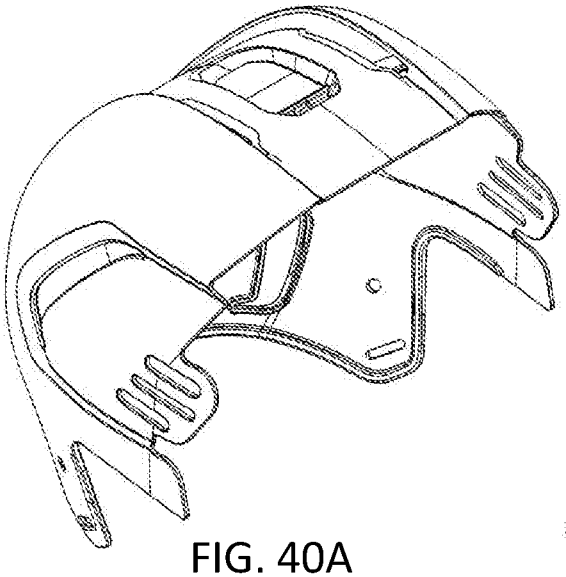


FIG. 40A

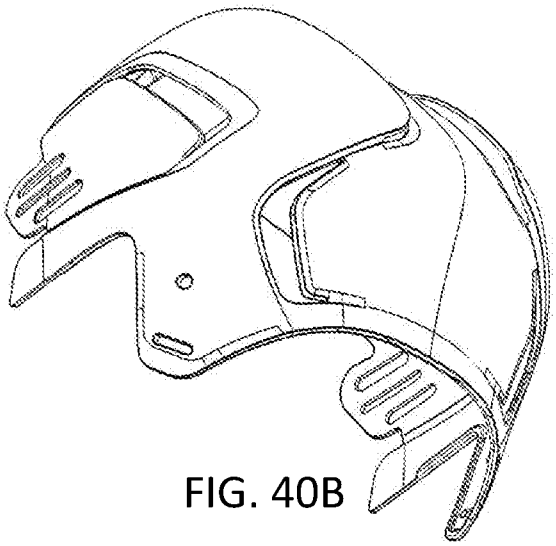


FIG. 40B

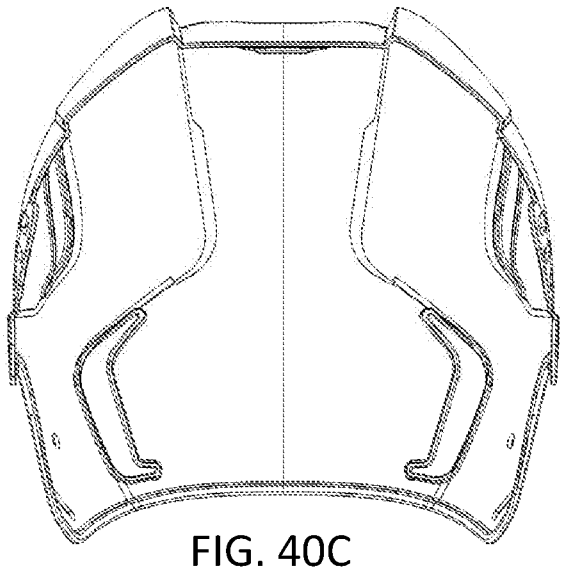


FIG. 40C

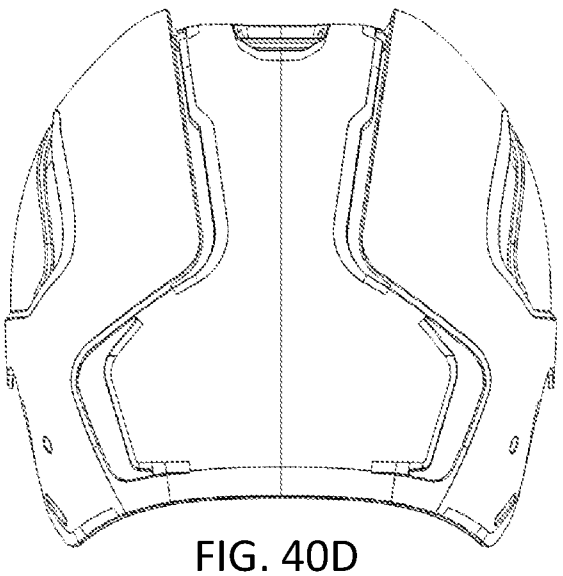


FIG. 40D

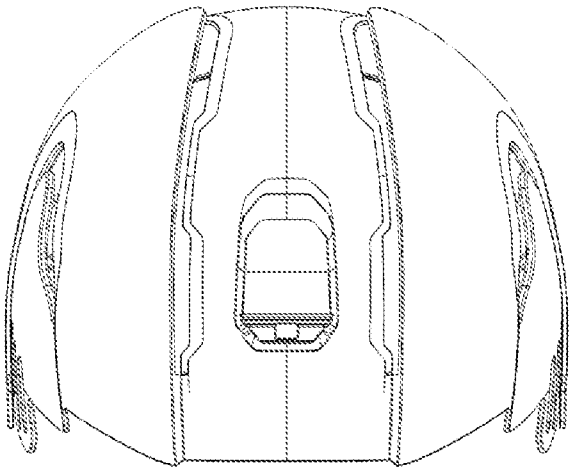


FIG. 40E

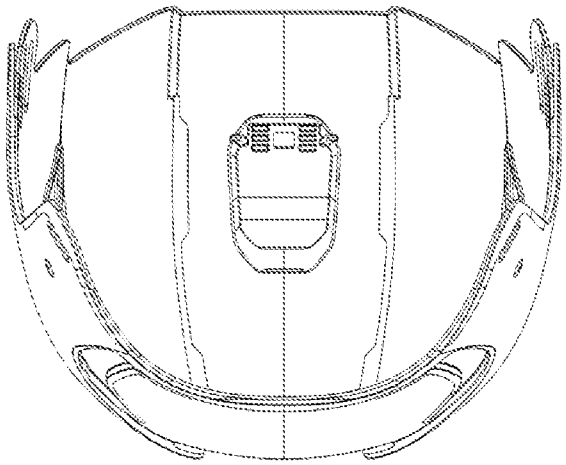


FIG. 40F

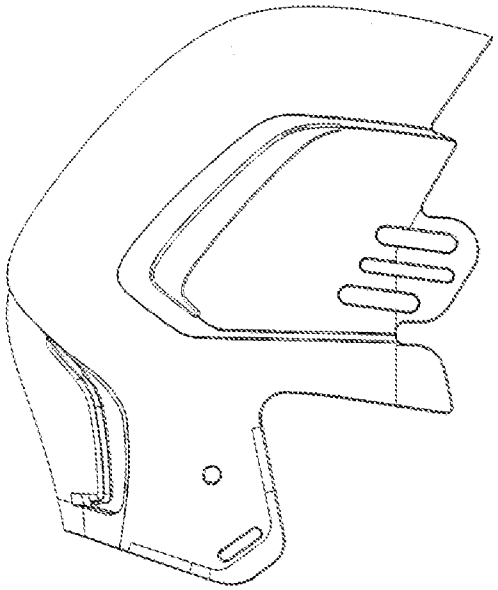


FIG. 40G

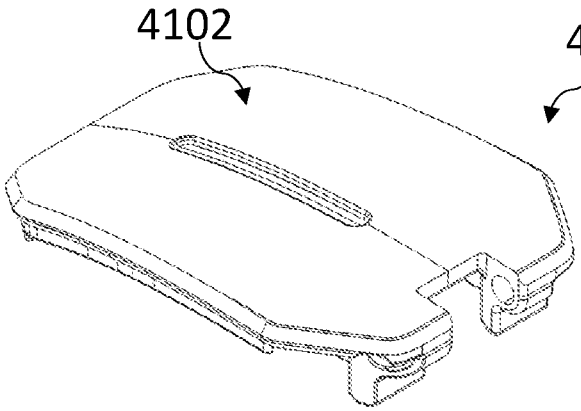


FIG. 41A

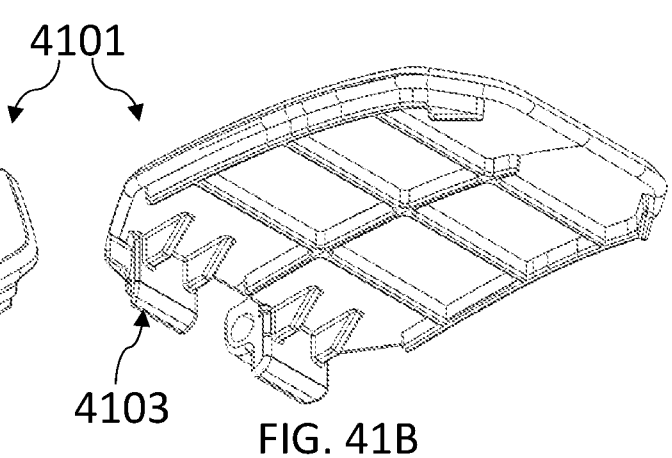


FIG. 41B

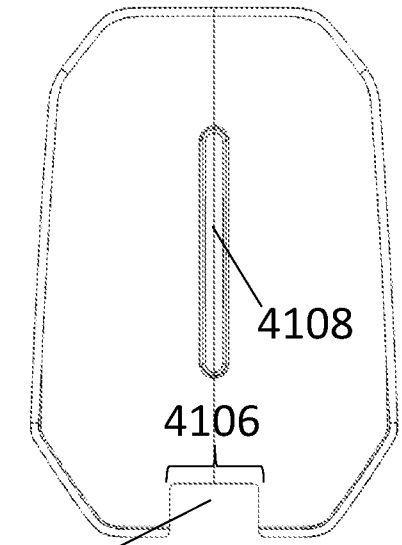


FIG. 41C

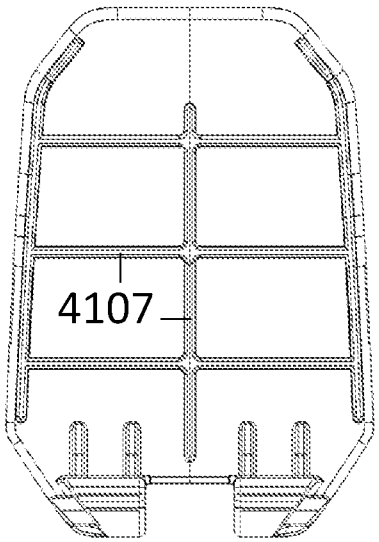


FIG. 41D

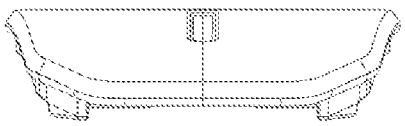


FIG. 41E

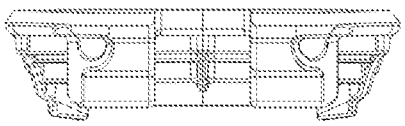


FIG. 41F

FIG. 41G

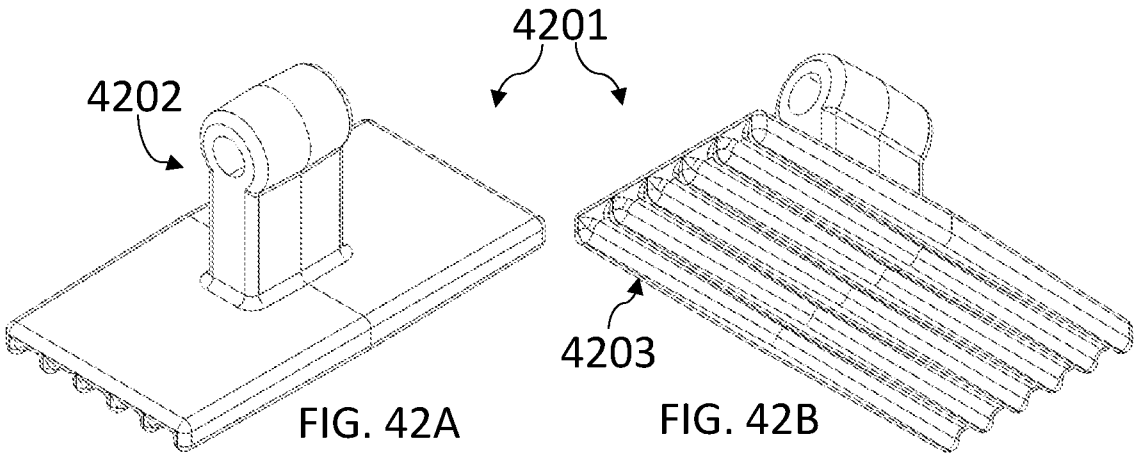


FIG. 42A FIG. 42B

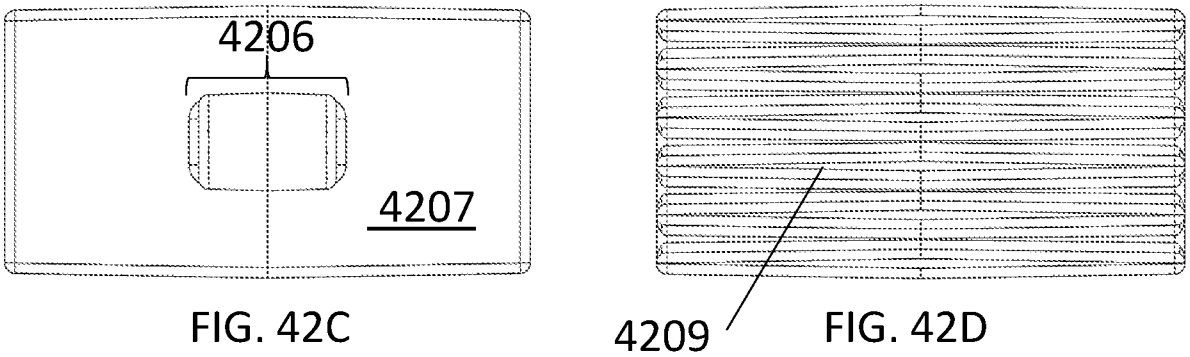
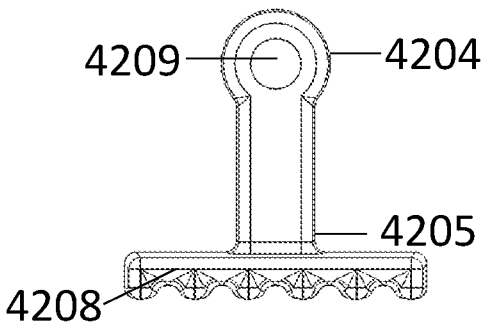


FIG. 42C FIG. 42D



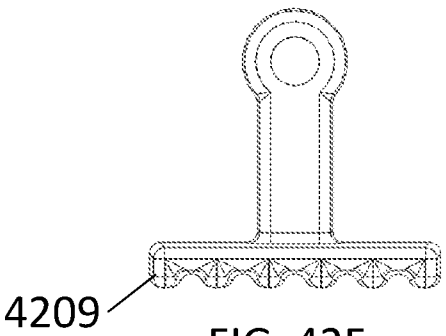
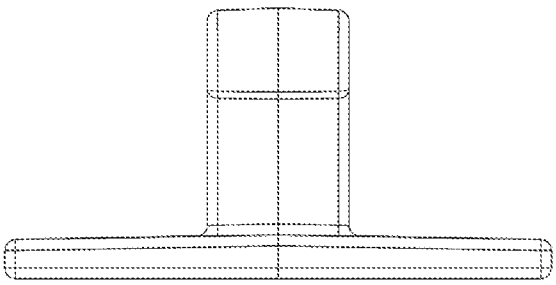


FIG. 42E FIG. 42F



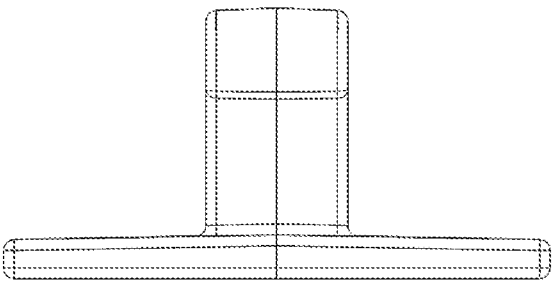


FIG. 42G FIG. 42H

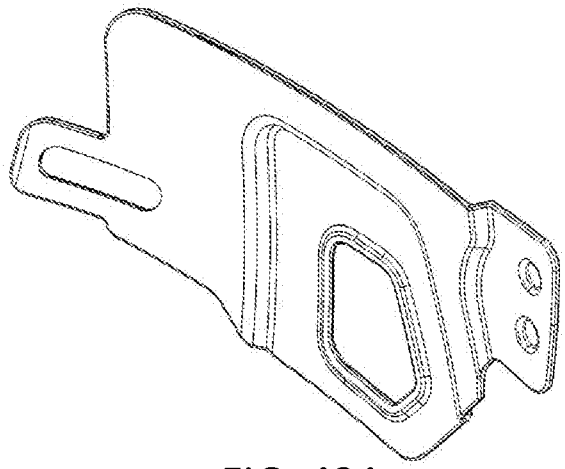


FIG. 43A

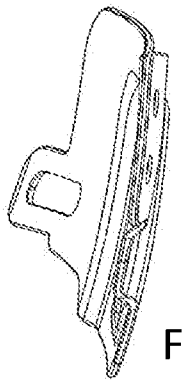


FIG. 43B

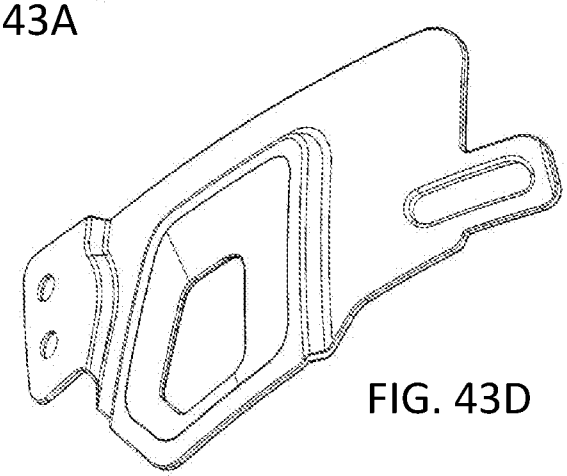


FIG. 43D

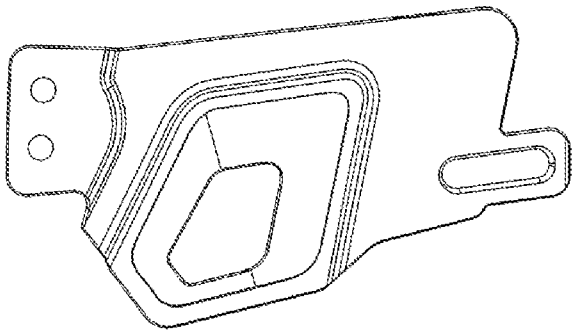


FIG. 43E

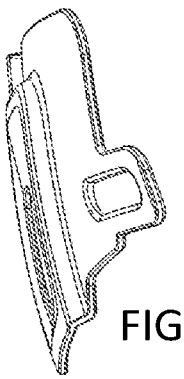


FIG. 43C

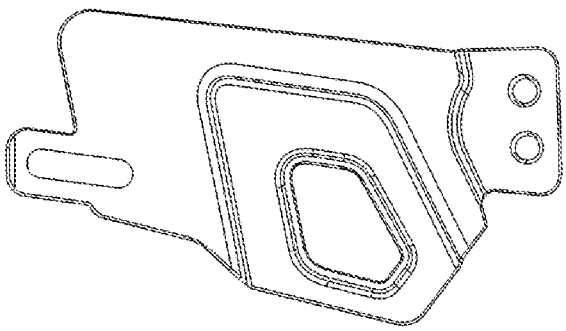


FIG. 43F

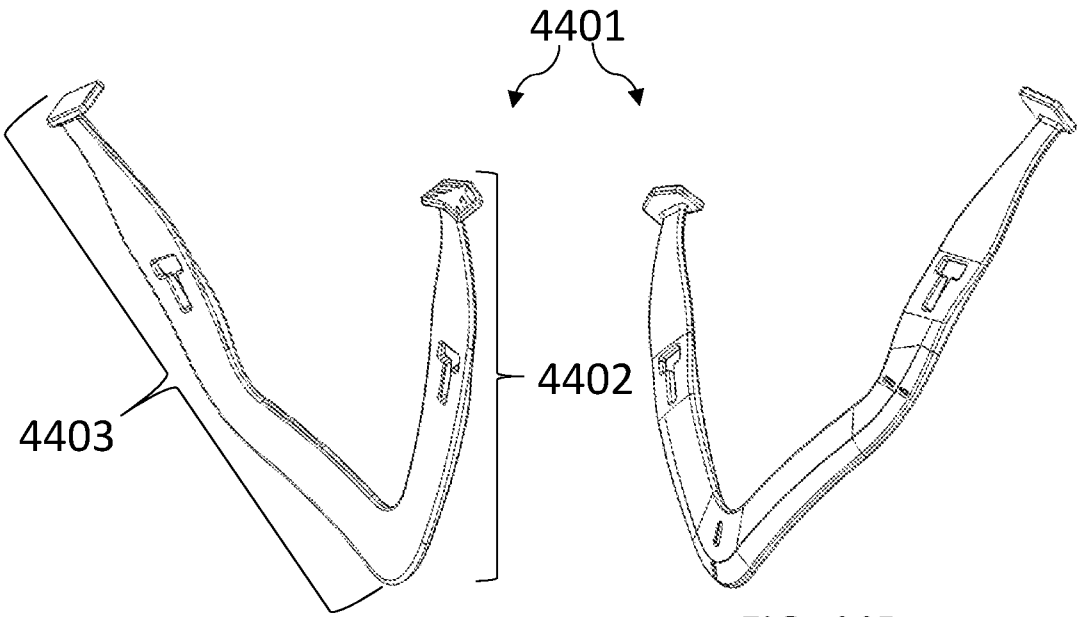


FIG. 44A FIG. 44B

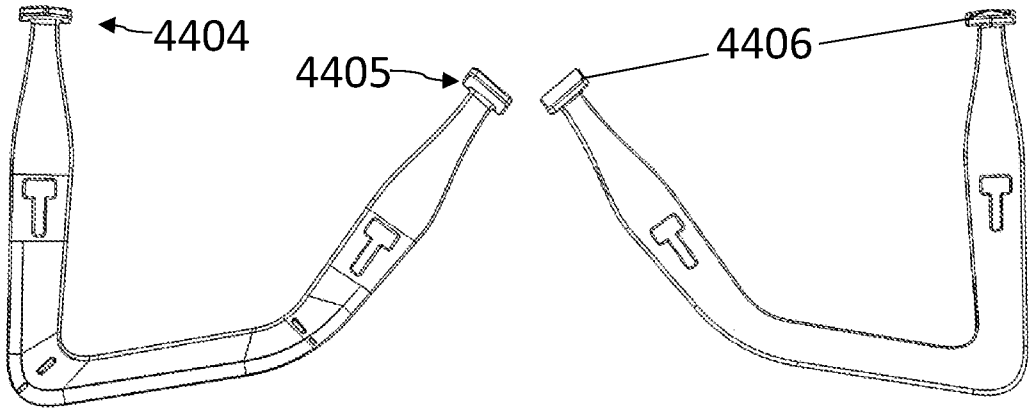


FIG. 44C FIG. 44D

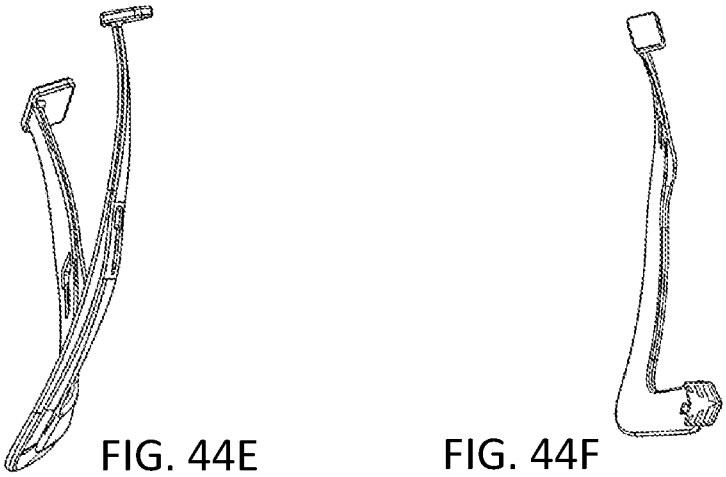


FIG. 44E FIG. 44F

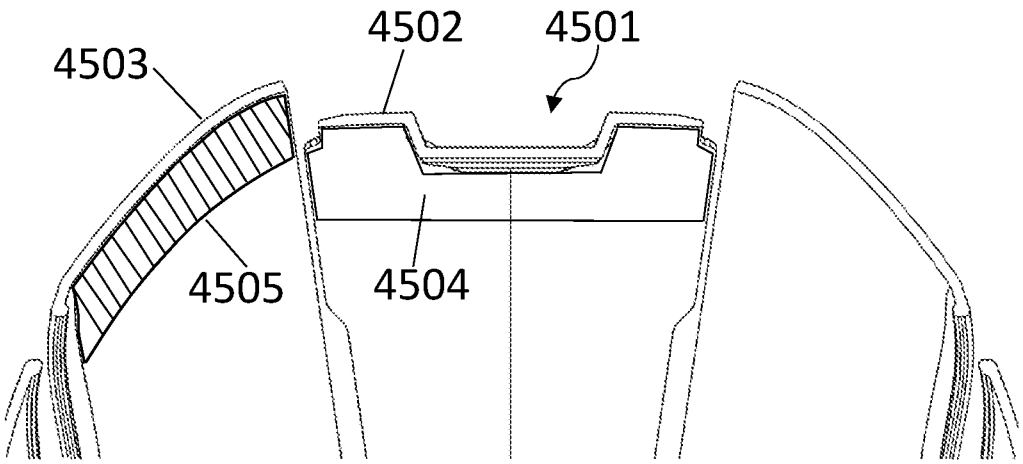


FIG. 45

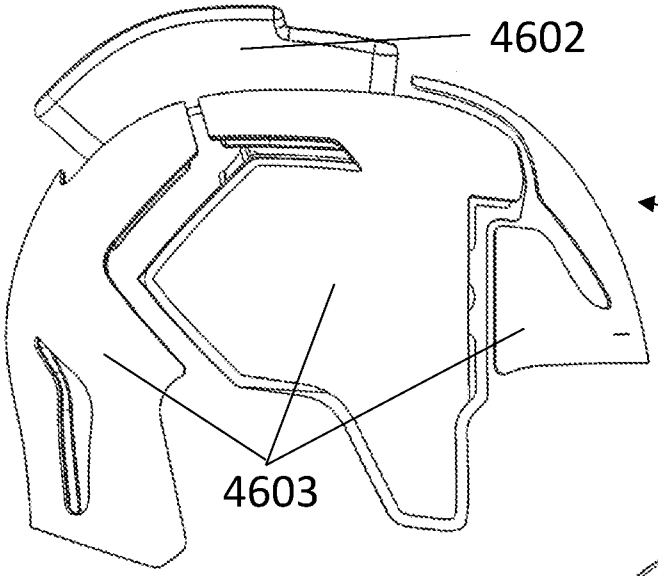


FIG. 46A

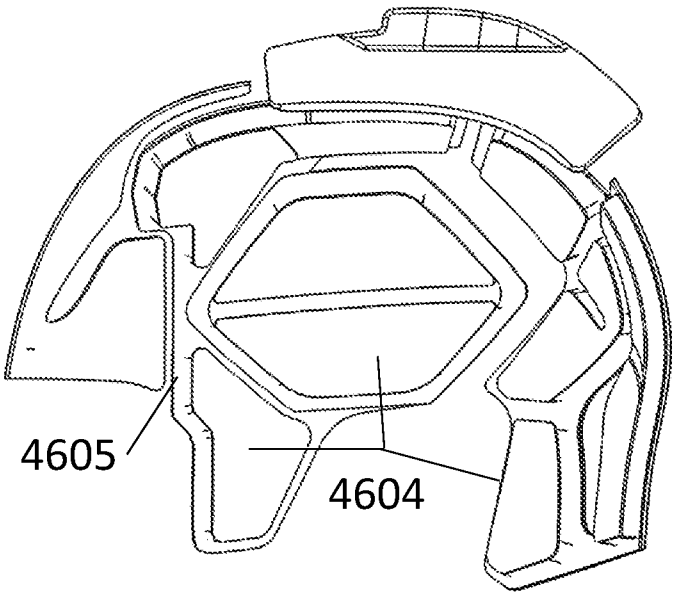


FIG. 46B

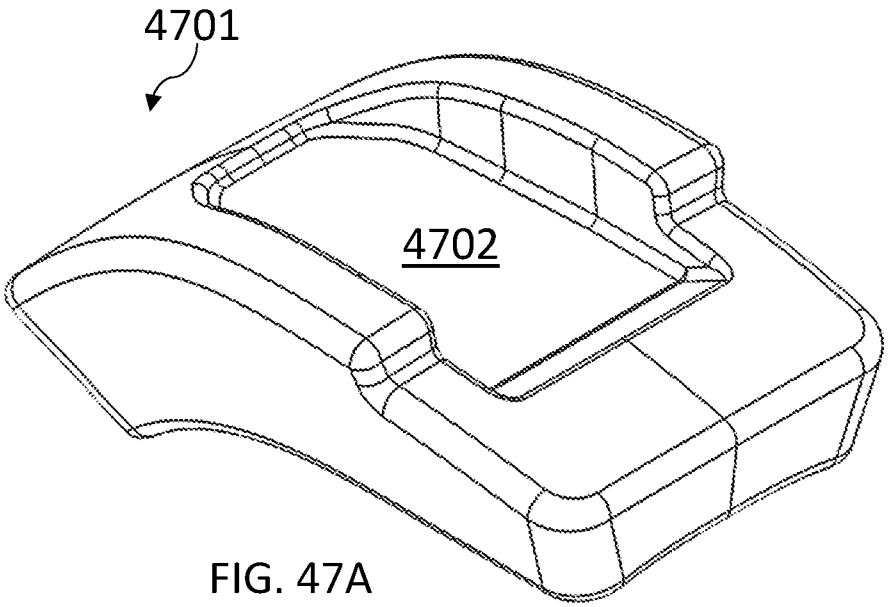


FIG. 47A

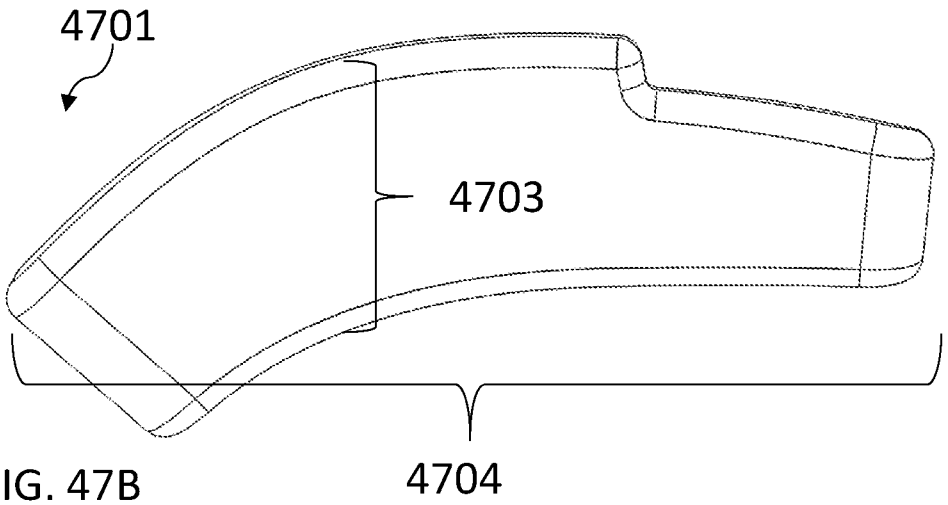


FIG. 47B

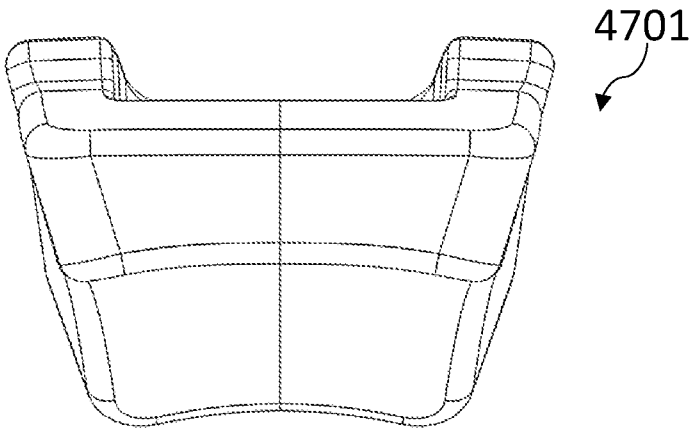


FIG. 47C

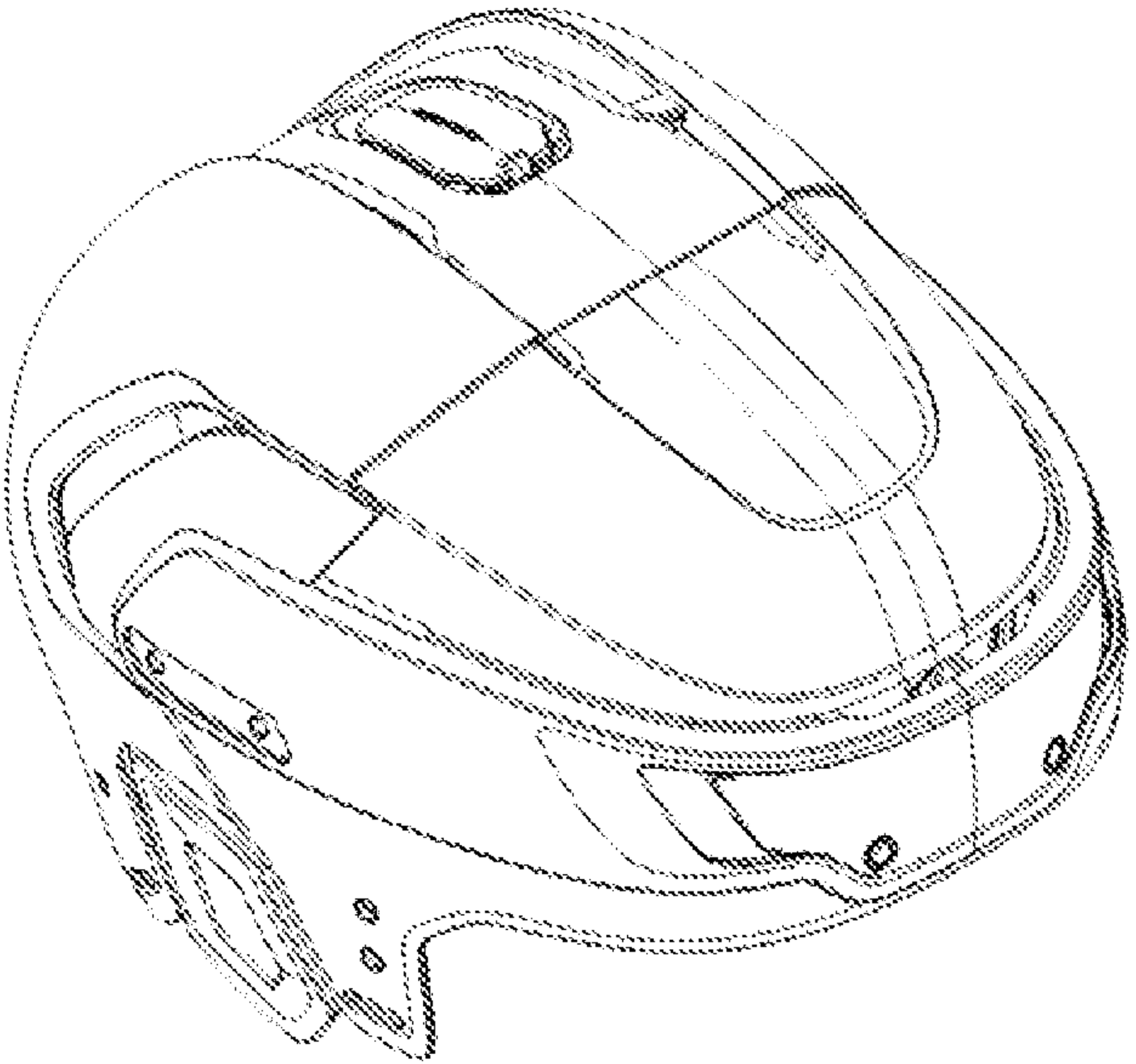


FIG. 38A