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(54) **Title:** HELMET COMPRISING INTEGRATED ROTATIONAL IMPACT ATTENUATION AND FIT SYSTEM

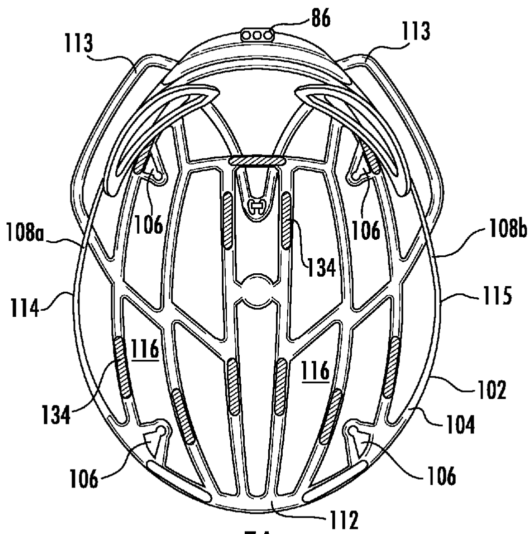

FIG. 5A

(57) **Abstract:** A helmet can include an energy absorbing shell including an outer surface and an inner surface opposite the outer surface. A fit system member can be coupled to a rear of the energy absorbing shell to adjust a fit of the helmet for a user. A sliding layer can include an outer sliding layer surface oriented towards the inner surface of the energy absorbing shell and an inner sliding layer surface opposite the outer surface. The sliding layer can include at least one attachment member and at least one integrated fit system arm. The at least one integrated fit system arm can be coupled to the fit system member. An elastomeric member can include a first end coupled to the energy absorbing shell and a second end coupled to the attachment member of the sliding layer. Comfort padding can be coupled to the inner surface of the Sliding layer.

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HELMET COMPRISING INTEGRATED ROTATIONAL IMPACT ATTENUATION AND FIT SYSTEM

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional patent application 62/347,053, filed June 7, 2016 titled "Integrated Rotational Impact Attenuation and Fit System," the entirety of the disclosure of which is hereby incorporated by this reference.

TECHNICAL FIELD

[0002] This disclosure relates to a protective helmet comprising an integrated rotational impact attenuation and fit system and method of forming the same.

BACKGROUND

[0003] Protective headgear and helmets have been used in a wide variety of applications and across a number of industries including sports, athletics, construction, mining, military defense, and others, to prevent damage to a user's head and brain. Damage and injury to a user can be prevented or reduced by helmets that prevent hard objects or sharp objects from directly contacting the user's head. Damage and injury to a user can also be prevented or reduced by helmets that absorb, distribute, or otherwise manage energy of an impact.

SUMMARY

[0004] A need exists for an improved helmet. Accordingly, in an aspect, a helmet can comprise an energy absorbing shell comprising an outer surface and an inner surface opposite the outer surface. A fit system member can be coupled to a rear of the energy absorbing shell and adjustable to fit the helmet for a user. A sliding layer can comprise an outer sliding layer surface oriented towards the inner surface of the energy absorbing shell and an inner sliding layer surface opposite the outer sliding layer surface. The sliding layer can comprise at least one attachment member and at least one integrated fit system arm. The at least one integrated fit system arm can be coupled to the fit system member. An elastomeric member can comprise a first end coupled to the energy absorbing shell and a second end coupled to the at least one attachment member of the sliding layer. Comfort padding coupled to the inner surface of the sliding layer.

[0005] The helmet can further comprise the comfort padding being disposed over the second end of the elastomeric member and the at least one attachment member of the sliding layer. The at least one attachment member of the sliding layer can be formed as an opening in the sliding layer, the second end of the elastomeric member can be disposed within the opening in the sliding layer, and the first end of the elastomeric member can be coupled to the energy absorbing shell with a pin. Helmet straps can be coupled to the energy absorbing shell and threaded through the fit system member. A second sliding layer can be disposed between the outer surface of the sliding layer and the outer surface of the energy absorbing shell. The sliding layer can be injection molded. The fit system member can be formed as a fit system cradle comprising a pinion, and the at least one integrated fit system arm can comprise a first fit system arm and a second fit system arm, the first fit system arm comprising teeth contacting a first side of the pinion and a the second fit system arm comprising teeth contacting a second side of the pinion.

[0006] In another aspect, a helmet can comprise an energy absorbing shell comprising an outer surface and an inner surface opposite the outer surface. A fit system member can be disposed inward of the energy absorbing shell and adjustable to adjust a fit of the helmet. A sliding layer can comprise an outer sliding layer surface oriented towards the inner surface of the energy absorbing shell and an inner sliding layer surface opposite the outer surface. The sliding layer can comprise an attachment member and at least one fit system arm. The at least one fit system arm can be coupled to the fit system member. An elastomeric member can comprise a first end coupled to the energy absorbing shell and a second end coupled to the attachment member of the sliding layer.

[0007] The helmet can further comprise the attachment member of the sliding layer being formed as an opening in the sliding layer, the second end of the elastomeric member being disposed within the opening in the sliding layer, and the first end of the elastomeric member being coupled to the energy absorbing shell. Helmet straps can be coupled to the energy absorbing shell and threaded through the fit system member. A second sliding layer can be disposed between the outer surface of the sliding layer and the outer surface of the energy absorbing shell. The sliding layer can be injection molded. The fit system member can be formed as a fit system cradle comprising a pinion, and the at least one integrated fit system arm can comprise a first fit system arm and a second fit system arm, the first fit system arm comprising teeth contacting a first side of the pinion and a the second fit system arm comprising teeth contacting a second side of the pinion. The fit system cradle can be coupled to the energy absorbing shell with a pin.

[0008] In another aspect, the helmet can further comprise an energy absorbing shell comprising an outer surface and an inner surface opposite the outer surface. A fit system member can be disposed inward of the energy absorbing shell. A sliding layer comprising at least one fit system arm can be coupled to the fit system member. An elastomeric member can be coupled to the energy absorbing shell and the sliding layer.

[0009] The helmet can further comprise the comfort padding being disposed over where the elastomeric member is coupled to the sliding layer. The sliding layer can comprise an opening disposed in the sliding layer, the elastomeric member can comprise a second end disposed within the opening in the sliding layer, and the elastomeric member can comprise a first end coupled to the energy absorbing shell with a pin. A second sliding layer can be disposed between the outer surface of the sliding layer and the outer surface of the energy absorbing shell. The fit system member can be formed as a fit system cradle comprising a pinion, and the at least one integrated fit system arm can comprise a first fit system arm and a second fit system arm, the first fit system arm comprising teeth contacting a first side of the pinion and a the second fit system arm comprising teeth contacting a second side of the pinion. The sliding layer can be formed with injection molding.

BRIEF DESCRIPTION OF THE DRAWINGS

[0001] FIG. 1 shows an embodiment of a helmet comprising an integrated rotational impact attenuation and fit system.

[0002] FIG. 2 shows a rotational sliding layer for an integrated rotational impact attenuation and fit system.

[0003] FIGs. 3A and 3B show a fit system member for the integrated fit system.

[0004] FIGs. 4A-4C show various views of a fit system member being coupled to a rotational sliding layer.

[0005] FIGs. 5A-5C show various views of a rotational sliding layer fit system.

[0006] FIGs. 6A-6D show elastomeric members coupled to a rotational sliding layer fit system.

[0007] FIGs. 7A and 7B show straps coupled to a helmet comprising an integrated rotational impact attenuation and fit system.

[0008] FIGs. 8A and 8B show detail at an interior of a helmet comprising an integrated rotational impact attenuation and fit system.

DETAILED DESCRIPTION

[0009] This disclosure, its aspects and implementations, are not limited to the specific helmet or material types, or other system component examples, or methods disclosed herein. Many additional components, manufacturing and assembly procedures known in the art consistent with helmet manufacture are contemplated for use with particular implementations from this disclosure. Accordingly, for example, although particular protective helmets are disclosed, such protective helmets and implementing components may comprise any shape, size, style, type, model, version, measurement, concentration, material, quantity, and/or the like as is known in the art for such protective helmets and implementing components, consistent with the intended operation of a protective helmet.

[0010] The word "exemplary," "example," or various forms thereof are used herein to mean serving as an example, instance, or illustration. Any aspect or design described herein as "exemplary" or as an “example” is not necessarily to be construed as preferred or advantageous over other aspects or designs. Furthermore, examples are provided solely for purposes of clarity and understanding and are not meant to limit or restrict the disclosed subject matter or relevant portions of this disclosure in any manner. It is to be appreciated that a myriad of additional or alternate examples of varying scope could have been presented, but have been omitted for purposes of brevity.

[0011] While this disclosure includes a number of embodiments in many different forms, there is shown in the drawings and will herein be described in detail, particular embodiments with the understanding that the present disclosure is to be considered as an exemplification of the principles of the disclosed methods and systems, and is not intended to limit the broad aspect of the disclosed concepts to the embodiments illustrated.

[0012] The disclosure presents a device, apparatus, system, and method for providing a protective helmet 30 comprising an integrated rotational impact attenuation and fit system 70, as will be discussed with respect to the figures. The helmet 30 can comprise vents or openings 32 in the helmet 30 and an energy absorbing shell 40. FIG. 1 shows a side profile view of the helmet 30 with a front 50 of the energy absorbing shell 40 disposed at the left of the figure, the rear or back 52 of the energy absorbing shell at the right of the figure, and a left side 54 of the energy absorbing shell being shown or presented in the FIG.

[0013] The vents 32 can be formed in, and extend through, a portion or entirety of the helmet 30, including the energy absorbing shell 40. The vents 32 can allow for airflow and circulation of air from outside the helmet 30 into the helmet 30 and adjacent the head of the user to cool the user and provide ventilation.

[0014] The energy absorbing shell 40 can optionally comprise an outer shell 42 and can be formed of energy management or energy-absorbing layers or materials 44, such as foam, which are discussed in greater detail below. The protective helmet 30 can be a bike helmet used for mountain biking or road cycling, or a helmet that can be used for other applications and in other industries that also use protective headwear. In any event, the protective helmet 30 can function to provide protection while minimizing interference with an activity.

[0015] The outer shell 42 can, without limitation, be formed of a plastic, resin, fiber, or other suitable material including polycarbonate (PC), polyethylene terephthalate (PET), acrylonitrile butadiene styrene (ABS), polyethylene (PE), polyvinyl chloride (PVC), vinyl nitrile (VN), fiberglass, carbon fiber, or other similar material. The outer shell 42 can be stamped, in-molded, injection molded, vacuum formed, or formed by another suitable process. The outer shell 42 can provide a shell into which the energy management layer 44 can be disposed, whether the helmet 30 be a hard shell helmet or a soft shell helmet, as known in the art. The outer shell 42 can also provide a smooth aerodynamic finish, a decorative finish, or both, for improved performance, improved aesthetics, or both. As a non-limiting example, the outer shell 42 can comprise PC shell that is in-molded in the form of a vacuum formed sheet, or is attached to the energy management layer 44 with, e.g., an adhesive. The outer shell 42 can also be permanently or releasably coupled to the energy management layer 44, using any suitable chemical or mechanical fastener or attachment device or substance including without limitation, an adhesive, permanent adhesive, pressure sensitive adhesive (PSA), foam-core adhesive, tape, two-sided tape, mounting foam adhesive, fastener, clip, cleat, cutout, tab, snap, rivet, hog ring, or hook and loop fasteners.

[0016] The energy absorbing shell 40 can comprise an outer surface 48 of the energy absorbing shell 40 (which can also be an outer surface of the outer shell 42, when the outer shell

42 is present) that can be oriented away from the user. The energy absorbing shell 40 can further comprise and an inner surface 46 opposite the outer surface 48, which can be oriented towards a head of the user. The energy management layer 44 can be made or formed of plastic, polymer, foam, or other suitable energy-absorbing material or impact liner to absorb, deflect, attenuate or otherwise manage energy and to contribute to energy management for protecting a wearer during impacts. The energy management layer 44 can include, without limitation, expanded polystyrene (EPS), expanded polypropylene (EPP), expanded polyurethane (EPU), expanded polyolefin (EPO), or other suitable material. An in-molded helmet 30 can be formed with the outer shell 42 of the helmet being bonded directly to the energy management layer 44, and by expanding foam or the energy management layer 44 into the outer shell 42. As such, the energy management layer 44 can, in some embodiments, be in-molded into outer shell 42, as single monolithic body of energy management material 44. Alternatively, in other embodiments the energy management layer 44 can be formed of multiple, or a plurality, of portions or layers. In any event, the energy management layers 44 can absorb or manage energy from an impact by bending, flexing, crushing, or cracking.

[0017] The energy absorbing shell 40 (including the outer shell 42 and the energy management material 44) can comprise a thickness measured in a radial direction extending from a center of the helmet 30 to the outer surface 48 of the energy absorbing shell 40, the thickness being measured from an inner surface 46 to the outer surface 48. The distance of the thickness can be in a range of 5-50 mm, 5-25 mm, or 8-15 mm.

[0018] The helmet 30 can also comprise straps or webbing 60 that can be attached to the helmet 30 and can be used to couple or releasably attach the helmet 30 to the head of the user. The straps 60 can comprise a rear portion or strap 62, a front portion or strap 64, a left portion or strap 66, and a right portion or strap 68. While the various portions 62, 64, 66, and 68 of strap 62 can be portions of one or more single continuous straps, the portions 62, 64, 66, and 68 of the strap 60 can also be separate, distinct, or discrete segments of strap. In either event, the portions 62, 64, 66, and 68 of the strap 60 can be coupled or joined together mechanically or chemically, including by sewing, by being threaded through strap adjustors or clips, or by any other suitable method. FIG. 1 shows an embodiment in which a clip, fastener, or attachment device 69 for releasably coupling portions of the straps 60 together, can be coupled at a position that will be below the chin or at a neck of the user when the helmet is worn. The clip 69 can comprise a left portion 69a and a right portion 69b that can be coupled by friction, magnetism, or both, as well as by any other desirable way. The helmet 30 can also comprise masks, visors, optional comfort liners, and other features known in the art to be associated with, or coupled to, helmets.

[0019] FIG. 2 shows a perspective view of a rotational sliding layer or sliding layer 100 separate, apart, or without the energy absorbing shell 40. An inner or bottom surface 104 of the sliding layer 100 is shown oriented towards the viewer of the figure, with an outer sliding layer surface 102, opposite the inner surface 104, that can be oriented towards the inner surface 46 of the energy absorbing shell 40 when the sliding layer 100 is disposed within, and coupled to, the energy absorbing shell 40. The Sliding layer 100 is shown with the front 112 of the Sliding layer shown at the bottom of FIG. 2, the rear 113 of the sliding layer 100 shown at the top of the figure, the left side 114 of the sliding layer shown at the left of the figure and the right side 115 of the sliding layer shown at the right of the figure. The sliding layer 100, can also comprise a plurality of openings, vents, channels, cutouts, or voids 116 formed completely through the sliding layer 100, extending from the outer surface 102 to the inner surface 104. In some instances, an area of the openings 116 will be greater than a solid portion or area of the sliding layer 100, such that more than half of the sliding layer comprises the openings 116. The sliding layer 100 in some instances can be completely solid or filed, while in other instances the sliding layer 100 can be open or opening-filled sliding layer 100 with more than half its area formed of holes or openings, and as much as 95% or more of its area filled, occupied, or defined by holes or openings.

[0020] The sliding layer 100 can comprise at least one attachment member, attachment anchor, or attachment opening 106 for being coupled to an elastomeric member 120, as shown and discussed in greater detail, e.g., with respect to FIGs. 6A-6D. FIG. 2 shows four attachment members 106 formed as keyhole or reentrant openings comprising an inlet for receiving and then locking into place the elastomeric members 120. However, the attachment members can be formed of openings of any desirable shape and size, and can also comprise pins, knobs, buttons, tabs, or attachment members. The four openings 106 are shown with two of the openings 106 formed at the front 112 of the sliding layer 100, and the other two openings 106 formed at the rear 113 of the sliding layer 100. Additionally, one of the front openings 106 and one of the rear openings 106 can be formed on the left side 114 of the sliding layer 100, while one of the front openings 106 and one of the rear openings 106 can be formed on the right side 115 of the sliding layer 100. However, in other embodiments, one, two, three, five, six, or any other suitable number of attachment members or openings 106 can be formed in the sliding layer 100 according to the configuration, design, and function of the sliding layer 100 and its desired movement with elastomeric members 120.

[0021] The sliding layer 100 can also comprise at least one integrated fit system arm108, such as a first or left integrated fit system arm 108a and a second or right integrated fit system arm 108b. The at least one integrated fit system arm 108 can be coupled to a fit system member or cradle 80, as shown an described in greater detail in FIGs. 4A-4C, or any suitable device for adjusting a size, shape, or both of the sliding layer 100 to better accommodate the head of the user.

[0022] The sliding layer 100 can be formed of a plastic, resin, fiber, metal, or other suitable low friction material or low friction coated material including nylon, polypropylene (PP), Polyoxymethylene (POM), PC, PET, ABS, PE, PVC, VN, fiberglass, carbon fiber, steel, aluminum, or other similar material or material suitable for injection molding. The outer shell 42 can be stamped, in-molded, injection molded, vacuum formed, or formed by another suitable process. In some instances a single step process like injection molding can be used, and in others a multistep process, such as vacuum forming a shape followed by cutting a feature, such as a gear rack. When the sliding layer 100 is formed by an injection molding process, the sliding layer 100 will be made of a suitable plastic for injection molding an such as nylon, or other suitable materials. The material selected for sliding layer 100 can also be selected based on its performance and suitability in the sizing or adjusting the size of the sliding layer 100 to match a size, shape, or both of the user. For example, nylon can work well not only with an injection molding process, but can also work well for forming integrated fit system arms 108 that can serve as rear racks used as part of a rack and pinion design for an sliding layer fit system 70 used to adjust to fit a size of the user's head. When selecting a size of the sliding layer 100, a general size of the sliding layer 100 should correspond to a specific size range of a size of the helmet 30 and a size of the user head, whether, e.g., small, medium, or large, so that only small adjustments are needed with the fit system 70 to provide final sizing or fine tuning of sizing to the user's head. Small differences in sizing of the fit system 70 can be understood to be sizes or adjustments that vary by percent difference of 0-20%, 0-10%, or 0-5% from a size of the user's head.

[0023] In addition to forming the sliding layers 100 in an injection molding process, vacuum molding or other suitable molding or forming process can also be used to form the sliding layer 100 as part of the fit system 70, whether or not the sliding layer 100 is formed as an integral or unitary piece of the fit system 70. As such, the sliding layer 100 can comprise arms 108 or other features or portions that are separately formed and added to the sliding layer 100 so that when the sliding layer 100 is assembled as part of the fit system 70, the composite sliding layer 100 can then acts as both an energy management feature, such as for rotation management, and a sizing feature, such as adjusting a size of the sliding layer 100 to match or correspond to a size of the head of the user. In some instances, a diameter of the sliding layer 100, as well as a height or effective height adjustment for the helmet wearer can also controlled by adjusting the sliding layer 100 as part of the fit system 70, such that all size adjustment of the helmet, including all height adjustment could be completely integrated or combined with adjustments to a size and shape of the sliding layer 100, which is further described below.

[0024] FIGs. 3A and 3B show a fit system member or fit system cradle 80 that can optionally be coupled to a rear 52 of the energy absorbing shell 40, as shown in FIG. 1, or could also be coupled directly to the sliding layer 100. The fit system cradle 80 can be disposed inward of the energy absorbing layer 40 such that an inner surface of the energy absorbing layer 40 is oriented towards the fit system 80, and the fit system 80 can be at least partially disposed within an area or space defined by the energy absorbing layer to receive the head of the user. In any event, the fit system cradle 80 can be used to adjust a fit of the helmet 30 for a user wearing the helmet 30. FIG. 3A shows the fit system cradle 80 separate or apart from the energy absorbing shell 40. Additionally, FIG. 3A shows a non-limiting example of the fit system cradle 80 formed of plastic, metal, resin, fiber, or other suitable material comprising a cradle 82, cradle pads 84, a dial 86, a front badge 88, a pinion 90, a fastener or screw 92, a rear badge 94, a base 96, and a cover 98. In moving from FIG. 3A to 3B, assembly of the fit system member 80 can comprise assembling the rear badge 94 to the cradle 82, assembling the base 96 to the rear badge 94, assembling the sliding layer 100 to the base part 96 as shown in FIGs. 4A-4C, assembling the pinion 90 to the base 96 and fit system arms 108 as shown in FIGs. 4A-4C, assembling the dial 86 to the pinion 90 and the base 96, assembling the cover 98 to the base 96 and the dial 86, testing the dial 86 for moving the pinion 90 to reel in and pay out the fit system arms 108, assembling the screw 92 to the base post or opening 93 as shown in FIG. 4C, and assembling the cradle pads 84 to the cradle wings 82c.

[0025] FIG. 3B, similar to FIG. 3A, shows the assembled fit system member 80 ready to be coupled to the low friction layer 100, such as with integrated fit system arms 108, which is shown and described in greater detail in FIGs. 4A-4C.

[0026] FIGs. 4A-4C show portions of the integrated sliding layer fit system 70 comprising the fit system member 80 coupled to the Sliding layer 100 with the fit system member 80 being formed as a fit system cradle comprising a pinion 90, and coupled to the at least one integrated fit system arm 108 comprising a first or left fit system arm 108a and a second or right fit system arm 108b.

[0027] FIG. 4A shows the second or right side fit system arm 108b can be disposed in a slot 83, such as a right side slot 83b formed in the cradle body 82, and passing under, or being held in place by, one or more slot covers or arches 85, such as a right side cover or arch 85b. The right side fit system arm 108b can comprise teeth or ridges 110 that are aligned with, and contact, a second side 90b of the pinion 90 as the right side fit system arm 108b is disposed within the right slot 83b. FIG. 4B shows the right side fit system arm 108b being disposed further along, or more completely within, the right slot 83b, until the arm 108b contacts a stop or arm stop 89, such as the right arm stop 89b.

[0028] FIG. 4C shows two fit system arms 108 with the first or left side fit system arm 108a being disposed in a slot 83, such as a left side slot 83a formed in the cradle body 82, and passing under, or being held in place by, one or more slot covers or arches 85, such as a left side cover or arch 85a. The left side fit system arm 108a can comprise teeth or ridges 110 that are aligned with, and contact, a first side 90a of the pinion 90 as the left side fit system arm 108a is disposed within the left slot 83a. The left side fit system arm 108a can be disposed within, the left slot 83s, until the arm 108a contacts a stop or arm stop 89, such as the left arm stop 89a.

[0029] While FIGs. 4A-4C show a non-limiting example of the integrated fit system arms 108 with teeth 110, the integrated fit system arms 108 could also be formed without teeth and other suitable attachment mechanisms, other than rack and pinion style mechanisms, can also be used. For example, rather than the fit system arms 108 comprising teeth 110, or even the sliding layer 100 comprising arms 108, the sliding layer 100 could comprise, or could be coupled to, a different size adjusting mechanism or feature such as elastic cords, bungees, or slidelocks that cold tighten or loosen, like a drawstring, to adjust a size of the sliding layer 100.

[0030] FIGs. 5A-5C show the fit system member 80 and sliding layer 100 coupled together as the sliding layer fit system 70. FIG. 5A shows a perspective view of the fit system 80 and the inner sliding layer surface 104, with the front 112 of the sliding layer disposed at the bottom of the figure, and the rear 114 of the sliding layer at the top of the figure. FIG. 5A also shows that the sliding layer 100 can comprise one or more attachment members, attachment anchors, or attachment openings 106 in the sliding layer 100. FIG. 5A shows a non-limiting example in which the sliding layer 100 comprises four openings 106, two of which are formed at the front 112 of the sliding layer 100, and the other two of the four openings 106 formed at the rear 113 of the sliding layer 100. Additionally, one of the front openings 106 and one of the rear openings 106 can be formed on the left 114 of the sliding layer 100, while one of the front openings 106 and one of the rear openings 106 can be formed on the right 115 of the sliding layer 100. In other embodiments, one, two, three, five, six, or any suitable number of attachment members or openings 106 can be formed in the sliding layer 100.

[0031] FIG. 5B shows a close up perspective view of the fit system 70 including the inner sliding layer surface 104 of sliding layer 100, similar to the view shown in FIG. 5A. FIG. 5B provides an enlarged view of the fit system 80, and the integrated fit system arm 108 being fed into the fit system 80, as well as showing a non-limiting example of the cradle pin 82b disposed at the top of the fit system 80. In some instances, the fit system member 80 can be only indirectly coupled or attached to the energy absorbing shell 40, rather than being directly coupled to the energy absorbing shell 40 with the cradle pin 82b. For example, the fit system member 80 can directly contact one or more portions of sliding layer 100, such as the arms 108, or can also be coupled to the sliding layer 100, rather than the energy absorbing shell 40, such as with one or more elastomeric members 120 that are coupled to the fit system member 80 in place of the cradle pin 82b.

[0032] FIG. 5C shows a rear perspective view of the fit system 70, with the fit system 80 comprising a cradle pin, knob, button, tab, or attachment member 82b. The pin 82b shown in FIG. 5C can be coupled to the energy absorbing shell 40 by being directly or indirectly attached to the energy absorbing shell 40. The pin 82b can be directly attached to the energy absorbing shell 40 such as by having the pin 82b disposed within an opening or receiving aperture in the energy absorbing shell 40. Alternatively, the pin 82b can be indirectly attached to the energy absorbing shell 40 such as by having an intermediate member or hanger coupled to the pin 82b, and then having a pin or portion of the intermediate member or hanger coupled to, or disposed within, an opening or receiving aperture in the energy absorbing shell 40.

[0033] FIGs. 5B-5C also show additional detail of the openings 106, which can be configured or adapted to receive a corresponding number of elastomeric members 120. The elastomeric members 120 can be mateably coupled to the openings 106 as shown and described with respect to FIGs. 6A-6D. Interaction among the various features or elements of the fit system 70 can with the relative movement of the energy absorbing shell 40 and the sliding layer 100 facilitated by the elastomeric members 120, can aid in retention and fit of the helmet 30 to a head of the helmet wearer.

[0034] Adjustment and performance of the sliding layer fit system 70 can be facilitated or advanced by forming the sliding layer 100 of nylon with injection molding, allowing for the fit system arms 108 to be formed at a same time as, and as part of, the sliding layer 100, which can interact with the pinion 90 of the fit system 80. Forming the sliding layer 100 of nylon with injection molding differs from conventional or normal vacuum molded sliding layer parts or layers that have been formed and used as for rotational energy management independent of the fitting process and a fit system. By forming fit system arms 108 as part of the sliding layer 100, an integrated sliding layer fit system 70 can be achieved, which improves helmet fit, user comfort, and can improve helmet performance with respect to energy management, while simplifying construction and decreasing cost. Performance of the helmet 30 can be improved by combining the Sliding layer and the fit system, the two components being joined or integrated to provide a more stable fit for the helmet wearer as the wearer puts on the helmet, adjusts helmet straps, takes the helmet off, or wears or conveys the helmet. To the contrary, previous systems have not used a sliding layer for actual fitting, but have instead relied on two separate systems or components, an sliding layer component and a separate and distinct fit system. In the present case, the foam or main body of the helmet, which can be embodied in energy absorbing shell 40, can float outside of the sliding layer fit system 70, suspended by deformable elastomer connections 120 or other suitable connections.

[0035] As shown in FIG. 1, the fit system 70, including the fit member 80 and sliding layer 100, can be disposed within the energy absorbing shell 40 with the outer surface 102 of the sliding layer oriented towards the inner surface 46 of the energy absorbing shell 40. In some instances, an interface between the outer surface 102 of the sliding layer oriented towards the inner surface 46 of the energy absorbing shell 40 can be spherical or substantially spherical in shape so as to facilitate the relative movement, or rotation of the energy absorbing shell 40 with respect to the sliding layer 100 and the head of the user. Additionally, although the term "spherical" is used with respect to the interface between the energy absorbing shell 40 and the sliding layer 100, it will be clear to one of ordinary skill in the art that the surfaces involved at the interface, including surfaces 46, 104 need not be full, complete spheres and that a portion of a spherical surface can be used to the extent the portion is needed. Thus, where "spherical" is used herein, the term can mean that the surface has a substantially consistent radius of curvature throughout the surface and in some embodiments to wherever the surface and layer extends, but at least for a majority of the extent of the surface. A substantially consistent radius of curvature means that the radius of curvature is between 70%-100% of a constant radius of curvature throughout the spherical surface, or within 30% of a radius of curvature of a majority of the spherical surface. In particular embodiments, the spherical surface can be a completely consistent radius of curvature, or within 5% of a constant radius of curvature. In other particular embodiments, the spherical surface can have portions similar in shape to a typical headform and other portions that have a substantially consistent radius of curvature throughout the portions of the spherical surface. The spherical surfaces, where used, may also be discontinuous and include gaps between sections of a spherical surface within a common spherical plane, or may be on different spherical planes.

[0036] FIGs. 6A-6D show various views of an elastomeric member or elastically deformable component 120 that can comprise a first end 122 configured or adapted to be coupled to the energy absorbing shell 40 and a second end 124 configured or adapted to be coupled to the sliding layer fit system 70, such as the attachment member 106 of the sliding layer 100. More specifically, FIG. 6A shows one elastomeric member 120 that can comprise or be formed of rubber, silicon, or other stretchable or elastically deformable material that is biased to return back to its original shape after being stretched. The elastomeric member 120 can comprise a first end 122 that can be coupled to the energy absorbing shell 40 with a pin 126, such as by having an opening or cut-out in the first end 122, into which the pin 126 can be disposed.

[0037] The pin 126 can be formed of plastic, metal, wood, fiber, or any other suitably strong and inexpensive material. The pin 126 can comprise any suitable or advantageous shape for remaining coupled, or directly attached, to the energy absorbing shell 40 and to the elastomeric member 120 during impacts of the helmet 30. As such, the pin 126 can remain coupled to the energy absorbing shell 40 while the elastomeric member 120 stretches and deforms, thereby allowing the sliding layer 100 to slip, slide, or move relative to the energy absorbing shell 40. As a non-limiting example, the pin 126 can comprise a shape that is elongate with a flat first end, and a rounded or ball shaped end on a second end opposite the first end.

[0038] The second end 124 of the elastomeric member 120 can be opposite the first end 122. The second end 124 can be shaped or formed to be mateably coupled, or directly attached, to one or more of the openings 106 in the sliding layer 100. The second end 124 can optionally comprise a hooked or bent end 124 that can be disposed within the opening 106 in the sliding layer 100. In other instances, the attachment member 106 of the sliding layer 100 can be a slot, clip, flange, hook, knob, protrusion, or other suitable physical structure to which the second end 124 of the elastomeric member 120 can be coupled. In other instances, the second end 124 can be chemically, thermally, or otherwise joined to the sliding layer 100, such as with another pin 126 or other intermediate structure or substance.

[0039] FIG. 6B shows a close-up view of a portion of the sliding layer 100, with the second end 124 of the elastomeric member 120 being inserted through one of the openings 106 in the sliding layer 100.

[0040] FIG. 6C shows a view of the sliding layer 100 and the elastomeric member 120 similar to that shown in FIG. 6B, but with the second end 124 of the elastomeric member 120 rotated and securely couple to the sliding layer 100, being seated within the re-entrant opening 106. By being securely seated, the elastomeric member 120 can can be pulled and placed in tension, elastically deform, and permit or facilitate rotational energy management by movement of the sliding layer 100 relative to the energy absorbing shell 40, the head of the user, or both, while still remaining securely attached to the sliding layer 100. Additionally, the second end 124 of the elastomeric member 120 can also be unseated or removed from the openings 106 in the sliding layer 100 by a user or individual, such as to remove or replace the elastomeric member 120.

[0041] FIG. 6D shows a larger perspective view showing all of the sliding layer fit system 70 from above the fit system 70. The sliding layer fit system 70 is shown with four elastomeric members 120 coupled to four corresponding openings 106 in the sliding layer 100, with second ends 124 of the elastomeric members 120 coupled to, or containing, pins 126 to be coupled to, or inserted within openings of, a portion of the helmet 30, such as openings in the energy absorbing shell 40.

[0042] FIG. 7A shows an elevational or side view of a rear or backside of the fit system member 80 coupled to the fit system arms 108a and 108b of the sliding layer 100. FIG. 7A additionally shows the helmet straps 60 coupled to, and threaded through, the fit system member 80 to be coupled to the energy absorbing shell 40. A rear portion 62 and a left portion 66 of the straps 60 is shown as a single piece of webbing being threaded through the left cradle wing 82c. Similarly, a rear portion 62 and a right portion 68 of the straps 60 is shown as a single piece of webbing being threaded through the right cradle wing 82c. The ends of the straps 60, both the front portions 64 and the rear portion 62, shown at the upper or top part of FIG. 7a can be coupled to the helmet 30.

[0043] FIG. 7B shows a side perspective view of an interior portion of the sliding layer fit system 70 disposed within the energy absorbing shell 40, with the straps 60 coupled to the helmet 30. FIG. 7B also shows comfort padding 130 coupled to the inner surface 104 of the sliding layer 100, and the comfort padding 130 also being disposed over the second ends 124 of the elastomeric members 120 and the attachment members 106 of the sliding layer 100. As such, the wearer or user of the helmet 30 can enjoy a comfortably fitting helmet 30 with the benefits of rotational impact energy management through the integrated sliding layer fit system 70 without any discomfort from the hidden or covered components of the system 70. Additionally, improved fit is also provided by having the sliding layer 100 and the sizing provided by the fit system member 80 integrated through the fit system arms 108. FIG. 7B also shows the rear 62 left 66 portion of the strap 60 threaded through the fit system member 80 at the rear or the helmet 40. Similarly, the front 64 left 66 portion of the strap 60 is shown attached to the helmet 30, such as by being coupled to the energy absorbing shell 40, by passing behind the sliding layer 100, such as between the outer surface 102 of the sliding layer 100 and the inner surface 46 of the energy absorbing shell 40.

[0044] FIGs. 8A and 8B show additional detail by providing views of the inside of the helmet 30, where the user's head will be disposed within the helmet 30 when the helmet 30 is worn by the user. FIG. 8 shows the comfort liner or fit liner 130 can optionally be disposed within, and coupled to the inner surface 104 of the Sliding layer 100, as well as to the inner surface 46 of the energy absorbing shell 40. The comfort liner 130 can be made of textiles, plastic, foam, polyester, nylon, or other suitable materials. The comfort liner 130 can be formed of one or more pads of material that can be joined together, or formed as discrete components, that can be coupled to the helmet 30, such as to the energy absorbing shell 40, the sliding layer 100, or both. The comfort liner 130 can be releasably or permanently attached to the helmet 30, with an attachment member, connector, or hook and loop fasteners 132. The attachment members 132 can also optionally comprise an adhesive, permanent adhesive, PSA, foam-core adhesive, tape, two-sided tape, mounting foam adhesive, fastener, clip, cleat, cutout, tab, snap, rivet, hog ring, or other interlocking surfaces, features, or portions. As such, the comfort liner 130 can provide a cushion and improved fit for the wearer of the helmet 30. When installed within the helmet 30, the comfort padding 130 can be disposed over the second ends 124 of the elastomeric member 120 and the attachment members 106 of the sliding layer 100 to prevent the head of the user from contacting the structures, which might create uncomfortable areas due to contact with the user's head.

[0045] FIG. 8B shows the helmet 30 can further comprise pad application zones 140 within the helmet 30, such as at an inner surface 46 of the energy absorbing shell 40. In some instances, the pad application zones 140 are locations at which the attachment members 134 can be positioned within the helmet, such as on the inner surface 46 of the energy absorbing shell 40, or on the inner surface 104 of the sliding layer 100. In other instances, the pad application zones 140 can comprise a location where a second sliding layer 100 is disposed between the outer surface 102 of the first sliding layer 100 and the inner surface 46 of the energy absorbing shell 40. When the second sliding layer 100 is present, the second sliding layer 100 can be coupled to the energy absorbing shell 40 with elastomeric members 120, or can be in-molded or integrally formed with the energy absorbing shell 40. In some instances, the second sliding layer 100 cold be formed as a coating applied to a portion of the helmet, such as energy absorbing shell 40, to help reduce friction between the sliding layer 100, and whatever it is in contact with. Additionally, the sliding layer 100 may itself have a low enough coefficient of friction together with whatever surface or surfaces it contacts that no additional layer, cover, or treatment is needed or desirable.

[0046] Conventional helmet systems with sliding layers have been limited to separate, discrete, or independent fit systems and sliding layers, such as to one or more of vacuum molded and trimmed sliding layers. The integrated sliding layer 100 and fit system 80 or integrated sliding layer fit system 70 described herein allows for the sliding layer 100 to be part of, and work seamlessly with, the fit system assembly 80. The integrated sliding layer and fit system 70 can provide improved comfort to the user through a better fit, as well as by simplifying a design of the helmet 30--by reducing a number of parts included within the helmet 30. In some instances, a better fit of the sliding layer 100 can also improve energy management performance by increasing rotation between the sliding layer 100 and the outer portion of the main helmet 30, such as energy absorbing layer 40, and decreasing rotation between the user's head and the sliding layer 100.

[0047] Thus, the integrated rotational impact attenuation and fit system 70 can comprise one or more sliding layers 100 that can be directly connected to, and interact with, a fit system member or fit system cradle 80 for sizing the helmet 30 to a head of the helmet wearer. In other words, the sliding layer 100 or portions thereof, such as the fit system arms 108, can be coupled to, or part of, the sizing of the helmet 30. Use of sliding layers 100 within a helmet 30 to assist in energy management, such as during collisions, can be achieved by facilitating rotational movement, and providing energy management through rotational movement within the helmet 30 and relative to the user's head. In addition to the rotational movement and energy management provided by the sliding layers 100, the helmet 30 can also facilitate other types of movement and energy management, such as translational movement, and as such, rotational energy management is included by way of example and not by limitation.

[0048] Where the above examples, embodiments and implementations reference examples, it should be understood by those of ordinary skill in the art that other helmet and manufacturing devices and examples could be intermixed or substituted with those provided. In places where the description above refers to particular embodiments of helmets and customization methods, it should be readily apparent that such components may be comprised of any shape, size, style, type, model, version, class, grade, measurement, concentration, material, weight, quantity, and / or the like consistent with the intended purpose, method and / or system of implementation and a number of modifications may be made without departing from the spirit thereof and that these embodiments and implementations may be applied to other to helmet customization technologies as well. Accordingly, the disclosed subject matter is intended to embrace all such alterations, modifications, and variations that fall within the spirit and scope of the disclosure and the knowledge of one of ordinary skill in the art, together with all changes that come within the meaning of, and range of equivalency of, the claims. The presently disclosed embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS

What is claimed is:

1. A helmet, comprising:

an energy absorbing shell comprising an outer surface and an inner surface opposite the outer surface;

a fit system member coupled to a rear of the energy absorbing shell and adjustable to fit the helmet for a user;

a sliding layer comprising an outer sliding layer surface oriented towards the inner surface of the energy absorbing shell and an inner sliding layer surface opposite the outer sliding layer surface, the sliding layer comprising at least one attachment member and at least one integrated fit system arm, wherein the at least one integrated fit system arm is coupled to the fit system member;

an elastomeric member comprising a first end coupled to the energy absorbing shell and a second end coupled to the at least one attachment member of the sliding layer; and

comfort padding coupled to the inner surface of the sliding layer.

2. The helmet of claim 1, wherein the comfort padding is disposed over the second end of the elastomeric member and the at least one attachment member of the sliding layer.

3. The helmet of claim 1, wherein:

the at least one attachment member of the sliding layer is formed as an opening in the sliding layer;

the second end of the elastomeric member is disposed within the opening in the sliding layer; and

the first end of the elastomeric member is coupled to the energy absorbing shell with a pin.

4. The helmet of claim 1, further comprising helmet straps coupled to the energy absorbing shell and threaded through the fit system member.

5. The helmet of claim 1, further comprising a second sliding layer disposed between the outer surface of the sliding layer and the outer surface of the energy absorbing shell.

6. The helmet of claim 1, wherein the sliding layer is injection molded.

7. The helmet of claim 1, wherein:

the fit system member is formed as a fit system cradle comprising a pinion; and

the at least one integrated fit system arm comprises a first fit system arm and a second fit system arm, the first fit system arm comprising teeth contacting a first side of the pinion and a the second fit system arm comprising teeth contacting a second side of the pinion.

8. A helmet, comprising:

an energy absorbing shell comprising an outer surface and an inner surface opposite the outer surface;

a fit system member disposed inward of the energy absorbing shell and adjustable to adjust a fit of the helmet;

a sliding layer comprising an outer sliding layer surface oriented towards the inner surface of the energy absorbing shell and an inner sliding layer surface opposite the outer surface, the sliding layer comprising an attachment member and at least one fit system arm, wherein the at least one fit system arm is coupled to the fit system member; and

an elastomeric member comprising a first end coupled to the energy absorbing shell and a second end coupled to the attachment member of the sliding layer.

9. The helmet of claim 8, wherein:

the attachment member of the sliding layer is formed as an opening in the sliding layer;

the second end of the elastomeric member is disposed within the opening in the sliding layer; and

the first end of the elastomeric member is coupled to the energy absorbing shell.

10. The helmet of claim 8, further comprising helmet straps coupled to the energy absorbing shell and threaded through the fit system member.

11. The helmet of claim 8, further comprising a second sliding layer disposed between the outer surface of the sliding layer and the outer surface of the energy absorbing shell.

12. The helmet of claim 8, wherein the sliding layer is injection molded.

13. The helmet of claim 1, wherein:

the fit system member is formed as a fit system cradle comprising a pinion; and

the at least one integrated fit system arm comprises a first fit system arm and a second fit system arm, the first fit system arm comprising teeth contacting a first side of the pinion and a the second fit system arm comprising teeth contacting a second side of the pinion.

14. The helmet of claim 8, wherein the fit system cradle is coupled to the energy absorbing shell with a pin.

15. A helmet, comprising:

an energy absorbing shell comprising an outer surface and an inner surface opposite the outer surface;

a fit system member disposed inward of the energy absorbing shell;

a sliding layer comprising at least one fit system arm coupled to the fit system member; and

an elastomeric member coupled to the energy absorbing shell and the sliding layer.

16. The helmet of claim 15, further comprising the comfort padding disposed over where the elastomeric member is coupled to the sliding layer.

17. The helmet of claim 15, wherein:

the sliding layer comprises an opening disposed in the sliding layer;

the elastomeric member comprises a second end disposed within the opening in the sliding layer; and the elastomeric member comprises a first end coupled to the energy absorbing shell with a pin.

18. The helmet of claim 15, further comprising a second sliding layer disposed between the outer surface of the sliding layer and the outer surface of the energy absorbing shell.

19. The helmet of claim 15, wherein:

the fit system member is formed as a fit system cradle comprising a pinion; and

the at least one integrated fit system arm comprises a first fit system arm and a second fit system arm, the first fit system arm comprising teeth contacting a first side of the pinion and a the second fit system arm comprising teeth contacting a second side of the pinion.

20. The helmet of claim 15, wherein the sliding layer is formed with injection molding.

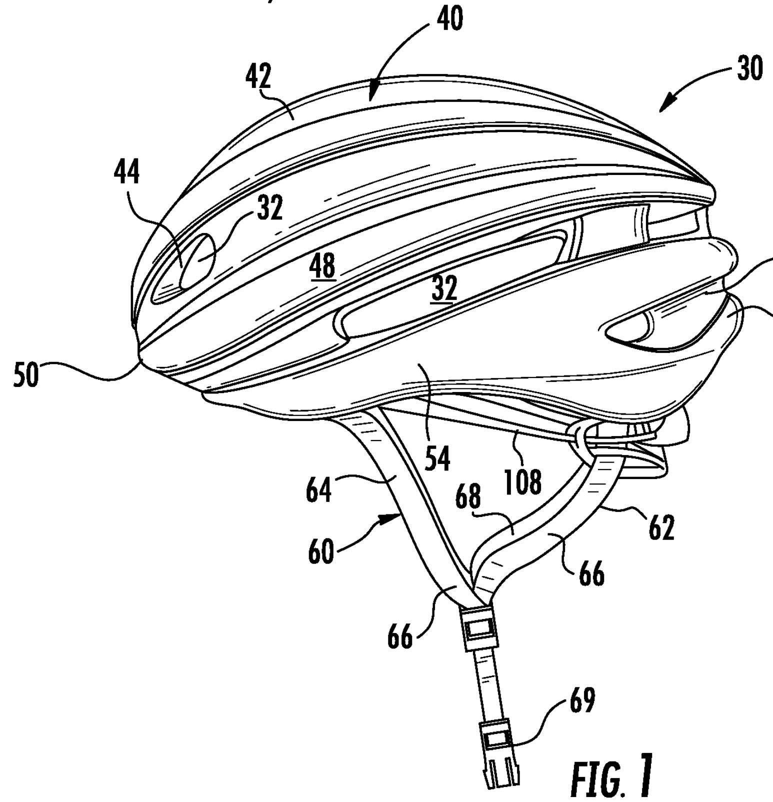
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FIG. 1

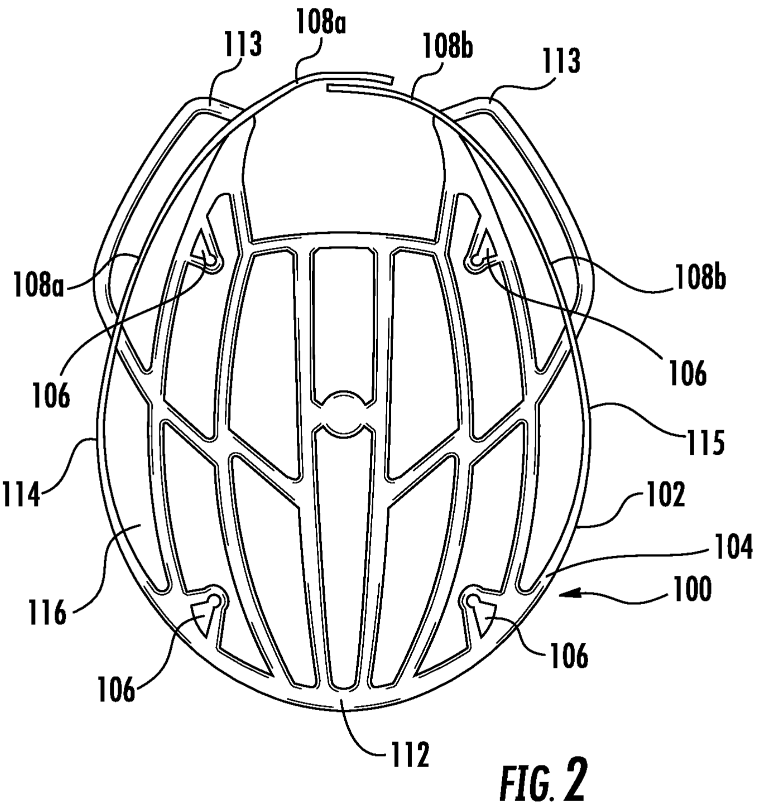
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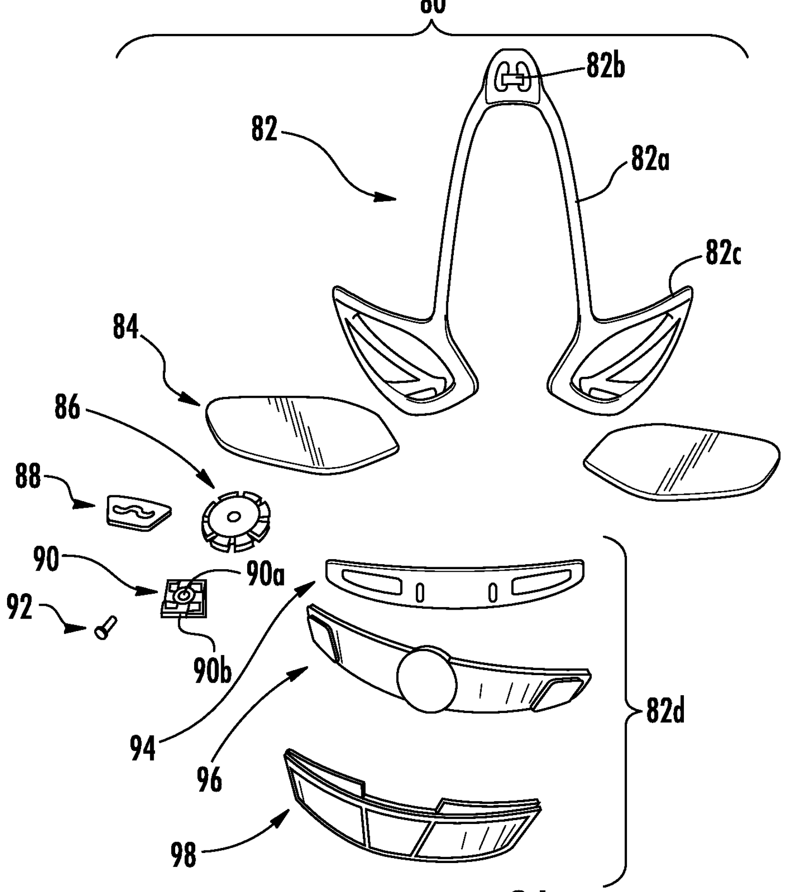
FIG. 2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82d
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FIG. 3A

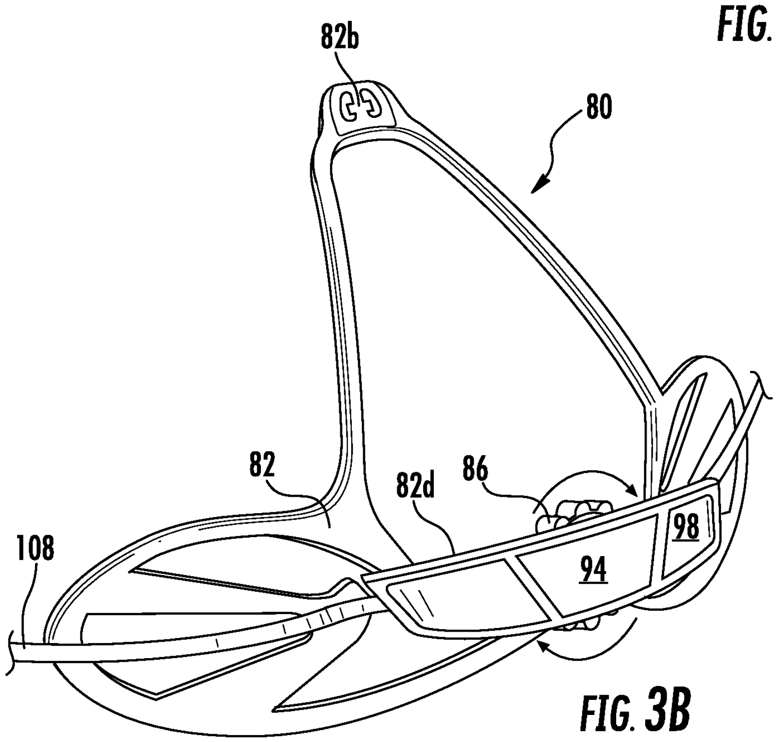
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FIG. 3B

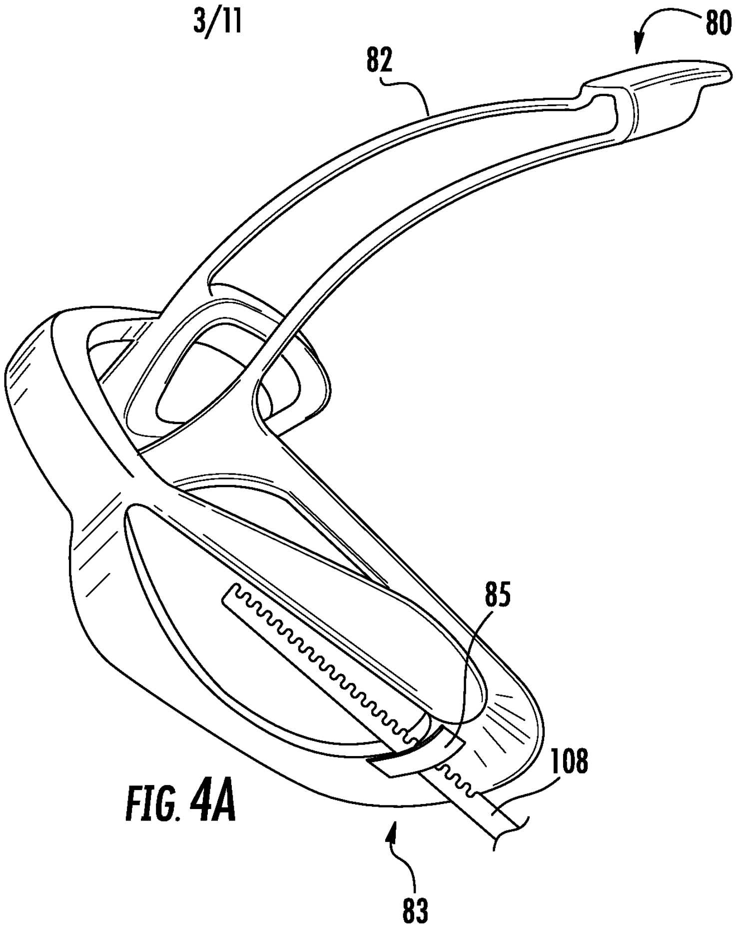

FIG. 4A

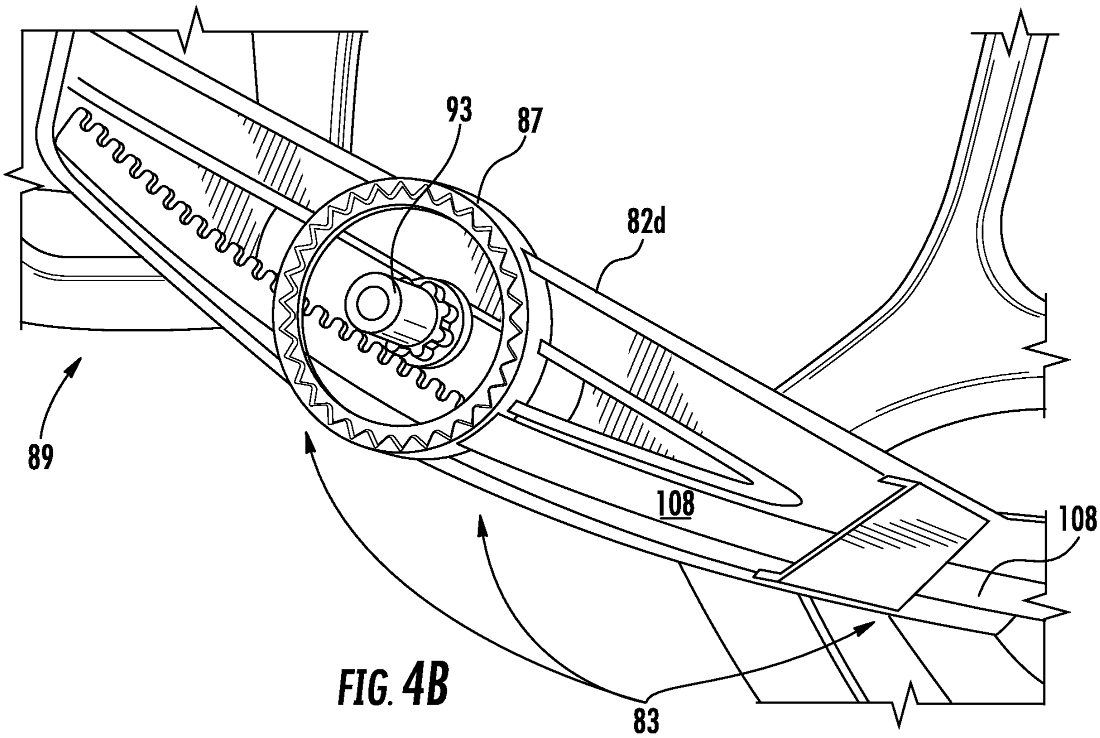

FIG. 4B

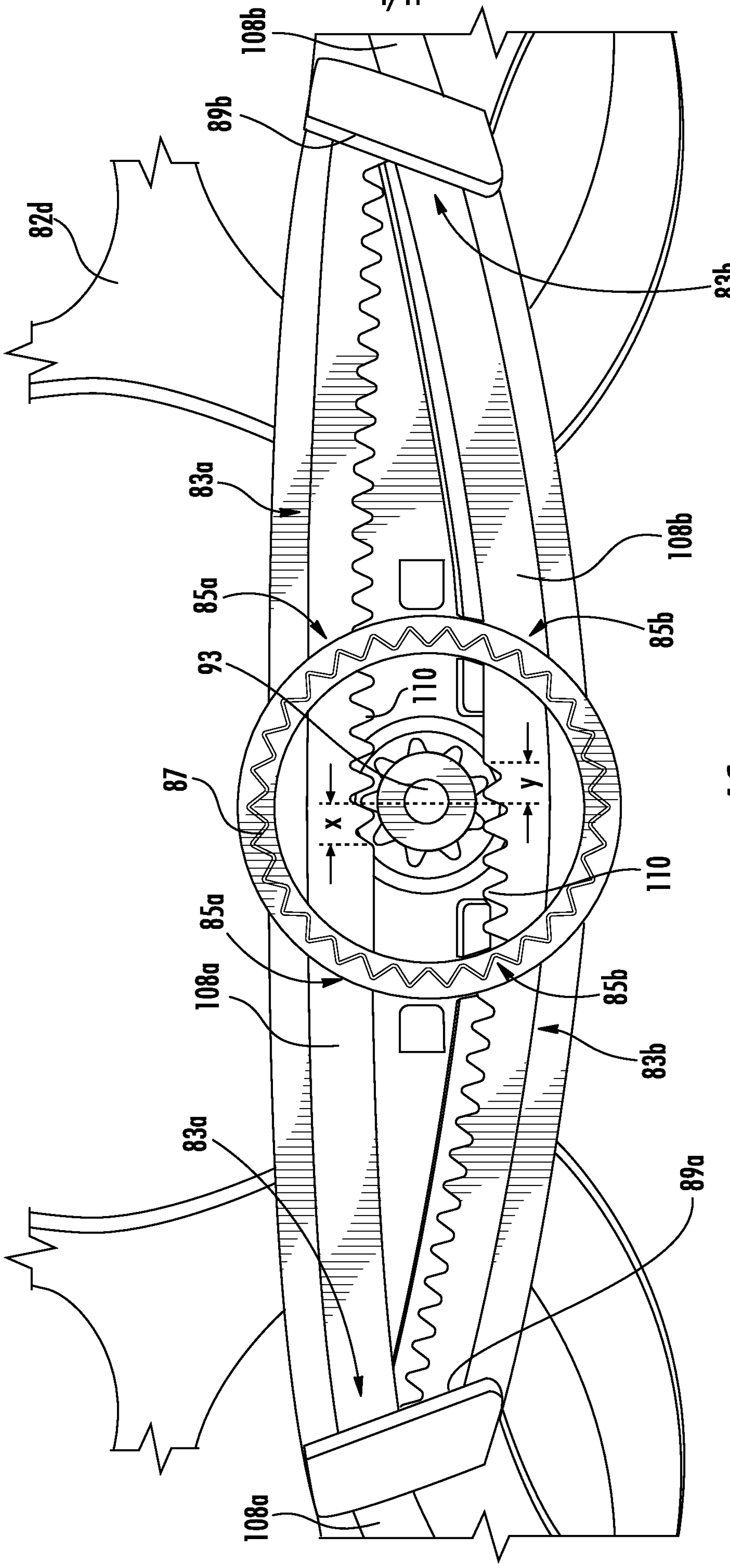
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FIG. 4C

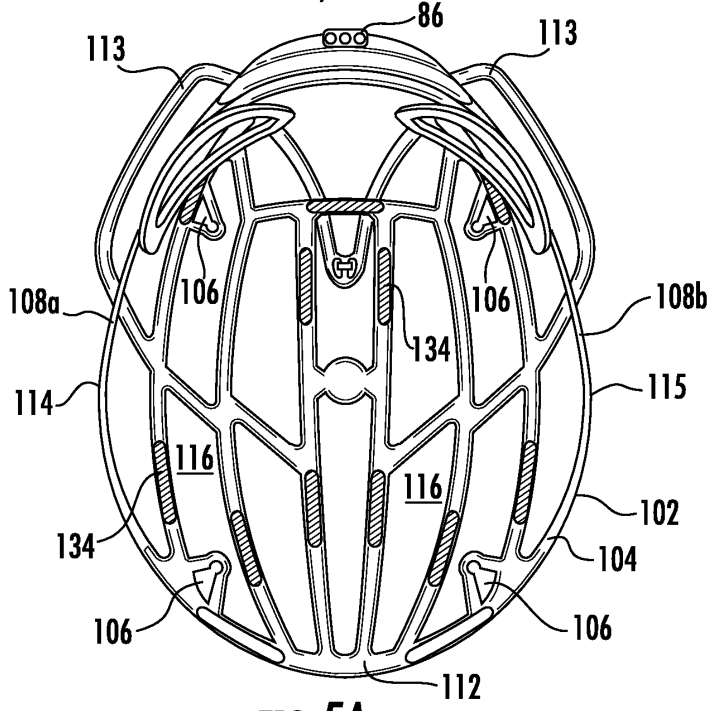
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FIG. 5A

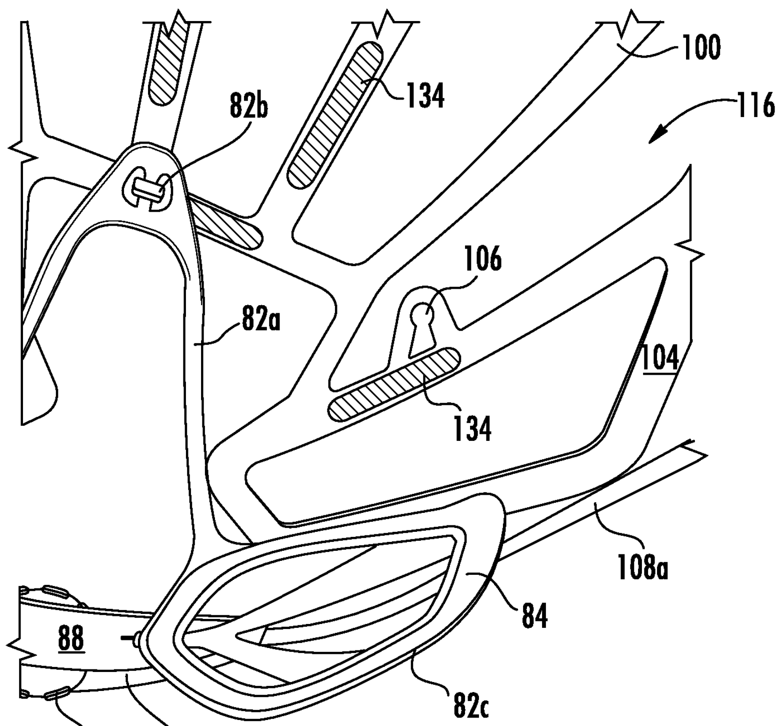
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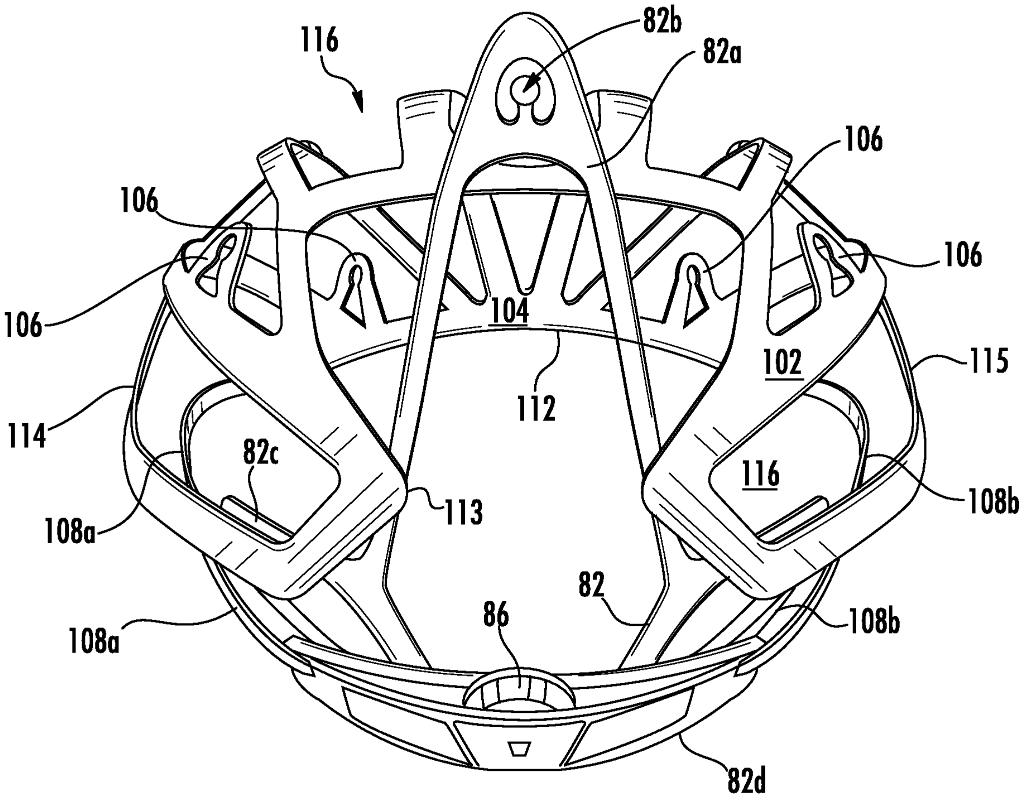
FIG. 5B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82d

FIG. 5C

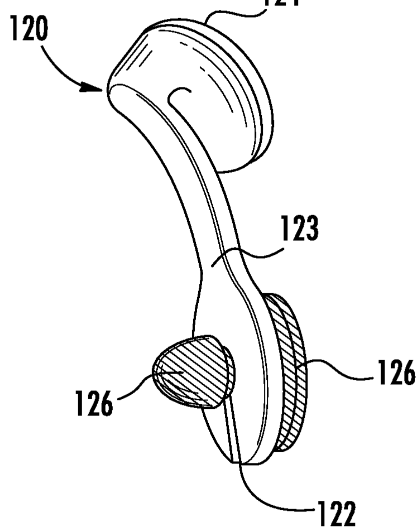
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FIG. 6A

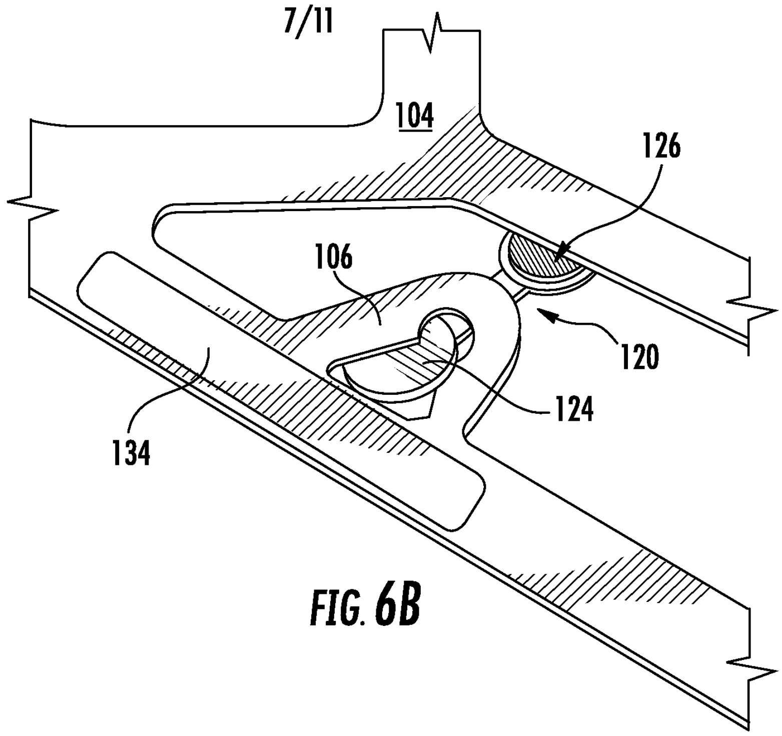

FIG. 6B

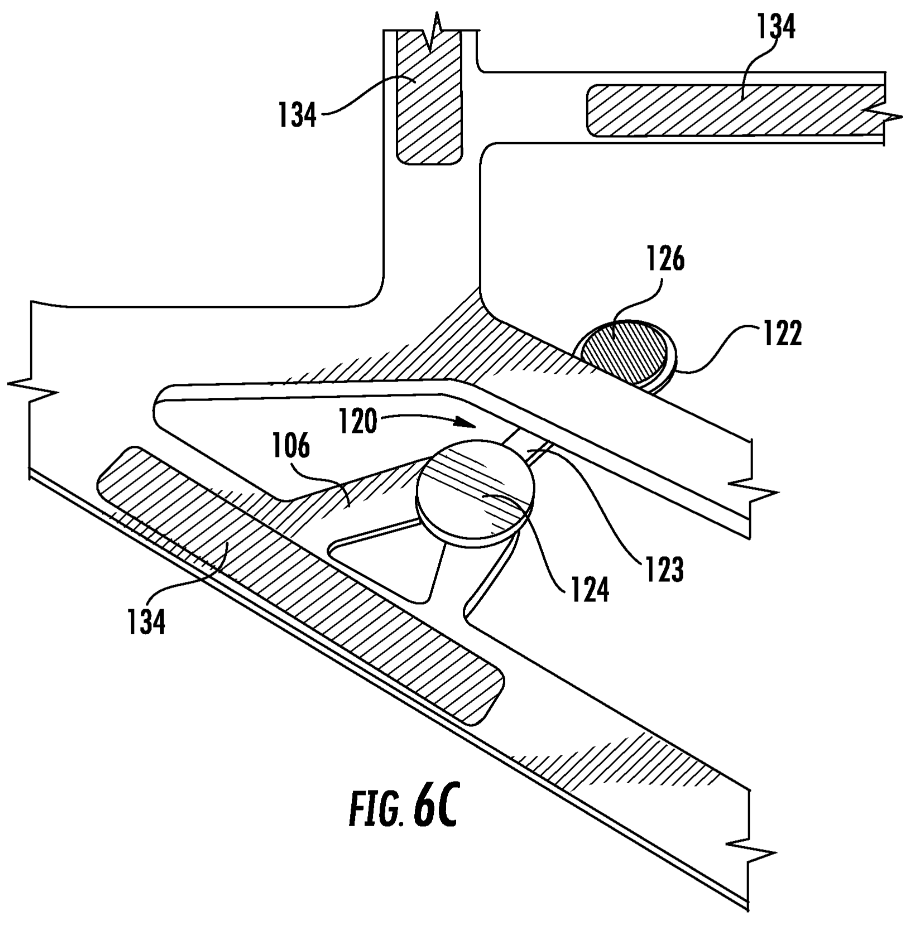

FIG. 6C

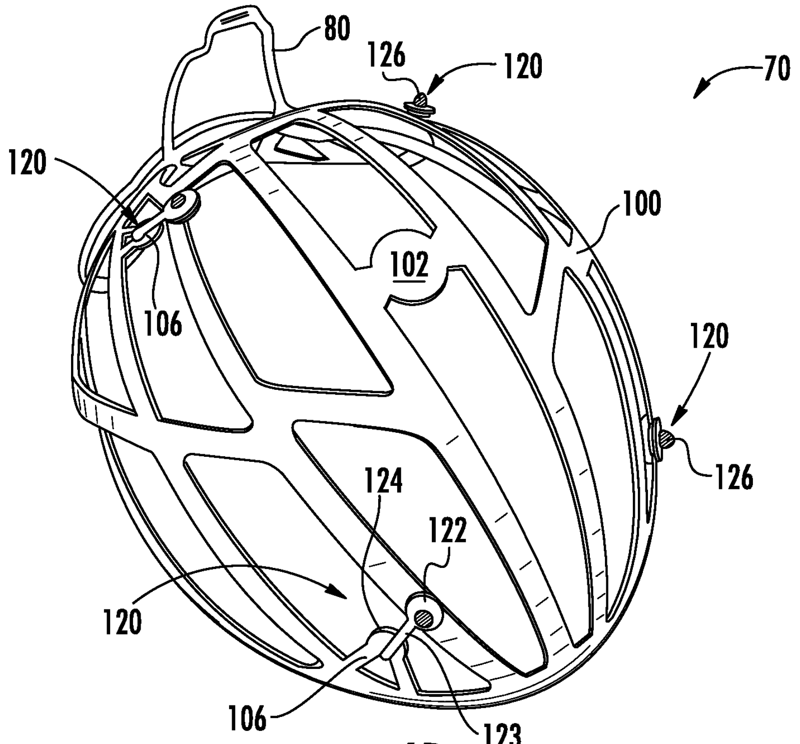

FIG. 6D

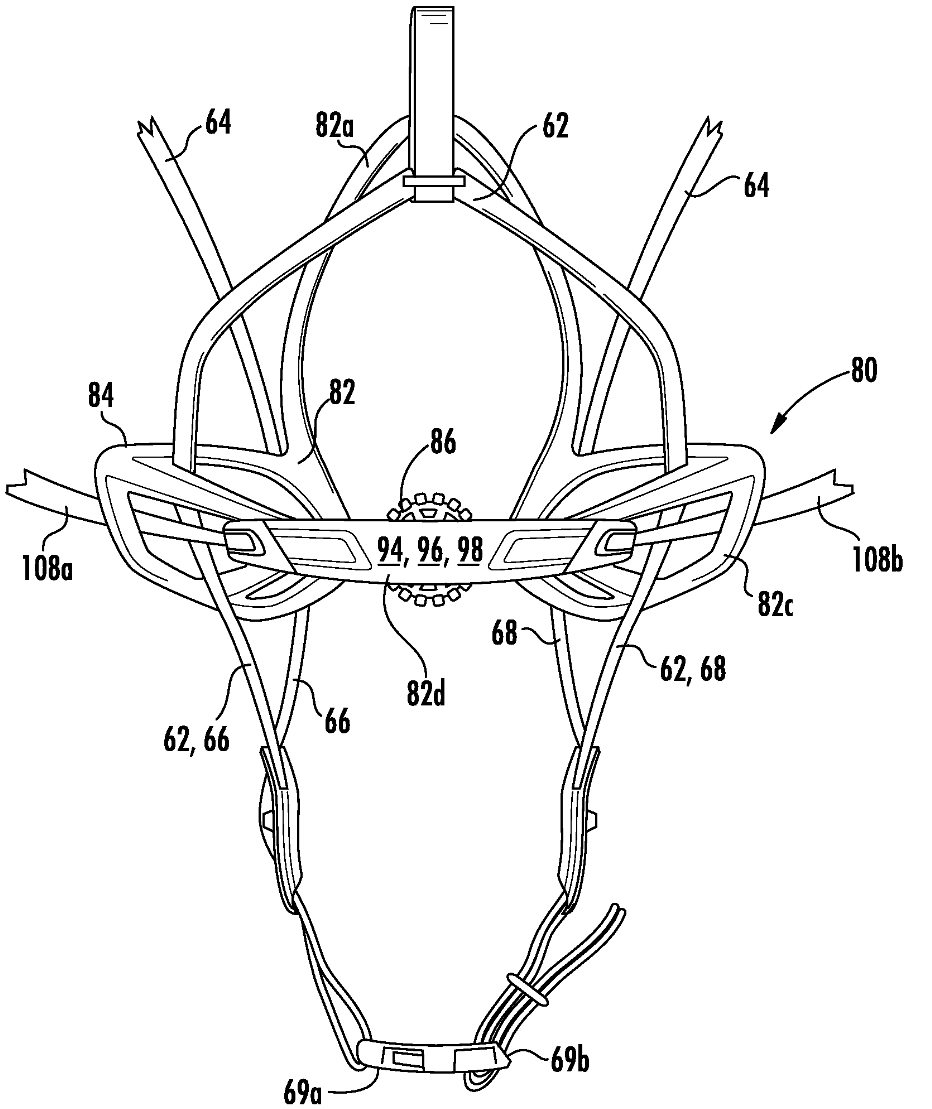
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FIG. 7A

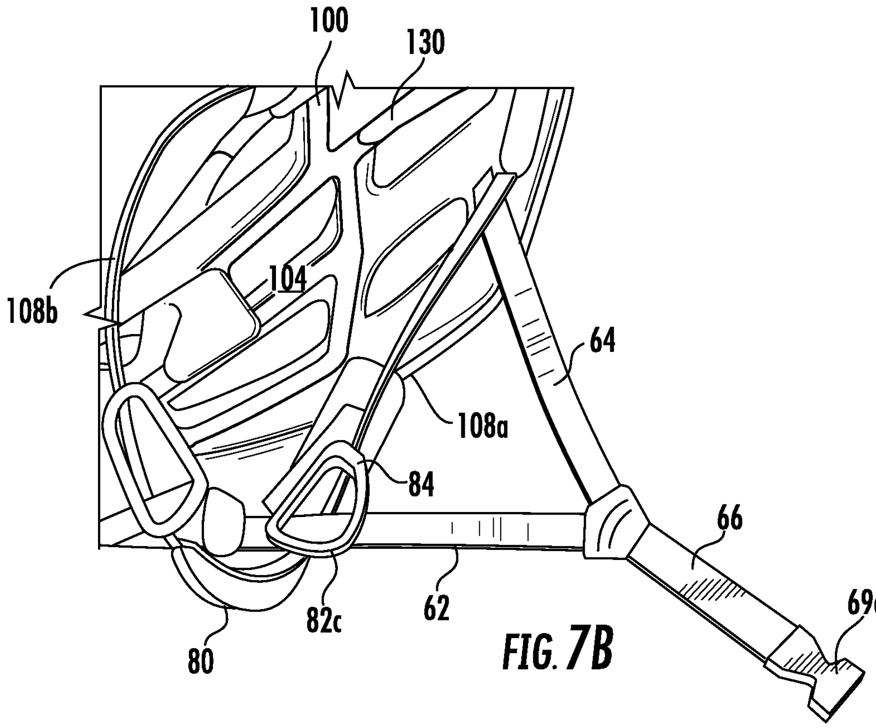
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FIG. 7B

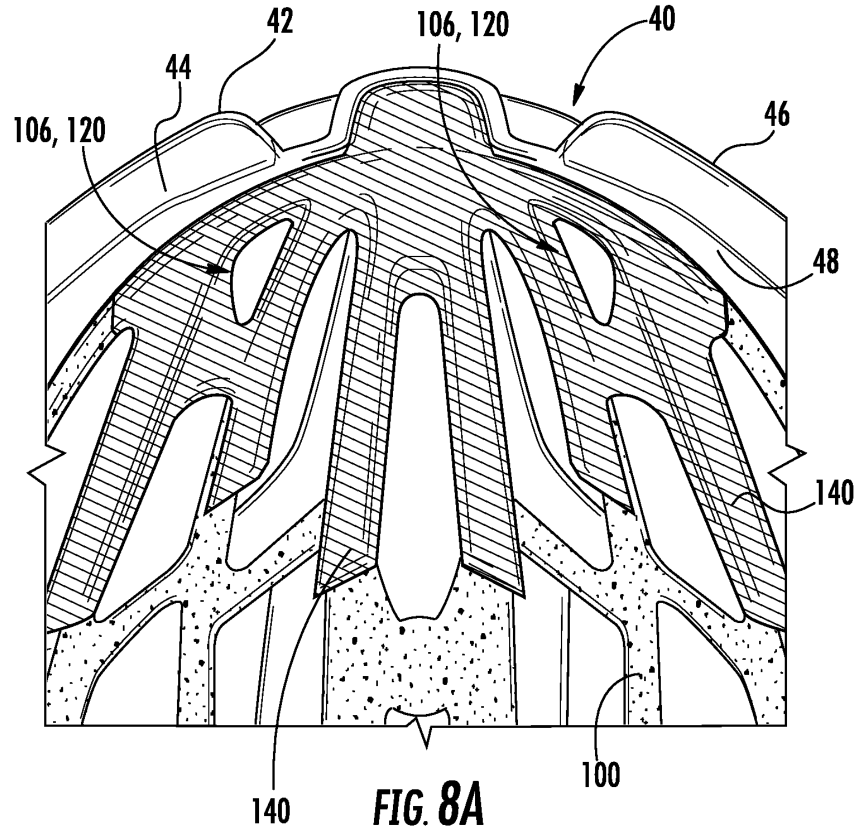
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FIG. 8A

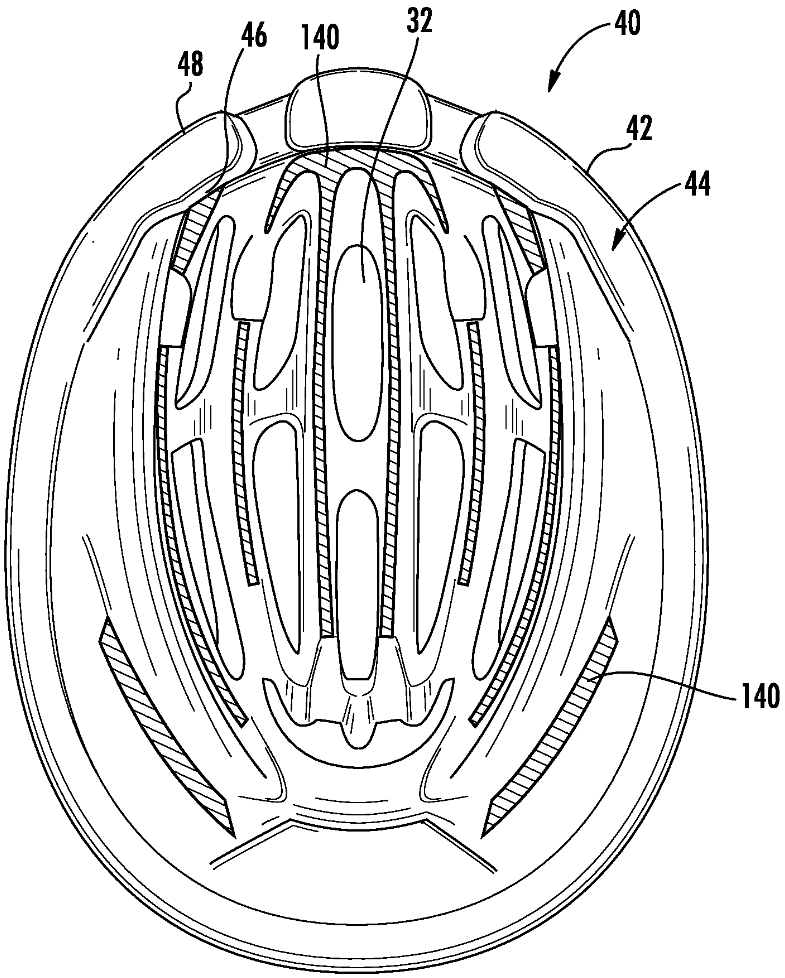

FIG. 8B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2016/069556

A. CLASSIFICATION OF SUBJECT MATTER

A42B 3/00 *(2006.01)*
A42B 3/04 *(2006.01)*
A42B 3/06 *(2006.01)*

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A42B 3/00, 3/04, 3/06, 3/10

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

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

PatSearch (RUPTO internal), Espacenet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015/0089724 A1 (BRET BERRY) 02.04.2015, fig. 1-3, paragraphs [0048] – [0051]	1-20
Y	EA 201300111 A1 (PFANNER ANTON) 28.06.2013, fig. 1, 2, 6, 9, p. 6, line 7 – p. 8, line 16	1-20
Y	US 2016/0044983 A1 (BRAINGUARD TECHNOLOGIES, INC.) 18.02.2016, fig. 5, 6, paragraphs [0054] - [0060]	5, 11, 18
Y	US 2014/0033405 A1 (ARTISENT, LLC) 06.02.2014, fig. 1-3, paragraphs [0037], [0038], [0042]	7,13, 14, 19

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

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier document but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 May 2017 (10.05.2017)	25 May 2017 (25.05.2017)

Name and mailing address of the ISA/RU:	Authorized officer
Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	P. Bystrov Telephone No. (495)531-64-81

Form PCT/ISA/210 (second sheet) (January 2015)