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(54) **SAFETY HELMET CAPABLE OF ABSORBING MULTI-DIRECTION IMPACT**

(57) A safety helmet includes a shell (20), a flexible frame (30) attached to the shell from inside, and a slide-facilitating member (40) attached to the flexible frame from inside. In virtue of the slide-facilitating member, the shell when receiving incoming impact can slide with respect to a head of a user wearing it, so that the safety helmet can absorb and convert energy of the incoming impact force into other forms of energy, thereby enhancing protection to the user's head.

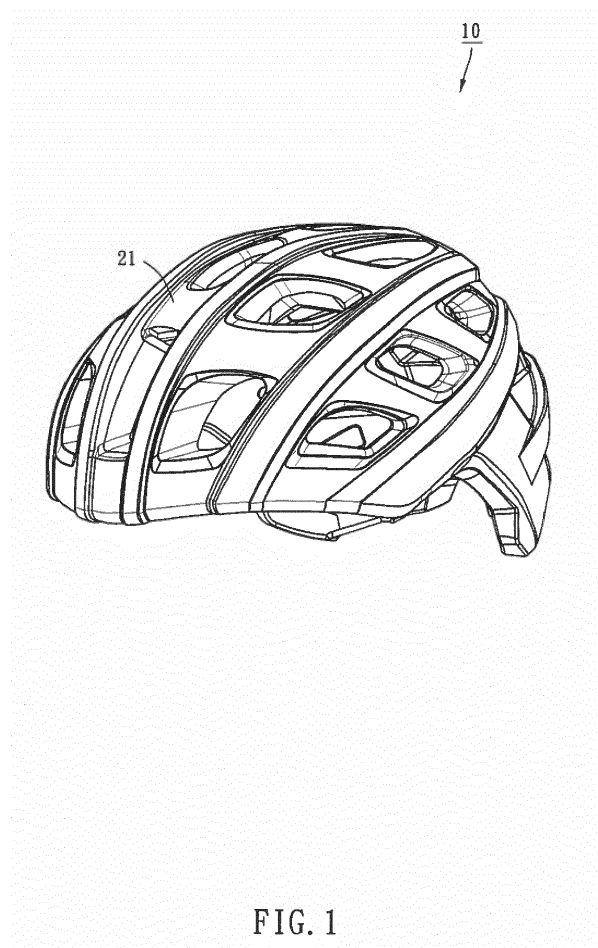


FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The present invention relates to safety helmets, and more particularly to a safety helmet that absorbs impact from multiple directions.

2. Description of Related Art

[0002] Most existing safety helmets are formed by a rigid casing and a buffer layer filled under the rigidity casing. When impact acts on such a known safety helmet, the rigidity casing first bears a part of the impact energy, and the buffer layer later absorbs a part of the energy. The remaining energy has to be borne by the user's head and cervical vertebra. For safety helmets, incoming impact can be divided into three types, namely radial impact, tangential impact, and diagonal impact. Radial impact can cause linear acceleration of a user's head that may lead to skull fracture and/or traumatic brain injury. Tangential impact can cause angular acceleration of a user's head that may bring about shear-based injury to brain and/or cervical vertebra. However, according to statistics, there have been seldom cases about pure radial or tangential impact. The most common type of injury is damage caused by diagonal impact, which is a combination of the two foregoing types of impact. When being subject to diagonal impact, a human head can have linear acceleration and slew acceleration at the same time, making it more vulnerable to grievous injury, such as cerebral concussion, traumatic brain injury (TBI), subdural hematoma (SDH) and diffuse axonal injury (DAI).

[0003] For ensuring protective capability of safety helmets, the relevant manufactures usually test their helmet products for impact absorption before shipment. Nevertheless, since these tests are usually designed for radial impact, the existing safety helmets may be good at absorbing radial impact, but are likely to fail to protect their user from impact acting in different directions (especially diagonal impact).

BRIEF SUMMARY OF THE INVENTION

[0004] The primary objective of the present invention is to provide a safety helmet that absorbs multi-direction and thereby provides improved protection to its user's head.

[0005] To achieve the foregoing objective, the disclosed safety helmet comprises a shell, a flexible frame, and a slide-facilitating member. The flexible frame is attached to the inner surface of the shell, and the slide-facilitating member is attached to the inner surface of the flexible frame. Therein, the flexible frame supports the shell, while retaining the slide-facilitating member, so that the slide-facilitating member can fittingly and comfortably

embrace a user's head. The slide-facilitating member facilitates slide of the shell. Thereby, when the shell receives incoming impact, especially diagonal impact, the slide-facilitating member allows the shell to slide with respect to the user's head. In this way, the impact force otherwise acting on the user's head can be absorbed and converted into other forms of energy, thereby providing better protection to the user's head.

[0006] Preferably, the foregoing slide-facilitating member has a slide-facilitating medium. The slide-facilitating medium may be realized in various aspects. For example, the slide-facilitating medium may be a fluid such as gas or liquid. Alternatively, it may be a plurality of freely rolling beads. Alternatively, the slide-facilitating medium may be two aligned substrates that abut against each other with a low-friction surface so as to have relative displacement therebetween. Alternatively, the slide-facilitating medium may be two aligned magnets facing each other with magnetic poles having the same polarity, so that the two magnets can easily have relative displacement due to magnetic repulsion. Alternatively, the slide-facilitating medium may be two aligned substrates and a plurality of flexible threads arranged therebetween. These flexible threads allow the two substrates to perform relative displacement. Alternatively, the slide-facilitating medium may be a plate made of a viscoelastic material. The plate has a plurality of recesses and a plurality of tongues, which are arranged next to each other alternately, so that the plate can use its own elasticity to allow such slide. Alternatively, the slide-facilitating medium has a substrate and a plurality of flexible bars connected to the substrates. The flexible bars have deforming property that allows such slide.

[0007] More information about the configuration, features, fabrication and uses of the safety helmet of the present invention will be provided in the following description in detail. However, people skilled in the art shall appreciate that the detailed description and embodiments as well as aspects are for illustration only, and by no means intended to limit the scope of the present invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0008]

FIG. 1 is a perspective view of a safety helmet of the present invention.

FIG. 2 is an exploded view of the disclosed safety helmet.

FIG. 3 is a cross-sectional applied view of the disclosed safety helmet.

FIG. 4, similar to FIG. 3, shows the shell receiving impact.

FIGs. 5a~5g illustrate different aspects of the slide-facilitating medium of the disclosed safety helmet.

DETAILED DESCRIPTION OF THE INVENTION

[0009] This is to be first emphasized herein that like elements or features will be identified by identical numbers throughout all figures.

[0010] Referring to FIGs. 1 and 2, a safety helmet 10 of the present invention comprises a shell 20, a flexible frame 30, and a slide-facilitating member 40.

[0011] The shell 20 has a casing 21 and a buffer layer 22. The buffer layer 22 is adhered to the inner surface of the casing 21 using an adhesive. The casing 21 is made of a rigid material, such as hard plastic, and serves to provide first-line protection. The buffer layer 22 is made of a shock-absorbing material, such as foam, for damping shock and buffering.

[0012] The flexible frame 30 is made of an elastic material, such as elastic plastic. As shown in FIG. 2, the flexible frame 30 has two symmetrical top ribs 32 and a side rib 34. The two top ribs 32 each have one end integrally connected to the front end of the side rib 34, and the rear end of the side rib 34 is provided with an adjuster 36, which can be used to adjust the circumference of the side rib 34 so that the side rib 34 can fittingly wrap different sizes of users' heads. Furthermore, the top ribs 32 and the side rib 34 are each detachably attached to the inner surface of the buffer layer 22 of the shell 20 inner surface through a fastener (not shown) such as a Velcro tape. Moreover, as shown in FIG. 3, the top ribs 32 and the side rib 34 may each have its outer surface provided with a plurality of tenons 38, so that in addition to the adhesion of the fasteners to the inner surface of the buffer layer 22 of the shell 20, these tenons 38 can engage with mortises 23 correspondingly arranged on the buffer layer 22 to enhance the combination between the flexible frame 30 and the shell 20 while allowing easy detachment of the flexible frame 30 for convenient adjustment.

[0013] The slide-facilitating member 40 has a covering 41, which is made of a low-friction material, such as flannel. The covering 41 has one side adhered to the inner surface of the flexible frame 30 through fasteners (not shown) such as velcro tapes, so that the slide-facilitating member 40 can be retained by the flexible frame 30 to have the reverse side of the covering 41 contact a user's head 12 directly. In this way, the covering 41 can be easily detached for convenient cleaning when staining. The slide-facilitating member 40 further has a slide-facilitating medium 42 wrapped by the covering 41. In the present embodiment, the slide-facilitating medium 42 has two aligned substrates 43 and a plurality of flexible threads 44. The two substrates 43 are fixed to the covering 41 by means of an adhesive. The flexible threads 44 are arranged between the two substrates 43 regularly or irregularly. With the presence of these flexible threads 44, the two substrates 43 can perform relative displacement easily. It is to be also noted that, the slide-facilitating member 40 shown in FIG. 2 contains two units, one corresponding to head top and the other embracing the head peripherally. However, in practice, the two units may be

integrated into a unity, or alternatively be divided into three or more units, depending on practical needs.

[0014] With the foregoing configuration, when the shell 20 is subject to incoming impact, the casing 21 of the shell 20 bears part of the energy, and the buffer layer 22 of the shell 20 absorbs a part of energy. Then when the remaining energy is transmitted to the slide-facilitating member 40, as shown in FIGs. 3 and 4, the slide-facilitating member 40 has the slide-facilitating medium 42 allow the shell 20 to slide with respect to the head 12, so that the impact force reaching the slide-facilitating member 40 is converted into potential energy generated by the relative displacement. The slide-facilitating member 40 can even slide with respect to the head 12 due to the low friction of the covering 41, so that the impact force reaching the slide-facilitating member 40 can be further converted into thermal energy generated by mutual friction. This makes the user's head 12 and cervical vertebra only have to bear the last remaining energy. In other words, when the disclosed safety helmet 10 is subject to incoming impact, it uses the deformation of the shell 20 itself, the relative slide between the shell 20 and the head 12, and the friction between the covering 41 and the head 12 to multiply absorb and convert the impact force otherwise directly acting on the head 12 into other forms of energy, so as to reliably protect the head 12 from impact coming in multiple directions, especially diagonal impact.

[0015] It is further to be noted that the slide-facilitating medium 42 may be embodied in various forms. For example, as shown in FIGs. 5a-5b, the slide-facilitating medium 42 is a fluid such as air or colloid, which uses its deforming property to allow the shell 20 to slide. Alternatively, as shown in FIG. 5c, the slide-facilitating medium 42 is composed of a plurality of rolling beads 46. These rolling beads 46 use their arbitrary rolling to slide the shell 20. Alternatively, as shown in FIG. 5d, the slide-facilitating medium 42 is composed of two aligned substrates 48 each having a low-friction surface 50. The low-friction surfaces 50 of the two substrates 48 abut against each other so that the two substrates 48 can move with respect to each other easily and in turn allow the shell 20 to slide. Further, the two substrate 48 may be made of a low-friction material such as Polyoxymethylene (POM), Aramid, plastic with chemical lubricants, Polyimide (PI), ultra-high molecular weight polyethylene (UHMWPE), or the like. Alternatively, as shown in FIG. 5e, the slide-facilitating medium 42 is in the form of two aligned magnets 52, which face each other with the magnetic poles 54 having the same polarity (not limited to the N pole or the S pole), so that the two magnets 52 can perform relative displacement easily in virtue of magnetic repulsion, thereby facilitating slide of the shell 20. Alternatively, as shown in FIG. 5f, the slide-facilitating medium 42 is a plate made of a viscoelastic material and having a plurality of recesses 56 and a plurality of tongues 58, these recesses and tongues 56, 58 are arranged next to each other alternately, so that when the slide-facilitating medium 42 performs elastic deformation under an external

force, slide of the shell 20 is achieved. At last, alternatively, as shown in FIG. 5g, the slide-facilitating medium 42 has a substrate 60 and a plurality of flexible bars 62 connected to the substrate 60, so that the elasticity of the flexible bars 62 allows the shell 20 to slide.

Claims

1. A safety helmet, comprising:

a shell (20);
a flexible frame (30), being attached to an inner surface of the shell (20); and
a slide-facilitating member (40), being attached to an inner surface of the flexible frame (30), and serving to allow the shell (20) to slide with respect to a user head wearing it when the shell (20) receives incoming impact.

2. The safety helmet of claim 1, wherein the slide-facilitating member (40) has a covering (41) and a slide-facilitating medium (42), in which the covering (41) is attached to the inner surface of the flexible frame (30) and the slide-facilitating medium (42) is wrapped by the covering (41).

3. The safety helmet of claim 2, wherein the slide-facilitating medium (42) is a fluid.

4. The safety helmet of claim 2, wherein the slide-facilitating medium (42) comprises a plurality of rolling beads (46).

5. The safety helmet of claim 2, wherein the slide-facilitating medium (42) has two aligned substrates (48) each having a low-friction surface (50), and the low-friction surfaces (50) of the two substrates (48) abut against each other.

6. The safety helmet of claim 2, wherein the slide-facilitating medium (42) comprises two aligned magnets (52), which faces each other with magnetic poles (54) having the same polarity.

7. The safety helmet of claim 2, wherein the slide-facilitating medium (42) has two aligned substrates (43) and a plurality of flexible threads (44) arranged between the two substrates (43).

8. The safety helmet of claim 2, wherein the slide-facilitating medium (42) is a plate made of a viscoelastic material and having a plurality of recesses (56) and a plurality of tongues (58), in which the recesses (56) and the tongues (58) are arranged next to each other alternately.

9. The safety helmet of claim 2, wherein the slide-facilitating

medium (42) has a substrate (60) and a plurality of flexible bars (62) connected to the substrate (60).

10. The safety helmet of any of claims 1 through 9, wherein the shell (20) has a casing (21) and a buffer layer (22), in which the buffer layer (22) has an outer surface thereof attached to the inner face of the casing (21), and the flexible frame (30) is attached to an inner surface of the buffer layer (22), and is also detachable.

11. The safety helmet of claim 10, wherein the flexible frame (30) is attached to the inner surface of the buffer layer (22) through a fastener.

12. The safety helmet of claim 11, wherein the flexible frame (30) has two symmetrical top ribs (32) and a side rib (34), in which the two top ribs (32) each have a front end thereof integrally connected to a front end of the side rib (34), and the side rib (34) has a rear end thereof provided with an adjuster (36) that is used to adjust a circumference defined by the side rib (34).

13. The safety helmet of claim 10, wherein the inner surface of the buffer layer (22) has a plurality of mortise (23) and an outer surface of the flexible frame (30) has a plurality of tenons (38), so that the tenons (38) of the flexible frame (30) engage with the mortises (23) of the buffer layer (22), respectively.

14. The safety helmet of claim 13, wherein the flexible frame (30) has two symmetrical top ribs (32) and a side rib (34), in which the two top ribs (32) each have a front end thereof integrally connected to a front end of the side rib (34), and the side rib (34) has a rear end thereof provided with an adjuster (36) that is used to adjust a circumference defined by the side rib (34).

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

1. A safety helmet, comprising:

a shell (20);
a flexible frame (30), being attached to an inner surface of the shell (20); and
a slide-facilitating member (40), being attached to an inner surface of the flexible frame (30), and serving to allow the shell (20) to slide with respect to a user head wearing it when the shell (20) receives incoming impact;
characterized in that
the slide-facilitating member (40) has a covering (41) and a slide-facilitating medium (42), in

which the covering (41) is attached to the inner surface of the flexible frame (30) and the slide-facilitating medium (42) is wrapped by the covering (41).

2. The safety helmet of claim 1, wherein the slide-facilitating medium (42) is a fluid. 5
3. The safety helmet of claim 1, wherein the slide-facilitating medium (42) comprises a plurality of rolling beads (46). 10
4. The safety helmet of claim 1, wherein the slide-facilitating medium (42) has two aligned substrates (48) each having a low-friction surface (50), and the low-friction surfaces (50) of the two substrates (48) abut against each other. 15
5. The safety helmet of claim 1, wherein the slide-facilitating medium (42) comprises two aligned magnets (52), which faces each other with magnetic poles (54) having the same polarity. 20
6. The safety helmet of claim 1, wherein the slide-facilitating medium (42) has two aligned substrates (43) and a plurality of flexible threads (44) arranged between the two substrates (43). 25
7. The safety helmet of claim 1, wherein the slide-facilitating medium (42) is a plate made of a viscoelastic material and having a plurality of recesses (56) and a plurality of tongues (58), in which the recesses (56) and the tongues (58) are arranged next to each other alternately. 30
8. The safety helmet of claim 1, wherein the slide-facilitating medium (42) has a substrate (60) and a plurality of flexible bars (62) connected to the substrate (60). 35
9. The safety helmet of any of claims 1 through 8, wherein the shell (20) has a casing (21) and a buffer layer (22), in which the buffer layer (22) has an outer surface thereof attached to the inner face of the casing (21), and the flexible frame (30) is attached to an inner surface of the buffer layer (22), and is also detachable. 40
10. The safety helmet of claim 9, wherein the flexible frame (30) is attached to the inner surface of the buffer layer (22) through a fastener. 45
11. The safety helmet of claim 10, wherein the flexible frame (30) has two symmetrical top ribs (32) and a side rib (34), in which the two top ribs (32) each have a front end thereof integrally connected to a front end of the side rib (34), and the side rib (34) has a rear end thereof provided with an adjuster (36) that 50

is used to adjust a circumference defined by the side rib (34).

12. The safety helmet of claim 9, wherein the inner surface of the buffer layer (22) has a plurality of mortise (23) and an outer surface of the flexible frame (30) has a plurality of tenons (38), so that the tenons (38) of the flexible frame (30) engage with the mortises (23) of the buffer layer (22), respectively. 55
13. The safety helmet of claim 12, wherein the flexible frame (30) has two symmetrical top ribs (32) and a side rib (34), in which the two top ribs (32) each have a front end thereof integrally connected to a front end of the side rib (34), and the side rib (34) has a rear end thereof provided with an adjuster (36) that is used to adjust a circumference defined by the side rib (34).

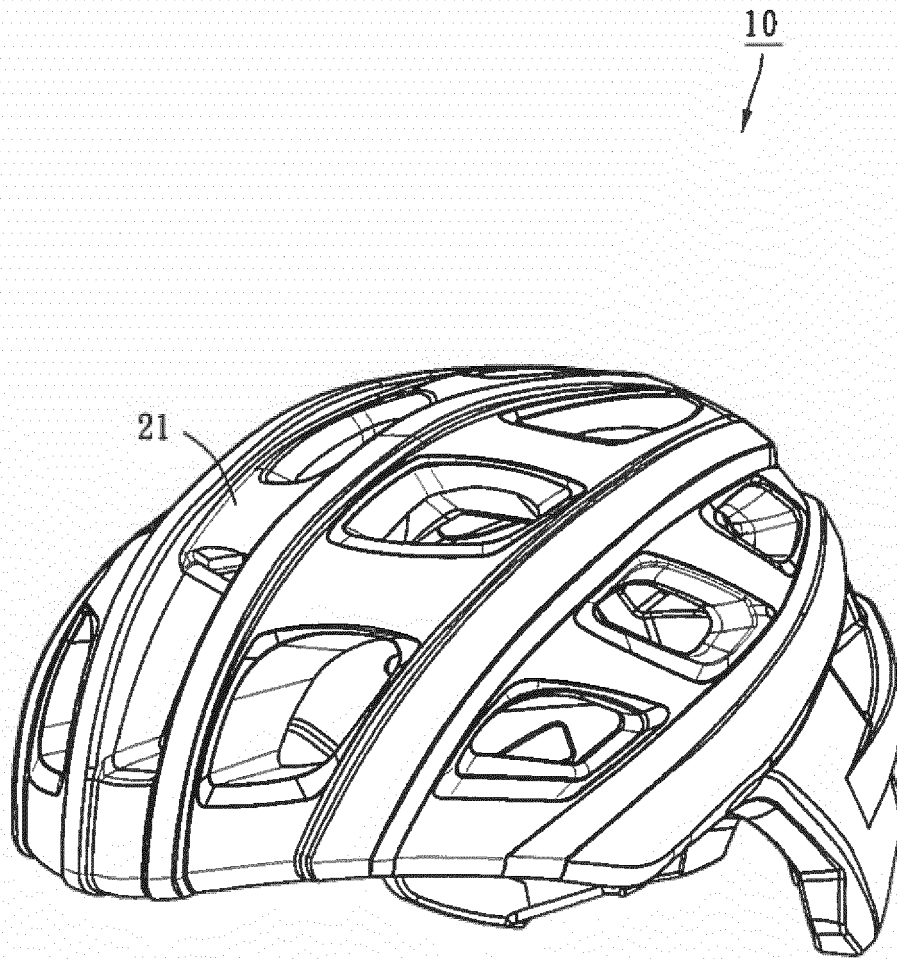


FIG. 1

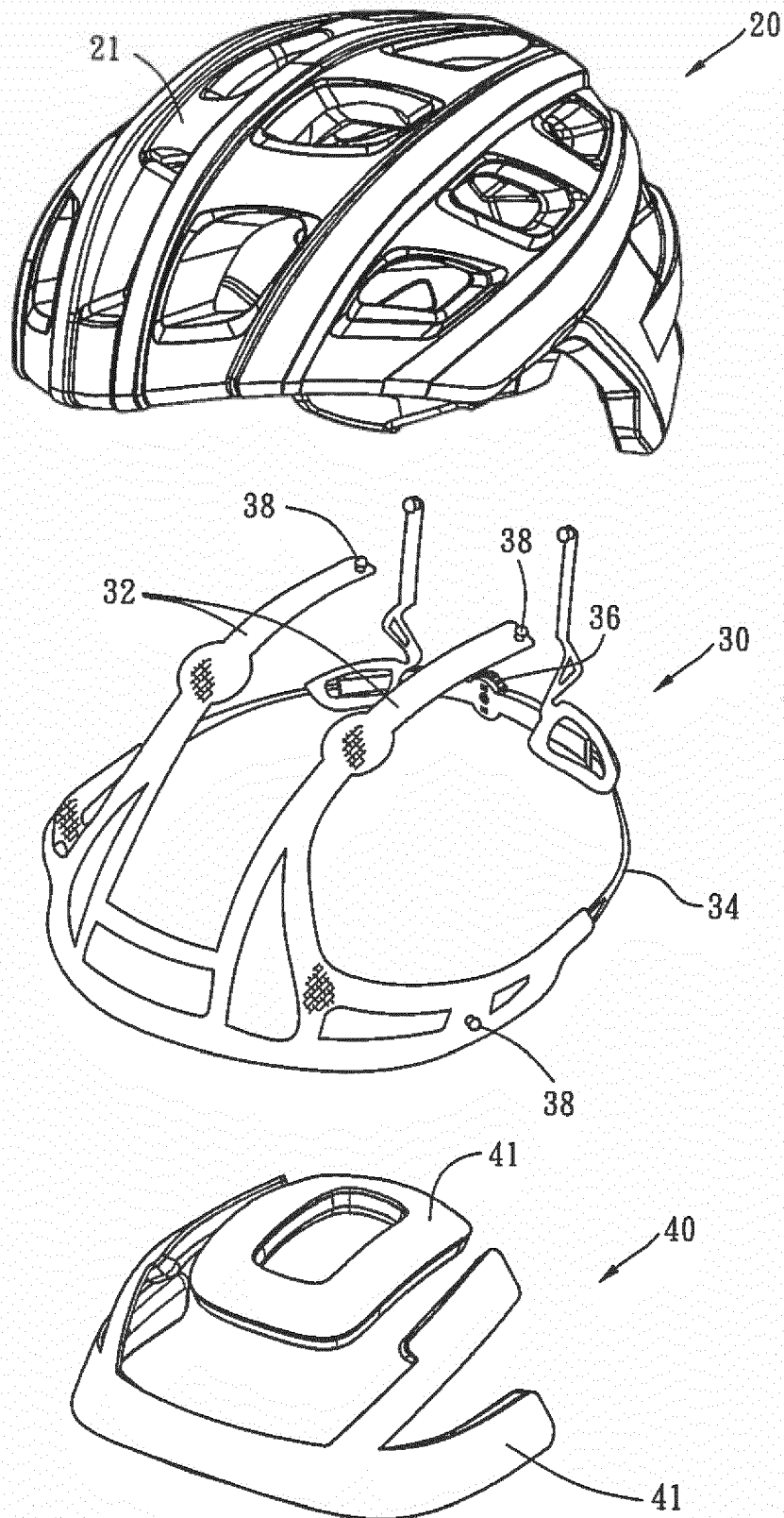


FIG. 2

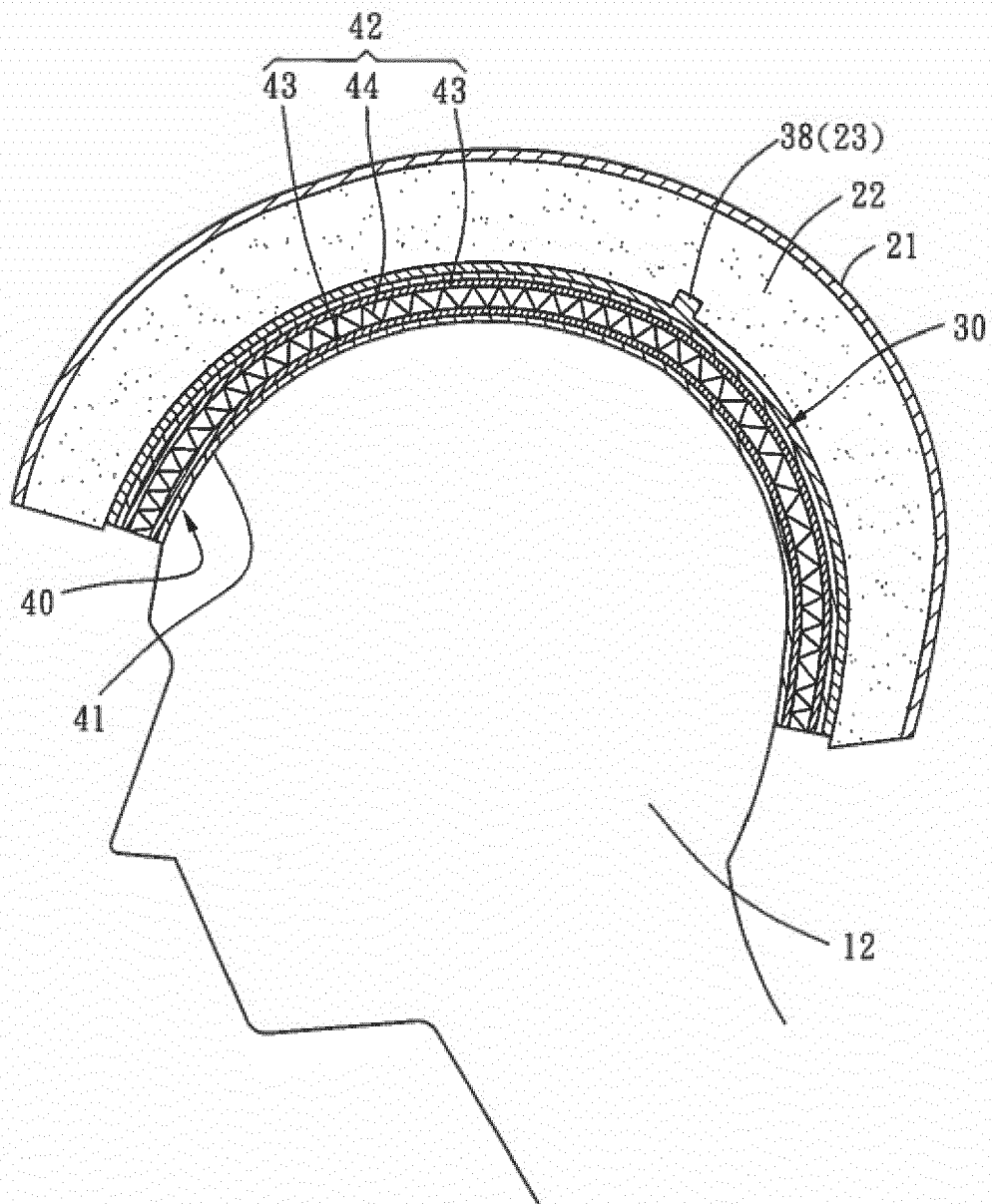
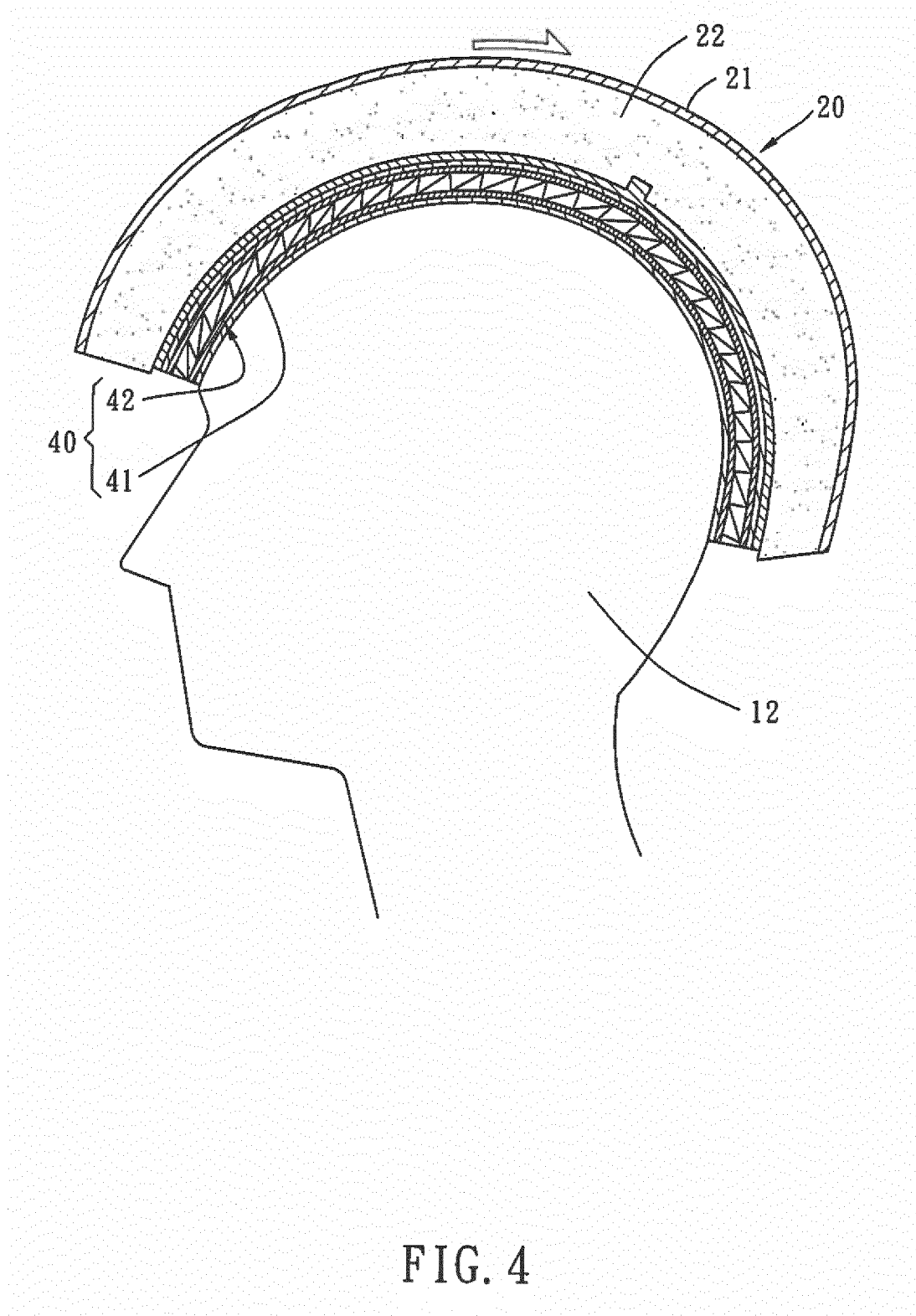


FIG. 3



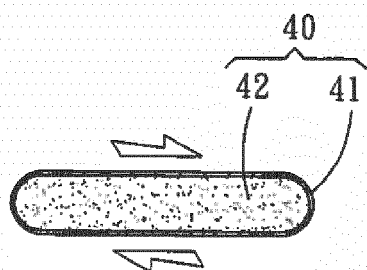


FIG. 5a

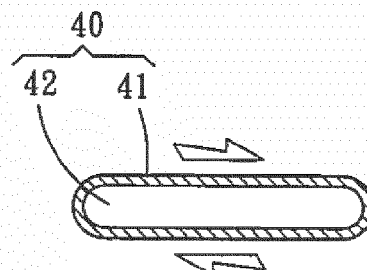


FIG. 5b

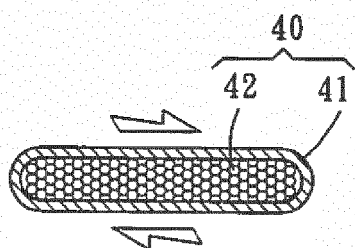


FIG. 5c

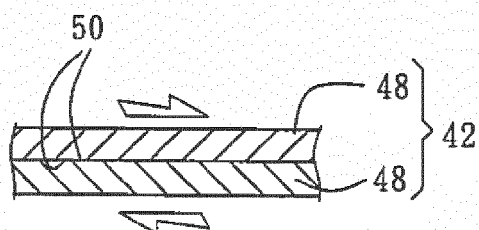


FIG. 5d

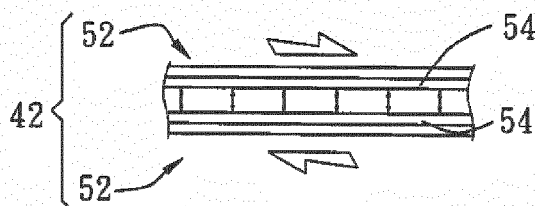


FIG. 5e

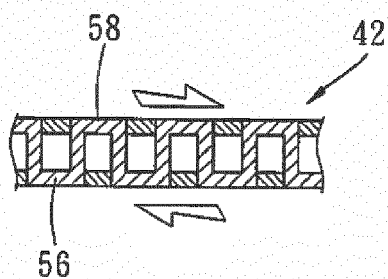


FIG. 5f

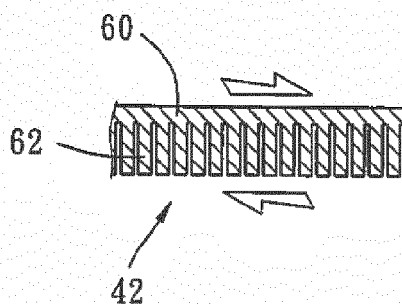


FIG. 5g



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Place of search The Hague		Date of completion of the search 14 December 2018	Examiner D'Souza, Jennifer
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