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(54) **SCALED IMPACT PROTECTION**

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(57) **ABSTRACT**

An impact protective structure including a plurality of individual impact members assembled in a scaled and/or overlapped configuration. As a result, upon impact, an individual flexible impact member bends and spreads the impact to adjacent, overlapping impact members to gradually slow the acceleration to a stop. An advantage of the present scaled configuration of impact members provide a gradual deceleration during impact, therefore, improving the protection of a user's body. The base or receiver of the impact members is rigid, and can be a separate from the impact members. A further advantage of the present invention is that the impact members can be configured in a curved structure, doubly-curved structure, and planar structure.

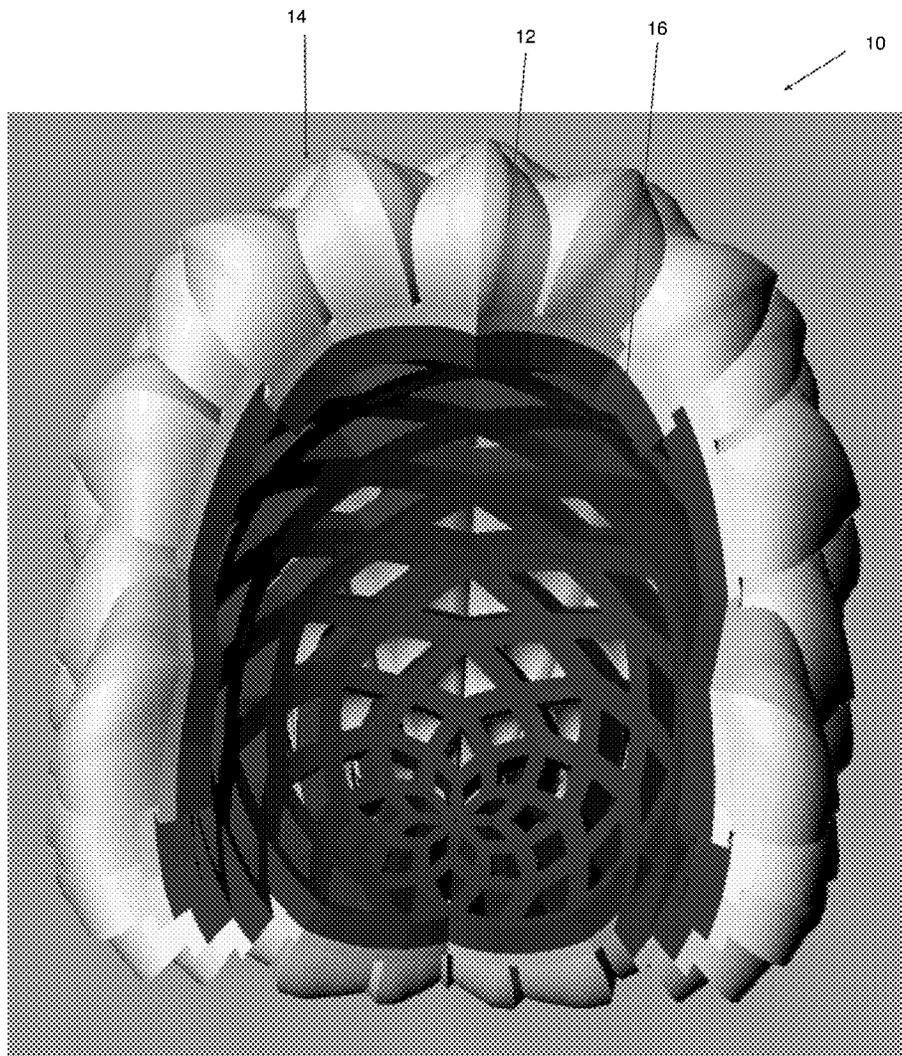


Fig. 1

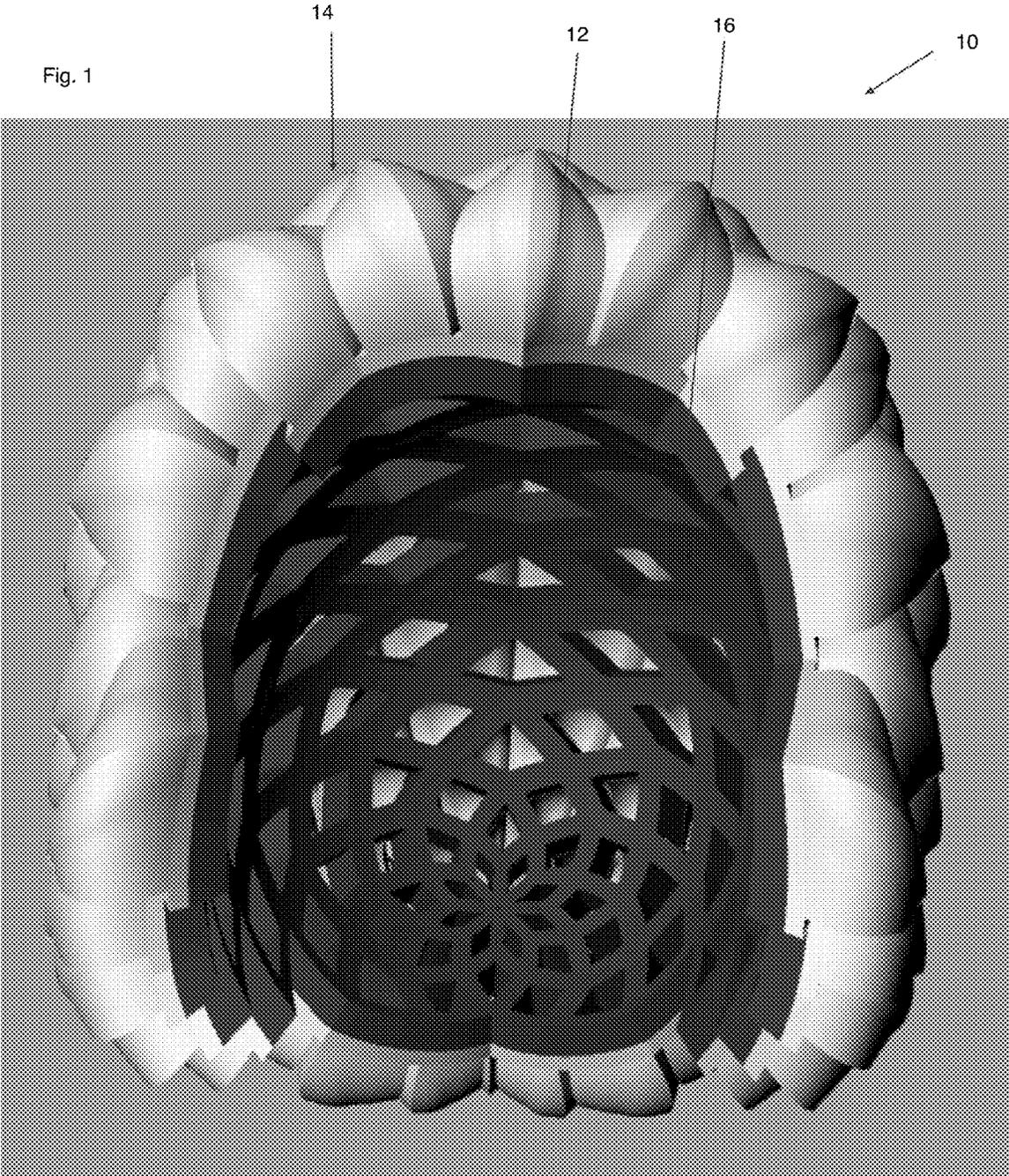


Fig. 2

16

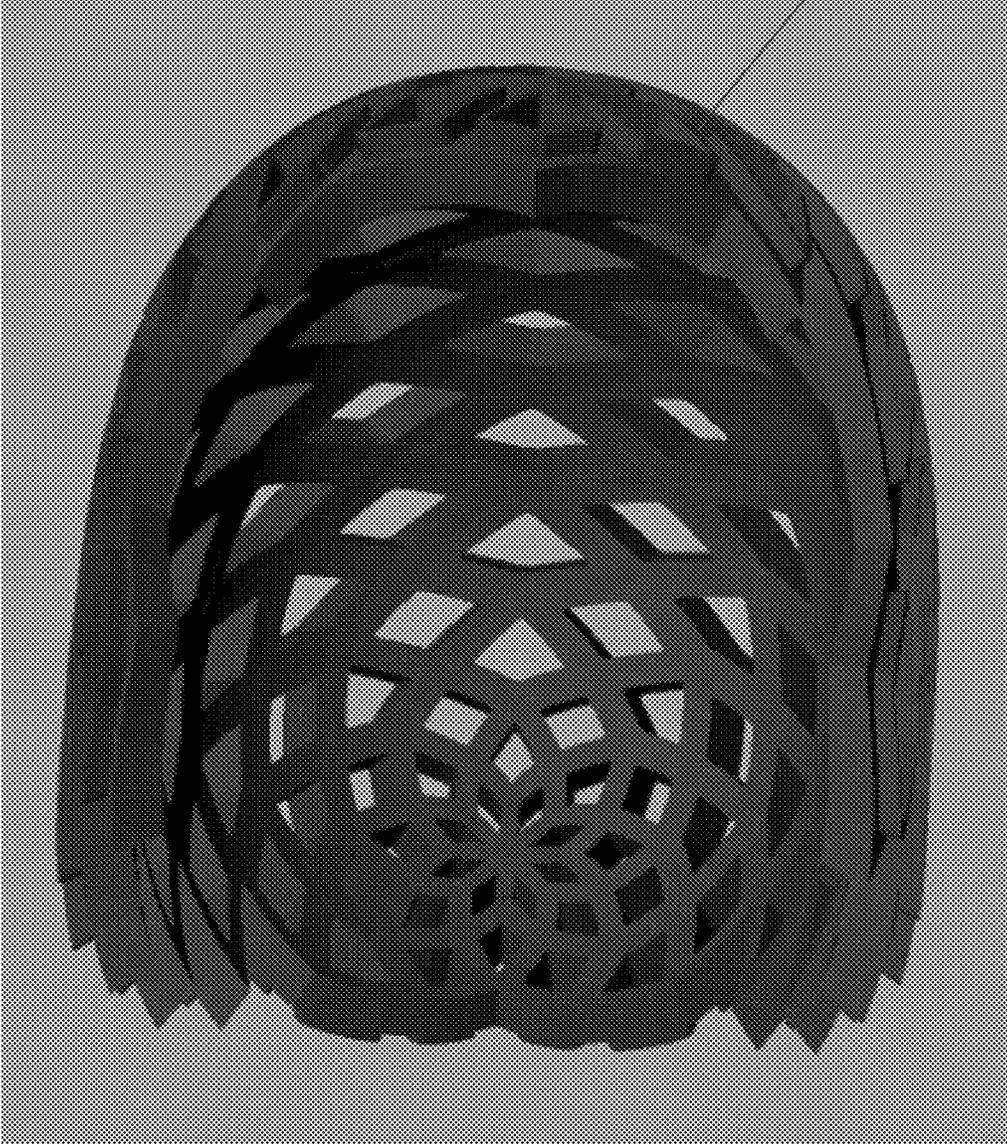


Fig. 3

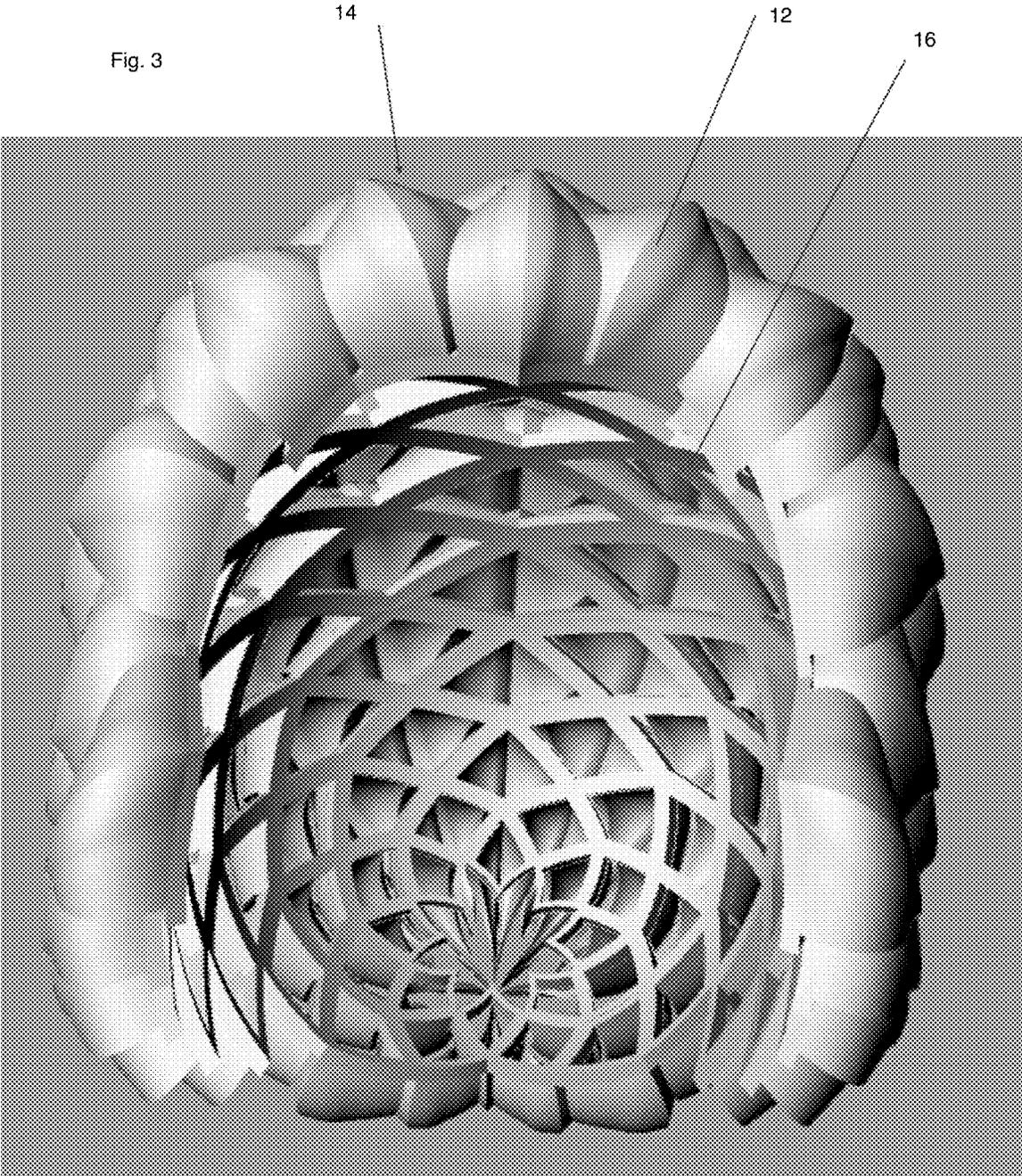


Fig. 4

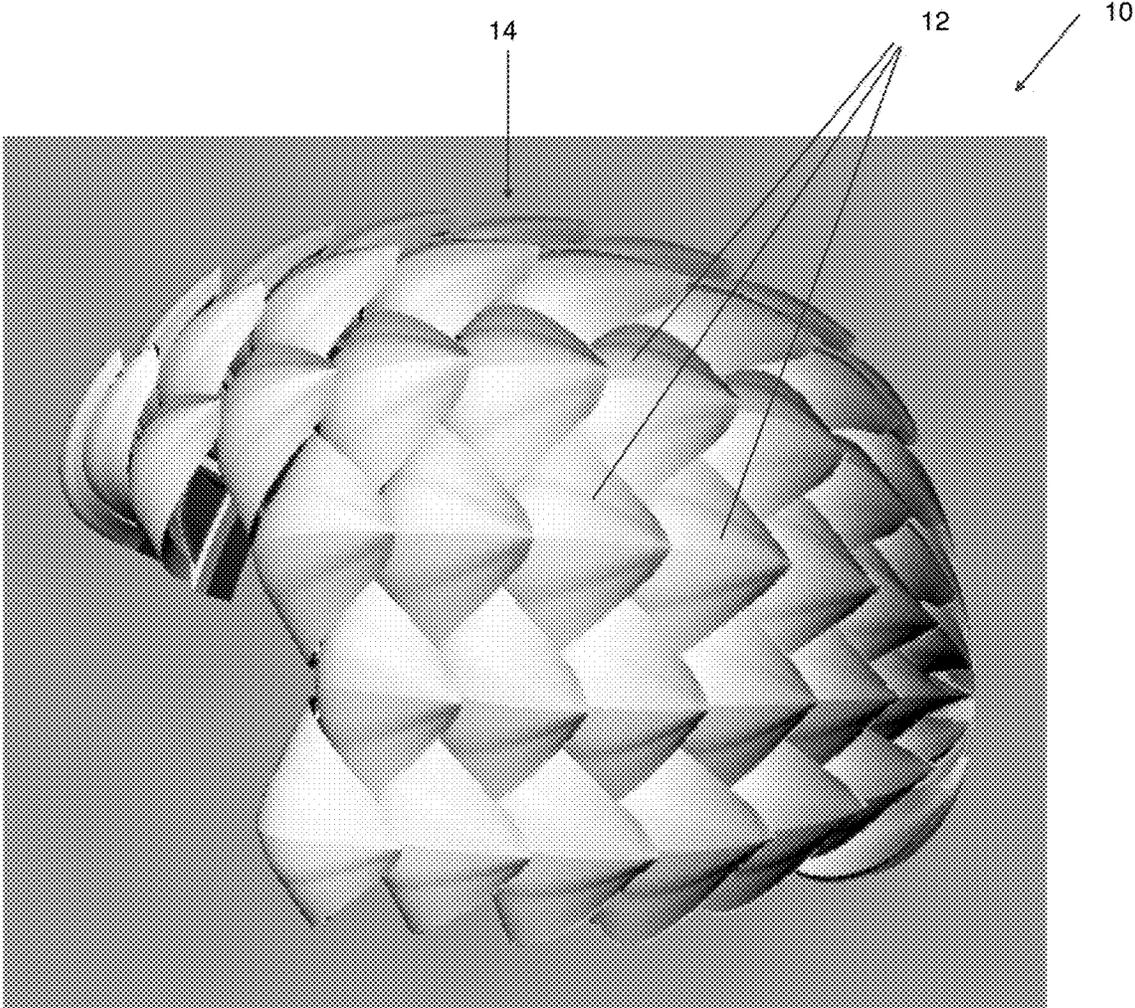


Fig. 5

16

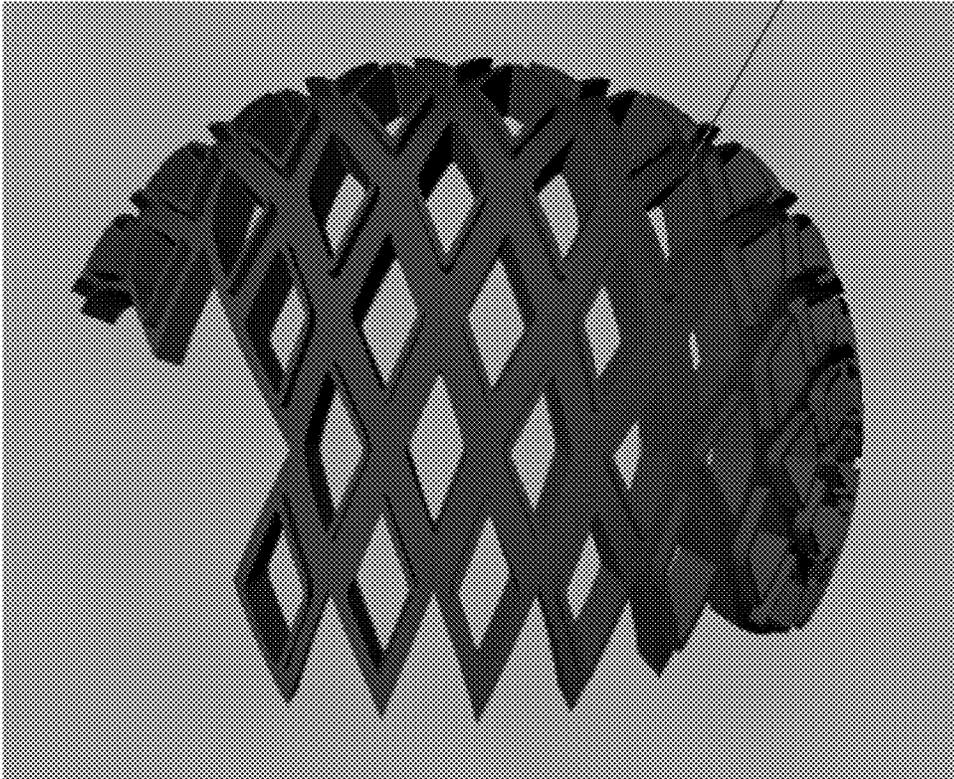


Fig. 6

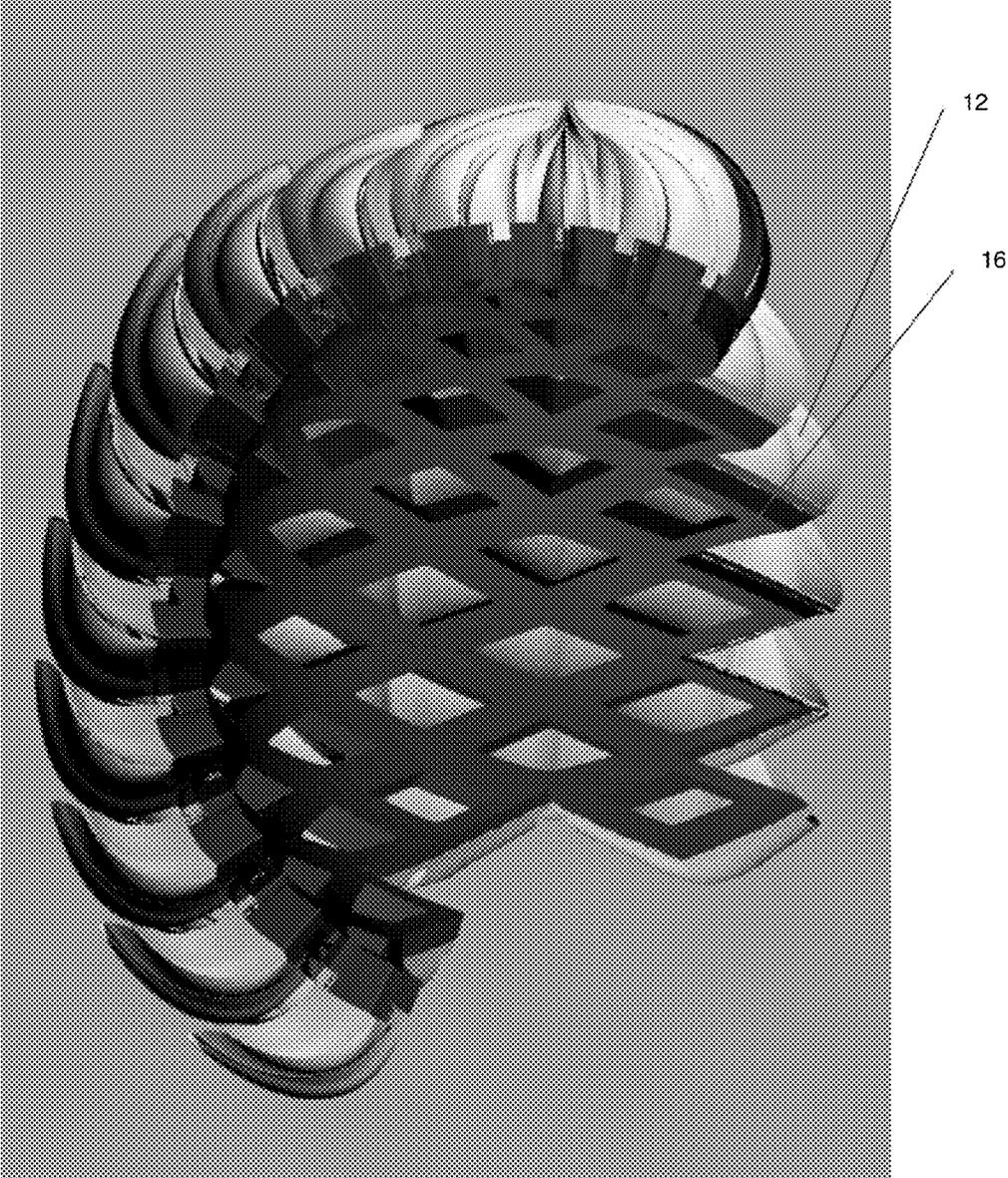


Fig. 7

16

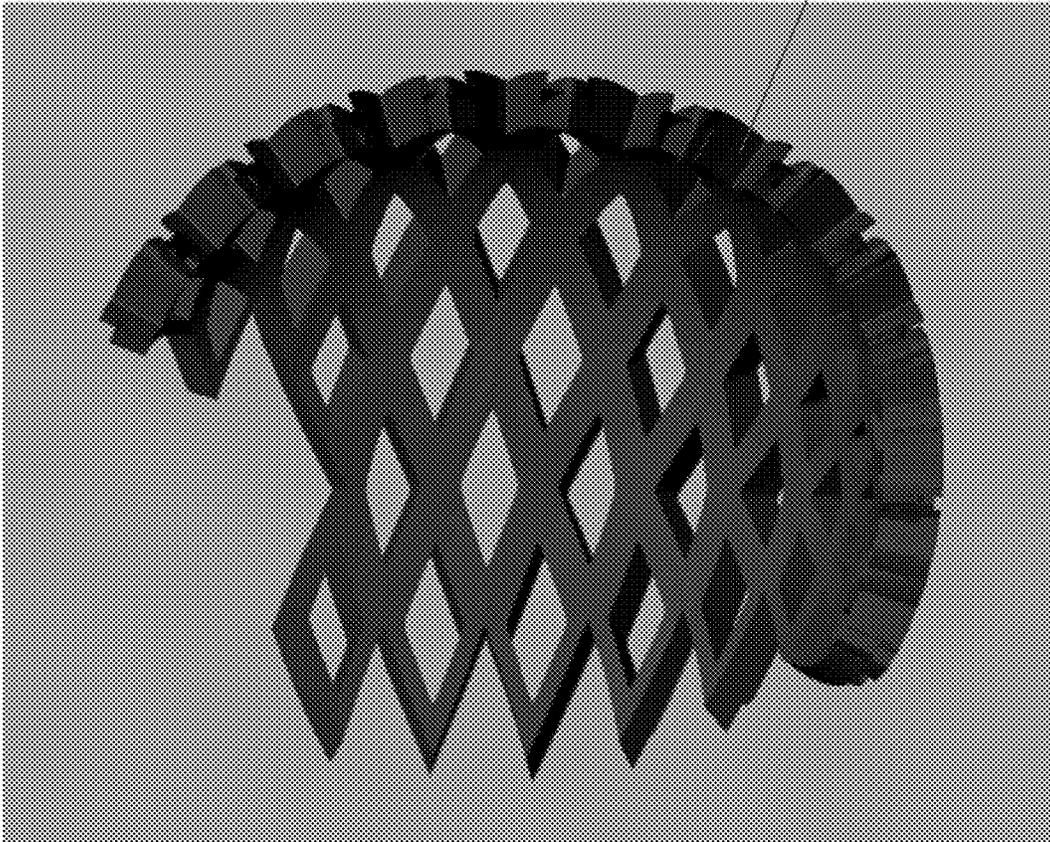
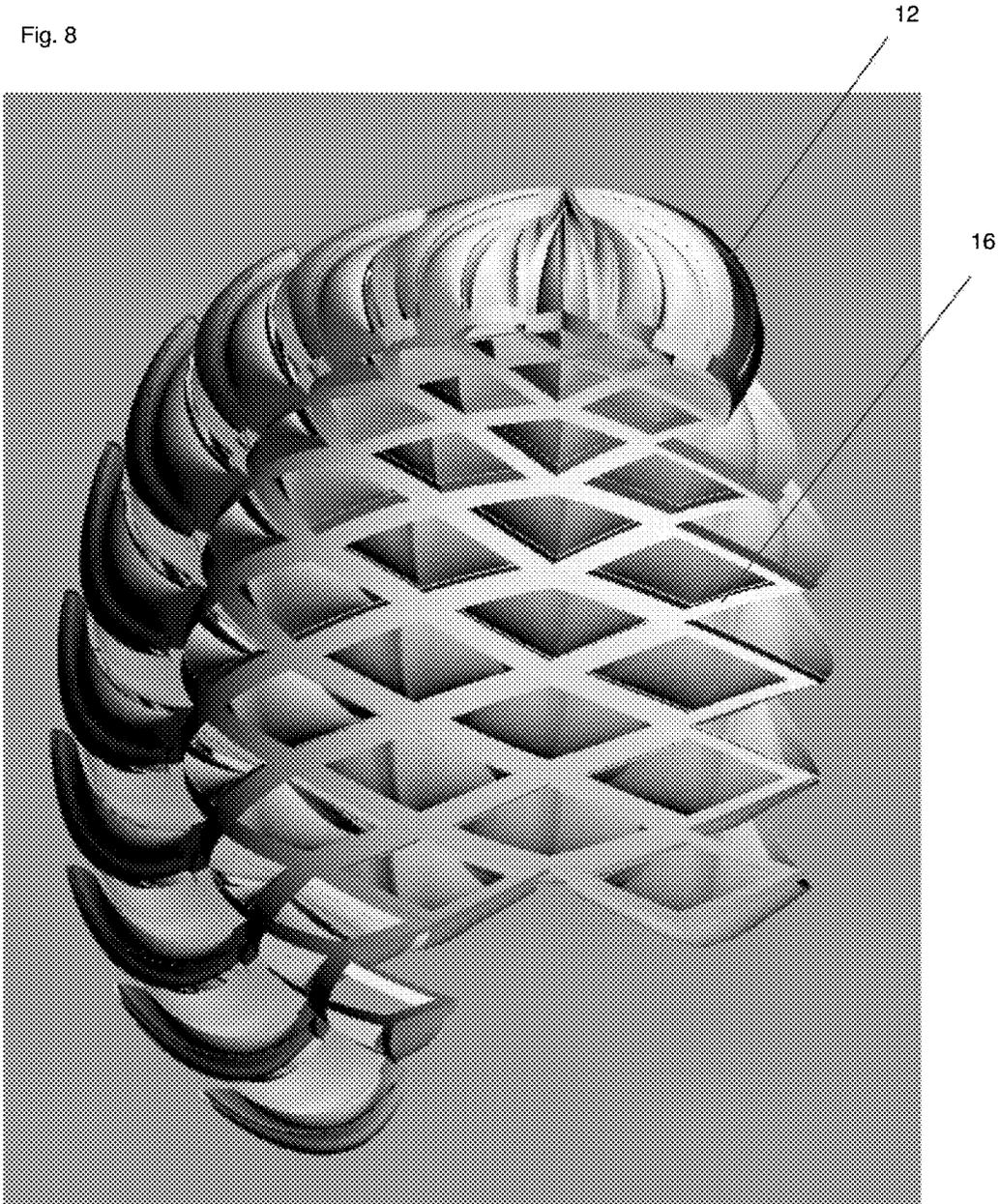


Fig. 8



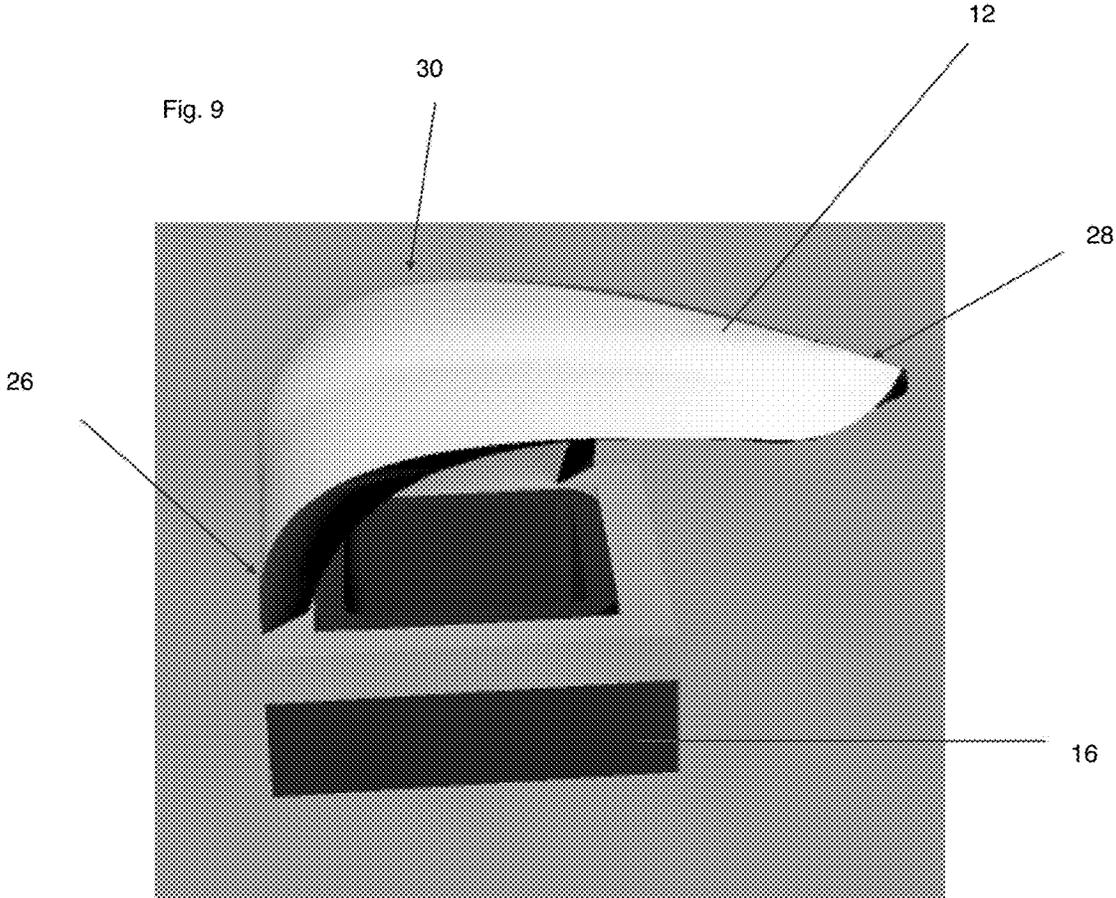


Fig. 10

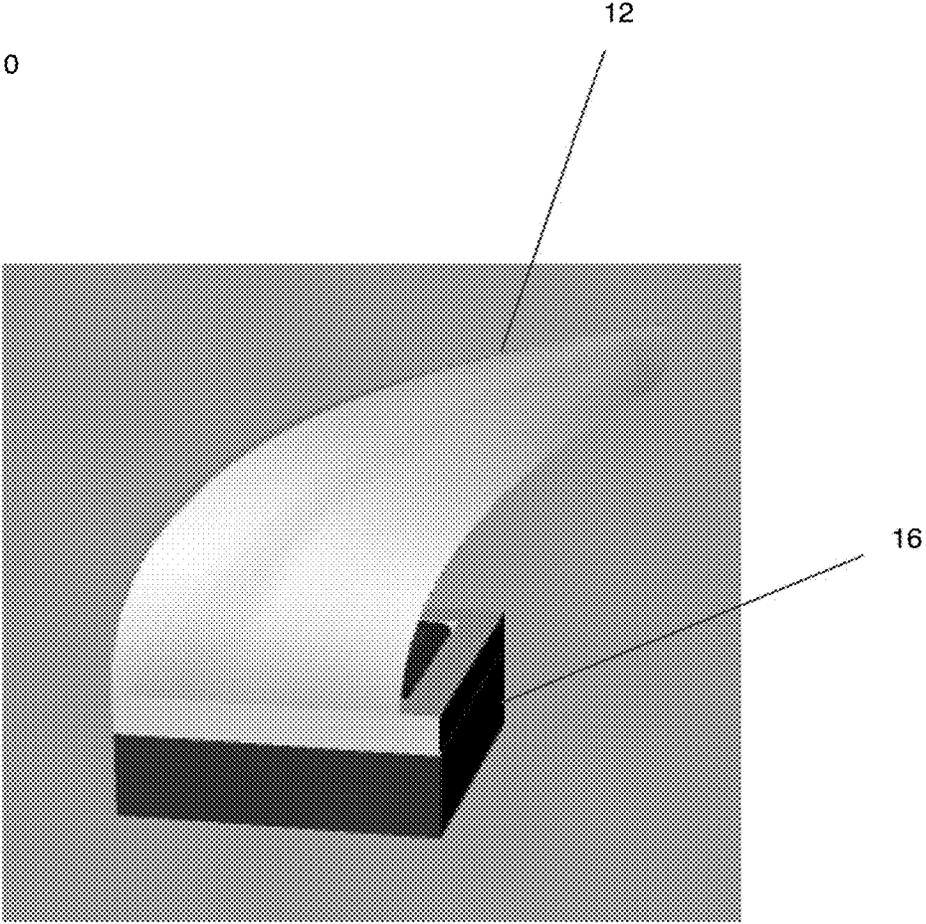
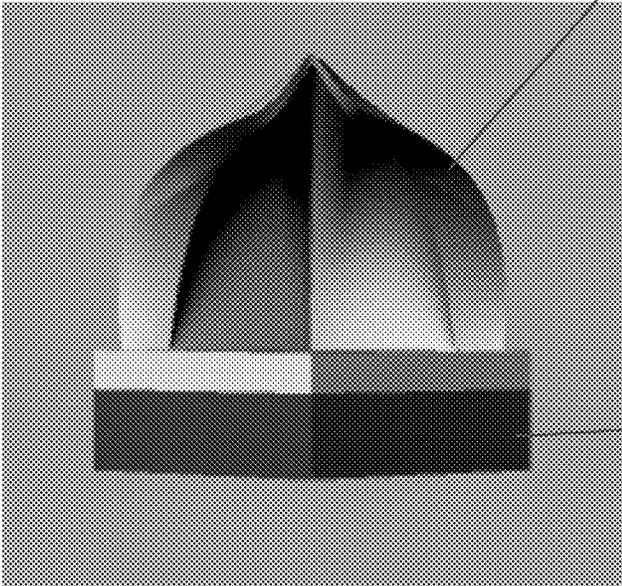


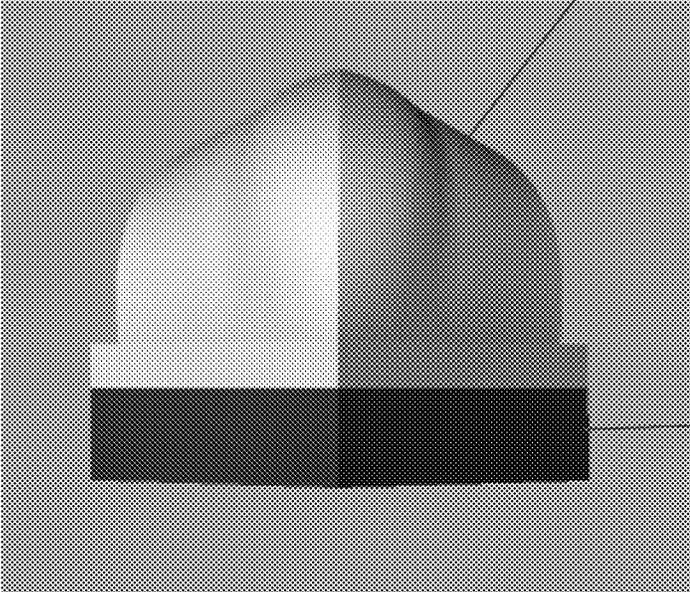
Fig. 11



12

16

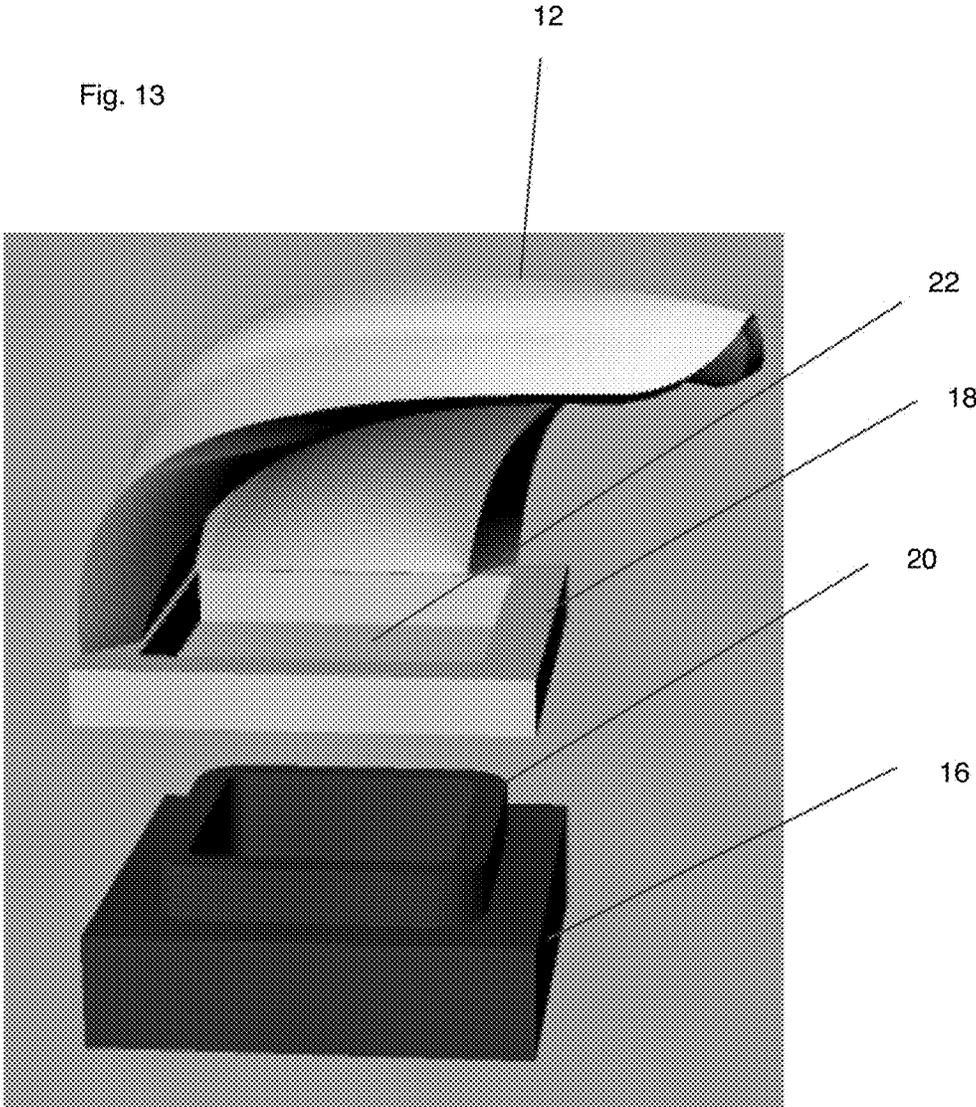
Fig. 12



12

16

Fig. 13



## SCALED IMPACT PROTECTION

**[0001]** This application is related to, and claims priority from, U.S. Provisional Patent Application No. 62/475,504 filed Mar. 23, 2017. Application No. 62/475,504 is hereby incorporated by reference in its entirety.

### BACKGROUND

#### Field of the Invention

**[0002]** The present subject matter relates generally to protective head ear and more particularly to impact absorbing structures.

#### Description of the Problem Solved

**[0003]** It has been reported that over 4 million concussions occur in sport and recreational activities per year. Studies of professional football players in the United States National Football League (NFL) indicate that approximately 150 players, or 1 player in every 2-3 games are diagnosed with a mild traumatic brain injury (MTBI) also referred to as a mild concussion. A study of over 1,000 former NFL players found that 60% had sustained at least one concussion and 26% had sustained three or more concussions in their career. Another study of retired NFL players suggested that 20% of players that sustained a concussion subsequently suffered from depression, which is three times the rate of depression in players who have not sustained a concussion. The risks of long-term cognitive deficit and cumulative effects of multiple concussions highlight the need for improvements in helmet design.

**[0004]** While various types of protective headgear have been developed to reduce injuries to the brain, skull, and neck resulting from head impacts using a hard outer shell in combination with internal padding made of an energy-absorbing material conventional helmet designs are generally based on reducing injuries associated with linear (translational) acceleration due to impacts. Conventional designs having internal padding secured to the outer shell by chemical fasteners, such as adhesives, or by mechanical fasteners, such as hook and loop closures, or similar structures, for example, may not adequately protect users from various types of traumatic brain injury (TBI), which may include diffuse brain injury (DBI) that forms a broad spectrum of injuries ranging from mild concussion without loss of consciousness, to classical cerebral concussion with transient disturbance of consciousness, to diffuse axonal injury (DAI) with prolonged loss of consciousness of varying duration and subdural hematoma (TBI) may result from impacts with another player, an object, or the ground, for example. While these types of injuries have been recognized in the prior art, there is disagreement with respect to the injury mechanism and therefore with respect to methods for mitigating these types of injuries using an appropriate helmet. The original design of helmets, for football in particular, was intended to prevent skull fractures. That problem was solved years ago. Today's TBI and DAI problem is far worse.

**[0005]** Protective gear is also used for athletes and law enforcement including protective gear for shoulders, chest, ribs, thighs, and back. Typically, conventional shoulder pads also utilize a pad body disposed beneath the body arch members, and the pad body is either fixedly secured, or releasably secured, to the body arch members. The structural members, such as the body arch members, as well as

conventional shoulder cups are manufactured from a suitable class of material having the requisite strength characteristics to withstand the forces of impact incurred in the playing of the game of football. In many instances football players will also wear a rib protector, or rib pads, which is a separate pad structure disposed about the football player and typically suspended by a pair of straps from the player's shoulders.

**[0006]** Despite various protection pads conventionally available, injuries from impact are prevalent among athletes, law enforcement, and other individuals participating in recreational activities. Accordingly, there is a need for improvement in protective gear that can be used to protect multiple body parts.

### SUMMARY OF THE INVENTION

**[0007]** The present disclosure provides an impact protective structure including a plurality of individual impact members assembled in a scaled and/or overlapped configuration. As a result, upon impact, an individual flexible impact member bends and spreads the impact to adjacent, overlapping impact members to gradually slow the acceleration to a stop. Various examples of the structure are provided herein.

**[0008]** An advantage of the present scaled configuration of impact members provide a gradual deceleration during impact, therefore, improving the protection of a user's body. The base or receiver of the impact members is rigid, and can be a separate from the impact members.

**[0009]** A further advantage of the present invention is that the impact members can be configured in a curved structure, doubly-curved structure, and planar structure.

**[0010]** A further advantage of the present configuration allows for aesthetic opportunities regarding design changes without effecting performance.

**[0011]** A further advantage of the present configuration allows heat to escape freely from the wearer's head ultimately reducing the probability of heat related injuries.

**[0012]** A further advantage of the disclosed configurations includes allowing different amounts of impact members that would change the deceleration forces during impacts in different activities. Various configurations and the amount of impact members used in each configuration allows for customizable designs for each wearers' activity.

**[0013]** A further advantage of the disclosed configurations include the ability to change the height and length of the impact member, thereby changing the deceleration forces appropriate for activity and aesthetic desire. In addition, the impact members can be made up of multiple materials. A rigid flexible material for impact as well as a soft, rubber-like material at the end or tip of the member to avoid injuries to others getting fingers caught or other body parts from being caught, cut, and the like. The rubber helps soften the edges of the shells.

**[0014]** Additional objects, advantages and novel features of the examples will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following description and the accompanying drawings or may be learned by production or operation of the examples. The objects and advantages of the concepts may be realized and attained by means of the methodologies, instrumentalities and combinations particularly pointed out in the appended claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The figures depict one or more implementations in accord with the present concepts, by way of example only, not by way of limitations. In the figures, like reference numerals refer to the same or similar elements.

[0016] FIG. 1 is a bottom view of an embodiment of the protective gear provided herein.

[0017] FIG. 2 is a bottom view of an example of an internal padding disclosed herein.

[0018] FIG. 3 is a bottom view of an example of the protective gear provided herein.

[0019] FIG. 4 is a side view of an example of the protective gear provided herein.

[0020] FIG. 5 is a side view of an example of the internal padding provided herein.

[0021] FIG. 6 is a sectional side view of an example of the protective gear provided herein.

[0022] FIG. 7 is a side view of an example of an internal padding disclosed herein.

[0023] FIG. 8 is a sectional side view of an example of the protective gear provided herein.

[0024] FIGS. 9 and 10 are perspective views of an example of an impact member engaged with a portion of the internal padding disclosed herein.

[0025] FIG. 11 is a back perspective view of an example of an impact member engaged with a portion of the internal padding disclosed herein.

[0026] FIG. 12 is a front perspective view of an example of an impact member engaged with a portion of the internal padding disclosed herein.

[0027] FIG. 13 is an exploded view of an example of an impact member engaged with a portion of the internal padding disclosed herein.

[0028] Several drawings and illustrations have been presented to aid in understanding the present invention. The scope of the present invention is not limited to what is shown in the figures.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] As shown in FIG. 1, the present disclosure is directed to an impact protective structure 10 including a plurality of impact members 12 assembled in an overlapping configuration to form an outer structure 14. Notwithstanding the examples and figures depicting personal protective gear in the form of a helmet, the disclosure includes shoulder, rib, back, chest, among other forms of protective gear. In other words, the overlapping structure of impact members can be configured into any shape including curved (helmet, shoulder protectors, knee protectors, and the like) and substantially linear structures (chest and back protectors) as well as inanimate object protection/bumpers. It should be noted that the present invention can be used for protecting objects as well as people.

[0030] It will be appreciated by those of ordinary skill in the relevant art that features and aspects of the protective gear described may be combined with common features of known protective gear. For instance, the protective helmets described herein may include various cushioning or padding to supplement the one or more viscous dampening elements provided for managing impacts to the helmets or to assist in fitting the helmets to users. In addition, the protective gear described herein may include various fit adjustment devices,

such as, for example, adjustable chin straps, adjustable bands and adjustable harnesses, as well as face guards and shields and “full face” configurations.

[0031] In addition, it will be appreciated that the examples shown and described herein are non-limiting examples and may vary significantly from the embodiments illustrated in the figures. Further, the disclosed protective gear can include additional components. For example, many helmet safety standards call for substantially smooth external and internal surfaces. Accordingly, an external or outer shell may be provided in examples featuring the outer structure comprising the plurality of overlapping impact members to cover and conceal the same and may be configured to offer minimal resistance to impact forces. Any internal projections may also be covered or concealed to avoid laceration and/or puncture hazards. The use of multiple material impact members mitigates these issues. Further, an inner cover may be added to the inner surface of the internal padding 16 shown in FIG. 2, described herein for a user's comfort.

[0032] FIG. 3 shows a combination internal padding 16 and impact members 12. FIG. 4 is a side view of the protective gear 10 wherein the impact members 12 form an outer structure 14 in the form of a helmet. The impact members 12 can connect to each other by any suitable connection mechanism including, but not limited to, pressure fit, adhesive, snaps, hooks, loops, cable tension among others. In other words, in an example, the outer structure 14 is an individual, self-supporting structure that can be attached to the internal padding. Alternatively, or in addition to, the individual impact members 12 can be attached to the internal padding 16, with or without the individual impact members being attached to each other.

[0033] The outer structure 14 can be attached to an internal padding structure 16 as shown in FIGS. 1, 3, and 6 that depict an interior view of the protective gear 10 illustrating the internal padding 16 of the outer structure of impact members. FIGS. 2, 5, and 7 are various views of an example of an internal padding. The internal padding can be solid or in a lattice formation, as shown in FIG. 5. The internal padding 16 can be made of any suitable material. In an example, the internal padding is less rigid than that of the impact members. The internal padding can be made of any suitable padding material, such as shock absorbing material. The internal padding material has the requisite compressibility, strength, and durability requirements necessary to withstand the impact forces incurred, as well as being capable of providing a level of protection to the user. The internal padding 16 is not overly flexible and compressible to prevent sufficient protection to the wearer, but it is not overly rigid or not compressible such that upon impact the wearer is injured from the impact of the internal padding to the wearer.

[0034] The impact member 12 can be in the form of a non-planar shape as shown in FIG. 9, the impact member 12 can be in the shape of a shell having a mounting end 26 and an overlapping end 28, wherein the mounting end 26 can be attached to the internal padding 26. In an example, the height of the overlapping end 28 is higher or above that of the mounting end 26. The central body portion 30 of the impact member 12 can have a greater width than that of the mounting end 26 and/or the overlapping end 28, wherein the central body portion 30 is positioned in between the mounting end 26 and the overlapping end 28.

[0035] In an example, only the mounting end 26 is attached to the internal padding 26, wherein the overlapping end 28 rests on at least one other surface of an overlapped impact member (impact members do not touch anything around them, only the mounting member at the base). Alternatively, or in addition to, the overlapping end 28 can be attached to a surface of at least one of the overlapped impact member (same goes for overlapping members, they also do not touch anything). As shown in FIG. 4, each impact member overlaps with at least three other impact members. However, each impact member 12 can overlap with at least two impact members to up to at least five impact members.

[0036] The impact member 12 can be made of any suitable material. The impact members 12 can be made of common materials for helmets, such as, for example, polycarbonate plastic, fiberglass, Kevlar, other suitable material, or combinations thereof. An impact event may deform the impact member 12 elastically, plastically, or a combination of both.

[0037] FIGS. 9-12 are various perspective views of an example of an impact member 12 engaged with a portion of the internal padding 16. FIG. 13 is an exploded view of the impact member 12 engaged with a portion of the internal padding 16. The impact member 12 can engage or connect to the internal padding 16 in any suitable manner. For example, the impact member 12 can engage or connect to the internal padding 16 with pressure fits, adhesive, hook and loop methods, snaps, hooks, cables, bands, rods, straps, ropes, among others. As shown in the example in FIG. 13, the impact member 12 engages or connects to the internal padding 16 by a pressure fit. For example, the impact member 12 can include a base 18 including an opening 22. An outer surface of the internal padding can have a plurality of raised structures 20 having a shape that is complementary to the opening 22, such that a raised structure 20 fits into the opening 22 of the impact structure base 18.

[0038] It should be noted that various changes and modifications to the embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. For example, various embodiments of the systems and methods may be provided based on various combinations of the features and functions from the subject matter provided herein.

I claim:

1. An impact protection structure comprising:
  - a plurality of impact members configured in an overlapping configuration, wherein the impact member is nonplanar, wherein each impact member is in contact with at least three other impact members.
2. The impact production structure of claim 1 wherein the impact member is in the shape of a shell or arch.
3. The impact production structure of claim 1 wherein the plurality of impact members are configured to form a curved structure.

4. The impact protection structure of claim 1 wherein the plurality of impact members are configured to form a planar structure.

5. The impact production structure of claim 1 further comprising an internal padding, wherein each impact member is attached to the internal padding.

6. The impact protection structure of claim 5 wherein an outer surface of the internal padding includes a plurality of raised structures, wherein each impact member includes a base including an opening, wherein the raised structure of the internal padding pressure fits within the opening of the base of the impact member.

7. The impact production structure of claim 1 wherein the impact protection structure is a helmet.

8. The impact protection structure of claim 1 wherein the impact protection structure is a rib protector.

9. The impact protection structure of claim 1 wherein the impact protection structure is a shoulder pad.

10. The impact protection structure of claim 1 wherein the impact protection structure is an abdominal protector.

11. The impact protection structure of claim 1 wherein the impact members are polycarbonate plastic, fiberglass, Kevlar or combinations thereof.

12. An impact protection structure comprising:
 

- a plurality of impact members configured in an overlapping configuration, wherein at least some of the impact members are in the shape of a shell or arch, wherein each impact member is in contact with at least three other impact members, and wherein the plurality of impact members are configured to form a curved structure.

13. The impact production structure of claim 12 wherein the impact protection structure is a helmet.

14. The impact protection structure of claim 12 wherein the impact protection structure is a rib protector.

15. The impact protection structure of claim 12 wherein the impact protection structure is a shoulder pad.

16. An impact protection structure in the form of a helmet comprising:

- a plurality of impact members assembled in an overlapping configuration to form an outer helmet-shaped structure, wherein each impact member is in contact with at least three other impact members;

- A lattice-like internal padding structure attached to the impact members to form a helmet constructed to be worn;

- wherein the internal padding structure is less rigid than the impact members.

17. The impact protection structure of claim 16 wherein the impact members are polycarbonate plastic, fiberglass, Kevlar or combinations thereof.

18. The impact protection structure of claim 16 wherein each impact member overlaps up to five other impact members.

19. The impact protection structure of claim 16 wherein the impact members are curved.

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