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(54) **PROTECTIVE ATHLETIC GARMENT**

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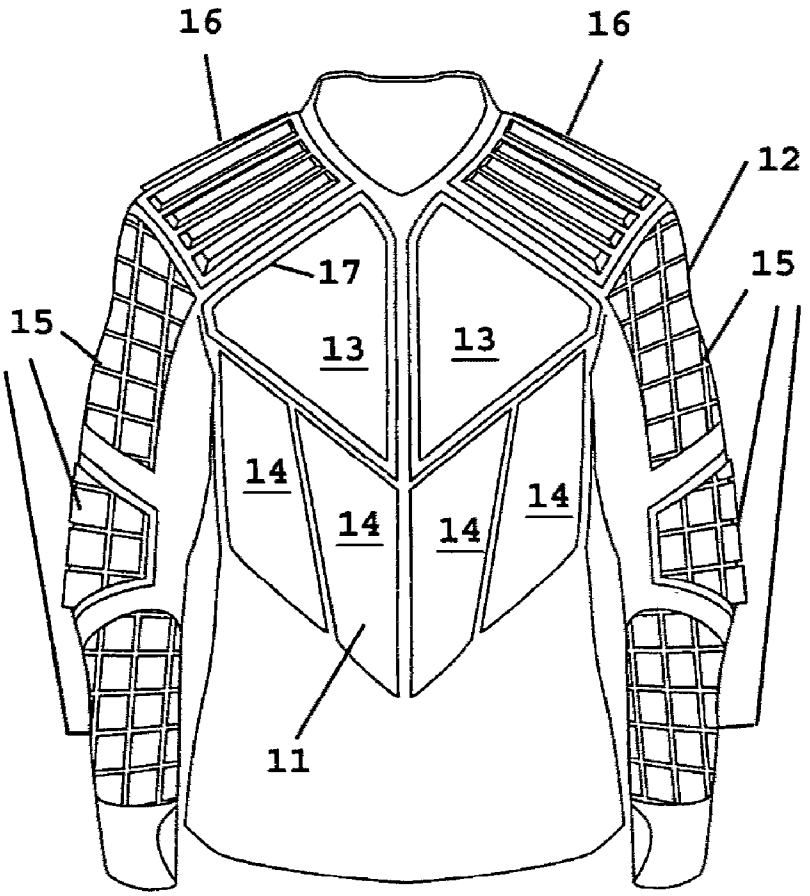
(57) **ABSTRACT**

A protective athletic garment provides segmented padding is patterned to conform to the size, shape and motion of the muscles it is protecting. Segmented padding is supplemented in joint areas by tangentially-stepped articulated shielding, each comprising a hingeably interconnected series of rigid shells. The structure and orientation of the shells deflects impact forces tangentially, while the rotational mobility of the shielding has a force-damping effect.



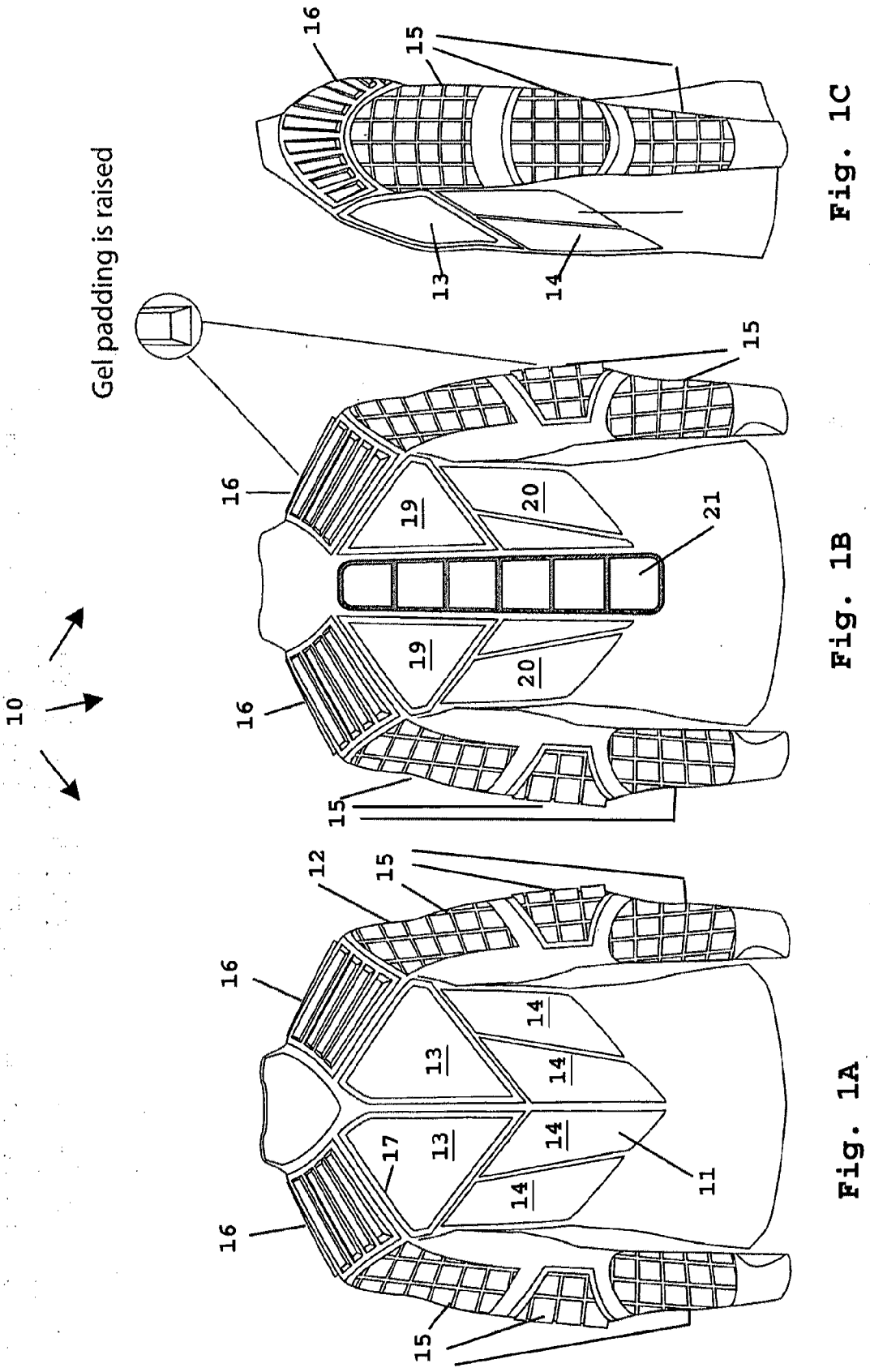


Fig. 1A

Fig. 1B

Fig. 1C

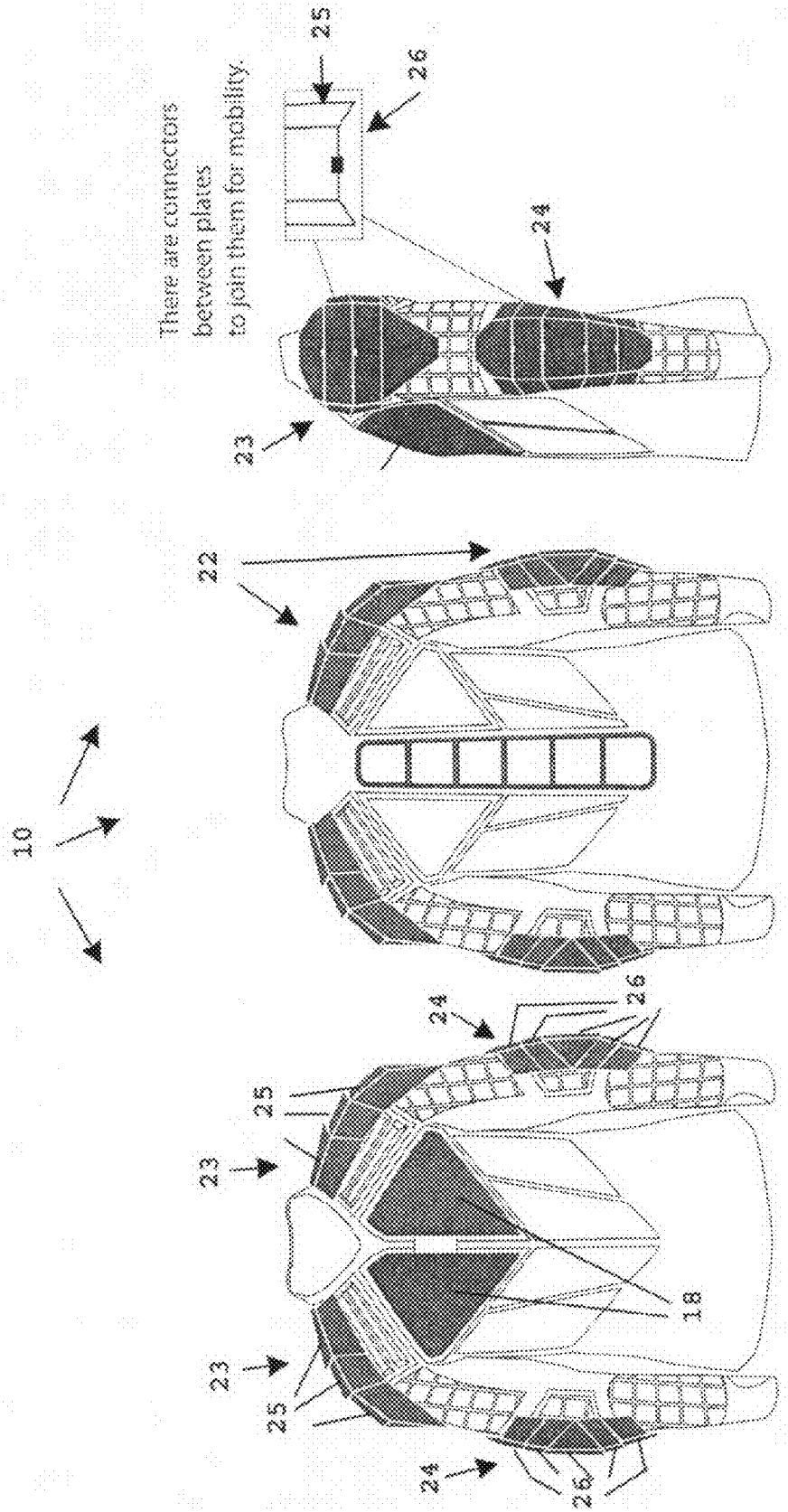


Fig. 2C

Fig. 2B

Fig. 2A

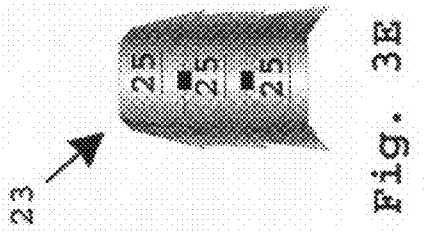


Fig. 3E

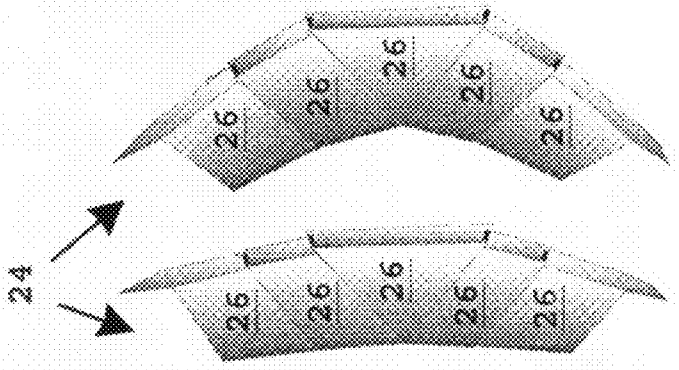


Fig. 3D

Fig. 3C

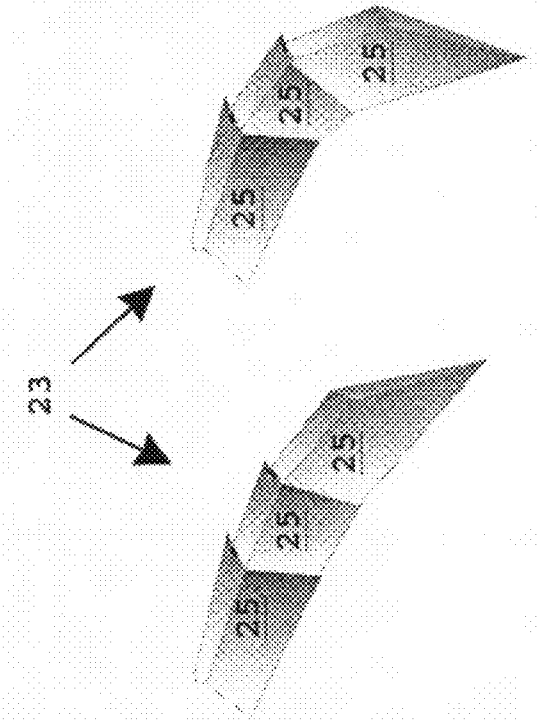


Fig. 3B

Fig. 3A

PROTECTIVE ATHLETIC GARMENT

BACKGROUND OF THE INVENTION

[0001] The present invention relates to the field of protective garments, and more particularly to garments to protect athletes competing in contact sports, such as lacrosse, football, hockey and motocross. While the present invention is primarily directed to protective athletic garments, however, it is also applicable to garments used in any activity involving potential high-impact bodily contact where there is a need provide protection without unduly restricting mobility.

[0002] Protective garments and equipment designed for use in contact sports typically rely on two modes of dissipating impact forces: padding and shielding. Padding dissipates the force through elastic deformation of the padding material, while shielding deflects a portion of the force away from the body. Optimally, padding and shielding are used in combination, with padding underlying shielding, so that undeflected forces transmitted through the shield can be absorbed by the padding beneath.

[0003] The major problem in designing effective athletic gear is the need to balance protection versus mobility. Even within the same sport, different degrees and types of protection and mobility are often demanded for different position players. Shoulder protectors suitable for a football lineman, for example, would be much too confining for a quarterback or wide receiver, while a quarterback's lighter padding would be ineffective for blocking on the line.

[0004] One way to provide both mobility and protection is to segment or articulate the padding and/or shielding, leaving interstices and/or joints within which flexing and bending can take place. Segmentation and/or articulation of both padding and shielding is needed to provide mobility where both modes of protection are being deployed in conjunction with one another. But, since segmentation and articulation introduce additional degrees of freedom of movement to padding and shielding beyond that associated with their protective functions, it's important that the mobility dynamics of the padding and shielding not work at cross purposes to their protective dynamics.

[0005] For example, a simplistic approach to segmenting an elbow protector would be to split it above and below the joint. But, while facilitating elbow movement, such segmentation would also leave the most sensitive outer part of the elbow exposed every time the elbow was bent.

[0006] Another important consideration in designing articulated body protection is the interaction between the padding and the shielding. For example, foam padding underlying a one-piece shield panel will compress downward to dissipate a downward force applied to the panel. But the same padding beneath a two-piece panel may be subject to sideward pressure which limits its downward compression and reduces force dissipation.

[0007] The prior art in this field includes garments in which segmented padding is inserted into pockets or openings in the garment. Examples of these garments are disclosed by Mattila, U.S. Pat. No. 4,700,407, Ketcham et al., U.S. Pat. No. 4,870,706, Valtakari, U.S. Pat. No. 5,105,473, and Davis, U.S. Pat. Pub. No. 2007/0199129. While pocket-type padding has the advantage of versatility, the padding adds to the bulk of the garment and impedes mobility.

[0008] Several prior art patents/applications teach the use of segmented protective pads which are integrated within the fabric of the garment. Examples of such integrated segmented padding designs appear in Fortier et al., U.S. Pat. No. 4,810,559, Stewart et al., U.S. Pat. No. 5,551,082, and Lamson et al., U.S. Pat. Pub. No. 2009/0044319. A joint protector with articulated padding is disclosed by Williams, U.S. Pat. No. 6,058,503, in which the resilient members conform to the contours of the protected joint.

[0009] The combination of segmented padding with overlying non-articulated panels is taught by Donzis, U.S. Pat. No. 4,453,271, wherein the panels conform to body contours, as do the pocket-insert panels disclosed by Valtakari and Davis. An upper body protector comprising inflatable air cells in combination with rigid non-articulated plastic epaulets is taught by Maynard, U.S. Pat. No. 5,235,703.

[0010] The present invention improves upon the prior art by providing a protective garment with a combination of segmented resilient padding covering vulnerable body areas, such as chest, arms and back, plus articulated rigid shield panels over joints areas, such as shoulders and elbows. Synergistic dynamic interaction of padding and shielding is achieved by converting impact forces to torques within a series of articulated shield panels and spreading out the forces transmitted to the underlying padding both over area and time.

SUMMARY OF THE INVENTION

[0011] The present invention can be practiced in a number of embodiments, which should be understood before one specific embodiment is described in detail. For illustrative purposes, some of these embodiments will now be discussed for the purpose of conveying a better understanding of the general intent of the present invention. It should be understood, however, that neither the following illustrative embodiments, nor the detailed embodiment described in the next section of this application, are intended to limit the scope of the present invention.

[0012] The present invention uses segmented resilient padding in conjunction with articulated shielding comprising a series of interconnected light-weight rigid panels. The garment has an outer layer and a liner layer, with some padding material distributed over various areas between the two layers, and other padding material attached to the outer layer and projecting above it. The former will be referred to as "interior padding" and the latter as "exterior padding". The padding material can consist of a gel, such as semi-solid silicone, a foam, such as open-cell polyurethane, or a polymer composite. Cells filled with compressed air or gas, as well as inflatable air bladders, can also be used as padding material.

[0013] Segmentation of the padding is patterned to conform to the size, shape and motion of the muscles it is protecting. Using the front of an upper body garment as an example, interior padding over the chest could comprise two large triangular foam segments over the right and left pectorals separated by an exterior vertical oblong strip of raised square or rectangular gel segments over the sternum. The outer sides of the upper arms and forearms could be covered with exterior padding comprising clusters of cubical or hemispherical cells containing compressed air, for greater mobility. Over the clavicle, exterior padding might consists of narrow raised polymer strips running across the shoulder, so as not to impede the upward movement of the arm.

[0014] The articulated shielding is designed to direct impact forces in a direction tangential to the contours of the protected body area. Over the shoulder, for example, the shielding might comprise a series of hingeably intercon-

nected shells arranged in a stepped configuration. Each of the shells would have multiple flat or slightly convex outer surfaces tangentially aligned with respect to the underlying shoulder contours. The shells would be fabricated from a light-weight impact-resistant plastic, fracture-resistant long glass fiber nylon, or ceramic material. The interconnection between the shells would permit each of the shells to rotate upward, sliding partially under the adjacent shell as the arm is raised.

[0015] The tangentially-stepped articulated shielding of the present invention will dissipate impact forces in two ways. First, an oblique impact to one of the shells will tend to move it in the direction of least resistance, which is at a tangent to the underlying body contour, so that the orthogonal component of the force is re-directed and deflected. Second, an orthogonal or oblique impact to one of the shells will generate a torque causing the shell to rotate about the hinge connecting it to the adjacent shell. This rotational motion will be transmitted down the series of interconnected shells, thereby generating an undulating movement which tends to dampen the force. Since this undulating motion of the shielding has both horizontal and vertical components, the orthogonal force component is again reduced. Moreover, the undulating transmission extends the force over a larger body area and protracts the time interval during which the force is applied to the body, thereby reducing the resulting pressure on the body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIGS. **1**A, **1**B and **1**C are front, back and left side views, respectively, of an exemplary upper torso protective garment, without the shielding components, according to the preferred embodiment of the present invention;

[0017] FIGS. **2**A, **2**B and **2**C are front, back and left side views, respectively, of an exemplary upper torso protective garment, with the shielding components, according to the preferred embodiment of the present invention;

[0018] FIGS. **3**A, **3**B, and **3**E are detail front views of the shoulder shielding component of an exemplary upper torso protective garment, according to the preferred embodiment of the present invention; and

[0019] FIGS. **3**C and **3**D are detail front views, and FIG. **3**E is a detail side view of the elbow shielding component of an exemplary upper torso protective garment, according to the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Referring to FIGS. **1**A and **1**C, the front and sides of the exemplary upper torso protective garment **10** include both interior padding **11** and exterior padding **12**. The interior chest padding **13** over the pectorals comprises two triangular pads of open cell polyurethane foam, approximately two to three inches thick. The interior rib-cage padding **14** comprises four semi-trapezoidal pads, likewise consisting of open cell polyurethane foam, approximately two to three inches thick. The exterior arm padding **15** comprises three clusters of raised cubical gel cells, approximately one-quarter to one-half inch in height, positioned over the outer surfaces of the upper arm, elbow and forearm. The exterior shoulder padding **16** comprises multiple narrow raised gel strips, approximately one-quarter to one-half inch in height, running front to back across the clavicle area. The outer garment layer above each of the pectorals is optionally provided with a pocket **17** into which a rigid breast plate **18** (see FIG. **2**A) can be inserted.

[0021] Referring to FIG. **1**B, the back of the exemplary upper torso garment **10** includes the exterior arm **15** and shoulder **16** padding described above. In addition, there is interior upper back padding **19** over the scapula areas comprising two triangular pads and interior lower back padding **20** over the latissimus dorsi areas comprising four semi-trapezoidal pads, with the pads in both cases consisting of open cell polyurethane foam, approximately two to three inches thick. Exterior spinal padding **21** over the backbone area comprises an oblong strip of raised cubical gel cells, approximately one-quarter to one-half inch in height.

[0022] Referring to FIGS. **2**A, **2**B and **2**C, tangentially-stepped articulated shielding **22** is attached over the padding and consists of two shoulder shields **23** and two elbow shields **24**. Optionally, as mentioned above, two triangular breast plates **18** can also be inserted into the pockets **17** for added protection of the pectoral areas. Preferably, the shielding **22** and breast plates **18**, are fabricated from a light-weight, rigid impact-resistant plastic or ceramic. Each of the shoulder shields **23** comprises three interconnected shoulder shells **25**, each having an open-rectangular or convex shape. Each shoulder shell **25** is hingeably connected at its base to the next adjacent shell **25**, such that each of the shells **25** can rotate upward and slide partially under the next adjacent shell when the garment wearer raises his/her arm. Each of the elbow shields **24** comprises five interconnected elbow shells **26**, each having an open-rectangular or convex shape.

[0023] Each elbow shell **26** is hingeably connected at its base to the next adjacent shell **26**, such that each of the shells **26** can rotate upward and slide partially under the next adjacent shell when the garment wearer bends his/her arm.

[0024] FIGS. **3**A, **3**B and **3**E illustrate in detail the tangentially-stepped articulated structure of one of the shoulder shields **23**. The rotational movement of the shoulder shells **25** when the arm is raised can be seen by comparing FIG. **3**A with FIG. **3**C. FIGS. **3**C and **3**D illustrate in detail the tangentially-stepped articulated structure of one of the elbow shields **24**. The rotational movement of the elbow shells **26** when the elbow is bent can be seen by comparing FIG. **3**D with FIG. **3**C.

[0025] Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that many additions, modifications and substitutions are possible, without departing from the scope and spirit of the present invention as defined by the accompanying claims.

What is claimed is:

1. A protective athletic garment conforming to a wearer's body contours, comprising:

an outer layer and an inner layer;

resilient padding distributed in multiple primary protective areas of the garment, wherein the resilient padding comprises both interior padding and exterior padding, and wherein the interior padding is distributed between the outer layer and the inner layer, and wherein the exterior padding is attached to the outer layer and projects above it, and wherein the resilient padding comprises multiple segments separated by multiple interstices, which facilitate flexing and bending of the garment; and

articulated shielding attached to the outer layer of the garment and covering multiple secondary protective areas of the garment, wherein the articulated shielding comprises multiple hingeably-interconnected shells

arranged in a stepped configuration, and wherein each of the shells has multiple flat and/or convex outer surfaces, and wherein the outer surfaces of the shells are tangentially aligned with respect to the underlying body contours of the wearer, and wherein the shells are made of a light-weight, rigid, impact-resistant material, and wherein the shells of the articulated shielding undulate when impacted by an external force, thereby damping the force and dissipating the impact of the force on the underlying body contours.

2. The protective athletic garment according to claim **1**, wherein the articulated shielding in the secondary protective areas of the garment overlay portions of the resilient padding in the primary protective areas of the garment.

3. The protective athletic garment according to claim **2**, wherein the secondary protective areas are located above the body contours that contain exposed joints and/or bone structures.

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