US 20130269075A1

(19) **United States**

(12) **Patent Application Publication**

Boye

(10) **Pub. No.: US 2013/0269075 A1**

(43) **Pub. Date: Oct. 17, 2013**

(54) **CONFORMABLE DEVICE FOR PROTECTING A JOINT AREA OF THE HUMAN BODY**

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(21) Appl. No.: **13/883,142**

(22) PCT Filed: **Oct. 31, 2011**

(86) PCT No.: **PCT/EP11/69113**

§ 371 (c)(1),
(2), (4) Date: **Jun. 13, 2013**

(30) **Foreign Application Priority Data**

Nov. 3, 2010 (FR) 1059061

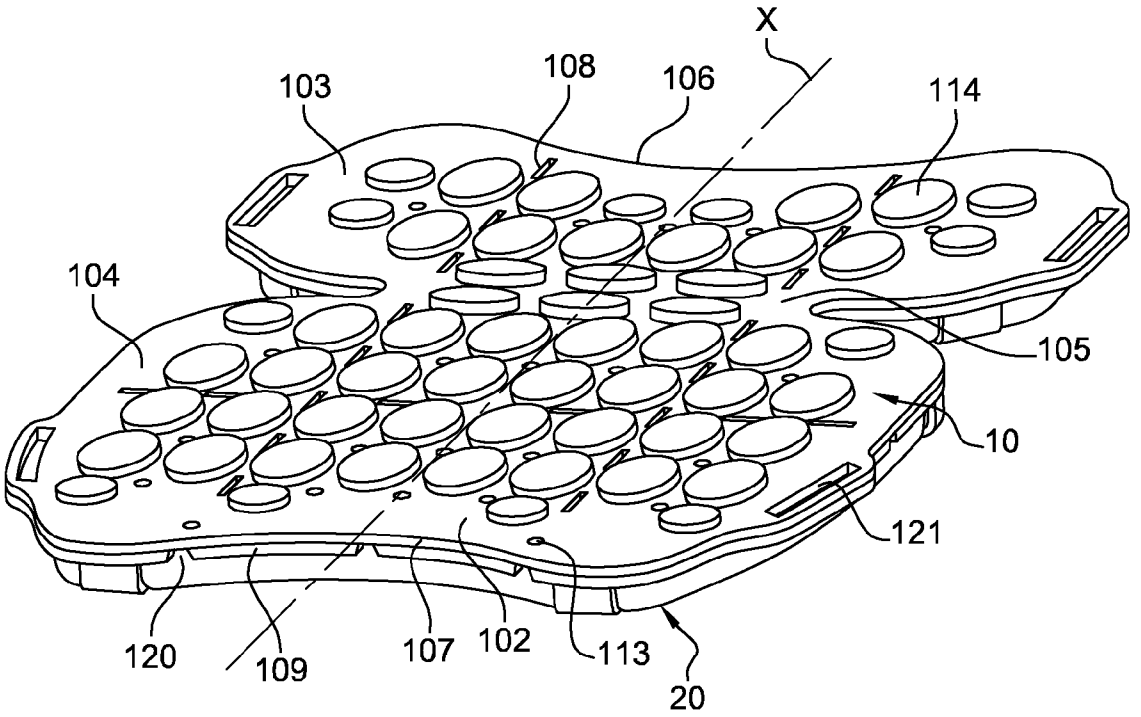
Publication Classification

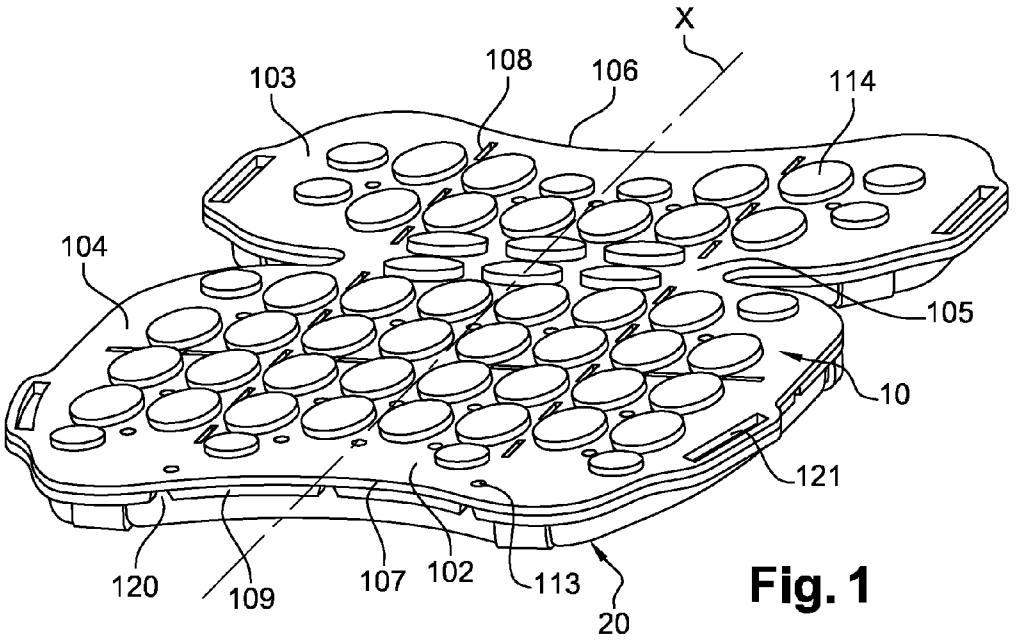
(51) **Int. Cl.**
A41D 13/05 (2006.01)

(52) **U.S. Cl.**
CPC ***A41D 13/05*** (2013.01)
USPC **2/16**

(57) **ABSTRACT**

A device for protecting an area of the human body including a joint, includes a semi-rigid outer shell (**10**) made of an elastically deformable material and an inner shock-absorbing protective element (**20**), intended to be placed facing the body. The device is able to be deformed laterally so as to match the shape of the body in the area including the joint. It also includes elements capable of maintaining it in each given lateral deformation position, in the form of deformable rigid transverse inserts, and elements (**105**, **205**) for folding the device along a transverse axis.




X
103
108
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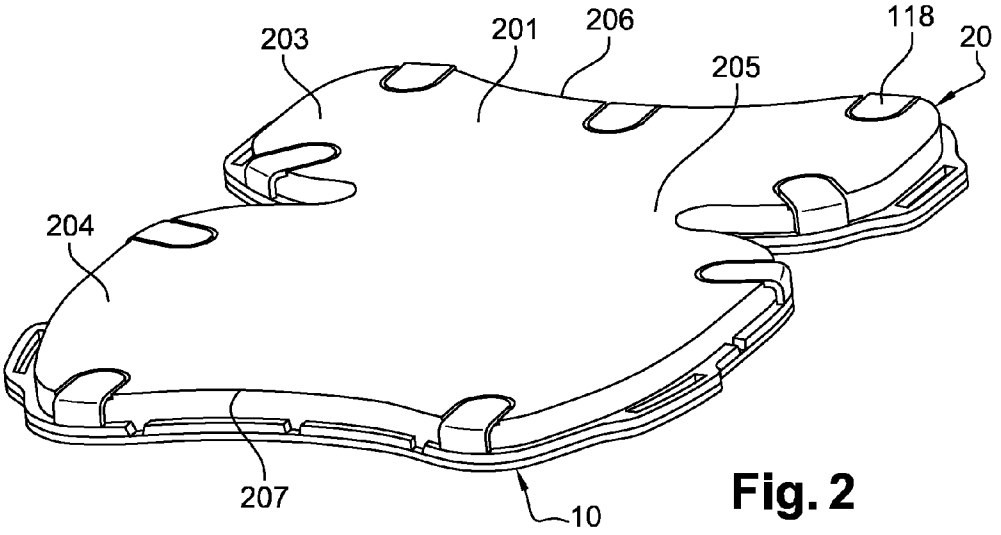
20

Fig. 1


203
201
206
118
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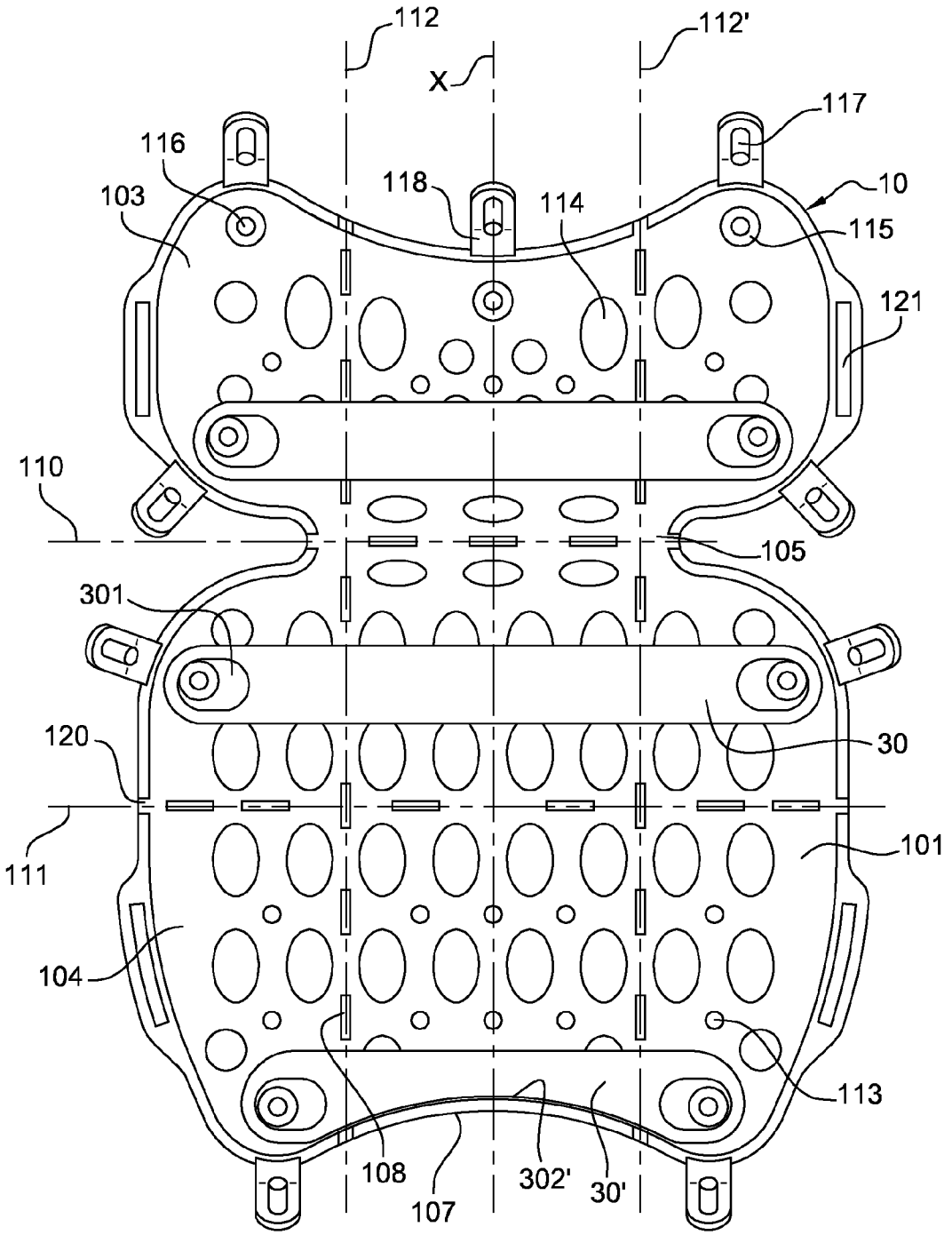
10

Fig. 2


112
112'
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117
116
118
10
103
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115
121
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105
301
120
30
111
101
104
113
108
107
302'
30'

Fig. 3

CONFORMABLE DEVICE FOR PROTECTING A JOINT AREA OF THE HUMAN BODY

[0001] This invention falls within the field of personal protection. More specifically, it relates to a device for protecting an area of the human body including a joint.

[0002] A particularly preferred field of application of this device is the protection of an area of the body that comprises a joint connecting two portions of a limb, such as a knee or elbow. The device according to the invention can, however, be used equally well for protecting other portions of the body comprising a joint, e.g. the shoulder, hip, instep, etc.

[0003] The device according to the invention finds application in personal protection in all fields, for example, but not exclusively, in the military, paramilitary, security fields, and also in the field of sports, of work, or, in general, in any field where protecting a portion of the body is desired.

[0004] Protective devices, of the kneepad or elbow-pad type, are known from the prior art, for example intended to enter into the constitution of military combat clothing. In the most common types these devices are made of a rigid outer protective cup, formed in the general shape of a knee or an elbow, lined inside with padding on a side designed to be placed facing the user's body. These articles also comprise lateral straps for securing them in place and keeping them on the body.

[0005] Such kneepads or elbow-pads of the prior art present a number of drawbacks. In particular, they are not very comfortable to use and they hamper the user's movements, which for the user, for example a soldier or civil protection officer in action, may be disadvantageous.

[0006] This invention aims to remedy the drawbacks of the existing devices for protecting an area of the human body comprising a joint, e.g. the knee or elbow, by proposing such a device that is comfortable to use and that hampers the movements of the person equipped with it as little as possible.

[0007] To this end, a device is proposed according to this invention for protecting an area of the human body including a joint. This device comprises an outer shell made of an elastically deformable, semi-rigid, material and an inner shock-absorbing protective element, intended to be placed facing the body. This device is able to be deformed laterally so as to match the shape of the body in said area including the joint, and it comprises retaining means for maintaining same in each given lateral deformation position, more specifically in each lateral deformation position which it is possible to impose on it.

[0008] The outer shell and the inner protective element each comprise a first side and a second, opposite, side. 'Inner protective element' means, in this description, an element to be placed with its first side, called 'inner side', facing towards the body. 'Outer shell' means that the shell is to be placed away from the body with respect to the inner protective element. According to the invention a first side of this outer shell, called 'inner', is placed facing the second side of the inner element, i.e. the side of the inner element designed to be fitted facing away from the body when the device is in use.

[0009] The device according to the invention can advantageously be shaped laterally, so that it is able to present any lateral deformation position desired, and thus to adjust to the specific morphology of any user, by matching the shape of the latter's body in the area comprising the joint for which protection is desired. It is noted here that the device according to the invention is intended to be placed against the user's body in a position wherein its axis referred to as longitudinal is substantially parallel to the axis of the portion of the body to be protected, e.g. of a leg or an arm. Once shaped into this optimal position, the device is advantageously kept blocked by the retaining means so that, shaped precisely to match the shape of each individual user's body, it provides the user with great comfort in use and at the same time a high level of protection, because of its semi-rigid shell and its inner shock-absorbing element.

[0010] According to preferred embodiments, the invention also exhibits the following features, implemented separately or in each of their technically possible combinations.

[0011] In preferred embodiments of the invention, the device comprises means of folding along a transverse axis. Preferably, the device comprises, along a longitudinal axis, a first portion intended to cover the targeted joint, e.g. the kneecap or the elbow, and a second portion intended to cover a portion of a limb next to this joint, e.g. the upper area of the tibia or the forearm, so as to protect this area when pressed against a hard surface, e.g. when kneeling or when the elbows are leaning on such a surface. The first portion and the second portion are advantageously connected by an area, called 'folding area', for folding along a transverse axis of the device, intended to be placed at the flexing area of the joint.

[0012] This folding area advantageously forms a hinge articulating the first portion and the second portion relative to each other, along a transverse axis of the device. The hinge thus formed allows the device to be deformed at the same time as the body of the user according to the user's movements, in particular the flexion and extension movements of the joint, continuing to match the shape of the portion of the body against which it is applied. As a result, the device according to the invention advantageously does not hamper the user's movements; on the contrary it follows them so that it provides optimum protection regardless of the circumstances, together with great comfort of use.

[0013] Preferably the width of the folding area, measured along a transverse axis of the device, is less than the width of the first portion and the second portion. Thus advantageously, the device has two lateral cut-outs at the folding area. Preferably the folding area also has sufficient height, measured along a longitudinal axis of the device, so that the first portion and the second portion never overlap, even when the device is completely folded on itself.

[0014] Preferably, the device has an outer contour adapted to the shape of the limb. In particular, it has generally curved shapes, so as not to hurt the user, and/or respectively upper and lower edges that are concave.

[0015] In preferred embodiments of the invention, the retaining means for maintaining the device in each given lateral deformation position comprise at least one, preferably a plurality of, deformable rigid transverse inserts, preferably metallic, secured to the shell. These inserts can either be assembled on a side of the shell, preferably on a side, called 'inner', placed facing the inner protective element, or included in the thickness of the shell. Their rigidity is both sufficiently low so that they can be deformed manually and sufficiently high so that, once deformed, they retain the shape imposed on them for a long time, regardless of the movements of the user equipped with the device. In the device's normal configuration of use, the inserts are thus positioned transversally to the limb, and deformed so as to locally match the shape of the limb.

[0016] Preferably, the device comprises at least two retaining inserts placed respectively either side of the folding area. Such a configuration advantageously makes it possible in particular to maintain the device firmly against the user's limb in the area stressed most during movements, around the area where the joint flexes. This results in significantly increased protection for the joint area and comfort in use.

[0017] In preferred embodiments of the invention, the device also comprises an additional insert positioned at its lower edge, so as to match the shape of the body as closely as possible in this place. This insert preferably has a lower edge with the same shape as the lower edge of the outer shell, preferably a concave edge.

[0018] According to an advantageous feature of the invention, the shell comprises, on a side called 'inner' facing the inner protective element, a peripheral rim with extra thickness, advantageously allowing it to be strengthened.

[0019] In preferred embodiments of the invention the shell is provided on its contour with folding notches. These notches are preferably arranged in the thicker peripheral rim. Their number and position on the shell's periphery can vary and are preferably chosen so as to favor the device's articulation along axes that are defined in a suitable way to allow optimum freedom of movement for the user equipped with the device.

[0020] Preferably, the shell comprises at least one, preferably a plurality of, series of through-slots forming fold lines. These fold lines are arranged so as to facilitate the user's movements, preferably in the continuity of the folding notches.

[0021] In preferred embodiments of the invention the shell is also pierced by a plurality of through holes, called 'ventilation holes', distributed over its surface, and advantageously favoring the evacuation of perspiration.

[0022] The shell also preferably comprises, on a side called 'outer', means of absorbing shocks, especially in the form of hollow cells, extending from this outer side in the direction opposite from the inner protective element. These cells can have any shape, e.g. round, oval, square, triangular, etc.

[0023] Preferably, the outer shell is made in a single piece. The inner protective element is also preferably made in a single piece.

[0024] The outer shell and the inner protective element are also preferably configured and arranged with respect to each other so that their facing sides substantially coincide with each other via their outer contour.

[0025] The device complying with one or more of the above features advantageously offers a high level of protection for the joint and a portion of an adjacent limb, together with significant comfort in use, in that it causes little hindrance to the user in movement. It is also able to be adjusted to the specific morphology of the user, and to deform itself at the same time as the joint and the adjacent portion of the limb that it is intended to protect.

[0026] The outer shell and the inner protective element can be secured to each other by any fastening means standard in itself, it being understood that this fastening means must not cause any hindrance or any risk of injury for the user.

[0027] In preferred embodiments of the invention, the device also comprises means of assembly to a system for fastening on the body, in particular loops for inserting fastening straps around the targeted limb.

[0028] The invention will now be described more precisely in the context of preferred embodiments, that are in no way limiting, shown in FIGS. **1** to **3**, wherein:

[0029] FIG. **1** shows a perspective view of a protective device according to the invention, seen from the outer shell side;

[0030] FIG. **2** shows a perspective view of the device of FIG. **1**, seen from the inner protective element side;

[0031] and FIG. **3** shows the side called inner of the outer shell of the device of FIG. **1**.

[0032] A device according to the invention for protecting an area of the human body comprising a joint, for example a knee or an elbow, also able in particular, but not exclusively, to be designated by the terms kneepad or elbow-pad, is shown in FIGS. **1** to **3**.

[0033] This device comprises an outer shell **10** and an inner protective element **20**, which have substantially identical general shapes and which are assembled together by their respective sides, called 'inner side' **101** for the outer shell **10**, and 'outer side' for the inner protective element **20**.

[0034] In the device's normal position of use for protecting a joint area of the human body, the inner protective element **20** is intended to be applied by a side called inner **201**, visible in FIG. **2**, against the joint to be protected, a side called outer **102** of the outer shell **10** then being positioned on the side away from the body. The device is also intended to be positioned on the portion of the body to be protected such that its longitudinal axis X is substantially parallel to the longitudinal axis of the portion in question, e.g. to the longitudinal axis of a lower limb, the leg, or an upper limb, the arm.

[0035] As shown in FIG. **1**, the outer shell **10**, and also the inner protective element **20**, have generally curved outer contours, with no protruding angles, so as to not cause a risk of injury for the user.

[0036] Both the outer shell **10** and the inner protective element **20** comprise two portions extending each to the other along the longitudinal axis X, of which a first portion, called 'upper portion', respectively **103**, **203**, intended to be positioned at the joint itself, e.g. the kneecap or elbow, and a second portion, called 'lower portion', respectively **104**, **204**, intended to be positioned at a portion of a limb next to this joint, e.g. the upper portion of the tibia or the forearm.

[0037] These two portions are connected to each other by an area called 'folding area', respectively **105**, **205**, which is preferably formed at the site of two opposite lateral cut-outs in the device. The width of this folding area **105**, **205** is thus preferably smaller than that of the first and second portions. It is configured so as to allow the device to be folded along a transverse axis substantially perpendicular to the longitudinal axis X, and consequently to allow the relative movements of the first and second portions with respect to each other.

[0038] The outer shell **10** is made of a semi-rigid elastically deformable material, so that it is able to be deformed, especially until a position in which it is able to match the shape of the limb against which the device is applied. It is in particular made of a polymer material, preferably compatible with an injection forming method, preferably based on a thermoplastic polymer, for example a polyolefin or polyurethane.

[0039] The protective element **20** is preferably in the form of a foam sheet able to absorb shocks, made of a flexible material, for example a polyolefin, polyethylene or polypropylene, polyvinyl chloride, rubber, polyurethane, etc. Its density is preferably between 30 and 300 kg/m^3. Preferably, on the inner side **201** of the protective element, this foam is covered by a protective layer, in particular fabric, which ensures its cohesion during the device's use.

[0040] In variants of the invention, the inner protective element **20** is formed by superimposing several foam sheets of different compositions, e.g. a more comfortable foam sheet placed towards its inner side **201**, and a sheet of foam with greater ability to absorb shocks placed towards its outer side.

[0041] The device according to the invention, comprising this outer shell **10** and this inner protective element **20**, is in particular able to be deformed laterally, i.e. by folding on itself parallel to the longitudinal axis X, such that it can advantageously be deformed so as to adopt a complementary shape to the shape of the limb against which it is to be applied, whatever the specific morphology of the user.

[0042] The upper, respectively **106**, **206**, and lower, respectively **107**, **207**, edges of the shell **10** and the inner protective element **20** are also preferably slightly concave, so as to be able to follow the contours of the limb, e.g. leg or arm, against which the device deformed laterally in this way is applied.

[0043] The outer shell **10** comprises at least one series of through-slots **108** forming a fold line. Preferably, a fold line **110** transverse to the longitudinal axis X, visible in FIG. **3**, is formed in this way at the folding area **105**.

[0044] Other fold lines can be formed in the outer shell **10**, so as to favor its folding along given axes.

[0045] As an example, FIG. **3** shows, in addition to fold line **110**, a cross-fold line **111**, positioned in the second lower portion **104**, and two longitudinal fold lines **112**, **112'**, extending over the entire length of the shell **10** substantially parallel to the longitudinal axis X, preferably symmetrical with respect to this. All these fold lines favor the device's preferred articulation along different predefined axes, and advantageously allow it to be deformed according to the user's movements, while continuing to match the shape of its limb thus protected.

[0046] The shell **10** also comprises a peripheral rim **109** with extra thickness, which strengthens it by making it locally more rigid.

[0047] At this rim, it is preferably pierced by notches, called 'folding notches' **120**, preferably distributed on its contour, which advantageously favor the shell's folding on itself along given axes. The number and arrangement of these notches can vary. Notches **120** are preferably positioned in the alignment of each fold line **110**, **111**, **112**, **112'**.

[0048] The shell **10** is also preferably pierced by through holes **113** distributed over its surface, which favor the evacuation of perspiration.

[0049] Cells **114** are formed on the outer side of the shell **10**. These cells advantageously play a role in absorbing shocks exerted on the shell from the external environment. Their number and shape, and their position on the shell's surface, can easily be determined by the person skilled in the art so as to ensure the best shock-absorbing capability for the shell **10**.

[0050] The device also comprises means able to maintain it in each given lateral deformation position. In the particularly preferred example of realization shown in FIG. **3**, these retaining means consist of inserts **30**, in the form of strips, arranged transversally to the longitudinal axis X, preferably so as to extend substantially over the entire width of the device, and having a rigidity that is both sufficiently low so that they can be deformed manually and sufficiently high so that they retain the shape imposed on them under the device's normal conditions of use, i.e. when it is placed on a limb of the human body, such as the leg or arm, to protect its joint and the portion of the limb next to it.

[0051] These strips **30** are preferably made of metal, for example aluminum.

[0052] Preferably, at least two strips **30** are respectively positioned either side of the folding area **105**, so as to keep the device in shape in the lateral deformation position imposed on it either side of the flexing area of the joint, the area where the most stress is exerted on the device as a result of the user's movements.

[0053] In the preferred example of realization shown in FIG. **3**, a third strip **30'** is positioned near the lower edge **107** of the shell. It preferably has a lower edge **302'** with a concave shape similar to the shape of this lower edge **107**. This strip **30'** ensures that the device's shape is maintained at its lower edge.

[0054] The strips **30**, **30'** are assembled in the device in an area where they will not cause any risk of injury for a person wearing the device, or for a person nearby.

[0055] Preferably, these strips **30**, **30'** are positioned between the inner protective element **20** and the outer shell **10**, preferably fixed against the latter's inner side **101**. In alternative embodiments, the strips **30**, **30'** can be included in the very thickness of the shell, during the latter's manufacturing process, for example by an injection molding method.

[0056] The strips **30**, **30'** can be assembled to the shell **10** by any means standard in itself.

[0057] Similarly, the inner protective element **20** can be assembled to the shell **10** by any means standard in itself.

[0058] In the preferred embodiment that is the subject of the figures, the means of fastening firstly the protective element **20**, and secondly the strips **30**, **30'**, to the shell **10**, are the same.

[0059] As shown in FIG. **3**, these fastening means comprise a plurality of fastening studs **115** arranged on the peripheral edge of the shell, on its inner side **101**. Each of these studs is pierced in its center by a hole **116**, inside which can be clipped a lug **117** borne at the end of a tab **118** secured to the shell **10** in an area close to the cooperating stud **115**.

[0060] The protective element **20** is pierced by holes, in areas arranged facing the studs **115** when the shell **10** and the protective element **20** are aligned with each other so as to put their outer contours substantially into alignment.

[0061] The protective element **20** and shell **10** are assembled by inserting the shell's studs **115** into the cooperating holes in the protective element **20**, then folding the tabs **118** so as to insert each lug **117** into a hole **116**. A solid fastening can then be achieved, in particular by ultrasonic or high-frequency welding, gluing, thermal welding, clipping lugs **117** in the holes **116**, or by any other fastening means standard in itself. The length of the tabs **118** is preferably advantageously fixed so that, when the lugs **117** are clipped in the holes **116**, the inner protective element **20** is pressed against the shell **20** by the tabs **118**, as shown in FIG. **2**, in several areas of its periphery.

[0062] The studs **115** are also preferably positioned so that at least one pair of studs is respectively aligned on each of the transverse lines coinciding with the desired position for each strip **30**, **30'** along the inner side **101** of the shell. Each strip is pierced at its opposite ends by a through-opening **301** able to receive a stud **115**.

[0063] Before the protective element **20** is assembled on the shell **10**, each strip **30**, **30'** is positioned against the shell **10**, by inserting a stud **115** into each cooperating opening **301**. The protective element **20** is then in its turn put in place on the studs **115**, so that the strips are then held wedged between the

shell **10** and the protective element **20**. The fastening is then implemented as described above.

[0064] For its use, the device according to the invention can, for example, be inserted into a pocket of an item of clothing worn by the user, in particular a pocket provided for this purpose in an item of military combat clothing.

[0065] Alternatively it can be fixed directly around the area of the body to be protected. For this purpose, it is provided with means of assembly to a system for fastening on the body. In particular, this system is comprised of fastening straps that are self-closing, in particular by fastening means such as self-gripping bands, of the hooks and loops type, or any other fastening means standard in themselves, such as, for example, buttons called press-studs. For this purpose, the shell **10** can for example be fitted with pairs of cooperating lateral loops **121** for such fastening straps.

[0066] The device according to the invention can advantageously be delivered as a flat shape, saving space. When a person wishes to use it, he applies it against the desired portion of his limb, at the joint, positioning the first portion **103**, **203** at the joint itself, and the second portion **104**, **204** at the associated portion of the limb. He shapes the devices, by deforming it laterally, to bring it to a position in which it locally matches the shape of his limb. This operation is easy and quick to carry out. At the end of this, the device advantageously retains this lateral deformation position.

[0067] The device held attached against the user's limb offers the limb effective protection against shocks and external pressure. It is also comfortable in use since, firstly, it is adjusted to the specific morphology of the user and, secondly, it is able to be deformed at the same time as the area of the body against which it is applied, in particular, but not exclusively, at the flexing area of the joint, thanks in particular to the presence of the different fold lines and folding notches provided on the shell **10**. In particular, the device is articulated at the folding area **105**, **205**, which allows the relative movements of the first portion and second portion during flexion and extension movements of the joint.

[0068] The above description clearly illustrates that, through its various features and their advantages, the present invention realizes the objectives it set itself. In particular, it provides a device for protecting an area of the human body including a joint, which is notably especially suited to a military or paramilitary use, in that it effectively protects the joint and a portion of an associated limb while allowing flexion and extension movement and causing little hindrance to the user's freedom of movement.

1-10. (canceled)

11. Device for protecting an area of the human body including a joint, comprising an outer shell made of an elastically deformable material and an inner shock-absorbing protective element intended to be placed facing the body, said device being able to be deformed laterally so as to match the shape of the body in said area, and comprising, along a longitudinal axis, a first portion intended to cover said joint, and a second portion intended to cover a portion of a limb next to said joint, said first portion and said second portion being connected by a folding area for folding along a transverse axis of the device, wherein the device comprises retaining means for maintaining same in each given lateral deformation position, said retaining means comprising at least two deformable rigid transverse inserts secured to said shell and respectively positioned either side of the folding area.

12. Device according to claim **11**, wherein the shell comprises, on a side, called 'inner', facing the inner protective element, a peripheral rim with extra thickness.

13. Device according to claim **11**, wherein the shell is provided on its contour with folding notches.

14. Device according to claim **11**, wherein the shell comprises at least one series of through-slots forming a fold line.

15. Device according to claim **11**, wherein the shell is also pierced by a plurality of through holes distributed over its surface.

16. Device according to claim **11**, wherein the shell comprises, on a side called 'outer', means of absorbing shocks.

17. Device according to claim **11**, comprising means of assembly to a system for fastening on the body.

18. Device according to claim **11**, wherein the inserts are made of metal.

19. Device according to claim **11**, comprising two lateral cut-outs at the folding area.

20. Device according to claim **11**, comprising an additional insert positioned at a lower edge of said device.

* * * * *