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EP 1149608 A1 **WO 2006/092551 A1**
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(54) Title of the Invention: **Limb shield**
Abstract Title: **A contoured limb shield with a multi layer structure**

(57) A limb shield comprising a first rigid shell portion 13a and a second shell portion 13b reconfigurable between a retracted configuration which conforms with the contours of a limb and an extended configuration wherein the second portion is resiliently biased to the retracted configuration. The device may be a shin pad. The first portion 13a may be positioned away from a limb and the second portion 13b may surround the periphery of the first. There may be a depression on the shell adjacent the limb of a user. The shell portions may be formed from laminated layers of aramid. There may also be a compressible high density impact foam layer 15 and a fabric covering 16. A method of forming a cured aramid structure is also disclosed.

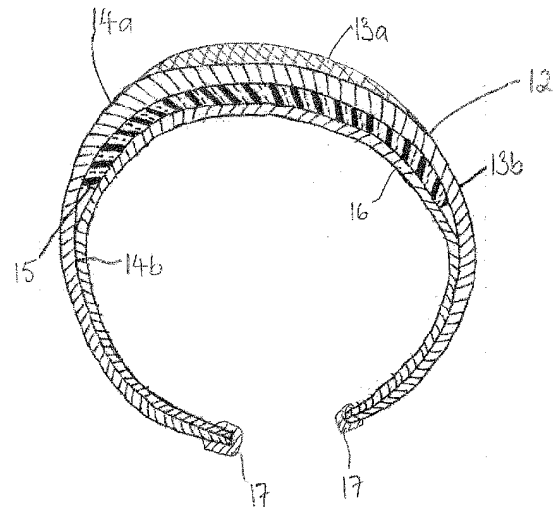


Figure 2

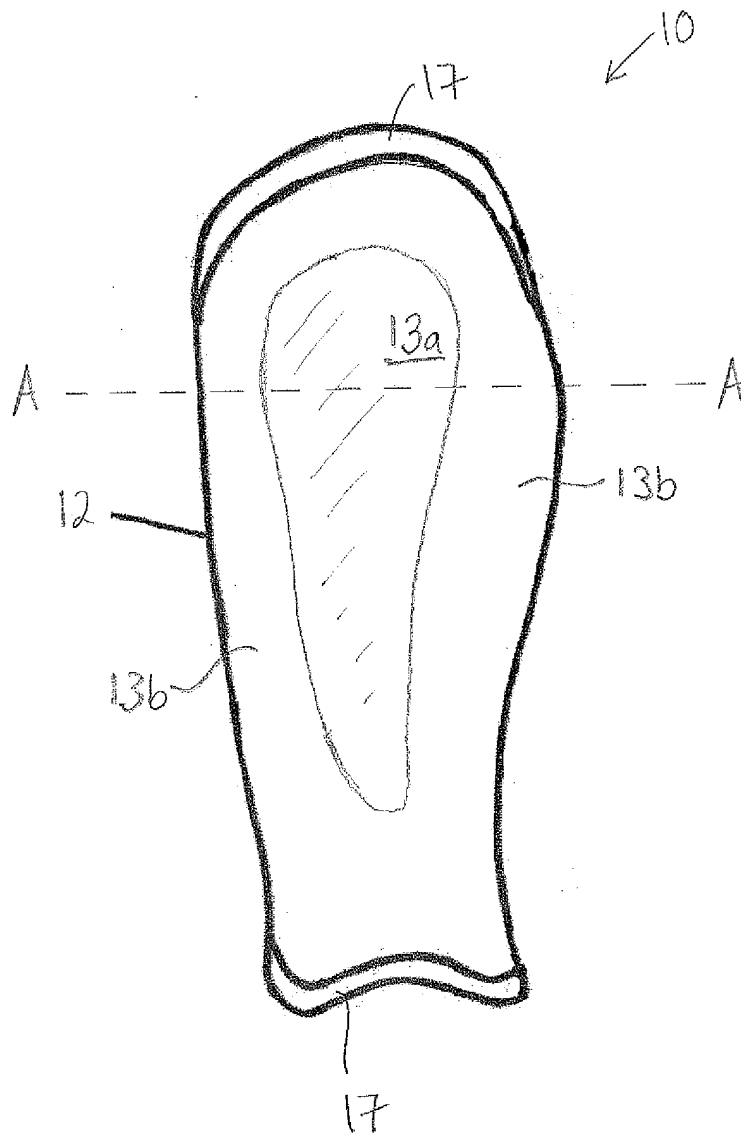


Figure 1

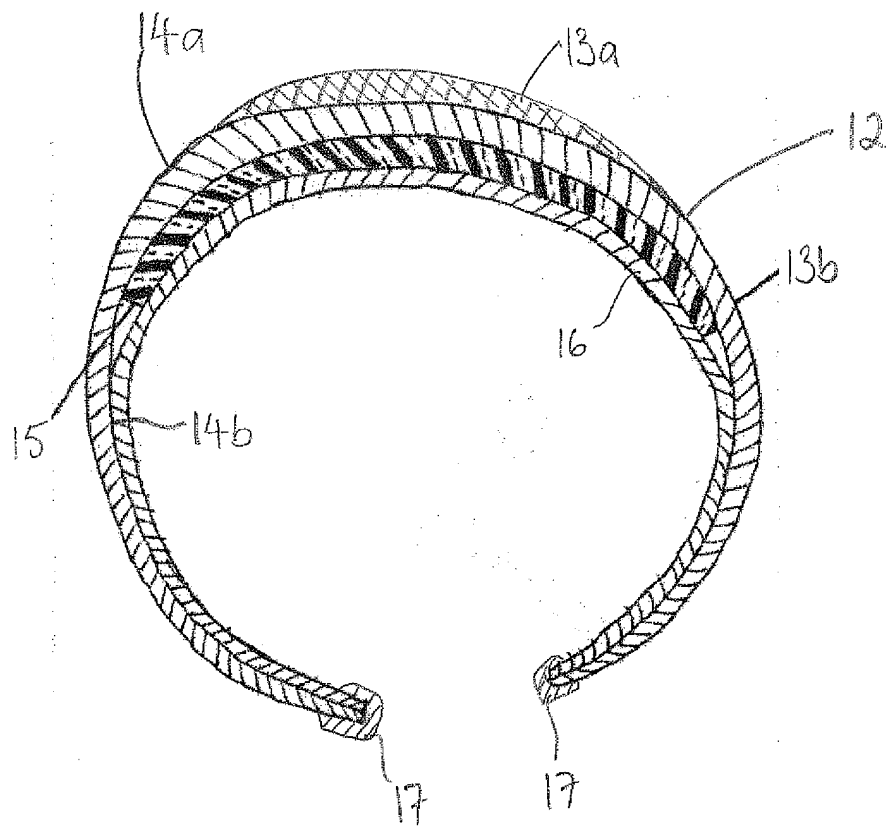


Figure 2

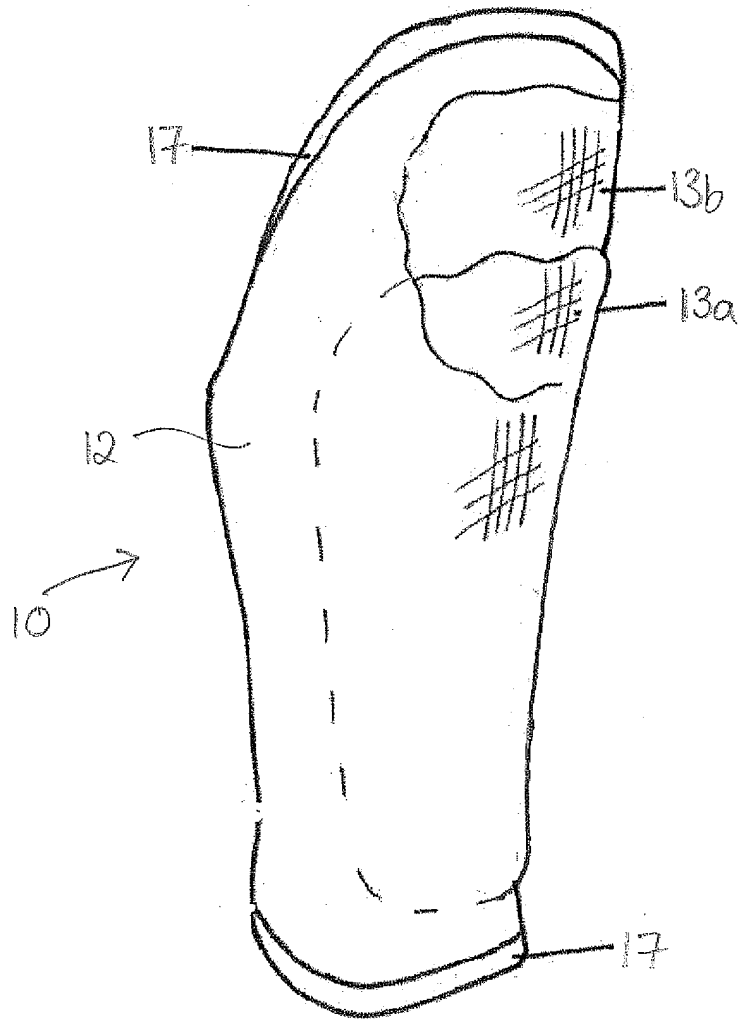


Figure 3

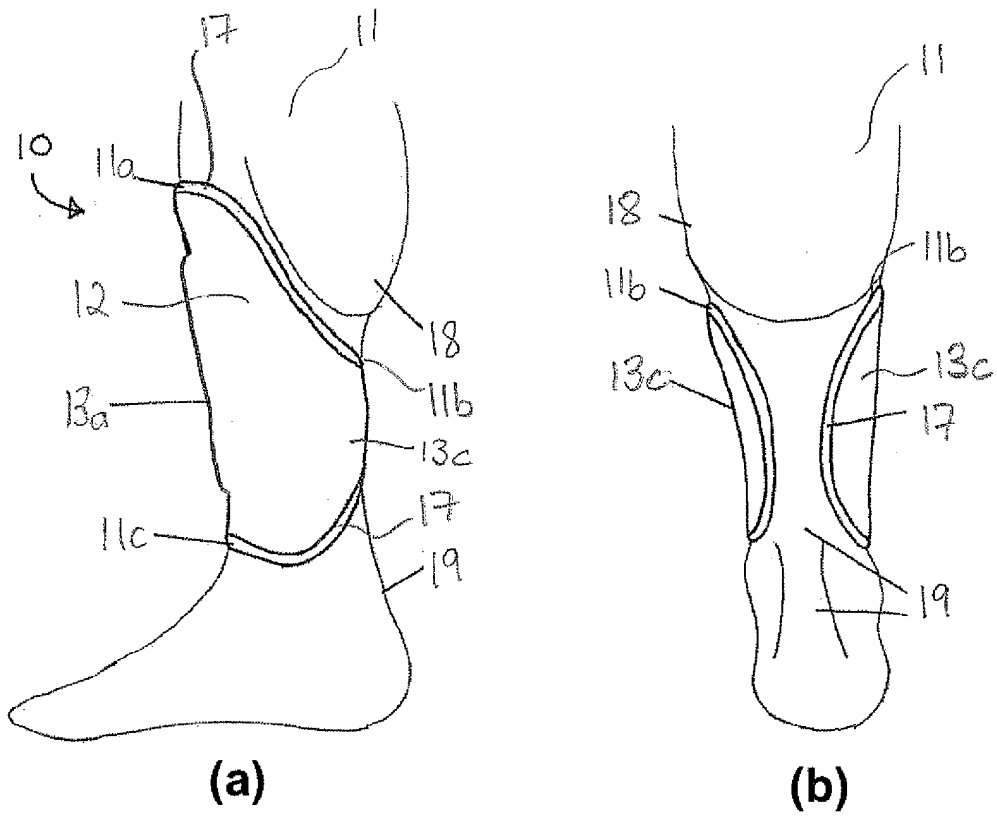


Figure 4

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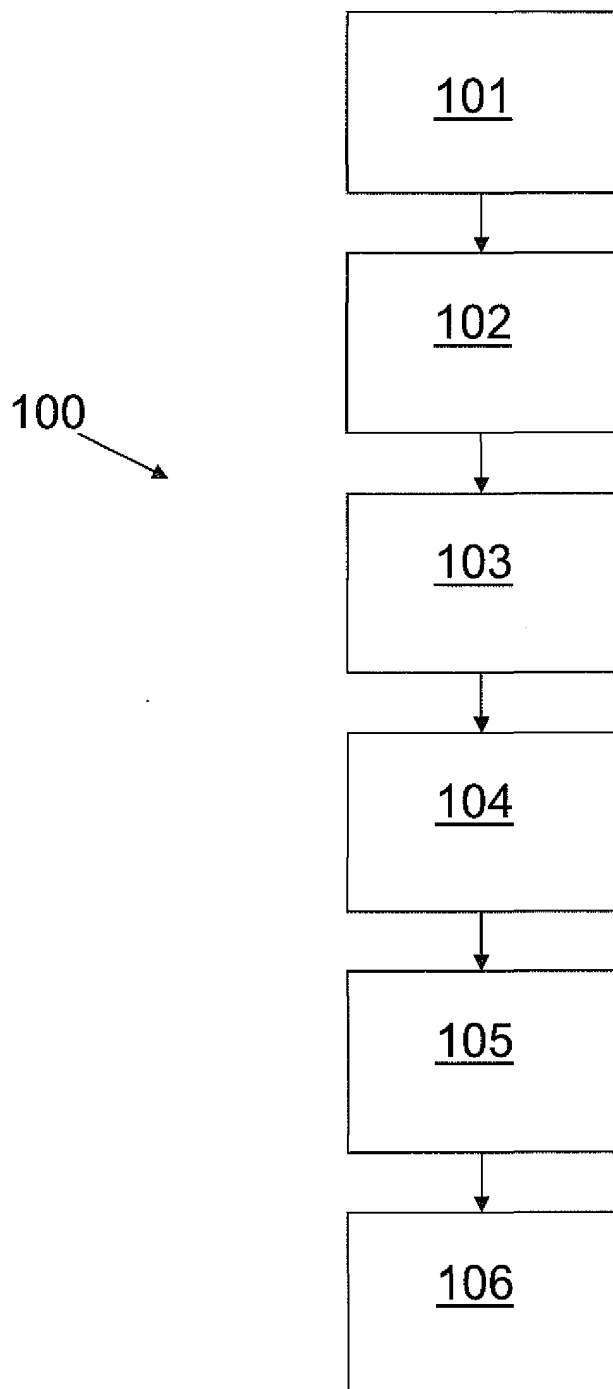


Figure 5

Limb Shield

The present invention relates to a limb shield and particularly, but not exclusively to a limb shield for shielding a limb of a wearer against impacts.

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Leg protection is worn when participating in a variety of activities. When playing football for example, shin guards are used to prevent injuries from tackling and collisions and these guards generally comprise an arcuate, rigid shell which is shaped to extend around at least the front of the leg. The guards are typically held in place using socks
10 which extend around the shell and the leg. However, such guards have a tendency to move out of position and slip down the leg during use, which is found to cause discomfort, limits the protection afforded by the guard and requires frequent repositioning during play.

15 It is also known to secure guards upon a leg using straps, for example which are arranged to extend around the guard and the leg. However, it is found that straps can restrict the movement of the muscle and thus the mobility of the limb. It is also found that the straps can create discomfort and in some cases cause the muscle to involuntarily contract.

20

We have now devised an improved limb shield.

In accordance with the present invention as seen from a first aspect, there is provided a limb shield for shielding a limb of a wearer against impacts, the shield comprising a shell
25 having a first shell portion and a second shell portion,

the first portion comprising a substantially rigid portion,

the second portion being reconfigurable between a retracted configuration in which the shell is configured to conform substantially with contours of the limb to hold the shield in place upon the limb, and an extended configuration in which the shell is
30 configured to receive the limb,

wherein the second portion is resiliently biased to the retracted configuration.

Advantageously, the shield provides for a secure fit around the wearer's limb without the requirement for securing straps or socks, for example to hold the shield in place.

Furthermore, the matched contour of the shell to the wearer's limb is found to support the limb and thus facilitates the recovery of an injured limb while also shielding the limb from impacts.

- 5 The second portion preferably extends around at least a portion of a periphery of the first portion.

The shell comprises an interior surface which is arranged to extend substantially adjacent the limb of the wearer and an exterior surface which is arranged to extend
10 away from the limb of the wearer. The first portion preferably comprises an increased shell thickness compared with the second portion and is arranged to extend further from the limb than the second shell portion. In this respect, the first portion comprises a raised portion of the exterior surface of the shell.

- 15 Preferably, the shell further comprises a depression formed within the shell at the side which is arranged to extend adjacent the limb of the wearer, substantially adjacent the first portion.

The first and second portions are preferably formed integrally and preferably comprise a
20 laminated arrangement of layers, such as layers of aramid fabric. The first portion preferably comprises more layers than the second portion.

Preferably, the second portion is contoured to extend either side of a limb tendon, such as an Achilles tendon, to minimise restrictive movement of the limb.

25

Preferably, the shield further comprises a compressible portion which is arranged to extend over at least a portion of a surface of the shell which is arranged to extend substantially adjacent the limb. The compressible portion preferably comprises a high density impact foam and is arranged to provide for a comfortable fit of the shield upon a
30 wearer's limb, in addition to providing further protection to the limb from impacts.

The shield preferably further comprises a fabric, preferably a breathable fabric, which is arranged to extend over at least a portion of the surface of the shell which is arranged to

extend substantially adjacent the limb. Preferably, the fabric is further arranged to extend over the compressible portion.

5 Preferably, the shield further comprises a strip which is arranged to extend around a periphery of the shell to cover the periphery of the shell and thus protect the wearer from any sharp or rough edges.

In accordance with the present invention there is provided a method of forming a cured aramid structure, the method comprising the steps of:

10 forming a mould from a foam material for moulding the structure;
disposing at least one aramid layer on the foam mould;
applying an epoxy resin to the at least one aramid layer to produce a wet composite; and,
allowing the wet composite to dry.

15

Preferably, the wet composite is dried at substantially room temperature.

The method preferably further comprises strengthening the mould by coating the mould with a strengthening material. Preferably, the strengthening material comprises fibre
20 glass and an epoxy resin.

An embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

25 Figure 1 is a perspective view of a limb shield according to an embodiment of the present invention configured for a lower leg of a wearer;

Figure 2 is a transverse sectional view across the limb shield illustrated in figure 1, taken across line A-A;

30

Figure 3 is a perspective view of the limb shield illustrated in figure 1, illustrating the first and second portion;

Figure 4a is a side view of the limb shield illustrated in figure 1 as worn upon the lower leg of a wearer;

Figure 4b is a rear view of the limb shield illustrated in figure 1 as worn upon the lower
5 leg of a wearer; and,

Figure 5 is a flow chart illustrating the sequence of steps associated with the method of forming a cured aramid structure.

10 Referring to figures 1 to 3 of the drawings, there is illustrated a limb shield 10 according to an embodiment of the present invention for shielding at least a portion of a wearer's limb, such as a lower leg 11 from impacts. The shield 10 comprises a protective shell 12 having a first 13a and second 13b shell portion, which is shaped to conform with the contours of the wearer's lower leg 11.

15

The shell 12 comprises a curved surface which is shaped to wrap around the wearer's lower leg 11. In the illustrated embodiment, the first portion 13a of the shell 12 is disposed substantially centrally of the shell 12 and as such, the second portion 13b extends around the entire periphery of the first portion 13a. However, it is to be
20 appreciated that the first portion 13a may extend to a peripheral position of the shell 12 and/or through a periphery of the second portion 13b and as such the second portion 13b may only extend along a portion of the periphery of the first portion 13a.

The first and second portions 13a, 13b are formed integrally and comprise a laminated
25 composite layers, such as a laminated composite of aramid layers. The second portion 13b typically comprises a three layer laminate whereas the first portion 13a typically comprises a seven layer laminate, however it is to be appreciated that the first and second portions 13a, 13b may comprise a different number of layers. The first portion 13a is arranged to extend outwardly of the shell 12 from the convex or exterior surface
30 14a of the shell 12 and comprises an increased thickness compared with the second portion 13b. In this respect the first portion 13a forms a protuberance on the shell 12 and is arranged to increase the strength of the shell and thus the shield 10. The first portion 13a further serves to increase the separation of the wearer's leg 11 from an impacting force and thus reduces the possibility of the impacting object (not shown) contacting the

leg 11 in the event the first portion 13a is penetrated. The transition from the first portion 13a to the second portion 13b is illustrated in the drawings as a stepped profile in the shell 12 thickness, however, the transition may comprise a gradual change in the thickness of the shell 12.

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In an embodiment of the invention, the shell 12 further comprises a depression (not shown) formed along the concave or interior surface 14b thereof, substantially adjacent the first portion 13a. The depression (not shown) is arranged to further increase the separation of the leg 11 from an impacting force upon the shield 10 and also to allow the muscle, such as the tibialis anterior muscle (not shown) at the front of the lower leg 11 to freely contract and expand, thereby improving the mobility of the leg 11.

10

The shield 10 further comprises a compressible portion 15, such as a high density impact foam, disposed on the interior surface 14b of the shell 12. The foam 15 is secured to the shell 12 using an adhesive or stitching (not shown) and is arranged to extend over at least the area of the shell 12 which is substantially adjacent the first portion 13a, to dampen any impacting force and assist in dispersing the force.

15

The first and second portions 13a, 13b are substantially rigid and inflexible, however, the increased thickness of the first portion 13a compared with the second portion 13b renders the first portion 13a substantially more rigid and less flexible than the second portion 13b. The second portion 13b is permitted to flex slightly to enable a wearer (not shown) to suitably locate the shield 10 upon the leg 11. However, the second portion 13b is resiliently biased to an unflexed configuration in which the second portion 13b substantially conforms with the contours of the leg 11 to hold the shield 10 upon the leg 11. The increased thickness of the shell 12 over the first portion 13a serves to increase the surface area of the shell 12 and as such is more effective at dispersing the impacting force thereby reducing the possibility of injuring the leg 11, compared with a shell 12 having a uniform thickness.

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The shield 10 further comprises an absorbent, breathable fabric 16 which is arranged to extend over the interior surface 14b of the shell 12 to cover the compressible portion 15, and is stitched or otherwise bonded to the periphery of the shell 12. The absorbent fabric 16 is arranged to absorb any excess moisture away from the leg 11 and provide for a

comfortable fit upon the leg 11. In order to reduce the possibility of any sharp edges of the shell 12 contacting the wearer's leg, a durable, flexible strip or binding member 17 such as leatherette or nylon denier, is secured to the periphery of the shell 13 and is arranged to extend over a peripheral edge of the interior and exterior surface 14a, 14b of the shell 12.

In the embodiment illustrated in figure 4 of the drawings, the shield 10 is arranged to protect the lower leg 11 and in particular the tibia bone and tibialis anterior muscle (not shown) of the lower leg 11. The periphery of the shield is arranged to extend from an upper position 11a at the front of the leg 11, around the leg 11 to a position either side of the leg 11b at the rear thereof and at the underside of the calf muscle 18. The periphery of the shield 10 is further arranged to extend from the underside of the calf muscle 18, down the rear of leg 11 either side of the Achilles tendon 19 and then back around to the front of the lower region 11c of the lower leg 11. In this respect, the shield 10 is arranged to protect the front and side of the lower leg 11, while enabling the muscle 18 and tendon 19 to freely expand and contract to avoid unduly restricting the movement of the lower leg 11.

The shield illustrated in figures 1 to 4 of the drawings is positioned upon the lower leg 11 by flexing the sides 13c the shell 12 to separate them, so that a wearer (not shown) can suitably position their lower leg 11 therebetween. The resilient bias of the second portion 13b subsequently causes the second portion 13b to recover its original configuration to suitably wrap around the wearer's leg 11 to hold the shield 10 in place. In order to remove the shield 10, the shield sides 13c are similarly flexed to separate the sides 13c so that the wearer (not shown) can pass their lower leg 11 therebetween.

In order to provide a secure fit of the shield 10 upon the wearer's leg 11, the shield 10 and in particular, the shell 12 is shaped in accordance with the contours of the leg. The bespoke shape of the shield 10 is formed by first taking a cast or mould of the leg 11. Alternatively, the shape of the leg 11 may be captured digitally using a 3-dimensional scanner, such as the Creaform 3-dimensional Handyscan (not shown).

Referring to figure 5 of the drawings, there is illustrated a method 100 of forming a cured aramid structure, such as the shell 12 of the limb shield 10, according to an embodiment

of the present invention. The method 100 comprises utilizing the digitally captured contour information to form a mould (not shown) of the leg 11 from a foam material at step 101, such as the so-called commercially available blue foam. The mould is then strengthened by coating the mould with a layer of fibre glass and epoxy resin for example, at step 102. The laminated composite 12, 13 is then formed by overlaying dry aramid fabric layers (not shown) on the mould (not shown) at step 103 and applying an epoxy resin at step 104 to the layers (not shown) to form a wet composite arrangement (not shown). Once the desired number of layers (not shown) have been built upon the mould (not shown), the wet composite is allowed to cure, namely dry, at room temperature at step 105.

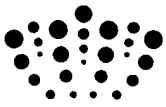
The cured structure is subsequently removed from the mould at step 106, and the periphery thereof is suitably cropped at step to remove any extraneous portions therefrom. The compressible portion 15 may then be bonded to the interior of the shell 12 and then covered with the breathable, absorbent fabric 16. Finally, the binding member 17 may be applied to the periphery of the shell 12 to cover any remaining rough edges and thus provide for a smooth comfortable feel against the leg 11.

From the foregoing therefore, is evident that the shield according to the above described embodiment, provides for an improved protection for limbs against impacts.

Claims

1. A limb shield for shielding a limb of a wearer against impacts, the shield comprising a shell having a first shell portion and a second shell portion,
5 the first portion comprising a substantially rigid portion,
 the second portion being reconfigurable between a retracted configuration in which the shell is configured to conform substantially with contours of the limb to hold the shield in place upon the limb, and an extended configuration in which the shell is configured to receive the limb,
10 wherein the second portion is resiliently biased to the retracted configuration.
2. A shield according to claim 1, wherein the second portion extends around at least a portion of a periphery of the first portion.
3. A shield according to claim 1 or 2, wherein the first portion comprises an
15 increased shell thickness compared with the second portion.
4. A shield according to any preceding claim, wherein during use, the first shell portion is arranged to extend further from the limb than the second shell portion.
5. A shield according to any preceding claim, wherein the shell further comprises a depression formed therein at the side of the shell which is arranged to extend
20 adjacent the limb of the wearer, substantially adjacent the first portion.
6. A shield according to any preceding claim, wherein the first and second portions are formed integrally.
7. A shield according to any preceding claim, wherein the first and second portions comprise a laminated arrangement of layers.
- 25 8. A shield according to claim 7, wherein the first portion comprises more layers than the second portion.
9. A shield according to any preceding claim, wherein the shell is contoured to extend either side of a tendon of the limb, to minimise restrictive movement of the limb.
- 30 10. A shield according any preceding claim, further comprising a compressible portion which is arranged to extend over at least a portion of a surface of the shell which is arranged to extend substantially adjacent the limb.
11. A shield according to claim 10, wherein the compressible portion comprises a high density impact foam.

12. A shield according to any preceding claim further comprising a fabric which is arranged to extend over at least a portion of the surface of the shell which is arranged to extend substantially adjacent the limb.
13. A shield according to claim 12, wherein the fabric is further arranged to extend
5 over the compressible portion.
14. A shield according to any preceding claim further comprising a strip which is arranged to extend around a periphery of the shell to cover the periphery of the shell and thus protect the wearer from any sharp or rough edges.
15. A method of forming a cured aramid structure, the method comprising the steps
10 of:
forming a mould from a foam material for moulding the structure;
disposing at least one aramid layer on the foam mould;
applying an epoxy resin to the at least one aramid layer to produce a wet
composite; and,
15 allowing the wet composite to dry.
16. A method according to claim 15, wherein the wet composite is dried at substantially room temperature.
17. A method according to claim 15 or 16, further comprising strengthening the mould by coating the mould with a strengthening material.
- 20 18. A method according to claim 17, wherein the strengthening material comprises fibre glass and an epoxy resin.



Application No: GB1116278.1

Examiner: Mr Daniel Cox

Claims searched: 1-14

Date of search: 9 November 2011

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-14	US2009/205097 A1 MANNING, See whole document
X	1-14	WO2006/092551 A1 COATES, See whole document
X	1-14	EP1149608 A1 MCFARLANE, See whole document
X	1-14	WO2004/049842 A1 LESOSKY, See whole document
X	1-14	US2007/214538 A1 CASTONGUAY, See whole document
X	1-14	US5890224 A CLARK, See whole document
X	1-14	DE4120135 A1 ZEPF, See figures and abstract accession number 1993-000609 [01]

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Field of Search:

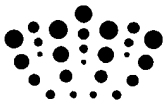
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A63B

The following online and other databases have been used in the preparation of this search report

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International Classification:

Subclass	Subgroup	Valid From
A63B	0071/12	01/01/2006
A41D	0013/00	01/01/2006
A41D	0013/015	01/01/2006
A41D	0013/05	01/01/2006