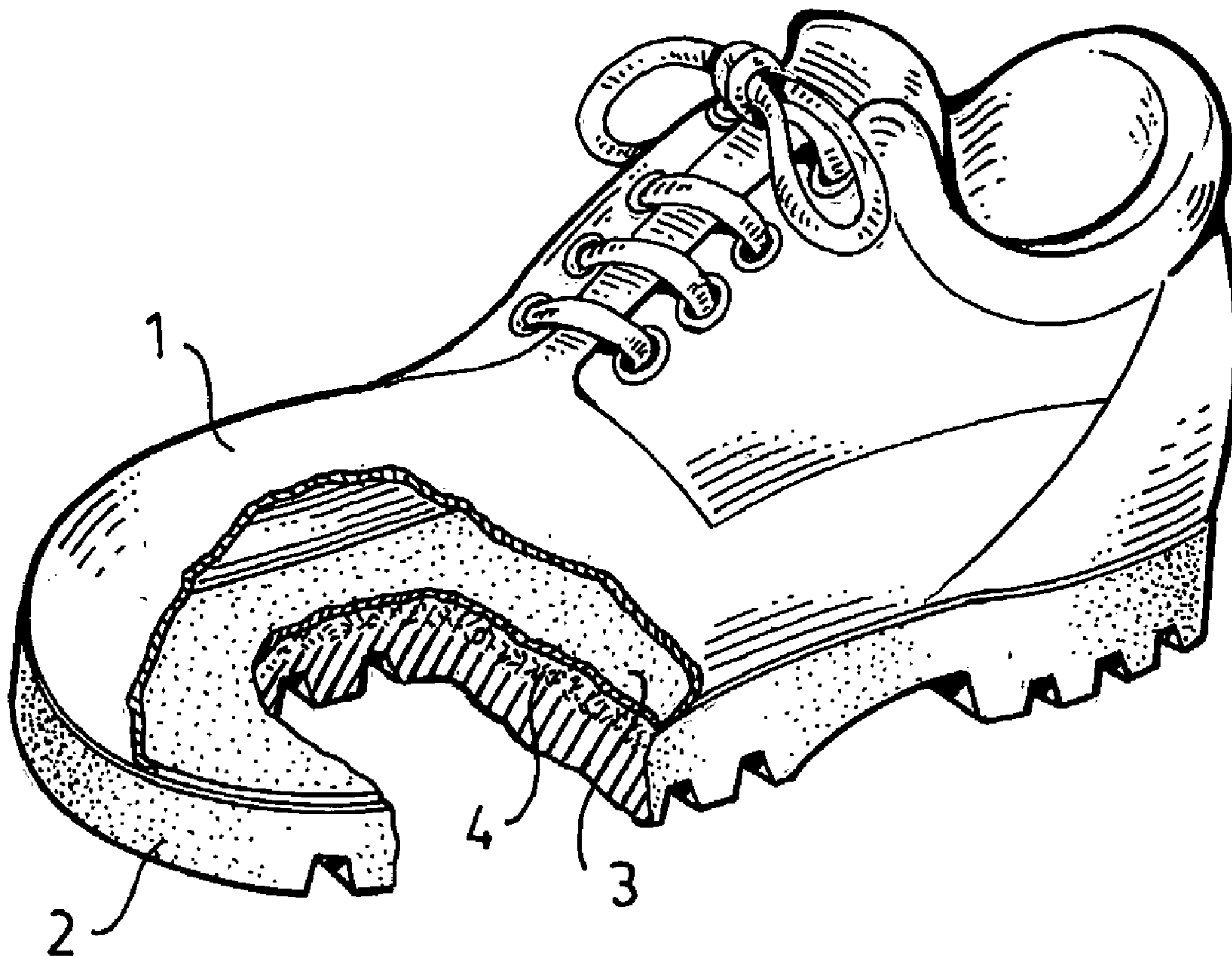




(86) Date de dépôt PCT/PCT Filing Date: 2001/12/19
(87) Date publication PCT/PCT Publication Date: 2002/06/27
(45) Date de délivrance/Issue Date: 2010/11/09
(85) Entrée phase nationale/National Entry: 2003/06/16
(86) N° demande PCT/PCT Application No.: SE 2001/002831
(87) N° publication PCT/PCT Publication No.: 2002/049466
(30) Priorité/Priority: 2000/12/20 (SE0004725-8)

(51) Cl.Int./Int.Cl. *A43B 13/12* (2006.01),
A41D 13/00 (2006.01), *A43B 7/32* (2006.01),
B32B 25/02 (2006.01), *B32B 5/16* (2006.01)
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(54) Titre : COUCHE SOUPLE DE PROTECTION POUR PRODUITS DE PROTECTION DU CORPS
(54) Title: A FLEXIBLE PROTECTION LAYER FOR BODY PROTECTING PRODUCTS



(57) Abrégé/Abstract:

Method for producing a flexible protection layer which can be incorporated in different body protecting products in order to prevent injuries caused by penetrating objects, such as nails, pointed weapons and the like. According to the method polymer fibres having



(57) **Abrégé(suite)/Abstract(continued):**

a high breaking point are embedded in a hardenable binding material so that the binding material surrounds the fibres and upon hardening fixes the fibres in their positions. The method is characterized in that the fibres are embedded in the binding material in a mutually unarranged order, preferably felted together. The invention also relates to a flexible protection layer produced in accordance with the method and which can be incorporated in different body protecting products.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

REVISED VERSION

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
27 June 2002 (27.06.2002)

PCT

(10) International Publication Number
WO 02/049466 A1(51) International Patent Classification⁷: **A41D 13/00 //**
A41H 1/00, A43B 13/12, B32B 5/16

(21) International Application Number: PCT/SE01/02831

(22) International Filing Date:
19 December 2001 (19.12.2001)

(25) Filing Language: Swedish

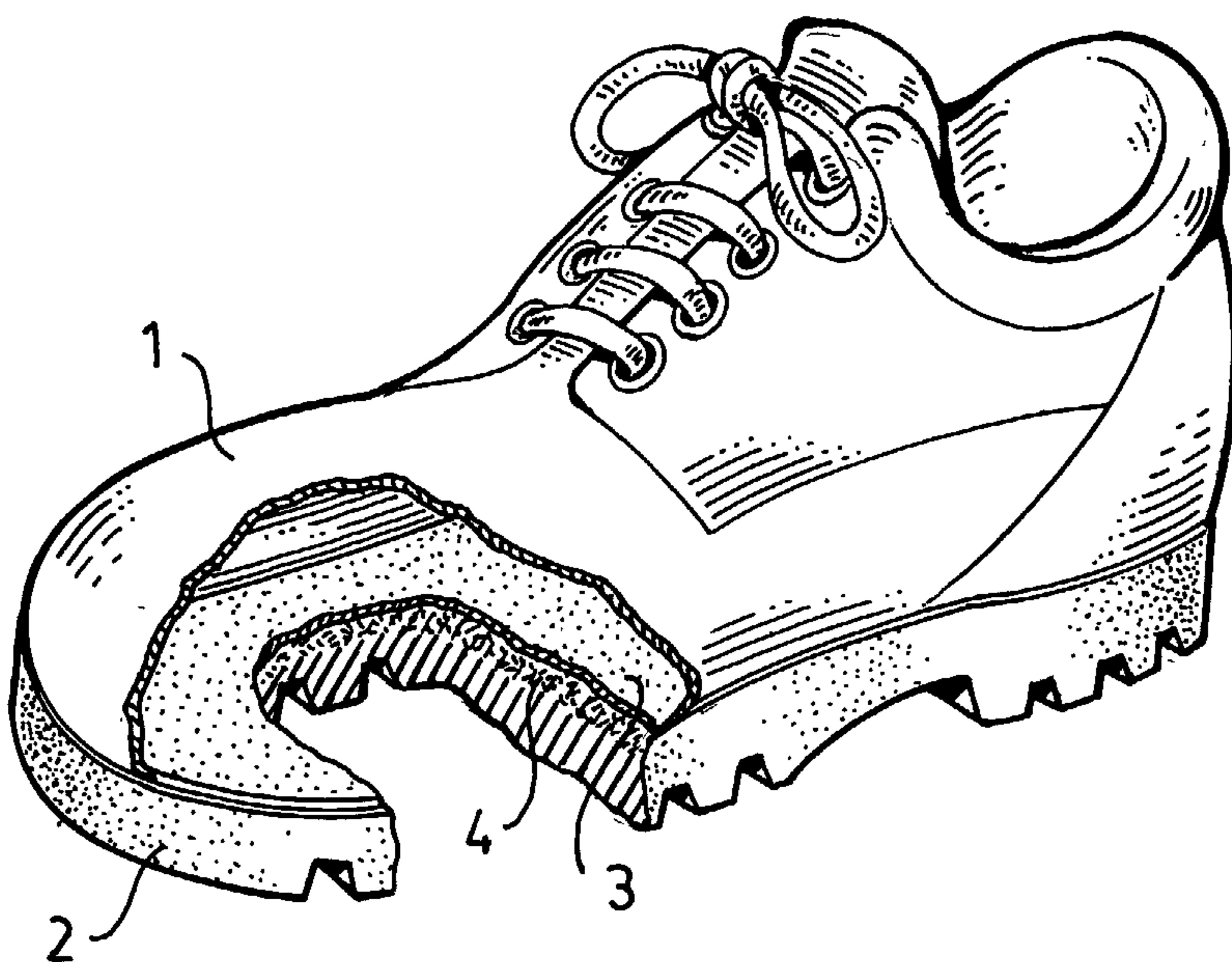
(26) Publication Language: English

(30) Priority Data:
0004725-8 20 December 2000 (20.12.2000) SECZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,
SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ,
VN, YU, ZA, ZW.(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR,
GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent
(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR,
NE, SN, TD, TG).(71) Applicant (*for all designated States except US*):
ARBESKO AB [SE/SE]; Box 1642, S-701 16 Öre-
bro (SE).**Published:**
— *with international search report*

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(75) Inventor/Applicant (*for US only*): **GEISLER, Peter**
[SE/SE]; Drottninggatan 18B, S-702 10 Örebro (SE).(88) Date of publication of the revised international search
report: 15 May 2003(74) Agents: **AXELSSON, Rolf** et al.; Kransell & Wennborg
AB, Box 27834, S-115 93 Stockholm (SE).(15) Information about Correction:
see PCT Gazette No. 20/2003 of 15 May 2003, Section II(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,*For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

(54) Title: A FLEXIBLE PROTECTION LAYER FOR BODY PROTECTING PRODUCTS



(57) Abstract: Method for producing a flexible protection layer which can be incorporated in different body protecting products in order to prevent injuries caused by penetrating objects, such as nails, pointed weapons and the like. According to the method polymer fibres having a high breaking point are embedded in a hardenable binding material so that the binding material surrounds the fibres and upon hardening fixes the fibres in their positions. The method is characterized in that the fibres are embedded in the binding material in a mutually unarranged order, preferably felted together. The invention also relates to a flexible protection layer produced in accordance with the method and which can be incorporated in different body protecting products.

WO 02/049466 A1

A FLEXIBLE PROTECTION LAYER FOR BODY PROTECTING PRODUCTSFIELD OF THE INVENTION

The present invention relates to a method of producing
5 a flexible protective layer which can form part of
various body-protecting products in order to prevent
injuries caused by penetrating objects, such as nails,
pointed weapons and the like, in which polymer fibers
with high ultimate strength are embedded in a
10 hardenable binder, so that the latter surrounds the
fibers and, after hardening, fixes the fibers in the
positions in which they are located.

The invention also relates to a flexible protective
15 layer which can form part of various body-protecting
products, and also footwear and articles of protective
clothing with such protective layers.

BACKGROUND OF THE INVENTION

20 In many situations, there is a need for protective
layers which can be integrated into various body-
protecting products in order to prevent injuries caused
by penetrating objects such as nails, pointed weapons
and the like. One area where a great need exists for
25 protection against penetrating nails is footwear for
people who work on construction sites, where inter alia
construction timber with projecting nails is found.
Treading on a nail can give rise to serious foot
injuries and infections.

30

It has long been known to use inserts made of steel or
metal in footwear for construction workers. Such metal
inserts can provide good protection but have certain
disadvantages. Among other things, they contribute to
35 making the shoe relatively rigid and stiff. This
prevents normal bending of the foot and impairs the
sense of feeling against the ground, which can increase
the risk of inter alia falling and slipping accidents.

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In order to overcome some of these problems, US-A-1701611 describes footwear with a flexible metal insert which comprises a woven metal wire fabric. However, the use of metal also results in other disadvantages, as metals are usually good conductors of both heat and electricity. Shoes with metal inserts therefore impair the possibility of keeping the foot warm in a cold climate and can, on account of their conductive capacity, constitute risks in some workplaces and for certain occupational groups such as, for example, electricians.

In order to eliminate problems associated with using metal, the use of synthetic fiber material embedded in a shoe sole has previously been proposed. In this connection, the fibers are woven into a fabric, and one or more layers of such a fabric can then be molded integrally in a shoe sole, so that the material of the shoe sole completely impregnates the woven layers. An example of a protective boot with such a sole is described in US-A-5979081.

WO 99/13744 describes a variant of a protective boot with layers of synthetic fiber fabric integrated into the sole. In this case, the fibrous fabric is not impregnated with binder in the sole but can, for example, be fitted in a pocket formed between the inner and the outer sole of footwear.

It is common to all known protective layers using synthetic fibers with high ultimate strength that the fibers are applied in the form of a woven fabric or the like, that is to say in a structure in which the fibers are in some way arranged in a predetermined pattern relative to one another. Testing has nevertheless shown that a nail, for example, is capable of "finding its way through" any arranged fibrous structure, even if the latter consists of a very tight weave. In order to prevent this, an impractical number and thickness of

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woven layers would be required. This would make the shoe clumsy, and increase its weight and the consumption of expensive fibrous material.

5 THE OBJECT OF THE INVENTION

A main object of the present invention is to provide a method of producing a flexible protective layer which can, for example, be used in footwear as anti-nail protection, affords improved protection and can consist
10 of relatively thin and light layers.

The invention is based on the insight that this aim can be achieved by using fibers made of a synthetic material with high ultimate strength, which fibers are
15 not woven or otherwise joined together so that they form a regular structure before they are embedded in the binder.

In this connection, according to the present invention,
20 the particularly characteristic feature of a method of the type indicated in the first paragraph is that the fibers are embedded in the binder in an unarranged state in relation to one another.

25 The protective layer will therefore consist of a binder layer reinforced with fibers which are located close together and are fixed in random positions relative to one another. Such a layer with randomly oriented fibers has been found to have very great resistance to
30 penetration and to constitute extraordinarily good protection against penetrating objects such as nails, pointed weapons and the like.

It is preferable for the fibers to be felted together
35 to form a handleable product before they are embedded in the binder. This facilitates handling of the fibers and thus the manufacture of the protective layer without the fibers having to be structured as in a woven fabric or the like.

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In an especially preferred method according to the invention, use is made of a high-molecular polyethylene fiber sold under the trademark DYNEEMA® which, as a consequence of its properties, inter alia a very high ultimate strength and great rigidity, has been found to afford extraordinarily good protection against penetration when, for example, fibers made of this material are molded integrally, in an unarranged state, in a shoe sole, suitably made of polyurethane.

Other features of a method according to the invention and a protective layer manufactured by means of the method and also products provided with such protective layers are identified below.

In accordance with an first aspect of the present invention, there is provided a method of producing a flexible penetration-resistant protective layer for footwear, the method comprising

- (i) felting polymer fibers in a random arrangement in relation to one another, to produce a manageable felted fiber product;
- (ii) embedding the felted fiber product in a hardenable binder, so that the binder surrounds the fibers;
- (iii) hardening the binder to fix the fibers in the positions in which they are located; and
- (iv) forming the hardened binder into a sole of the footwear.

In accordance with another aspect of the present invention, there is provided a flexible penetration-resistant protective layer for footwear, the layer comprising

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a hardened binder formed into a sole of the footwear; and
a manageable felted fiber product embedded in and surrounded
5 by the binder, the felted fiber product comprising polymer
fibers felted together and fixed in a random arrangement in
relation to one another.

In accordance with another aspect of the present invention,
10 there is provided footwear comprising a penetration-resistant
protective member, wherein the footwear has a sole comprising
a flexible protective layer of the invention.

In accordance with another aspect of the present invention,
15 there is provided a method of producing a flexible
penetration-resistant protective layer for a body-protecting
product, the method comprising

(i) felting polymer fibers in a random arrangement in
relation to one another, to produce a manageable felted fiber
20 product;

(ii) embedding the felted fiber product in a hardenable
binder, so that the binder surrounds the fibers; and

(iii) hardening the binder to fix the fibers in the positions
in which they are located to produce the flexible protective
25 layer.

In accordance with another aspect of the present invention,
there is provided a flexible penetration-resistant protective
layer for a body-protecting product, the layer comprising a
30 hardened binder, and a manageable felted fiber product
embedded in and surrounded by the binder, the felted fiber
product comprising polymer fibers felted together and fixed
in a random arrangement in relation to one another.

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In accordance with another aspect of the present invention,
there is provided an article of protective clothing
comprising a flexible penetration-resistant protective layer
5 of the invention.

The invention will be described in greater detail below with
reference to the illustrative embodiment shown by way of
example in the accompanying drawing.

10

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 illustrates a shoe made with a sole with a
protective layer according to the invention.

15 Fig. 2 is a cross section through the shoe according to Fig. 1.

Fig. 3 is an enlarged part of Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

20 Figs 1 and 2 show a protective shoe according to the
invention with an upper part 1 which, if desired, can be made
with a protective cap (not shown) of conventional type.
Reference number 2 indicates an outsole, suitably made of
polyurethane, and reference number 3 an insole made of a
25 comfort-improving material.

The designation 4 indicates a layer for protection against
penetration by nails or other sharp,

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penetrating objects when trodden on. This layer consists of a fibrous material which is molded integrally in the polyurethane material of the outsole 2, so that the fibers in the layer 4 maintain the relative positions they adopted in connection with the molding process. The fibrous material is therefore completely impregnated with the polyurethane material of the sole, so that this material completely surrounds the fibers and fixes their directions relative to one another, as can be seen more clearly from Fig. 3.

According to the invention, the fibers in the layer 4 are arranged randomly in relation to one another, so that they do not form an arranged fibrous structure like a woven fabric or equivalent.

In order to produce a handleable product made of such randomly oriented fibers, which can be inserted into the mold in which the outsole is molded during shoe manufacture, the fibers can be felted together. Felting means that the fibers become hooked together and attached to one another without forming a regular pattern. Such a felted or tangled layer can, even if it is thin, be handled as a unit during the procedure for manufacturing the sole. Other methods of holding the fibers together without them being structured but which facilitate their handling can also be used. The important feature is that the fibers are in "chaos", that is to say in an entirely unarranged state.

The fibers can, for example, be felted together to form layers with a weight per unit area of roughly 500 g/m². During manufacture of the sole, it is then suitable for two layers to be arranged one on another. Depending on the thickness, it is also possible to use a single layer or more than two layers.

According to the invention, it is preferable to use fibers made of a high-molecular polyethylene material

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which is marketed under the tradename DYNEEMA®. Other fibrous materials with equivalent properties can also be used. The invention also includes the use of new fibers with improved values which may be developed in the future.

What makes fibers made of DYNEEMA® especially suitable is inter alia their high ultimate strength and great rigidity, which properties together afford very good protection against penetrating objects. A suitable fiber quality is DETEX 2.2.

According to the above, the invention aims primarily to provide a means of protection against penetrating objects of the type indicated above, such as nails, pointed weapons and the like, which have a relatively low speed in comparison with projectiles, such as bullets.

The invention has been described above in connection with the protective shoe shown in the figures, in which a protective layer is molded integrally in the outsole. As an alternative to this, the protective layer can also be molded integrally in a loose insole or in the fixed insole.

The protective layer according to the invention is also suitable for producing, for example, flexible protective jackets and protective trousers which provide protection against, for example, stabbing with a knife. In this context, the possibility of producing a flexible protective layer is of the greatest importance. This is achieved owing to the fact that a protective layer according to the invention can be made thin and contains flexible fibers. The binder is then selected depending on application and can consist of, apart from polyurethane, other polymeric elastomers.

We Claim:

1. A method of producing a flexible penetration-resistant protective layer for footwear, the method comprising
 - 5 (i) felting polymer fibers in a random arrangement in relation to one another, to produce a manageable felted fiber product;
 - (ii) embedding the felted fiber product in a hardenable binder, so that the binder surrounds the fibers;
 - (iii) hardening the binder to fix the fibers in the positions
 - 10 in which they are located; and
 - (iv) forming the hardened binder into a sole of the footwear.
2. The method as claimed in claim 1, wherein the polymer fibers are selected from at least one of high-molecular
- 15 polyethylene fibers and fibers having equivalent strength properties.
3. The method as claimed in claim 1 or claim 2, wherein in step (iv) the sole is an outsole, and step (ii) comprises
- 20 molding the fibers integrally in a layer of the outsole.
4. The method as claimed in claim 3, wherein the outsole is constructed of polyurethane.
- 25 5. The method as claimed in claim 1, wherein in step (iv) the sole is selected from a fixed insole and a removable insole.
6. The method as claimed in any one of claims 1-5, wherein in step (i), the manageable felted fiber product comprises at
- 30 least one fibrous layer.

7. The method as claimed in any one of claims 1 to 6, wherein the felting in step (i) is performed to create a protective layer resistant to penetration by sharp pointed objects.

5 8. A flexible penetration-resistant protective layer for footwear, the layer comprising
a hardened binder formed into a sole of the footwear; and
a manageable felted fiber product embedded in and surrounded
by the binder, the felted fiber product comprising polymer
10 fibers felted together and fixed in a random arrangement in
relation to one another.

9. The protective layer as claimed in claim 8, wherein the
polymer fibers are selected from at least one of high-
15 molecular polyethylene fiber and fibers having equivalent
strength properties.

10. The protective layer as claimed in claim 8 or claim 9,
wherein the sole is an outsole and the fibers are molded
20 integrally in a layer of the outsole.

11. The protective layer as claimed in claim 10, wherein the
outsole is constructed of polyurethane.

25 12. The protective layer as claimed in claim 8, wherein the
sole is selected from a fixed insole and a removable insole.

13. The method as claimed in any one of claims 8 to 12,
wherein the protective layer is constructed and arranged to be
30 resistant to penetration by sharp pointed objects.

14. Footwear comprising a penetration-resistant protective member, wherein the footwear has a sole comprising a flexible protective layer as claimed in any one of claims 8 to 13.

5 15. A method of producing a flexible penetration-resistant protective layer for a body-protecting product, the method comprising

- (i) felting polymer fibers in a random arrangement in relation to one another, to produce a manageable felted fiber product;
- 10 (ii) embedding the felted fiber product in a hardenable binder, so that the binder surrounds the fibers; and
- (iii) hardening the binder to fix the fibers in the positions in which they are located to produce the flexible protective layer.

15

16. The method as claimed in claim 15, wherein the polymer fibers are selected from at least one of high-molecular polyethylene fibers and fibers having equivalent strength properties.

20

17. The method as claimed in claim 15 or claim 16, wherein the manageable fiber product comprises at least one fibrous layer.

18. The method as claimed in any one of claims 15 to 17,
25 wherein the felting in step (i) is performed to create a protective layer resistant to penetration by sharp pointed objects.

19. The method as claimed in claim 18, wherein the sharp
30 pointed objects are selected from nails and pointed weapons.

20. A flexible penetration-resistant protective layer for a body-protecting product, the layer comprising a hardened binder, and a manageable felted fiber product embedded in and surrounded by the binder, the felted fiber product comprising
5 polymer fibers felted together and fixed in a random arrangement in relation to one another.

21. The flexible penetration-resistant protective layer as claimed in claim 20, wherein the polymer fibers are selected
10 from high-molecular polyethylene fibers and fibers having equivalent strength properties.

22. The flexible penetration-resistant protective layer as claimed in claim 20 or claim 21, wherein the protective layer
15 is constructed and arranged to be resistant to penetration by sharp pointed objects.

23. The flexible penetration-resistant protective layer as claimed in claim 22, wherein the sharp pointed objects are
20 selected from nails and pointed weapons.

24. An article of protective clothing comprising a flexible penetration-resistant protective layer as claimed in any one of claims 20 to 23.

25

25. An article of protective clothing as claimed in claim 24, wherein the article is selected from a protective jacket and protective trousers.

30

Fig.1

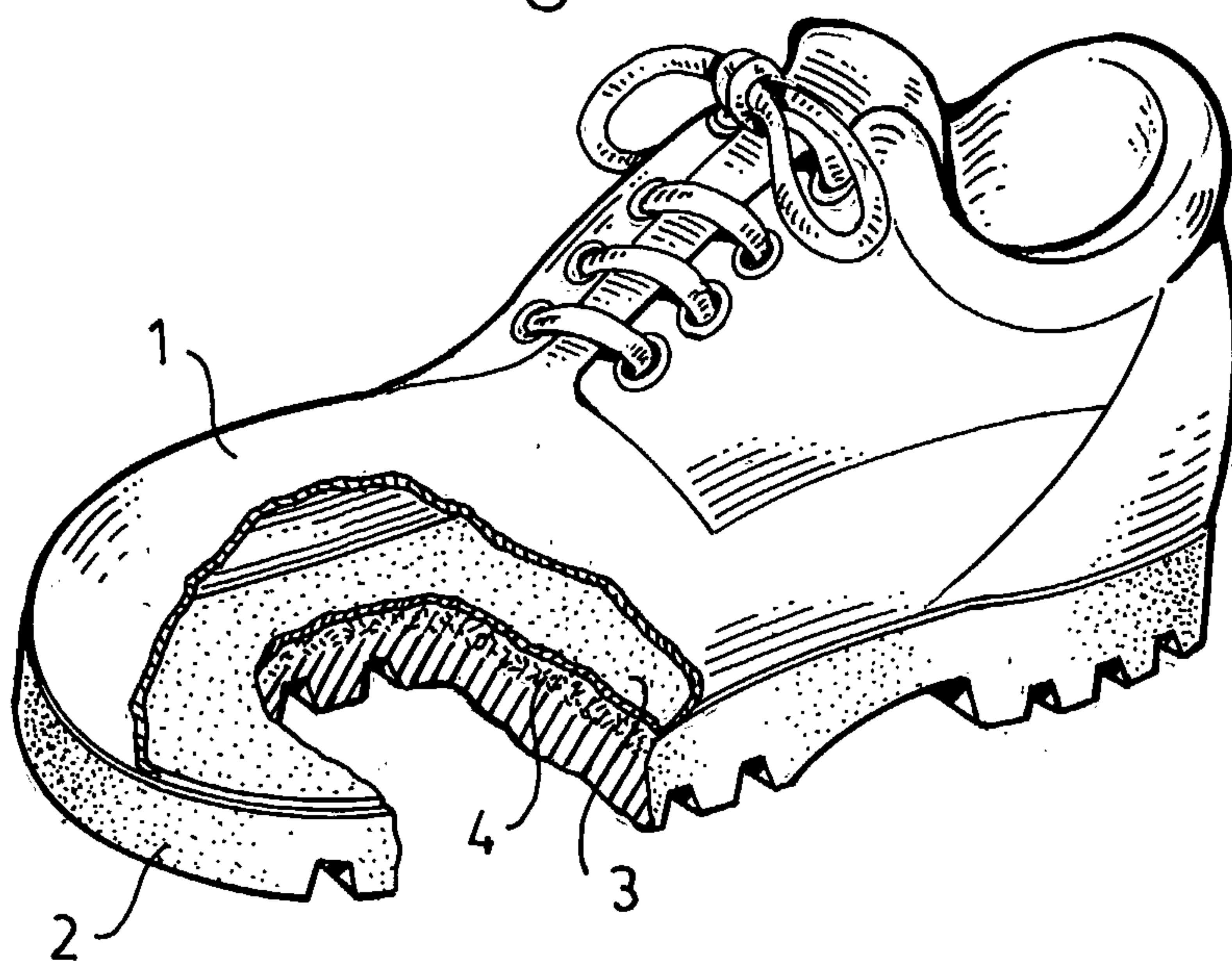


Fig.3

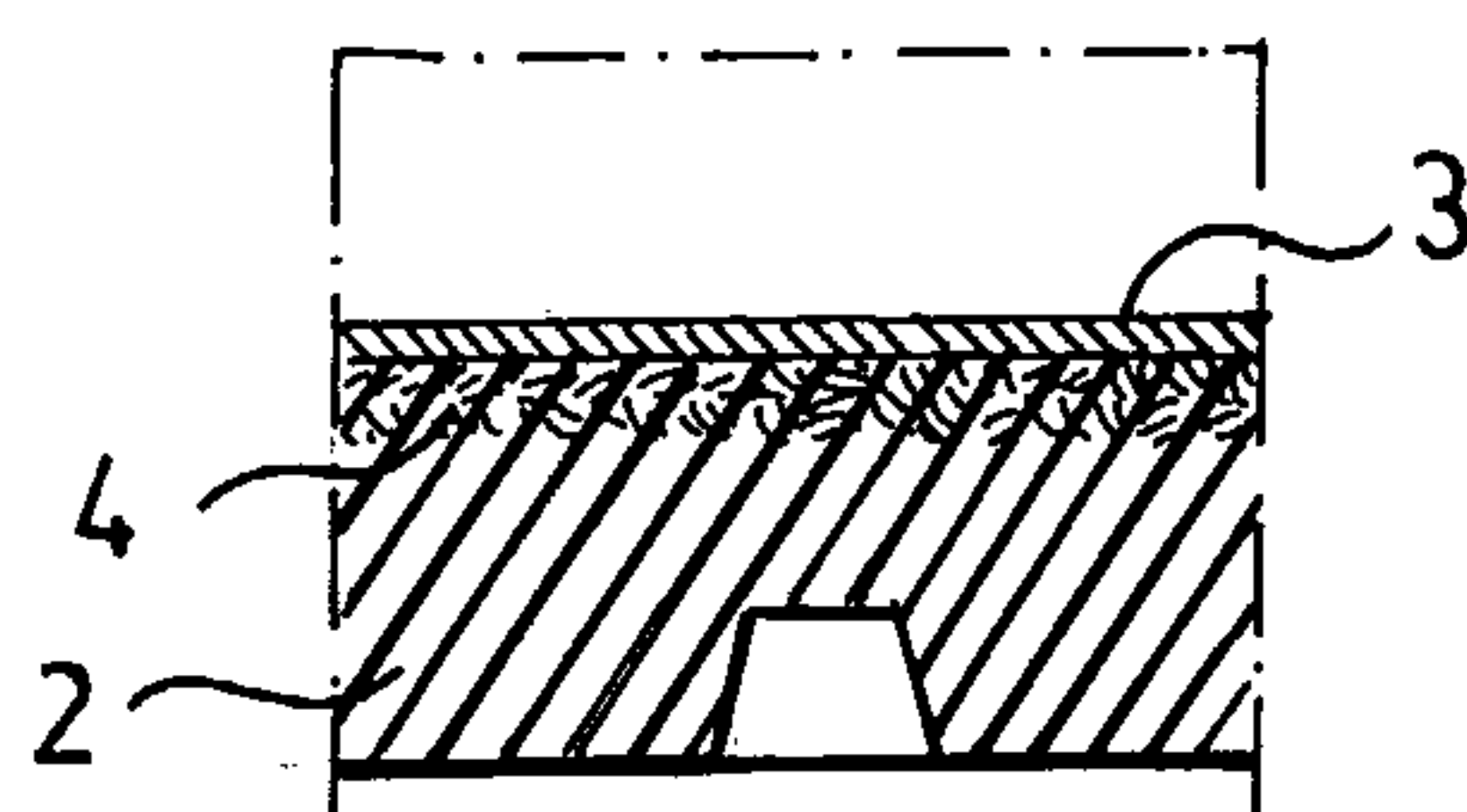


Fig.2

