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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A43B 13/00, 13/04, 13/12, 13/18, 13/38, 23/00, 23/07 — A1

(11) International Publication Number: **WO 99/43229**

(43) International Publication Date: 2 September 1999 (02.09.99)

(21) International Application Number: PCT/US99/03719

(22) International Filing Date: 26 February 1999 (26.02.99)

(30) Priority Data:
60/076,187 27 February 1998 (27.02.98) US

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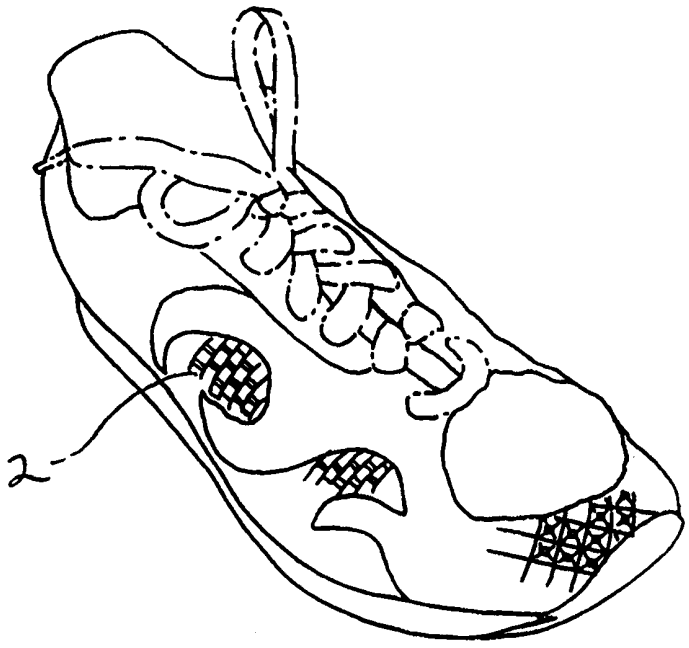
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, 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), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: THERMOFORMABLE FABRIC SHOE SOLE AND UPPER

(57) Abstract

Thermoformable fabric (4) includes a sole and an upper connected to the sole, the upper including a lining (2) made of at least one layer of a flexible thermoformable material. A midsole (10) is connectable to the lining (2), the midsole (10) being formed of a substantially stiff thermoformable fabric (6) which may be embedded within a foam layer. The thermoformable fabric (6) in the midsole (10) may be provided with a plurality of corrugations (8) so as to permit the midsole (10) to have a spring–like flexibility. The cones (8) are of variable sizes and arrangement so as to be disposed throughout the midsole (10) so as to correspond to the biomechanics of the different portions of the foot of the person wearing the footwear.



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THERMOFORMABLE FABRIC SHOE SOLE AND UPPER

This application is based on U.S. provisional application serial no. 60/076,187, filed February 27, 1998.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is directed to footwear having a thermoformable fabric midsole and upper.

Discussion of the Background

It is known to provide a midsole for footwear with elastically deformable members to provide energy conservation associated with athletic activities such as running and jumping. For example, U.S. Patent 5,092,060, the subject matter of which is hereby expressly incorporated by reference, teaches a shoe comprising a sole with elastically deformable elements provided therein. The elastically deformable elements provide energy conservation of the users' movements and thereby enhance the users' performance. However, the elastically deformable elements taught by U.S. Patent 5,092,060 can be costly to manufacture and therefore it has been found desirable to provide elastically deformable elements which are more easily and inexpensively manufactured.

The construction of uppers for footwear typically is in form in the form of a relatively heavy material to provide adequate protection of the wearer and is often not lined. Thus, such does not provide a proper ventilation or provide for comfort of the upper portion of the foot of the wearer by softening the impact of the foot with the upper when worn by the wearer. It has therefore been recognized that a need exists for providing a lightweight upper or a liner for an upper which provides greater air flow and greater comfort when worn.

U.S. Patent 4,458,429 discloses a padded tongue for footwear comprising a front layer having multiple orifices passing therethrough, each orifice having a porous or reticular material therein wherein the tongue is assembled by adhering the front layer to the back layer along the circumference of the tongue and each of the orifices through to the meshes of an

intermediate layer by heat-welding. It is also known from U.S. Patent 4,592,943 to utilize an apparatus and method of forming an open mesh belt on the fabric by heat or fusion bonding a web comprising conjugate fibers. The foregoing patents, the disclosure of which is also incorporated herein by reference, fail to teach, however, the provision of a thermoformable fabric for the upper or the lining of an upper of a shoe so as to provide the benefits of comfort and air flow as explained above.

Conventionally, foam has been used to line shoe uppers. However, it has been found that foam is heavier, requires the use of cement, and is less breathable than thermoformable fabrics. For example, when a foam is laminated to the inside face of the upper fabric of footwear and a further inner lining material such as a nylon tricot is applied, a three layered structure results. Such soft layers are typically held in firm alignment by the use of cement provided between each layer. Such construction results in an upper that has a high degree of stiffness due to the layers of cement.

SUMMARY OF THE INVENTION

In view of the above-noted drawbacks of the prior art, it has been recognized that it would be advantageous to improve upon the state of the prior art. It is therefore an object of the present invention to accomplish this by the use of a woven or knitted material that is shaped by application of a heating pressure and a forming mold, for construction of various components of footwear. According to one aspect of the present invention, a flexible, dimpled thermoformable fabric is used as an upper lining sheet. This lining sheet provides slight cushioning of a foam-lined upper but with less weight and greater breathability.

According to a further aspect of the present invention, a stiff thermoformable fabric is provided as a rigid element for use as the midsole or as part of the midsole of footwear. The shape of the rigid elements serve to provide cushioning by mechanical distortion when a load is applied to the midsole.

It is a further object of the present invention to provide an upper or lining for an upper as described above in combination with a midsole having stiff thermoformable fabric positioned thereon or located therein in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description.

Figure 1 is a right side perspective view of a first embodiment of the shoe showing a dimpled upper lining in accordance with the present invention;

Figure 2 is a top plan view thereof;

Figure 3 is a right side elevational view thereof;

Figure 4 is a rear elevational view thereof;

Figure 5 is a perspective of a flexible dimpled thermoformable fabric utilized in the embodiment shown in Figure 1; and

Figure 6 is a perspective view of a stiff thermoformable fabric with corrugations in the shape of truncated cones that is utilized in the second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figures 1 through 4 illustrate an embodiment of the present invention where footwear 1 is illustrated with a lining for an upper 2 which is made of the flexible thermoformable fabric 4 shown in Figure 5, and covered with a mesh shell. By manufacturing a shoe upper with such fabric, greater flexibility in manufacturing is achieved than that resulting from a conventionally made upper. For example, a lining made from a sheet of flexible thermoformable material has a mechanical spring resiliency similar to that provided by a layer of foam. However, the sheet is allowed to float freely within some or all of the upper.

Preferably, the lining is spot welded, glued, riveted or stitched to reduce relative movement between multiple layers forming a shoe upper. The corrugations formed in the flexible fabric also provide cushioning for the user's foot, and provide increased ventilation between the user's foot and the upper.

The fabric may be a polyester, polymer, polyurethane, nylon or other plastic fiber. The fibers of the fabric may be of any thickness that provides sufficient stiffness and abrasion resistance in the desired use. For example, a 1000 dernier fiber might be stiff and abrasion resistant enough for outdoor hiking boot applications while a lighter weight, such as 220 denier fibers, might be used in women's casual footwear. The overall height of the

corrugations formed in the flexible thermoformable fabric, i.e. the distance between the upper and lower faces of the material, must exceed twice the thickness of the textile sheet before it is provided with corrugations. Preferably, the upper to lower face distance in the corrugated flexible thermoformable material is in excess of 5 times the thickness of the textile sheet from which it is formed. The preferred thickness of the material depends on the intended use and the desired stiffness of the final product.

The method for manufacturing such a fabric as shown in Figure 5, is generally known, and includes heating the fabric to approximately 300 degrees Fahrenheit, depending on the material used, then pressing the material between a male and female die.

According to the second aspect of the invention, as discussed above, a stiff thermoformable fabric 6 is included in the midsole 10 of the footwear although it would be possible to also place this in an outsole. Thus the term sole is intended to include midsoles or outsoles. Figure 6 shows an example of a stiff thermoformable fabric 6 with truncated cone corrugations 8, which can be suspended in a midsole of the footwar, thereby creating a sole with spring-like flexibility. Preferably, the truncated cones are arranged according to the biomechanics of a user's foot, and are suspended in the material comprising the midsole 10 of the footwear. Typically, the midsole is made from a foam type material. The truncated cones, when suspended in the foam, provide the energy conservation sought.

The fabric used for the stiff thermoformable fabric in Figure 6 is generally thicker than that used in the fabric in Figure 5. The fabric used for stiffening the midsole of the footwear may be of any thickness that provides a suitable stiffness for the intended use. For example, a carbon fiber and resin composite material may be only 0.5 mm thick and still be stiff enough to provide the desired midsole support. Preferably, a midsole of footwear provided with a thermoformable fabric in accordance with the invention, should decelerate a missile striking the top surface of the midsole with a peak g force not greater than 28g. It is preferred that the material provides a peak g force of 12 to 18g in a traditional footwear missile impact test. It has been found that the maximum desirable thickness is approximately 3mm, while the average thickness is from 0.5 to 1.5mm for the materials used in the present invention.

It is conceived that a plurality of the truncated cones 8 shown in Figure 6 will be dispersed throughout the sole of a shoe, wherein the cones will have varying sizes and

arrangements according to the biomechanics of the foot and the intended activity for which the footwear is used.

The foregoing illustrate only preferred embodiments of the invention. However, variations onto and modifications of the foregoing are possible as would be understood by one of ordinary skill in the art.

Claims

1. Thermoformable fabric footwear, which comprises:

a sole, and

an upper connected to said sole, said upper including a lining made of at least one layer of a flexible thermoformable material.

2. The footwear claimed in Claim 1, wherein said at least one layer comprises a plurality of layers which are interconnected to reduce relative movement of the layers with respect to one another.

3. The footwear claimed in Claim 2, wherein said plurality of layers are interconnected by one of spot welding, gluing, rivoting and stitching.

4. The footwear claimed in Claim 1, wherein said material has a mechanical spring resiliency which substantially corresponds to a layer of foam material and which is freely movable within at least part of the upper.

5. The footwear claimed in Claim 1, wherein said material has a plurality of corrugations formed therein and has a thickness sufficient to provide abrasion resistance.

6. The footwear claimed in Claim 1, wherein said material comprises a material with a denier value of from 200 to 1,000 deniers.

7. The footwear claimed in Claim 5, wherein said corrugations have a height in excess of twice the thickness of the material.

8. The footwear claimed in Claim 7, wherein said material is formed from a textile sheet of material and said corrugations have a height greater than five times the thickness of said textile sheet from which the material is formed.

9. The footwear claimed in Claim 1, wherein said footwear comprises a midsole formed of a substantially stiff thermoformable fabric.

10. The footwear claimed in Claim 9, wherein said fabric of said midsole has a plurality of corrugations formed therein such that said midsole has a spring-like flexibility.

11. The footwear claimed in Claim 10, wherein said midsole includes a foam layer having said stiff thermoformable fabric positioned therein.

12. The footwear claimed in Claim 9, wherein said midsole includes a foam layer having said stiff thermoformable fabric positioned therein.

13. The footwear claimed in Claim 5, wherein said corrugations comprise truncated cones.

14. The footwear as claimed in Claim 9, wherein said material of said midsole has a peak g force deceleration value of from 12-18 g.

15. The footwear as claimed in Claim 9, wherein said fabric has an average thickness of from 0.5 to 1.5 mm.

16. The footwear as claimed in Claim 13, wherein said cones are of variable sizes and arrangements and are disposed throughout the midsoles so as to correspond to biomechanics of different positions of the foot of a person wearing the footwear.

17. The footwear claimed in Claim 11, wherein said thermoformable fabric is formed by heating the fabric to 300°F and pressing the fabric between a male and female die.

18. The footwear claimed in Claim 12, wherein said fabric has an average thickness of from 0.5 to 1.5 mm.

19. Thermoformable fabric footwear, which comprises:
a midsole formed of a substantially stiff thermoformable fabric; and
an upper connected to said midsole.

20. The footwear claimed in Claim 17, wherein said fabric of said midsole has a plurality of corrugations formed therein such that said midsole has a spring-like flexibility.

21. The footwear claimed in Claim 19, wherein said midsole includes a foam layer having said stiff thermoformable fabric positioned therein.

22. The footwear claimed in Claim 20, wherein said midsole includes a foam layer having said stiff thermoformable fabric positioned therein.

23. The footwear claimed in Claim 19, wherein said corrugations comprise truncated cones.

24. The footwear claimed in Claim 19, wherein said fabric of said midsole has a peak g force deceleration of from 12 to 18 g.

25. The footwear claimed in Claim 19, wherein the fabric has an average thickness of from 0.5 to 1.5 mm.

26. The footwear claimed in Claim 23, wherein said cones are of variable sizes and arrangement and are disposed throughout the midsole so as to correspond to biomechanics of different portions of the foot of a person wearing the footwear.

27. A method of forming footwear, which comprises:
forming a lining with at least one layer of thermoformable fabric for an upper; and
attaching the lining to a midsole.

28. A method claimed in Claim 27, which comprises forming said lining by

interconnecting a plurality of layers of said thermoformable fabric so as to reduce the relative movement of the layers with respect to one another.

29. The method claimed in Claim 27, which comprises forming said materials so as to have a mechanical spring resiliency which substantially corresponds to a layer of foam material so as to be able to move freely within at least part of the upper.

30. The method claimed in Claim 27, which comprises forming a plurality of corrugations in said material.

31. The method claimed in Claim 27, wherein said material comprises the material with a denier value of from 200 to 1,000 deniers.

32. The method claimed in Claim 30, which comprises forming said fabric from a textile material and forming corrugations therein so as to have a height greater than 5 times the thickness of said textile material.

33. The method claimed in Claim 27, which comprises:
forming said midsole of a substantially stiff thermoformable fabric.

34. The method claimed in Claim 27, which comprises forming a plurality of corrugations in said fabric of said midsole such that said midsole has a spring-like flexibility.

35. The method claimed in Claim 27, which comprises forming said midsole so as to have a foam layer positioning said stiff thermoformable fabric within said foam layer.

36. The method claimed in Claim 33, which comprises forming said midsole with a foam layer having said thermoformable fabric positioned therein.

37. The method claimed in Claim 32, which comprises forming said corrugations so as to form a plurality of truncated cones.

38. The method claimed in Claim 27, which comprises forming said midsole so as to have a peak g force deceleration value of from 12 to 18 g.

39. The method claimed in Claim 27, which comprises forming said fabric so as to have an average thickness of from 0.5 to 1.5 mm.

40. The method claimed in Claim 37, which comprises forming said cones so as to be of variable sizes and arrangement and disposing said cones throughout the midsole so as to correspond to biomechanics of different portions of the foot of the person wearing the footwear.

41. The method claimed in Claim 27, wherein forming of the material comprises heating a thermoformable fabric to approximately 300°F and pressing the material between a male and female dye.

42. Footwear made by the method claimed in Claim 27.

43. A method of making thermoformable fabric footwear, which comprises:

forming an upper;

forming a midsole, said midsole being formed of a material made from a textile material and forming corrugations therein so as to have a height greater than five times the thickness of said textile material; and

connecting the midsole to the upper.

44. The method claimed in Claim 43, which comprises forming said midsole of a foam layer and positioning said thermoformable fabric therein.

45. The method claimed in Claim 44, wherein the material has an average thickness of from 0.5 to 1.5 mm.

46. The method claimed in Claim 43, which comprises forming said corrugations as

truncated cones.

47. The method claimed in Claim 43, which comprises forming said material so as to have a peak g force deceleration value of from 12 to 18 g.

48. The method claimed in Claim 46, wherein the step of forming the material comprises forming a material having an average thickness of from 0.5 to 1.5 mm.

49. The method claimed in Claim 46, which comprises forming said cones so as to be of variable sizes and arrangements and disbursing the cones throughout the midsole so as to correspond to biomechanics of different portions of a foot of a person wearing the footwear.

50. The method claimed in Claim 43, which comprises forming the thermoformable fabric by heating the same to approximately 300°F and pressing the material between a male and female dye.

51. Footwear made according to the method claimed in Claim 43.

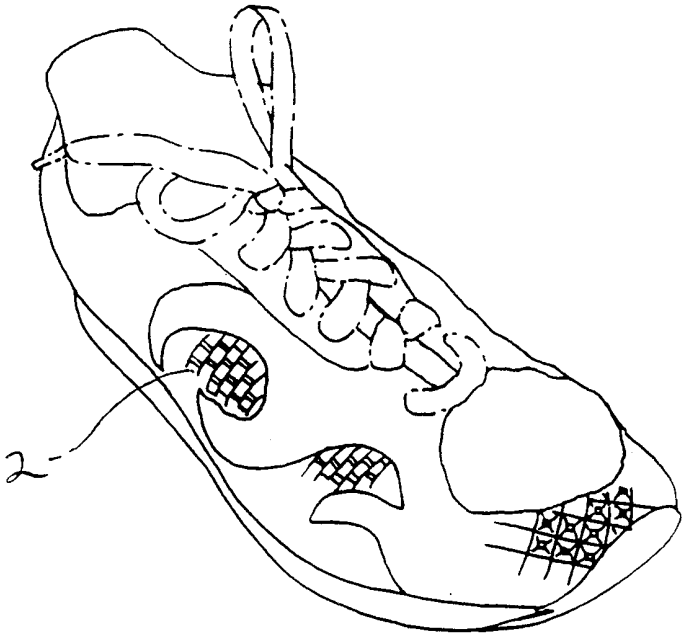

FIG. 1

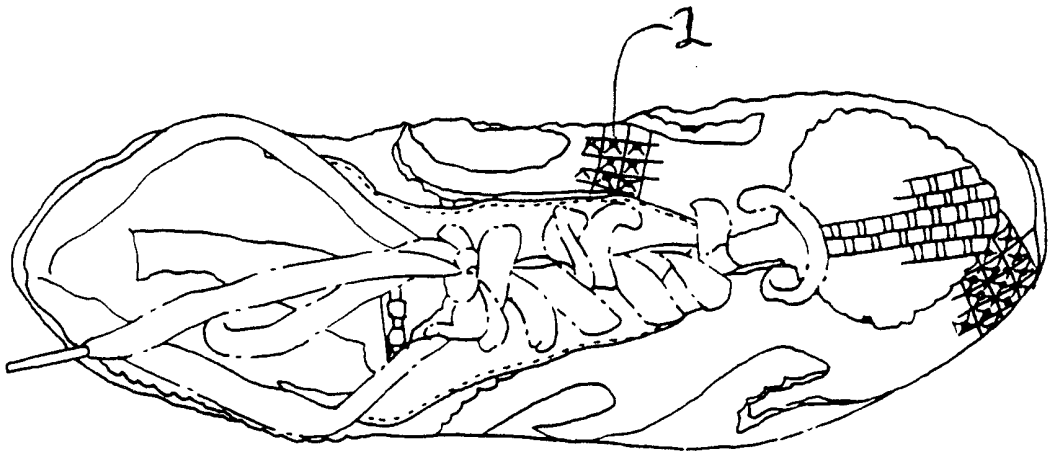

FIG. 2

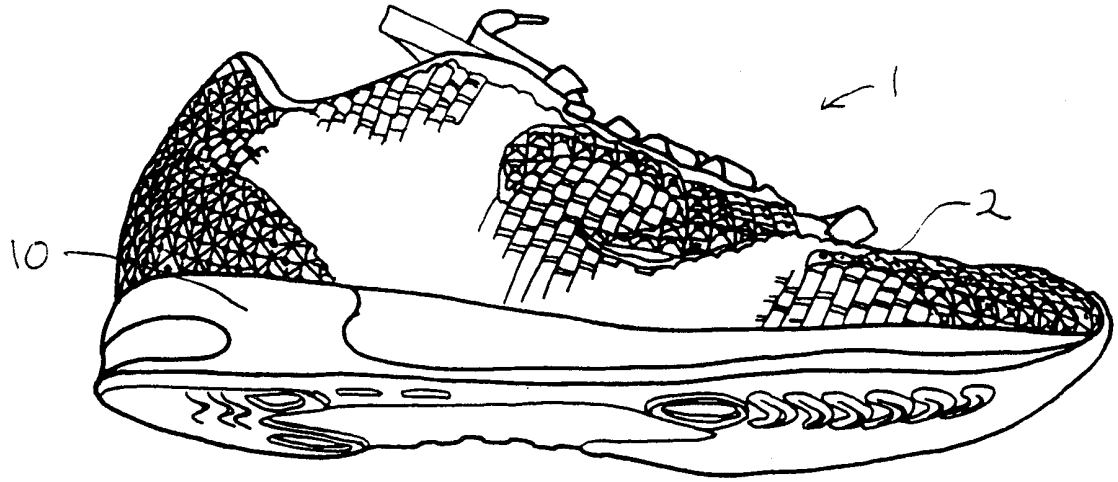

FIG. 3

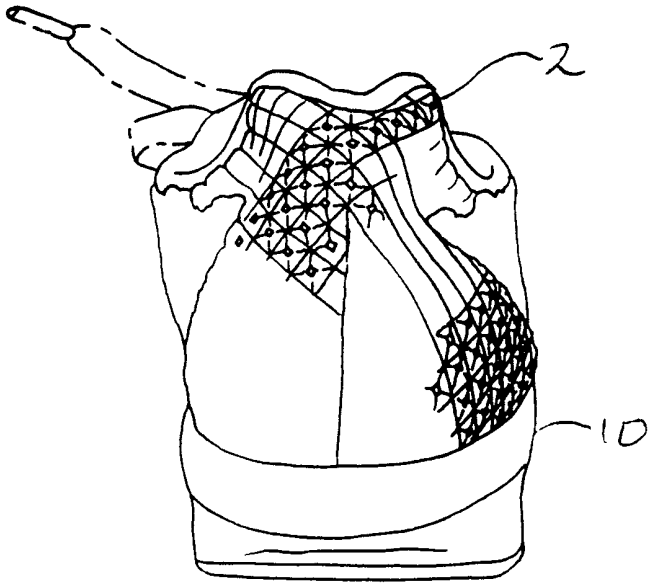

FIG. 4

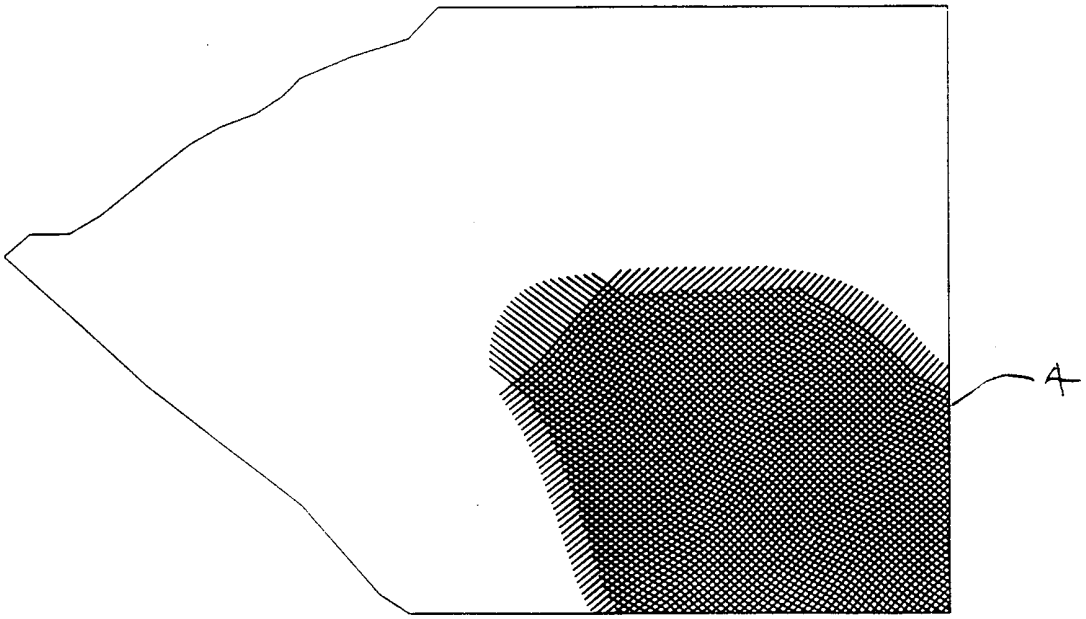

FIG. 5

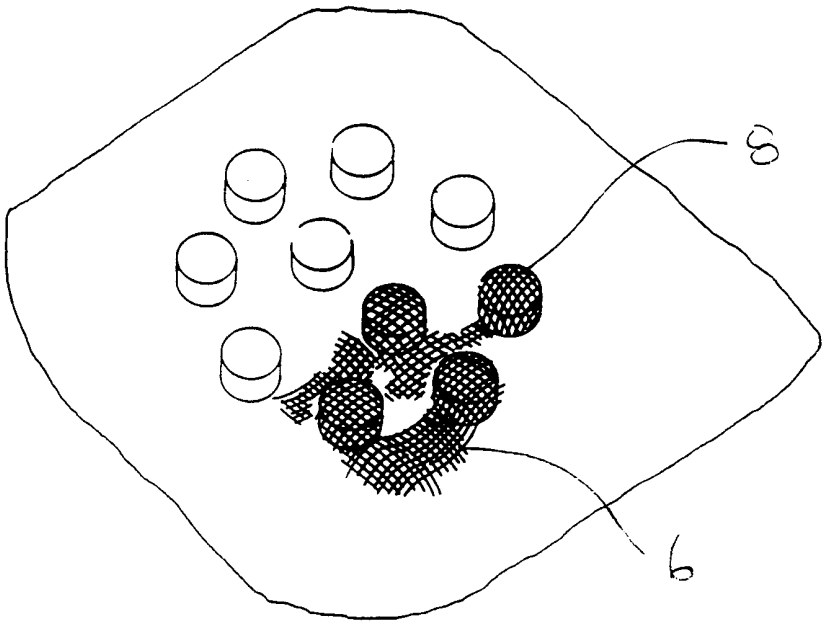

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/03719

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A43B 13/00, 13/04, 13/12, 13/18, 13/38, 23/00, 23/07
US CL :36/45, 55, 28, 25R, 30R
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 36/45, 55, 28, 25R, 30R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS: Search terms: Class 36, textile, corrugations, heat, plastic, fabric

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 5,731,062 A (KIM ET AL.) 24 March 1998, Whole Document, especially col. 2, lines 26-30, 48-49, col. 3, lines 25-30, col. 4, lines 5-8, col. 6, lines 5-8, 11-12, and 57-58, col. 7, line 7	2, 3, 5-10, 13, 15, 17, 19, 20, 23, 25, 27-34, 37, 39, 40-43, 46, 48-51
Y	US 5,572,804 A (SKAJA ET AL.) 12 November 1996, Whole document, Figures, 3-5, 11, 13, 22-25, see col. 8, lines 18-20, col. 13, lines 46-50, col. 15, line 31-col. 16, line 56,	9, 10, 16, 19, 20, 23, 25, 26, 33, 34, 37, 39, 40, 43, 46, 48, 49, 51

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/03719

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,364,686 A (DISSELBECK ET AL.) 15 November 1994, whole document	5, 7-9, 10, 13, 15, 18, 19, 20, 23, 25, 30, 32, 33, 34, 37, 39, 43, 46, 48
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X ------ Y	US 5,673,448 A (LANG ET AL.) 07 October 1997, Figures 1-4, 7I, 7J, 8, Summary of invention, whole document	1-4, 27 --------- 9, 19, 28, 29, 33-42
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/03719

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/03719

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claim(s)1-42, drawn to thermoformable fabric footwear containing at least one layer of thermoformable fabric material.
Group II, claim(s) 43-51, drawn to the method of making thermoformable fabric material.

The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The special technical feature of the first group appears to be the layer of thermoformable fabric material. This thermoformable fabric material layer is lacking in the second group, the second group only claims a textile material, thereby lacking unity between the two groups.