



(43) International Publication Date
6 December 2012 (06.12.2012)

- (51) International Patent Classification:
A43B 13/38 (2006.01)
- (21) International Application Number:
PCT/US2012/039294
- (22) International Filing Date:
24 May 2012 (24.05.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/491,190 28 May 2011 (28.05.2011) US
- (71) Applicant (for all designated States except US): **BROWN SHOE COMPANY, INC.** [US/US]; 8300 Maryland Avenue, St. Louis, MO 63105 (US).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **VATTES, David, L.** [US/US]; 7453 Cornell Avenue, University City, MO 63130 (US).

(74) Agent: **COHN, Dan**; Husch Blackwell LLP, 190 Carondelet Plaza, Suite 600, St. Louis, MO 63105 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

[Continued on next page]

(54) Title: PRESSURE RELIEF SYSTEM FOR FOOTWEAR

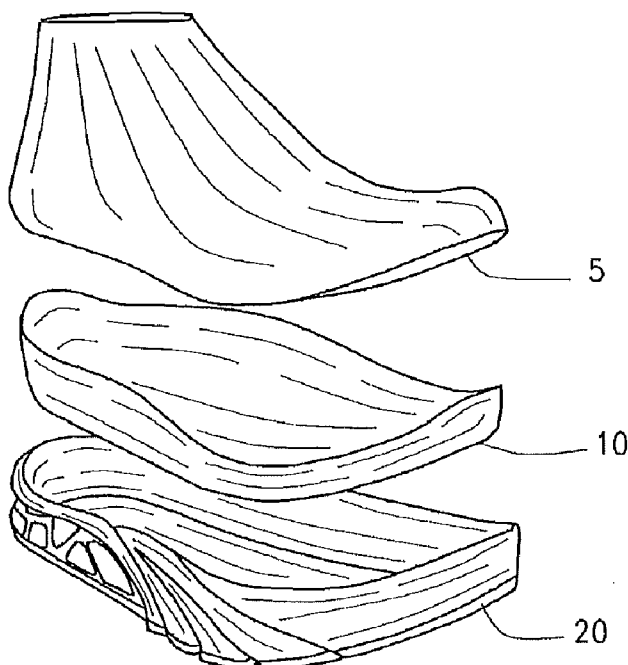


FIG. 1

(57) Abstract: A shoe having a last which includes a shape and volume that reflects the thickness of an internal sock liner, and a shoe interior made specifically for inclusion of the sock liner. The sock liner itself includes an anatomically shaped foot bed surface with a cupped heel, contoured arch, radiused forepart and beveled toe area. The sock liner material specifications and thicknesses are engineered or tuned to have a high amount of deflection when compressed without getting stiff.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, **Published:**
ML, MR, NE, SN, TD, TG).

— *with international search report (Art. 21(3))*

PRESSURE RELIEF SYSTEM FOR FOOTWEAR

BACKGROUND OF INVENTION

The present invention relates to a pressure relief system for footwear that relieves plantar pressures via an anatomical sock liner which is engineered with a shape designed to achieve a high amount of deflection when compressed without becoming stiff.

Many footwear brands market shoes as "comfortable," and there are many footwear products in the marketplace which claim to deliver on comfort. However, there is a misconception in the footwear industry as to what the definition of comfort actually is. Indeed, there is no universal standard for "comfort." Consumers have a hard time understanding precisely what comfort means, and how it is designed into the footwear they are buying.

Most articles of footwear are designed for the masses to wear. However, the resulting fit and comfort experience will be different for everyone wearing a single shoe design, and satisfying such a broad range in population is very difficult.

Most non-athletic shoes today contain hard materials, flatter interior foot contact surfaces and/or are made with low density foams that easily bottom out (i.e., which fully compress too quickly, and therefore fail to provide sufficient cushioning). These constructions lead to higher than desired interior pressures created against the plantar surface of the foot, which eventually lead to discomfort. Essentially, most non-athletic shoes are build to be too hard and stiff.

Athletic shoes, on the other hand, are generally made with softer cushioning materials designed to provide shock absorption during high impact activities. However, these designs are not as comfortable when used for everyday wear, because the cushioning materials are tuned for the high-impact performance conditions, rather than the lower impact casual situations.

In order to correct for these design deficiencies in athletic and non-athletic shoes, many consumers buy after-market insoles in an attempt to compensate for a shoe's shortcomings. However, many of today's after-market insoles marketed for improving comfort or relieving foot problems cause fit and comfort compromises because these insoles were not
5 designed holistically together with the shoes they are to be put inside. The comfort potential of these insoles is often offset by the functional deficits of the footwear into which they are installed (hard, stiff, inflexible, heavy, etc.).

Numerous combinations of after-market insoles and shoe constructions have been used in shoes in attempts to provide comfort. In most cases, layers of foam or other similar
10 materials are added to the sole construction to create the initial perception of comfort, but such constructions typically lose their effect after a short time. Many actually end up creating discomfort. Beneath the soft foams are often hard, stiff structural components. Insoles, sock liners and bottom shapes generally don't match the plantar surface of a person's foot. When the shapes of the insole and/or the sock liner don't match the plantar surface of a wearer's
15 foot, such shoe interiors have minimal/low arch and heel contact with the foot. When combined with increased pressures encountered when toeing off, inflexible soles create pressures on the plantar area of the foot up to four times higher as compared to standing still.

This invention improves upon the comfort benefits delivered in footwear by focusing on a specific comfort dimension: plantar pressure relief.

20 Specific advantages and features of the present invention will be apparent from the attached drawings and the description of an illustrative embodiment of the present invention.

SUMMARY OF INVENTION

A shoe is designed utilizing a last having a shape and volume that reflect the thickness of an internal sock liner, and a shoe interior made specifically for inclusion of this sock liner.

25 The sock liner itself contains an anatomically shaped foot bed surface with a cupped heel,

contoured arch, radiused forepart and beveled toe area. The sock liner material specifications and thicknesses are engineered or "tuned" to have a high amount of deflection when compressed without getting "stiff."

The sock liner of the present invention includes a raised area in the midfoot region and a recessed area located in the hind foot or heel region. The raised area is positioned to underlie the medial arch of the wearer's foot and the recessed area is positioned to underlie the heel of the wearer's foot. The recessed area is defined by the peripheral edges formed around the hind foot region from the medial side to the lateral side of the heel. The peripheral edge in the hind foot region forms a raised portion where it wraps around the heel of the wearer's foot. The anatomically shaped and formed sock liner reflects the natural shapes of the human foot. The shaped plantar surface topography maximizes surface contact with the wearer's foot and increases comfort.

In order to "tune" the sock liner material dimensions, design and specifications are engineered through an analysis of: 1) the desired deflection ranges, which are generally between 40-70% of the overall thickness of the sock liner; 2) the target loading ranges being designed for active wearing occasions, which are generally between 30-70 pounds, depending on gender and/or foot size; 3) the physical properties of the materials to be used (as specified below); 4) the desired pressure range targets for various plantar areas of the foot, which are generally below 40 pounds per square inch; and 5) anatomical shapes that create additional surface contact with the foot. The deflection of the sock liner is preferably approximately 25% while standing and approximately 50% while running or walking.

Unlike most shoes designed for "extra comfort," the exterior of the shoe can be designed for any wearing occasion and/or end use. The shoe may be designed with less midsole thickness than conventional shoes, in order to compensate for added thickness of the sock liner. In this way, the system can be applied to any type of footwear category or end use

as long as there is adequate sockliner thickness available. Athletic shoes (running, training, walking), sandals, work shoes (duty/service industries), and casual shoes may all incorporate such sock liners. Consideration is given for the exterior shoe sole design to complement the functionality designed for this system, such as: anatomically correct flex location; and

5 material thicknesses and specifications that do not contribute to inflexibility, thus increasing pressure against the foot's plantar surface by the poor shoe design/materials.

Preferably, materials may include polyurethane, SEBS foam, EVA, rubber sponge, latex, and/or co-polymer blended foams. The materials preferably have a hardness of between 10C and 70C on the Asker C scale, with a material density of between 0.05 g/cc and
10 0.60 g/cc. The thickness of the sock liner (measured at the center of the heel and center of the forefoot – not wall heights) varies by shoe design. However, the thickness generally ranges from 5mm to 50mm at the heel center, and from 3mm to 35mm in the forefoot center.

The overall design of a sock liner according to the present invention should increase contact between the foot and sock liner surface - especially during weight bearing -
15 preferably at or above 75% rate of surface contact between the foot and sock liner. The sock liner also improves pressure re-distribution from peak pressure areas, and spreads the pressure across the entire plantar surface area such that preferably no single location experiences a pressure above 40psi. In so doing, cushioning and shock absorption protection should prevent stresses above 10 Gs.

20 In order to reduce such pressures exerted by the shoe against the plantar surface of the foot, the sock liner surface yields and deflects under the foot without a significant increase of hardness and stiffness of the sock liner, which could create discomfort. Such deflection can also increase foot stimulation through more utilization of bones, tendons, muscles during foot-strike. The deflection can also promote a wearer's natural gait/foot-strike during
25 walking, by straightening the wearer's center of force trajectory during foot-strike. Further, a

flexibility improvement may be realized where less foot force is required to bend a shoe across the foot's flex area. Preferably below about 5 pounds of force is required to bend flex the shoe at such flex areas.

The sock liners may be removable, and as noted above, either polyurethane or EVA materials may be utilized (both as 100% standalone sock liners, i.e., not combined). Alternatively, non-removable sock liner foot beds may be utilized in an open sandal or other type of shoe. Alternative embodiments may utilize: "gel" as either a shock absorber or comfort element on the sock liner; the addition of flex grooves on the bottom of the sock liner; a visible sock liner, either through a window of the upper or midsole; multiple foam types in one sock liner unit; a sockliner made via injection molding, compression molding, open-pouring or die-cut/cementing; a closed shoe with a non-removable sock liner; additives to provide anti-microbial, anti-hydrolysis, and/or anti-UV enhancements and/or to strengthen the cell structure; a sock liner which can be combined with an insole layer (above or below) to reduce thickness/weight and/or can be designed as a "midsole" unit that is dropped into a unit sole or laminated with an outsole layer in a stitch-out construction.

These and other objects and advantages of the present invention will become more apparent to those skilled in the art after considering the following detailed specification taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a three dimensional perspective view of a last, the sock liner of the present invention, and an outsole designed with a recess to receive the sock liner's added thickness.

FIG. 2 is a typical material "Force/Compression" chart which illustrates a typical relationship between force (in pounds) and percent deflection of the material.

FIGS. 3A and 3B are a bottom plan view and side elevational view, respectively, of an exemplary sock liner.

FIGS. 4A, 4B and 4C are schematics of a right elevational view, a top plan view and a left elevational view, respectively, of a sock liner according to the present invention.

FIGS. 5A, 5B and 5B are cross sectional schematic views, taken along the horizontal lines of FIGS. 4A-4C at the ball, arch and heel of the sock liner, respectively.

5 FIG. 6A is an exemplary pressure test-image of a sock liner according to the present invention.

FIG. 6B is an exemplary pressure test image of a prior art sock liner.

It should be understood that the present drawings are not necessarily to scale and that the present embodiments are sometimes illustrated by graphic symbols, phantom lines,
10 diagrammatic representations and fragmentary views. In certain instances, details which are not necessary for an understanding of the present invention or which render other details difficult to perceive may have been omitted. It should also be understood that the present invention is not necessarily limited to the particular embodiments illustrated herein. Like numbers utilized throughout the various Figures designate like or similar parts or structure.

15 DETAILED DESCRIPTION

In the present invention, a sock liner is provided which improves comfort and can be built into any type of shoe. As shown in FIG. 1, a shoe will include an upper or last 5, the sock liner 10 and the midsole/outsole 20 ("outsole"). Outsole 20 is positioned on the underside of the shoe for engagement with a walking surface such as the ground, sidewalk,
20 floor or other supporting surface. Preferably, the top surface of the outsole is shaped to conform to the bottom surface of the sock liner 10. The thickness of outsole 20 may be less than conventional shoes in order to compensate for the added thickness of the sock liner 10. The outsole 20 may be constructed of any suitable material for example, leather, elastomer, polymer, a composite thereof or the like depending upon the type of shoe desired. The sock

liner 10 and outsole 20 may be secured to one another using any suitable attachment means including cement, adhesives, glue, welt and direct attachment constructions

For ease of reference herein, the foot of a human may be considered to have three regions: the forefoot region (area adjacent the toes), the midfoot region (area adjacent the arch), and the hind foot region (area adjacent the heel). As shown in FIGS. 3A, 3B, 4A-4C and 5A-5C, the sock liner 10 similarly includes three regions substantially underlying the above-referenced corresponding three regions of the wearer's foot: the forefoot region 16 of the sock liner 10, the midfoot region 14 of the sock liner 10, and the hind foot region 12 of the sock liner 10. It should be understood, however, that the boundaries between the forefoot, midfoot and hind foot areas are not precise and that these terms should be interpreted loosely and with a great deal of flexibility. The ball of the foot is generally the area of the foot at the juncture between the metatarsal bones and the phalange bones.

The midfoot region 14 of sock liner 10 is raised to underlie the medial arch of the wearer's foot, while the hind foot region 12 is cupped to underlie the heel of the wearer's foot.

The hind foot region 12 is defined by the peripheral edges 13 formed around the hind foot region 12 from the medial side to the lateral side of the heel. The peripheral edge 13 in the hind foot region 12 forms a raised portion where it wraps around the heel of the wearer's foot. The forefoot region 16 includes a radiused forepart and a beveled toe area. The anatomically shaped and formed sock liner is thereby designed to reflect the natural shapes of the human foot. The shaped plantar surface topography maximizes surface contact with the wearer's foot and increases comfort.

The sock liner material specifications and thicknesses are engineered or "tuned" to have a high amount of deflection when compressed without getting "stiff." In order to "tune" the sock liner 10 material dimensions, design and specifications are engineered through an analysis of: a) the desired deflection ranges, which are generally between 40-70% of the

overall thickness of the sock liner and preferably about 25% while standing and about 50% while running or walking; b) the target loading ranges being designed for active wearing occasions, which are generally between 30-70 pounds, depending on gender and/or foot size; c) the physical properties of the materials to be used (as specified below); d) the desired pressure range targets for various plantar areas of the foot, which are generally below 40 pounds per square inch; and e) anatomical shapes that create additional surface contact with the foot.

An exemplary chart of the relationship between pressures exerted on the sock liner 10 as compared to the deflection of the sock liner 10 is shown in FIG. 2. As can be seen, as the force (in pounds per square inch) increases, so too does the deflection of the sock liner 10. At about 70 psi, which as noted above is at the high end of the target loading range for an active wearing occasion (e.g., running), the deflection is shown to be approximately 55% - close to the desired 50% deflection discussed above. Further, at about 25 psi, which is below the low end target loading range for an active wearing occasion (e.g., walking or standing), the deflection is close to 25% - approximately the desired deflection discussed above. Thus, the exemplary specimen tested in FIG. 2 is appropriately "tuned" to provide optimal pressure relief according to the present invention. It is noted that FIG. 2 illustrates the measured characteristics of an exemplary material of an exemplary thickness. Other materials would need to be "tuned" to determine the proper thicknesses for achieving improved pressure relief.

Preferably, materials for the sock liner 10 may include polyurethane, SEBS foam, EVA, rubber sponge, latex, and/or co-polymer blended foams. The materials preferably have a hardness of between 10C and 70C on the Asker C scale, with a material density of between 0.05 g/cc and 0.60 g/cc. The thickness of the sock liner 10 (measured at the center of the heel 12 and center of the forefoot 16 – not wall heights) varies by shoe design. However, the

thickness generally ranges from 5mm to 50mm at the heel center 12, and from 3mm to 35mm in the forefoot center 16.

The overall design of a sock liner 10 according to the present invention should increase contact between the foot and sock liner 10 - especially during weight bearing - preferably at or above 75% rate of surface contact between the foot and sock liner 10. The sock liner 10 also improves pressure re-distribution from peak pressure areas, and spreads the pressure across the entire plantar surface area such that preferably no single location experiences a pressure above 40psi. In so doing, cushioning and shock absorption protection should prevent stresses above 10 Gs. This can be seen in FIG. 6A as compared to 6B. FIG. 6A illustrates an exemplary foot pressure diagram of a foot utilizing the sock liner 10 of the present invention, in which the hind foot portion 12 and forefoot portion 16 of the foot experience a pressure level below the target threshold of 40 psi (shown by the blue image color). In FIG. 6B, which illustrates a prior art foot pressure diagram without an improved sock liner 10, the forefoot region 16, and the hind foot region 12 experience a pressure level well above (2-3 times) the target threshold of 40 psi (shown by the red image color). Thus, by tuning the thickness and shape of the material used in the sock liner 10 construction, the deflection has been tuned such that the forces experienced by the foot have been greatly reduced to below 40 psi from over 100 psi.

The sock liners 10 may be removable, and as noted above, or they may be formed from polyurethane or EVA materials (both as 100% standalone sock liners, i.e., not combined). Alternatively, non-removable sock liner 10 foot beds may be utilized in an open sandal or other type of shoe. Alternative embodiments may utilize: "gel" as either a shock absorber or comfort element on the sock liner 10; the addition of flex grooves on the bottom of the sock liner 10; a visible sock liner 10, either through a window of the upper or outsole; multiple foam types in one sock liner unit 10; a sock liner 10 made via injection molding,

compression molding, open-pouring or die-cut/cementing; a closed shoe with a non-removable sock liner 10; additives to provide anti-microbial, anti-hydrolysis, and/or anti-UV enhancements and/or to strengthen the cell structure; or a sock liner 10 which can be combined with an insole layer (above or below) to reduce thickness/weight and/or can be
5 designed as a “midsole” unit that is dropped into a unit sole or laminated with an outsole layer in a stitch-out construction.

Further, the overall dimensions of the present sockliner 10 and outsole 20 as well as the specific shape and configuration of the various sections thereof are also subject to wide variations and may be sized and shaped into a wide variety of different sizes and
10 configurations so as to be compatible with the size and shape of the particular footwear onto which the present structures may be mounted, or to conform with any space limitations associated therewith without impairing the teachings and practice of the present invention.

It is also understood that various modifications may be made to all of the various embodiments without departing from the spirit and scope of the present invention.

15 Thus, there has been shown and described several embodiments of an anatomical sock liner system. As is evident from the foregoing description, certain aspects of the present invention are not limited by the particular details of the examples illustrated herein, and it is therefore contemplated that other modifications and applications, or equivalents thereof, will occur to those skilled in the art. The terms “having” and “including” and similar terms as
20 used in the foregoing specification are used in the sense of “optional” or “may include” and not as “required”. Many changes, modifications, variations and other uses and applications of the present invention will, however, become apparent to those skilled in the art after considering the specification and the accompanying drawings. All such changes, modifications, variations and other uses and applications which do not depart from the spirit

and scope of the invention are deemed to be covered by the invention which is limited only by the claims which follow.

CLAIMS

What is claimed is:

1. A shoe sole construction comprising:

an outsole;

- 5 a sockliner having an anatomical shape which creates at least about a 75% contact rate between a wearer's foot and a top surface of the sockliner during weight bearing of the wearer's foot by the sockliner, the sockliner comprised of a material having a hardness between about 10C and 70C on the Asker C scale, having a material density of between about 0.05 g/cc and 0.60 g/cc, and having a thickness of between about 5mm and 50mm at the heel
10 center and between about 3mm to 35mm at the forefoot center, where the anatomical shape and material composition of the sockliner cause it to deflect by about 25% at about 25psi and by about 50% at about 70psi;

wherein a top surface of the outsole is sized and shaped to receive and conform to a bottom surface of the sockliner.

15

2. The shoe sole of claim 1 wherein the sockliner is comprised of one of:

polyurethane, SEBS foam, EVA, rubber sponge, latex and/or a co-polymer blended foam.

3. The shoe sole of claim 1 wherein the deflection of the sockliner is about 25%

20 during weight bearing when a wearer is standing thereon.

4. The shoe sole of claim 1 wherein the deflection of the sockliner is about 50%

during weight bearing when a wearer is running.

25

5. The shoe sole of claim 1 wherein the outsole includes a midsole.

6. The shoe sole of claim 1 wherein sockliner includes a midsole.

7. The shoe sole of claim 1 wherein the sockliner is raised at the midfoot region
5 to underlie the medial arch of the wearer's foot.

8. The shoe sole of claim 1 wherein the sockliner is cupped at the hind foot
region to underlie a wearer's heel.

10 9. The shoe sole of claim 8 wherein peripheral edges of the sockliner are raised
at the hind foot region from a medial side to a lateral side of the sockliner to wrap around a
wearer's heel.

10 10. The shoe sole of claim 1 wherein the sockliner includes a radiused forepart
15 region and a beveled toe area at the forefoot region.

11. The shoe of claim 1 wherein the outsole is comprised by at least one of:
leather, elastomer, and polymer.

20 12. The shoe sole of claim 1 wherein the sockliner yields a target threshold
pressure of 40 psi or below.

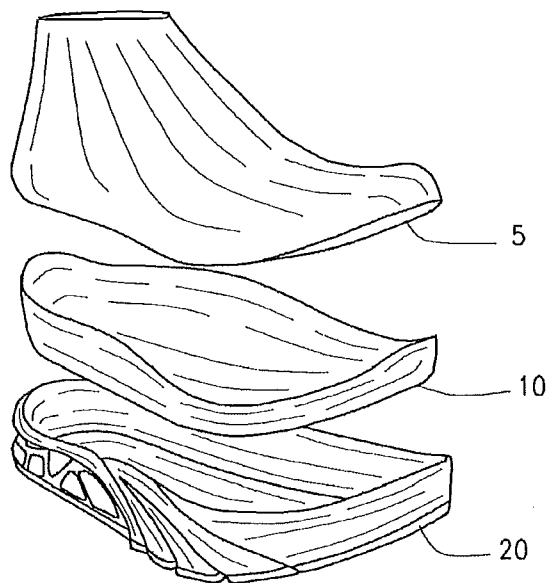


FIG. 1

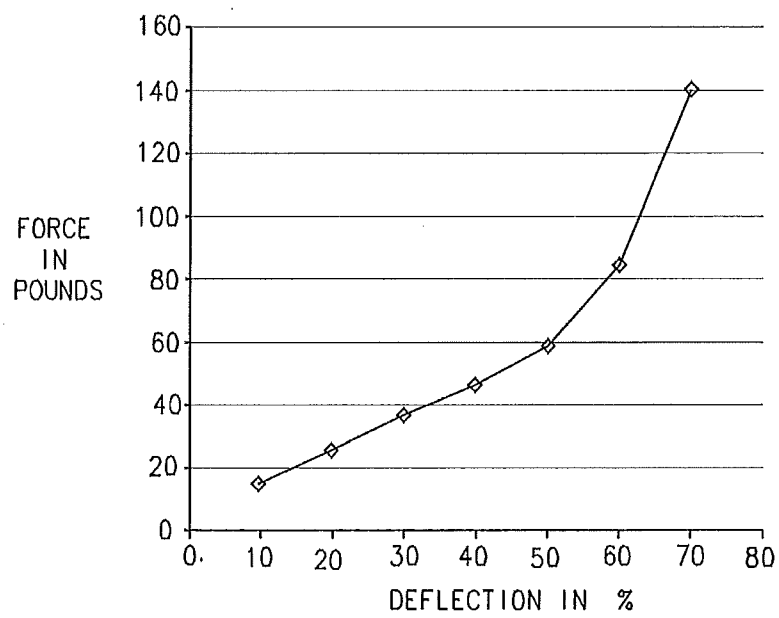


FIG. 2

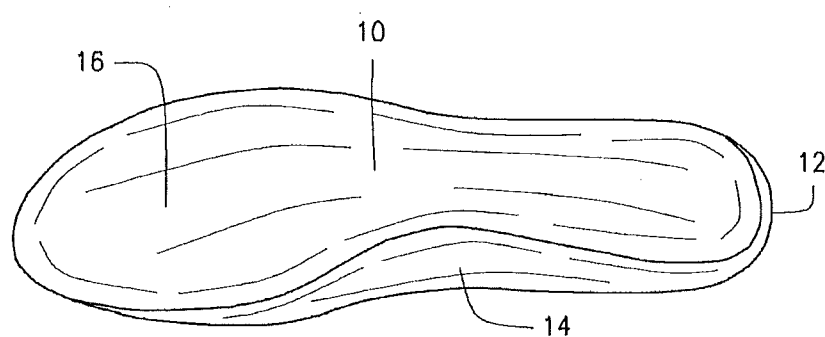


FIG. 3A

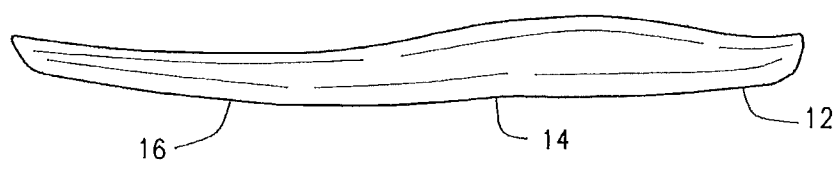
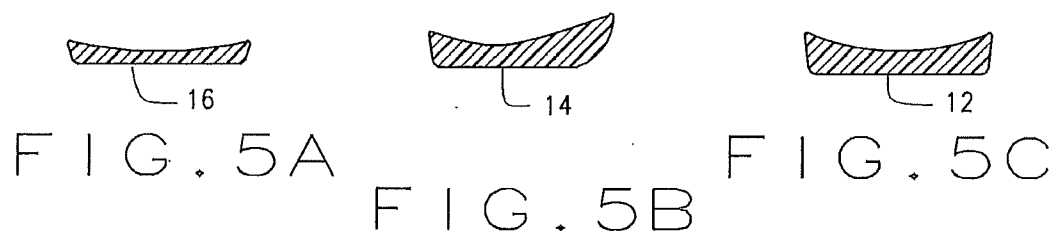
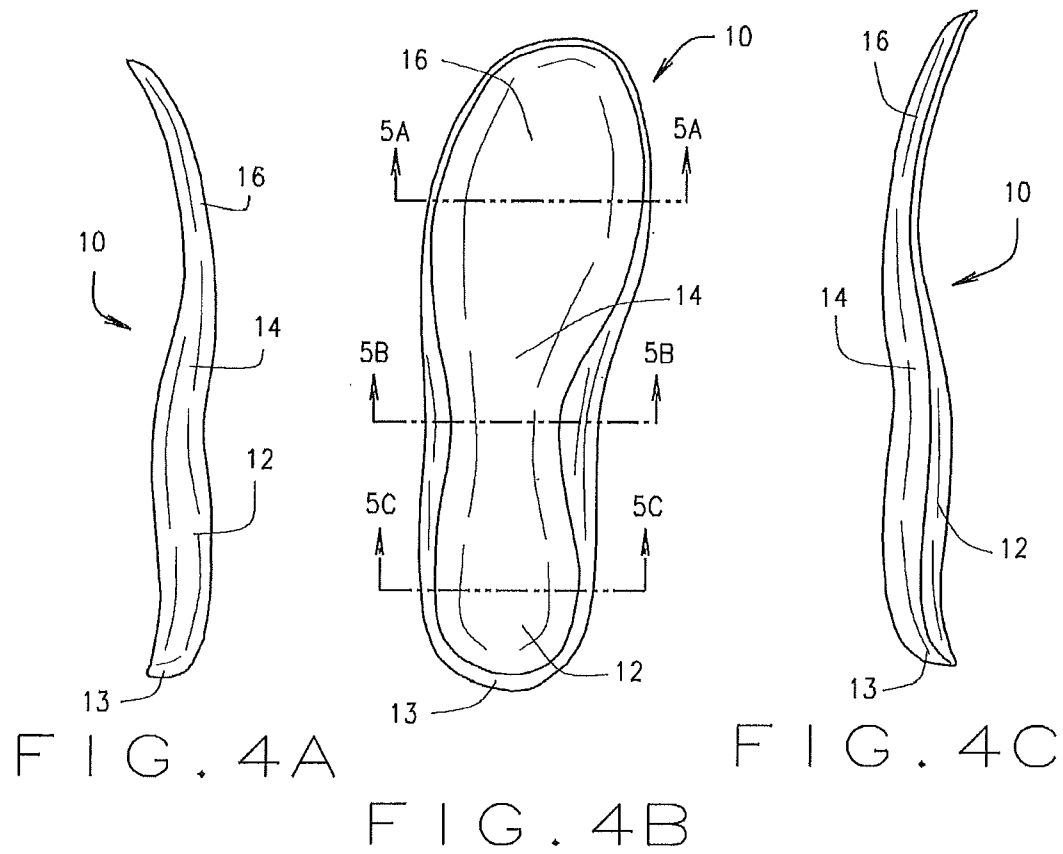


FIG. 3A



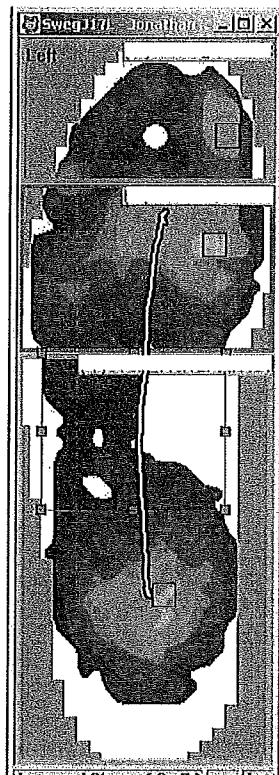


FIG. 6A



FIG. 6B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/039294

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A43B 13/38 (2012.01)

USPC - 36/43

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)

IPC(8) - A43B 13/38, 13/40, 13/42 (2012.01)

USPC - 36/43, 44; D2/961

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)

Patbase, Google Patents

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,155,180 A (PHILLIPS) 22 May 1979 (22.05.1979) entire document	1-5, 7, 10-12
Y		6, 8-9
Y	US 4,800,657 A (BROWN) 31 January 1989 (31.01.1989) entire document	6, 8-9
A	US 4,597,196 A (BROWN) 01 July 1986 (01.07.1986) entire document	1-12
A	US 2002/0043005 A1 (BLACKBURN et al) 18 April 2002 (18.04.2002) entire document	1-12

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

20 July 2012

Date of mailing of the international search report

07 AUG 2012

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774