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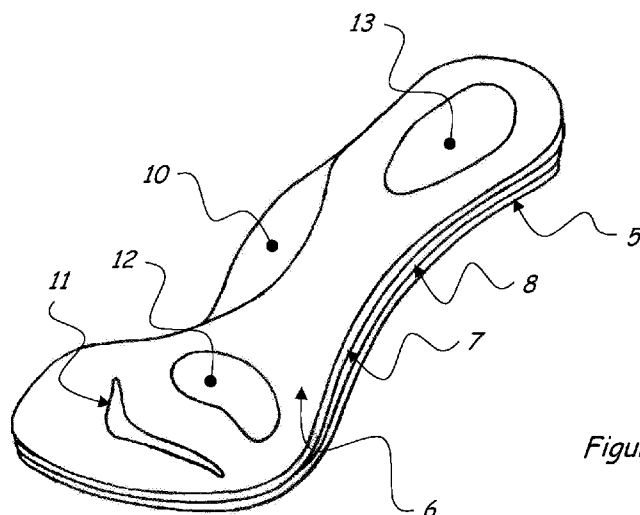


Figure 1b

(57) Abstract: A footwear with arch-support insole (6) and midsole (7) is the output of a shoe-making method comprising the step of: 1. Scanning a wearer's foot using a 3D scanner; 2. Generating an appropriate foot profile data using a proprietary software programme, in terms of shape, abnormality, foot print contours and pressure or bunion points; 3. Rectifying and fine-tuning the foot profile data to a normalized angle and state; 4. Designing and aligning an insole layer (6) with lateral curved extension (10) disposed on its inside and at its mid-section, a midsole layer (7) with a lateral curved extension (10) disposed on its inside and at its mid-section, protruded contour profiles (11, 12, 13) on the top surface of the insole layer (6), and an outsole layer (5), all using a computer-aided design software programme, and sending the above foot profile data to a 3D printer; 5. Printouting and hermetically bonding the above layers (6, 7, 5); 6. Customerization and touch-up with an upper (2) and accessories to manufacture an integral footwear.

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A FOOTWEAR WITH CUSTOMIZED ARCH-SUPPORT MIDSOLE AND INSOLE, AND A METHOD OF SHOE MAKING

Technical Field

5 The present invention relates generally to an article of footwear, and specifically to a footwear with customized arch-support midsole and insole, and a method of shoe making.

Background Art

10 A human foot has 26 bones. Of these, 7 are tarsals, 5 are metatarsals and 14 are phalanges. The bones form three arches, two running lengthwise and one running across the instep. The largest longitudinal arch called the medial arch is located on the inside of the foot. The lateral arch is the smaller longitudinal arch and is located on the outside of the foot. The metatarsal arch is the primary transverse arch.

15

Prior art teachings on arch supports are available. Some references were made here below:- US 1501765 (arch support), US 1602675 (arch support), US 2786282 (arch support), US 2826833 (arch support), and US 3081774 (arch support with metatarsal support bar). These arch supports have novel anchoring means inhibiting both lateral
20 movement of the foot relative to the arch support, and lateral movement of the arch support relative to the shoe. The arch supports may be built into shoes or maybe separate elements inserted into shoes. These arch supports support the longitudinal arch and the metatarsal arch of the wearer. These arch supports are not visible, allowing the wearer to wear the shoe with the confidence of its pleasing looks. It was
25 known that an inner insole has an integral lateral extension adapted to fit beneath, and provide increased support for the arch of the foot.

With the advent of technologies, there have been further prior art teachings on insoles, midsoles, footbeds, and shoe pads. US 7206718 B2 discloses a method for design and
30 manufacture of insoles. CN 104699908 A discloses a manufacturing method for 3D orthopedic insole. CN 104908319A discloses a preparation method for orthopedic shoe pad and orthopedic shoe pad.

Most prior art orthopedic shoes and sandals would claim these features:- They are
35 constructed with an anatomical wide footbed which quickly aligns to the specific

contours of the wearer's feet. The footbed allows body weight to be distributed equally over the entire foot for better posture and minimize joint stress. The insole is erosion-resistant, flexible and is constructed from high quality rubber, polyurethane and latex material. The elevated footbed or insole center provides the wearer with superior arch support and releases pressure in the joints of the central part of the foot to prevent arch pain. Deep heel indentation provides support, heel bone protection and heel pain prevention. Built-in hallux support in the shoe and sandal provides a comfortable hold for the big toe, preventing the foot from slipping forward and keeping the foot in a stable, orthopedically sound position. Shock-resistant suede-coated latex and cork footbed wicks away moisture to prevent athlete's foot and blisters. Shoe upper is made from fine natural Italian leather. The breathability of the fabric further ensures that feet remain dry and less prone to painful friction. These shoes and sandals are stylish as well as comfortable, classically fashionable and orthopedic.

In the United States patent application publication US 2014/0149072 A1, a scanner-assisted selection of fitting footwear with individualized footbed is described. With the aid of multisensory foot scanner, a geometric three-dimensional shape of the foot and a plantar pressure image registered with it are determined at the same time. A database of digitized shoe interiors is used for determining, by means of a best-fit selection, a series-produced shoe that best matches the 3D foot model. Using a conventional system for producing individualized insole and/or footbeds, an insole that matches the sole of the foot is selected or prepared.

The United States patent application publication US 2014/0020192 A1 disclosed a footwear assembly method with three-dimensional printing. It is generally known that printed material may be made of a material that includes an ink, a resin, an acrylic, a polymer, a thermoplastic material, a thermosetting material, a light-curable material, or combinations of composites thereof. Printed material may be formed from printing of one or more layers in a sequence of depositions or materials to any desired thickness, and may also include a filler material to impart a strengthening or aesthetic aspect to printed material. For an example, the filler material may be powdered material or dye designed to impart desired color or color patterns or transitions, metallic or plastic particles or shavings, or any powdered mineral, metal or plastic, and customize the hardness, strength or elasticity of printed material depending on desired properties. The 3D printer, powered by a PolyJet technology for an example, is capable of printing

multiple plastic and rubber-like materials with desired softness or hardness distributed on different locations on the sole. These mix and match materials are heterogeneous materials from combinations of liquid-based materials. The 3D printer will print out each layer of profile one by one:- printing one layer with a preset material, solidifying that
5 layer with ultra-violet light, and then repeated printing a next layer on top of the previous layer.

CN 104647757A also discloses a manufacturing method for 3D printing shoe pad.

10 The WO 2014207423 specification disclosed an article of footwear, having a sole and upper. The sole comprises an outsole for contact with the ground, an insole for contact with the wearer's foot, and a midsole layer between the insole and the outsole. The midsole layer comprises resilient material in a lattice arrangement with an array of hollow cells formed between upright walls of the resilient material. The midsole layer
15 has a thickness of at least about 5 mm.

In the current retail industry for fashion lifestyle footwear, there is no commercial provision for foot fitting shoes for various types of feet, including flat, mid heel, high heel, casual, party or corporate shoes for ladies, man or even children feet. This present
20 invention is targeted to provide commercially, in the fashion lifestyle footwear retail market, a non-orthopedic footwear through technology advancements. In the case of orthopedic footwear, the feet of the wearer are already substantially compromised or distorted. The above term "non-orthopedic" is used to imply that the invention is meant to be worn by "non-distorted" feet.

25

A perennial challenge lies in the manufacture of an article of customized arch-supporting footwear, including high heels, casual shoes and dress shoes, particularly that of shoe last, midsole, insole or footbed or shoe pad.

30 One issue with shoe lasts, midsoles, insoles, footbeds or shoe pads in prior art commercially available footwear is that they are generally flat and non-arch supporting, that is not fitting to different types of feet. The prior art shoes generally are not conforming to the arches of the feet. The weight of a person is not well supported and his or her posture is therefore not aligned. A shoe with good arch support reduces
35 muscle strains and helps to maintain balance. It can also reduce the risk of plantar

fasciitis, which is a painful inflammatory process of the plantar fascia, the connective tissue on the sole (bottom surface) of the foot. It is often caused by overuse of the plantar fascia or arch tendon of the foot. It is a very common condition and can be difficult to treat.

5

Another issue with midsoles, insoles, footbeds or shoe pads is their durability. The competing factors of stiffness and comfort mean that a supporting shank is made with layers of stronger and padded materials such as wood, plastic or cork. Oftentimes, at least a steel element is incorporated to its supporting shank, which poses security alerts when such a shoe wearer passes through security check points, for an example at an airport.

Therefore, both the 3D scanning technology and the 3D printing technology offer a new trend in the shoe manufacture. They are advantageously employed in the present invention to provide an arch support function and a foot profiling/fitting function in arch support shoes. Thus, it would be a boon to manufacture insoles, footbeds or shoe pads that reliably and consistently provide sufficient arch support for the feet, with the assistance of modern 3D scanning and printing technologies. Here lies the inventive step for the proposed invention, that is the insole and the midsole are customized to be foot profiling/fitting and arch-supporting, with the assistance of said technologies. Together the customized arch supporting insole and midsole are incorporated to constitute an arch support shoe as a fashion lifestyle footwear.

Summary of the Invention

One object of the present invention is to provide a foot profiling/fitting function to a fashion lifestyle footwear, using foot profile data applied to midsole, insole or footbed, with the assistance of a 3D scanning and 3D printing technology, thus allowing arch-support and foot alignment that will fits all types of feet.

Another object of the present invention is to manufacture arch-support midsole and insole further comprising at least three hermetically bonded layers, with the assistance of a 3D printing technology.

Still, another object of the present invention is to apply the arch-support midsole and insole to other forms of fashion lifestyle footwear including high heels and flat shoes.

Yet, another object of the present invention is to render the fashion lifestyle footwear with arch-support midsole and insole that is comfortable and fashionable to use.

Essentially, the applicants have developed a footwear with customized arch-support midsole and insole using 3D scanning technology and 3D printing technology. This footwear with customized arch-support midsole and insole is an output of a shoe-making method comprising the steps of:

1. Scanning a wearer's foot using a 3D scanner;
2. Generating an appropriate foot profile data using a proprietary software programme, in terms of shape, abnormality, foot print contours and pressure or bunion points;
3. Rectifying and fine-tuning the foot profile data to a normalized angle and state;
4. Designing and aligning an insole layer with a lateral curved extension on its inside and at its mid-section, a midsole layer with a lateral curved extension on its inside and at its mid-section, protruded contour profiles on the top surface of the insole layer, and an outsole layer, all using a computer-aided design software programme, and sending the above foot profile data to a 3D printer;
5. Printouting and hermetically bonding the above layers;
6. Customerization and touch-up with an upper and accessories to manufacture an integral footwear.

Other objects may be subsequently discovered upon further elaboration of the present invention.

Brief Description of the Drawings

Preferred embodiments of the present invention will be described, by way of examples only, with reference to the accompanying drawings in which:-

Figure 1a is a side view of an arch-support sole in a high heel, made in accordance with the present invention.

Figure 1b is a perspective view of the arch-support sole shown in Figure 1a.

Figure 2a is a side view of a first embodiment of a high heel with arch-support sole according to the present invention.

Figure 2b is a side view of a second embodiment of a high heel with arch-support sole according to the present invention.

5 Figure 2c is a side view of a third embodiment of a high heel with arch-support sole according to the present invention.

Figure 3a is a side view of a first embodiment of a flat shoe with arch-support sole according to the present invention.

10 Figure 3b is a side view of a second embodiment of a flat shoe with arch-support sole according to the present invention.

Detailed Description

15 Referring to the Figures, several embodiments of a high heel and a flat shoe, with customized arch-support soles, will be explained.

An article of footwear generally has an upper (2) and a sole.

20 The upper (2) may be formed from a plurality of material elements (i.e. one or more layers of a textile, a natural fabric, a synthetic fabric, a knit, a woven material, a nonwoven material, a mesh, a leather, a synthetic leather, a polymer, a rubber and a foam and so on). It is stitched or adhesively bonded to form a void on the interior of the footwear for comfortably and securely receiving a foot. More particularly, the upper forms a structure that extends over instep and toe areas of the foot, along medial and
25 lateral sides of the foot, and around a heel area of the foot. The upper may also incorporate a lacing system, as well as permitting entry and removal of the foot from the void within the upper. In addition, the upper may include a tongue that extends under the lacing system to enhance adjustability and comfort of the footwear, and the upper may include a heel counter. For an example, the upper may be a high tensile strength
30 knit or mesh sockfit upper. Shoe upper is made from fine natural Italian leather. The breathability of the fabric further ensures that feet remain dry and less prone to painful friction.

35 It is important to note that the sole is eventually made according to measurements, such as shape and pressure measurements, taken from a wearer's foot, with the assistance

of a 3D scanning technology, and ultimately with a 3D printing technology which is being programmed individually according to the individual wearer's requirements. This arch-support midsole is secured to the lower portion of the upper so as to be positioned between the foot and the ground. This arch-support midsole may also include a
5 sockliner positioned within the upper and proximal to a lower surface of the foot to enhance footwear comfort.

It is also important to note that the applicants had developed a portable 3D scanning machine, with at least eight scanning cameras, to scan and measure all types of feet
10 and heights. The machine can also scan with a person's alignment point. The applicants had also developed proprietary softwares to generate and printout foot profile and contour profiles data.

Referring to Figures 1a and 1b, the sole comprises at least an outsole layer (5) in
15 contact with the ground, a midsole layer (7) and an insole layer (6) in contact with an individual wearer's foot.

A prior art outsole layer (5), the midsole layer (7) and the insole layer (6) are engaged with the assistance of a metallic securing mechanism. This metallic securing
20 mechanism often time causes security alerts when the shoe wearer passes through a security checkpoint, such as at an airport checkpoint. One main advantage of using a 3D printing technology is that no metallic component is employed in a supporting shank, whereas the three laminated layers (6, 7, 5) in the present invention are hermetically bonded. The customized arch-support sole comprises at least a top insole layer, a
25 midsole layer and an outsole layer; the three layers are laminated and manufactured from a 3D printing technology, so that the three layers are hermetically bonded together, without a metallic engaging means. This is a non-obvious advantage of using 3D printing technology.

30 The midsole layer (7) may be formed from a polymer foam material that attenuates ground reaction forces (i.e. provides cushioning) during walking, running and other ambulatory activities. The midsole layer (7) may also cushions, such as fluid-filled chambers, plates, moderators or other elements that further attenuates forces, enhances stability or influence the motions of the foot, for an example.

The outsole layer (5) forms a ground contacting element of the footwear and is usually fashioned from a durable and wear-resistant rubber material that includes texturing to impact traction.

- 5 In Figure 1b, protruded contour profiles shown on the top surface of an insole layer (6) include a medial arch contour profile supported by a lateral curved extension (10), a toe contour profile (11), a ball contour profile (12) and a heel contour profile (13). Both the toe contour profile (11) and the ball contour profile (12) serve to support the metatarsal arch.

10

- The insole layer (6) is constructed with an anatomical wide footbed which quickly align to the specific contour profiles of the wearer's feet. The footbed allows body weight to be distributed equally over the entire foot for better posture and minimize joint stress. The insole layer (6) is erosion-resistant, flexible and is constructed from high quality
15 rubber, polyurethane and latex material. The elevated footbed/insole center provides the wearer with superior arch support and releases pressure in the joints of the central part of the foot to prevent arch pain. Deep heel indentation provides support, heel bone protection and heel pain prevention. Built-in hallux support in the shoe and sandal provides a comfortable hold for the big toe, preventing the foot from slipping forward and
20 keeping the foot in a stable, orthopedically sound position. Shock-resistant suede-coated latex and cork footbed wicks away moisture to prevent athlete's foot and blisters.

Consequently, the above footwear with customized arch-support sole is the output of a shoe-making process envisaged by the applicants which comprise the following steps:-

- 25 1. Scanning a wearer's foot using a 3D scanner;
2. Generating an appropriate foot profile data using a proprietary software programme, in terms of shape, abnormality, foot print contours and pressure or bunion points;
3. Rectifying and fine-tuning the foot profile data to a normalized angle and state;
4. Designing and aligning an insole layer (6) with a lateral curved extension (10)
30 disposed on its inside and at its mid-section, a midsole layer (7) with a lateral curved extension (10) disposed on its inside and at its mid-section, protruded contour profiles (11, 12, 13) on the top surface of the insole layer (6), and an outsole layer (5), all using a computer-aided design software programme, and sending the above foot profile data to a 3D printer;
35 5. Printouting and hermetically bonding the above layers (6, 7, 5);

6. Customerization and touch-up with an upper (2) and accessories to manufacture an integral footwear.

Referring to Figures 2a, 2b, and 2c, the customized arch-support insole (6) and midsole
5 (7) according to the invention are applied to three embodiments of high heels (1), where
the heel is raised or elevated relative to its forepart, with the assistance of a shoe heel
support (3) with a toe piece (4), or a wedge (14).

Referring to Figures 3a and 3b, the customized arch-support insole (6) and midsole (7)
10 according to the invention are applied to two embodiments of substantially flat shoes.

Claims

- 1) A footwear having at least an upper (2) and a sole, the sole comprising at least an insole layer (6) in contact with a wearer's foot, a midsole layer (7) and an outsole layer (5) in contact with the ground, is characterized in which
- the sole is disposed to match and fit a customized foot profile of an individual wearer, which is preferably computed from a 3D scanning technology;
- the top insole layer (6), the midsole layer (7) and the outsole layer (5) are manufactured from a 3D printing technology, so that the three layers (6, 7, 5) are hermetically bonded together, without a metallic engaging means in its shank (8); and
- the sole is secured to the lower portion of the upper (2) as an integral footwear, whereas the wearer's foot is substantially non-distorted/non-orthopedic;
- whereby the integral footwear also supports the arches of the foot and aligns the standing posture of the wearer.
- 2) The footwear with customized arch-support sole as in Claim 1 in which
- the insole layer (6) includes integrally a lateral curved extension (10) disposed on its inside and at its mid-section, whereby the lateral curved extension (10) serve as a medial arch support.
- 3) The footwear with customized arch-support sole as in Claim 1 in which
- the midsole layer (7) includes integrally a lateral curved extension (10) disposed on its inside and at its mid-section, whereby the lateral curved extension (10) serve as a medial arch support.
- 4) The footwear with customized arch-support sole as in Claim 1 in which
- the top surface of the insole layer (6) in contact with the wearer's foot is disposed with a toe contour profile (11) and a ball contour profile (12) at its forepart, both of which serve to support the metatarsal arch of the foot.
- 5) The footwear with customized arch-support sole as in Claim 1 in which
- the top surface of the insole layer (6) in contact with the wearer's foot is disposed with a heel contour profile (13) at its heel part.

- 6) The footwear with customized arch-support sole as in Claim 4 or 5 in which the protruded contour profiles (11, 12, 13), which is preferably printed from a 3D technology, match and fit with the customized foot profile of an individual wearer, which is preferably computed from a 3D scanning technology.
- 5
- 7) The footwear with customized arch-support sole as in Claim 2 or 3 in which the customized arch-support insole layer (6) and the midsole layer (7) with lateral curved extension (10) are integrally applied to a high heel (1).
- 10
- 8) The footwear with customized arch-support sole as in Claim 2 or 3 in which the customized arch-support insole layer (6) and the midsole layer (7) with lateral curved extension (10) are integrally applied to a flat shoe.
- 9) A shoe-making method comprises the step of:
- 15
1. Scanning a wearer's foot using a 3D scanner;
 2. Generating an appropriate foot profile data using a proprietary software programme, in terms of shape, abnormality, foot print contours and pressure or bunion points;
 3. Rectifying and fine-tuning the foot profile data to a normalized angle and state;
 - 20
 4. Designing and aligning an insole layer (6) with lateral curved extension (10) disposed on its inside and at its mid-section, a midsole layer (7) with a lateral curved extension (10) disposed on its inside and at its mid-section, protruded contour profiles (11, 12, 13) on the top surface of the insole layer (6), and an outsole layer (5), all using a computer-aided design software programme, and sending the above foot profile data to a 3D printer;
 - 25
 5. Printouting and hermetically bonding the above layers (6, 7, 5);
 6. Customerization and touch-up with an upper (2) and accessories to manufacture an integral footwear.

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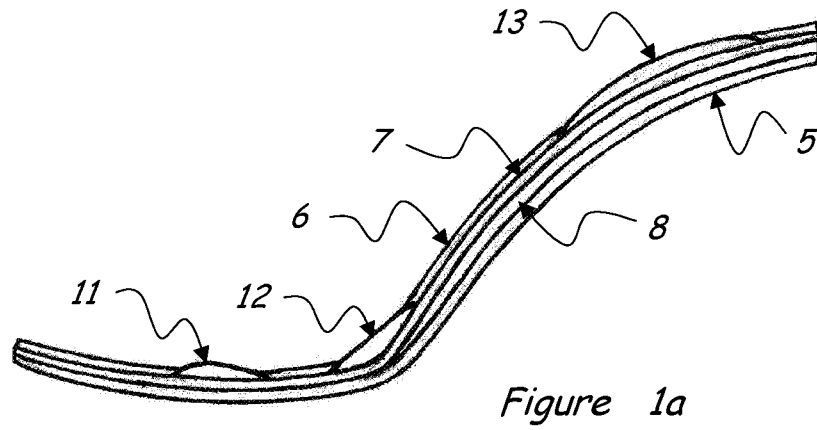


Figure 1a

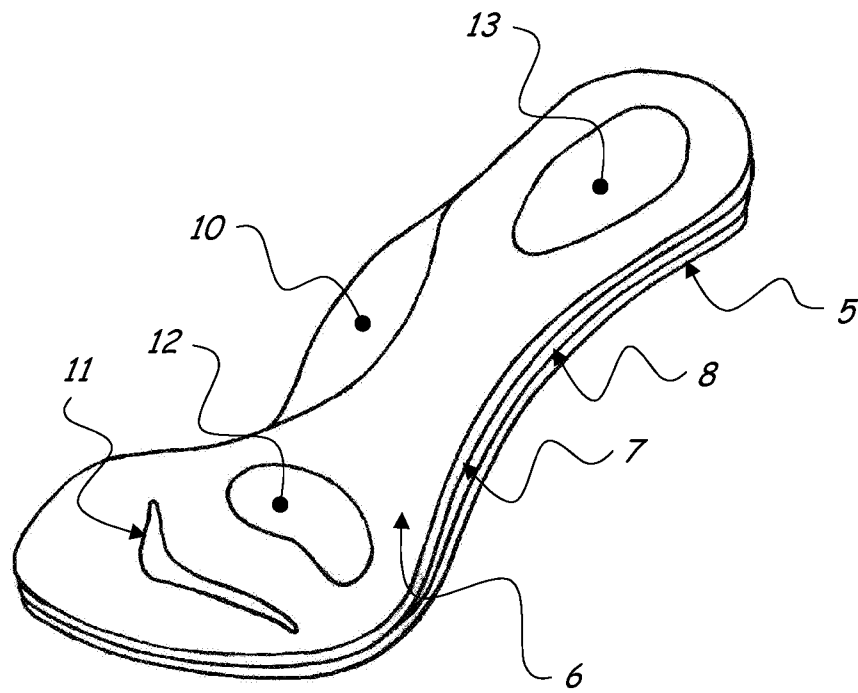


Figure 1b

2 / 4

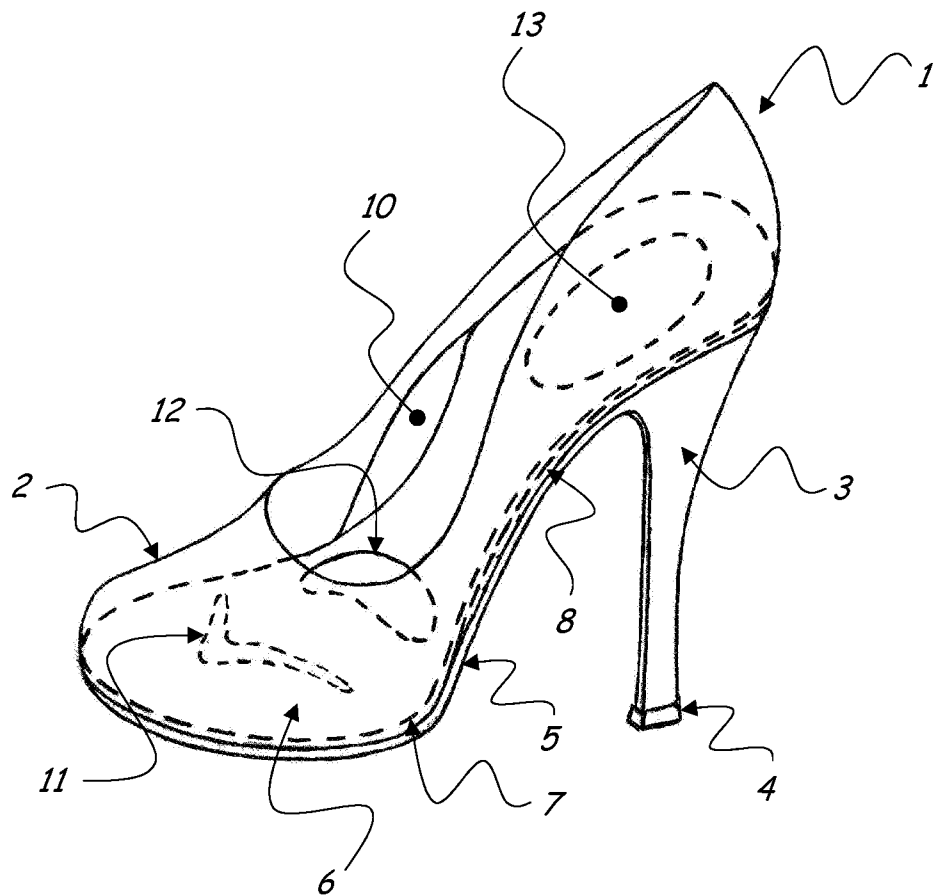


Figure 2a

3 / 4

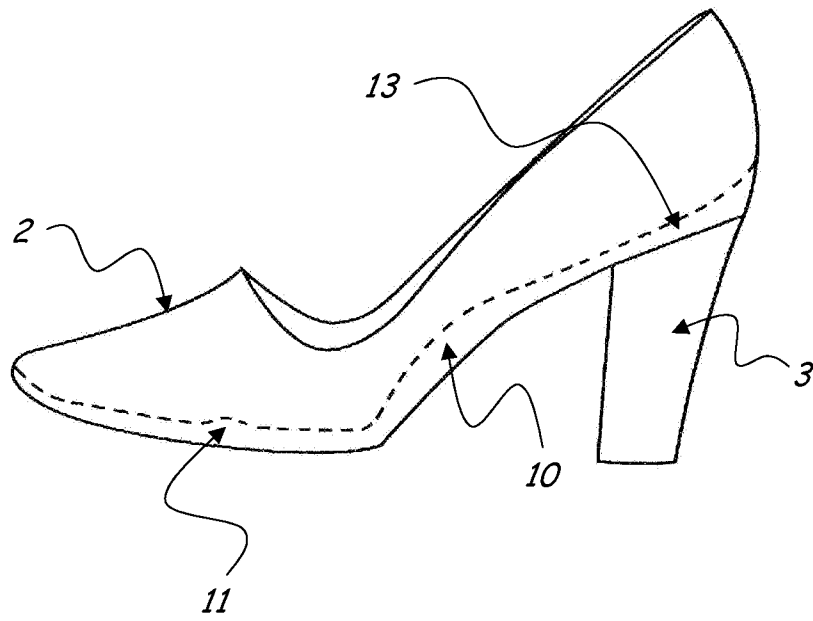


Figure 2b

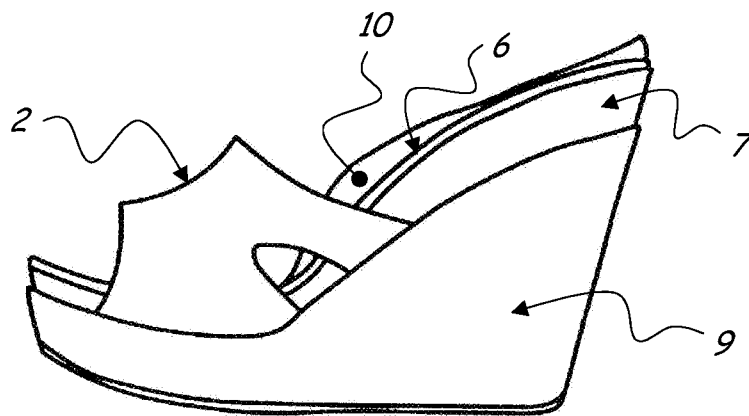


Figure 2c

4 / 4

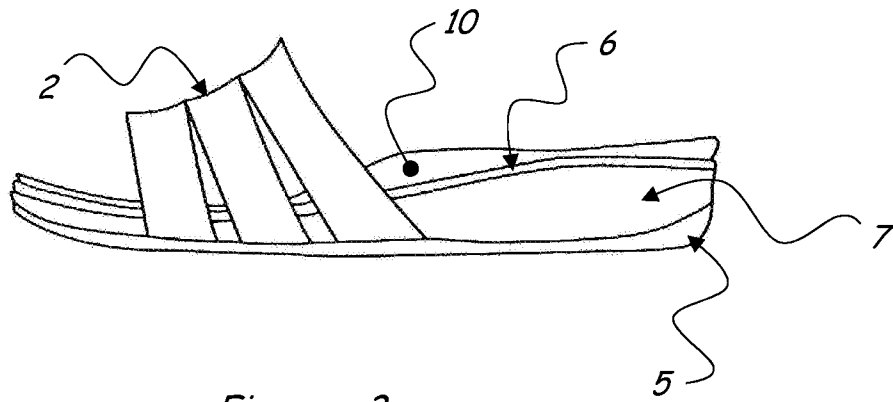


Figure 3a

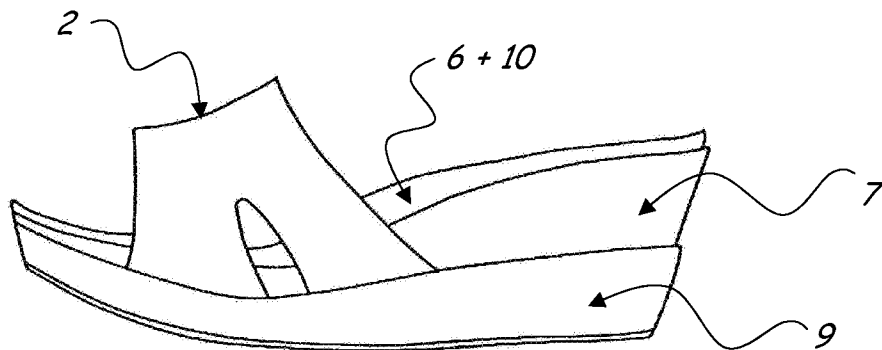


Figure 3b