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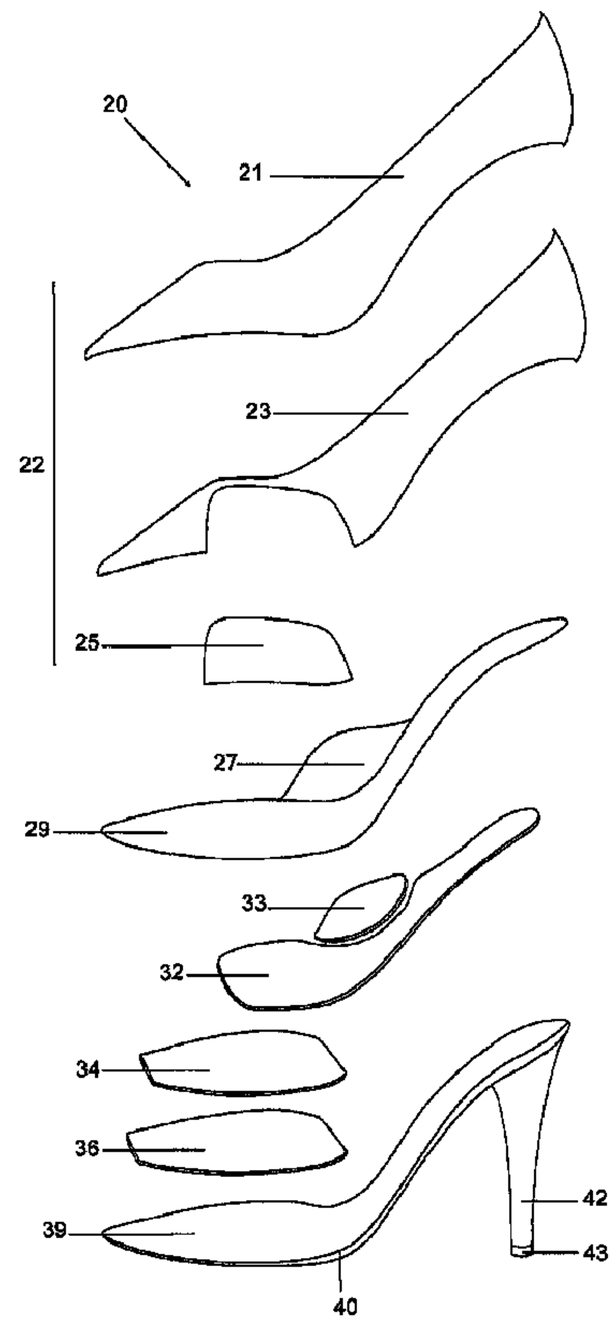

Figure 3

(57) Abrégé/Abstract:
A footwear last (1) comprising a hind foot section and a forefoot section joined by a midfoot section. The forefoot section is defined by a three reference points which define a reference point circumference (9, Figures 1 and 2). The hind foot section is equivalent to

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(57) Abrégé(suite)/Abstract(continued):
a predetermined shoe (20) size (37) while the forefoot section is equivalent to a shoe (20) size (37) between 2 and 3 sizes larger than said predetermined shoe (20) size (37) using the Paris point system. An article of footwear made using said last (1) comprises an upper (22), a midsole (30, Figure 6) and an outer sole (40). The upper (22) has an outer layer (21) and an inner layer, which inner layer comprises an elastic panel (25) arranged to cover the first and/or fifth metatarsophalangeal joint of a user. The midsole (30) has a first layer and a second layer, wherein the first layer is arranged to line the footbed of the shoe (20) and the second layer is arranged to provide a shock absorbing layer. The outer sole (40) is secured to the upper (22) on assembly to complete the article of footwear. Figure 3 A footwear last (1) comprising a hind foot section and a forefoot section joined by a midfoot section. The forefoot section is defined by a three reference points which define a reference point circumference (9, Figures 1 and 2). The hind foot section is equivalent to a predetermined shoe (20) size (37) while the forefoot section is equivalent to a shoe (20) size (37) between 2 and 3 sizes larger than said predetermined shoe (20) size (37) using the Paris point system. An article of footwear made using said last (1) comprises an upper (22), a midsole (30, Figure 6) and an outer sole (40). The upper (22) has an outer layer (21) and an inner layer, which inner layer comprises an elastic panel (25) arranged to cover the first and/or fifth metatarsophalangeal joint of a user. The midsole (30) has a first layer and a second layer, wherein the first layer is arranged to line the footbed of the shoe (20) and the second layer is arranged to provide a shock absorbing layer. The outer sole (40) is secured to the upper (22) on assembly to complete the article of footwear.

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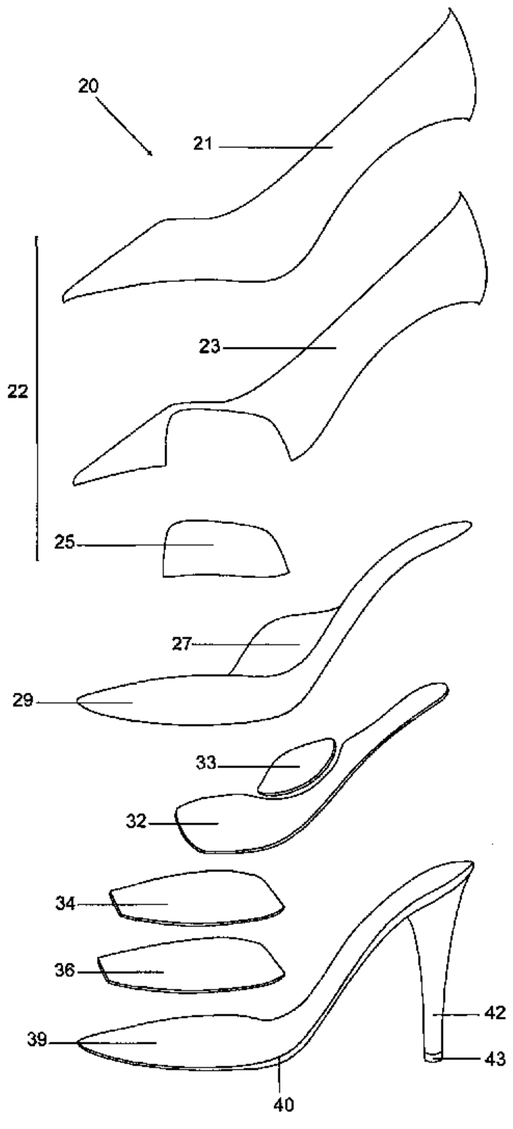

Figure 3

(57) Abstract: A footwear last (1) comprising a hind foot section and a forefoot section joined by a midfoot section. The forefoot section is defined by a three reference points which define a reference point circumference (9, Figures 1 and 2). The hind foot section is equivalent to a predetermined shoe (20) size (37) while the forefoot section is equivalent to a shoe (20) size (37) between 2 and 3 sizes larger than said predetermined shoe (20) size (37) using the Paris point system. An article of footwear made using said last (1) comprises an upper (22), a midsole (30, Figure 6) and an outer sole (40). The upper (22) has an outer layer (21) and an inner layer, which inner layer comprises an elastic panel (25) arranged to cover the first and/or fifth metatarsophalangeal joint of a user. The midsole (30) has a first layer and a second layer, wherein the first layer is arranged to line the footbed of the shoe (20) and the second layer is arranged to provide a shock absorbing layer. The outer sole (40) is secured to the upper (22) on assembly to complete the article of footwear. Figure 3 A footwear last (1) comprising a hind foot section and a forefoot section joined by a midfoot section. The forefoot section is defined by a three reference points which define a reference point circumference (9, Figures 1 and 2). The hind foot section is equivalent to a predetermined shoe (20) size (37) while the forefoot section is equivalent to a shoe (20) size (37) between 2 and 3 sizes larger than said predetermined shoe (20) size (37) using the Paris point system. An article of footwear made using said last (1) comprises an upper (22), a midsole (30, Figure 6) and an outer sole (40). The upper (22) has an outer layer (21) and an inner layer, which inner layer comprises an elastic panel (25) arranged to cover the first and/or fifth metatarsophalangeal joint of a user. The midsole (30) has a first layer and a second layer, wherein the first layer is arranged to line the footbed of the shoe (20) and the second layer is arranged to provide a shock absorbing layer. The outer sole (40) is secured to the upper (22) on assembly to complete the article of footwear.

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Footwear and last

The present invention relates to articles of footwear suitable for users with foot deformities. In particular, but not exclusively, hallux valgus, frequently known as a bunion.

In anatomy, the hallux is the first toe or big toe. Hallux valgus is a deformity of the foot caused by a deviation of the first metatarsal bone. It is often accompanied by the formation of a bursa over the first metatarsophalangeal joint. Bursitis, that is, inflammation of the bursa causes severe pain and/or discomfort. Over time, the sesamoid bones beneath the first metatarsal may also become deviated. Further, hallux valgus may also be accompanied by discomfort when pressure is applied to the first metatarsophalangeal joint or said joint moves, or by arthritis of the first metatarsophalangeal joint and/or altered range of motion of said joint.

According to Nix, Smith and Vicenzino (J Foot Ankle Res. 2010; 3:21) prevalence of hallux valgus is on average 23% for adults between the ages of 18 and 65 and 35.7% in people over the age of 65. Prevalence is higher in females and also increases with age.

Treatment for hallux valgus can be either surgical or non-surgical. Non-surgical-options include use of, among others, insoles, bunion pads or splints and toe spacers. In addition, hallux valgus sufferers often wear wider footwear or buy a larger size to accommodate the hallux valgus. Nevertheless, in more extreme cases, surgical intervention may be necessary.

Regardless of whether poorly fitting footwear, such as shoes a size larger than those required by a person or shoes that fit the toes too tightly, cause hallux valgus, it is widely agreed that poorly fitting shoes exacerbate bunions. Currently, footwear options suitable for hallux valgus sufferers include wider fit shoes, typically flat. Some alternatives include extra cushioning to alleviate foot pain while other orthopaedic alternatives may include toe spacers.

Although footwear suitable for hallux valgus sufferers may be available, people with hallux valgus often have secondary and/or additional foot problems. For example, hallux valgus is often accompanied or exacerbated by foot over-pronation, that is, placing most

of a person's weight on the inside edge of the foot when walking or running thereby causing the foot to tilt inwards.

A tailor's bunion or bunionette is a deformity of the foot caused by a deviation of the fifth metatarsal bone. It can also be accompanied by a bursa, arthritis and/or altered function of the fifth metatarsophalangeal joint and/or deviation of the relevant sesamoid bones. Prevalence of bunionettes has not been established.

In shoemaking, a last is a model or mould for shaping or repairing footwear shaped to replicate or resemble the human foot. Traditionally, lasts were hand carved in wood; however, in modern manufacture, lasts are typically made from a resin.

Historically, footwear was custom-made and handcrafted by shoemakers. Modern footwear manufacture is generally based on mass production of footwear assembled on a last.

Current footwear manufacture involves cutting of suitable material to produce a shape or shapes which will eventually become the footwear upper. Once the shape or shapes is or are cut, the material components are sewn together and, if necessary, said material components are treated and any embellishments or fastenings attached. Once a footwear upper has been created, said uppers are assembled on a last and a lasting sock is secured to the edge of the uppers to hold the upper in place and mould the article of footwear into the shape of a foot. Subsequently, either a heel or an outsole is secured to the underside of the lasting sock. If the heel, if any, is secured first, the outsole is then attached. Alternatively, if the outsole is secured first and the shoe comprises a heel, said heel is attached. Additional treatment of the sole or footwear upper, if required, is then carried out; for example, most manufacturers secure an insole and an internal or lining sock including a brand name and/or logo across the interior length of the shoe. In some instances, a midsole, if any, is secured to the lasting sock before the shoe is lasted, that is assembled on the last, or to the lining sock, when said lining sock is secured. Finally, the shoe is subjected to quality control and brushing (or similar treatments) and packaged. Certain types of shoe such as closed shoes and/or welted shoes require additional manufacturing steps.

Footwear manufacturers have tried to accommodate and/or cater for people who suffer from feet problems such as hallux valgus or bunionettes. However, fashion-led shoe construction is seldom altered and, when it is, the results are typically ineffective

from a comfort and/or design perspective. Further, even when suitable footwear is produced, said footwear is generally produced to address a single problem, for example, flat feet or hallux valgus.

The present invention seeks to provide footwear for people with hallux valgus and/or bunionettes. Further, the present invention seeks to provide footwear suitable for hallux valgus sufferers having secondary and/or additional foot problems.

According to a first aspect of the present invention, there is provided an article of footwear for a hallux valgus sufferer, the article of footwear comprising: an upper having an outer layer and an inner layer, the inner layer comprising an elastic panel arranged to cover the first and/or fifth metatarsophalangeal joint of a user; a midsole comprising a first layer and a second layer, wherein the first layer is arranged to line the footbed of the shoe and the second layer is arranged to provide a shock absorbing layer; and an outer sole arranged to engage the ground, the outer sole being secured to the upper on assembly to complete the article of footwear.

Preferably, the elastic panel is made from a layer of polychloroprene. More preferably, the polychloroprene is foamed polychloroprene.

Advantageously the article of footwear further comprises a third layer located between the first and second layers, which third layer is arranged to provide additional support for a ball of a foot. In a preferred embodiment, the midsole further comprises an anti-pronation element. In a further preferred embodiment the anti-pronation element is made from polyurethane memory foam.

In yet another embodiment, the first, second and third layers are made from urethane memory foam. Preferably, the first layer is made of a urethane memory foam having higher compression force deflection properties and resilience properties than the compression force deflection properties and resilience properties of the urethane memory foam of the second layer. More preferably, the third layer is made of a urethane memory foam harder than the urethane memory foam of the first layer and higher resilience properties than the urethane memory foam of the second layer.

Preferably, the article of footwear further comprises an insole having a lining arranged to accommodate a foot. More preferably, the article of footwear further comprises a shock resistant heel-piece.

In yet another preferred embodiment, the article of footwear is a slingback, a court shoe, a boot, a peep toe shoe or a ballerina flat.

According to a second aspect of the present invention, there is provided a footwear last comprising a hind foot section and a forefoot section joined by a midfoot section; the forefoot section is defined by a first, second and third reference points having a reference point circumference; wherein the hind foot section is equivalent to a predetermined shoe size determined by using the Paris point footwear sizing system and the forefoot section has a reference point circumference equivalent to a shoe size between 1.5 and 3.5 sizes determined by using the Paris point footwear sizing system larger than said predetermined shoe size.

Advantageously, the reference point circumference of the last measures between 220 mm and 260 mm. In a preferred embodiment, a European size 37 as determined by using the Paris point footwear sizing system has a reference point circumference of between 230 mm and 235 mm and reference point circumference increases or decreases by 2.5 mm per half size.

Preferably, the footwear last comprises a tread surface, which tread surface measures between 80 mm and 85 mm. More preferably, the tread surface measures between 81.5 mm and 82.5 mm.

In a preferred embodiment, the footwear last has a toe depth of between 20 mm and 25 mm.

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

Figure 1 is a perspective view of a last according to a first aspect of the present invention;

Figure 2 is a top view of the last of figure 1;

Figure 3 is an exploded view of an article of footwear according to an embodiment of a second aspect of the present invention;

Figure 4a shows a first pattern used for an embodiment of the elastic panel shown in Figure 3;

Figure 4b shows a second pattern used for an embodiment of the elastic panel shown in Figure 3;

Figure 5 is an underside view of the lining sock of Figure 3;

Figure 6 is a perspective view of the midsole of Figure 3; and

Figure 7 is a top view of the anti-pronation element of the article of footwear of Figure 3.

In the drawings, like parts are denoted by like reference numerals.

Referring now to Figures 1 and 2 a shoe last 1 is a solid cast made to resemble the human foot. A last 1 can be made of different materials but its construction is based on the same principles. In correspondence with a foot, a last 1 may be divided into toes, a fore portion, a waist, a heel area, an upper portion and a base. The front point of the base of the last is typically at an angle from the horizontal to define a space between the toe portion and the horizontal plane; this distance is known as the toe spring 3. Similarly, the height of the last corresponding to the height of the hallux tip point is called toe depth 5.

The front portion of the last is defined by a first point representing the first metatarsophalangeal joint A of a foot and a second point representing the fifth metatarsophalangeal joint B of a foot. An imaginary line on the base of the last between the first and second points is known as the bottom support surface or tread point 2 and corresponds to the ball of a foot. The circumference of the last between these joint points defines the ball girth 8. This anterior portion of the last defines the toe box, that is, the portion arranged to cover and protect the toes in a shoe. If a last 1 is for manufacturing high heels, the base of the heel is on a horizontal plane higher than that of the tread point 2. The vertical distance between the base of the heel portion and the tread point 2 is known as heel elevation 6 while the curve defined by the outline of the contoured base of the last is called heel gradient or pitch. According to an embodiment of the present invention, a last is graded across European shoe sizes 36 to 42 and is shaped to accommodate a foot with a bunion and/or bunionette. When designing a last in accordance with European tradition, it is generally accepted that three traditional reference points will be used as a marker on the last instead of the ball girth 8. These reference points are selected for ease of visibility on the last and allow for accurate measurements when the lasts are graded across different sizes. These reference points are located on either side of the last 1 and the top of the last and are placed a little closer to the heel relative to points A and B and the ball girth. The sizing measurements consist of measuring the circumference 9 around these reference points, this dimension will be

referred to as reference point circumference 9 and is typically located between the standard ball girth 8 and instep girth (not shown). Thus, the reference point circumference 9 is located around 0.5 to 20 mm higher relative to the ball girth 8. A last in accordance with an embodiment of the present invention comprises a reference point circumference 9, a ball girth 8 and a bottom support surface 2 width greater than those used in standard lasts. Specifically, for a European size 37, the ball girth is between 227 mm and 229 mm while the tread point or bottom support surface 2 measures between 79 mm and 82.5mm. The bottom support surface 2 provides an increase between 1 and 4 mm in relation to a standard tread point for an equivalent standard last, which is typically around 76-78 mm. Further, the reference point circumference 9 for a European size 37 is between 223 mm and 234 mm, and increases or decreases by 2 to 2.5 mm per half size. This represents an increase in reference point circumference, usually in a range of 215 to 220 mm and generally about 218 mm, of between 9 and 16 mm over a standard last. Accordingly, the reference point circumference 9 of the last of the present invention is increased by the equivalent of two to three European shoe sizes relative to the traditional reference point circumference of a standard last of the same type. However, the overall appearance of a shoe produced using the last of the present invention is not significantly altered. Finally, toe depth 5 is also increased for the purposes of this invention, from a standard toe depth of 14 mm to a depth of 20-21 mm.

The length 11 of a last for a heeled European size 37 shoe is approximately between 253 and 263 mm increasing or decreasing by 3.3 mm per half a size assuming the heel elevation 6 is approximately between 4 and 9 cm. The last 1 usually has a toe spring 3 in a range of 9 to 12 mm. Development of the last 1 of the present invention was carried out by hand-carving traditional wooden lasts and then using said wooden lasts to mould a final last in polyethylene resin. Intermediate adjustments were carried out by shaving the traditional wooden lasts with a rasp and or adding small amounts of putty to the lasts. After each adjustment, a revised version of the wooden last was made. Subsequently, a corresponding polyethylene version was also made. To manufacture a shoe in accordance with a preferred embodiment of the present invention described below in relation to Figures 2 to 9, the wooden last, corresponding lasting socks (defined below), heels, uppers, insoles and outsoles were manufactured and samples produced. At each sampling stage, a revised shoe was tested.

As mentioned above in relation to Figures 1 and 2, the last used to produce a shoe in accordance with the invention has a reference point circumference 9 which is between 9 and 20 mm, preferably between 9 and 15 mm, greater than that of a standard shoe. As

a result, the reference point circumference is equivalent to the reference point circumference of a shoe approximately two to three numerical sizes larger while the remainder of the shoe (i.e. overall length, heel width, etc.) is equivalent to its numerical size. This allows a hallux valgus sufferer to wear the correct size shoe with reduced or without pain caused by an ill-fitting toe box.

The following table shows four examples of a size 37 last according to the present invention:

	Example 1	Example 2	Example 3	Example 4
Reference point circumference of a standard last	218 mm	220 mm	215.5 mm	213.5 mm
Reference point circumference of a last according to the invention	232.8 mm	234 mm	224.5 mm	223.5 mm
Difference	14.5 mm	14 mm	9 mm	10 mm

Examples 1, 2 and 3 relate to lasts having a heel elevation of between 40 and 80 mm. Example 4 relates to a last arranged to be used in the manufacture of flat footwear (i.e. footwear having a heel elevation of no more than 25 mm).

Referring now to Figure 3 there is shown an article of footwear according to an embodiment of the present invention. The article is a shoe 20 comprising a vamp or shoe upper 22 to secure the shoe 20 onto the foot, a vamp lining 23 to insulate a wearer's foot, an insole 27, 29 arranged to receive a foot and insulate its sole, a midsole to provide shock absorption, support and cushioning, an outsole 40 arranged to contact the ground and a heel 42. The shoe upper 22 comprises an outer layer 21 and an inner layer formed by a vamp lining 23 and an elastic panel 25 arranged to fit over the first metatarsophangeal joint of a foot, roughly covering the area from the base of a hallux to the area surrounding a first metatarsal. The outer layer 21 is made of a first material such as leather, suede or fabric and has a first elastic modulus while the elastic panel 25 is made from a second material described in detail with reference to Figures 4a and 4b below, which material has a second elastic modulus. The second elastic modulus is lower than the first elastic modulus; thus, the elastic panel 25 is much more flexible than the outer layer 21. The insole comprises a sock lining 29 arranged to cover the foot bed of

the shoe and to come into contact with a wearer's foot and an arch portion 27 attached to the sock lining 29 and arranged to receive a wearer's medial longitudinal arch. The midsole is formed by three distinct layers 32, 34, 36. A cushioning top layer 32 is provided under the sock lining 29. The cushioning layer generally has the same outline as the sock lining 29 but with a slimmer contour, a truncated anterior portion and a cut-out portion arranged to receive an anti-pronation element 33, which anti-pronation element 33 is provided on the arch portion of the foot bed under the arch portion 27 of the insole, adjacent to and on the side of the cushioning layer 32. The midsole further comprises a middle layer 34 located on the base of the foot bed and arranged to provide additional cushioning and support for the ball of the wearer's foot. Finally, the midsole comprises a base layer 36 provided between the middle layer 34 and a lasting sock 39. The base layer 36 provides shock absorption and resilience. The lasting sock 39 which comprises a shank, a sock layer and a further half-length layer is formed of any suitable material such as cellulose fibre, leather board, or non-woven materials, in use, is secured to the outsole and the heel 42. Upon assembly, the elastic panel 25 is secured to the lining 23 and the resulting inner layer is secured to the vamp outer layer 21 to form the shoe upper 22. Further, the base and middle layers of the midsole are secured to the lasting sock 39 to form a lasting assembly. The cushioning layer 32 and anti-pronation element 33 are secured to the underside of the lining sock 29 and the arch portion lining 27 respectively. Subsequently, the shoe upper 22 and the lasting assembly are secured to each other over the last described in relation to Figures 1 and 2 above. Then, the outsole 40 and heel 42 are secured to the underside of the lasting sock 39 while a heel-piece 43 is secured to the free end of the heel 42. Finally, the assembly formed by the cushioning layer 32, anti-pronation element 33, lining sock 29 and the arch portion lining 27 are secured to the footbed to create an assembled shoe 20.

In use, the elastic panel 25 is arranged to provide cushioning and protection over the first metatarsophangeal joint while remaining invisible from the outside of the assembled shoe 20. When the shoe 20 is not in use, the elastic panel 25 returns to its original shape. Referring now to Figures 4a and 4b, the elastic panel 25 is preferably made from sheet polychloroprene, also known as NEOPRENE (RTM), which can be produced as a fine layer, has a 100% memory, is highly elastic and is also highly resistant. Said sheet material is cut into a contoured elastic panel using the patterns 250 shown in Figures 4a or 4b. The patterns 250 have channels 260 arranged to allow the polychloroprene to be marked. The markings indicate the section of the panel 25 which will be secured to the lasting assembly when the shoe is constructed. Upon assembly, the elastic panel 25 is sewn to the lining 23 at 1 cm from the top line of the shoe 20 to

allow for stitching of the elastic panel 25 to the lining and for stitching of the inner layer to the shoe upper 22. In a preferred embodiment of the invention, the elastic panel 25 has a thickness of 1 mm to provide a lighter support, protection, and compression, thereby allowing a greater degree of motion and functional use. In this embodiment, the polychloroprene sheet is foamed thereby allowing minimal air and water exchange and providing excellent insulation. Further, the elastic modulus of the polychloroprene used is between two and three orders of magnitude lower than the elastic modulus of leather. Generally, the elastic modulus of polychloroprene is between 0.7 and 2 MPa (0.0007 0.002 GPa), although any suitable material with an elastic modulus lower than 50 MPa (0.05 GPa), preferably lower than 5 MPa (0.005 GPa) would be suitable. The elastic modulus at 200% of the polychloroprene used in this embodiment is 1-3 kg/cm^2 or 0.098-0.29 MPa while tensile strength is higher than 6 kg/cm^2 (0.59 MPa) and tear strength/resistance is higher than 2 kg/cm. Use of polychloroprene is advantageous because it is known to decrease shear stress to tissue and bony prominences such as bunions. Typically, the raw polychloroprene pattern is provided with a one-sided or double-sided protective covering. In a preferred embodiment, the polychloroprene elastic panel is provided with a nylon covering. Nylon has been used because it allows the material to stretch and marginally increases thickness of the panel. Advantageously, a one-sided covering reduces the amount of skiving , that is paring of the edge of the material to reduce its thickness, required on the reverse side of the elastic panel thereby ensuring that said panel is not visible from the outside of the shoe when said shoe is worn. The height of the elastic panel is calculated so that it adequately fits over the first metatarsophangeal joint and its vertical edge is positioned within the lining where the base of the hallux is received by the shoe. The maximum height of the elastic panel is also determined by the last used and by the specific pattern of the shoe. The elastic panel pattern of Figure 4b is made in accordance with a pattern cut to three distinct alternatives designed to accommodate different shoe sizes, a first alternative to accommodate a European shoe size 36-37.5, a second alternative to accommodate a European shoe size 38-39.5 and a third alternative to accommodate a European shoe size 40-41.5. In the elastic panel pattern shown in Figure 4a, the alternatives accommodate European shoe sizes 37-38.5, 39-40 and 40.5-41.5.

Referring now to Figure 5, the shoe of the present invention has a wider tread point that a standard shoe. Accordingly, the lining sock 29 the anterior portion of the lining sock 29 is wider than a standard lining sock. In this particular embodiment, the lining sock 29 and arch portion 27 are made of leather. The cushioning layer 32 provides additional cushioning from the heel to the ball of a foot, as described in detail in relation to Figure 6.

Further, the anti-pronation element 33 abuts the cut-out portion of the cushioning layer 32 to provide additional support and ensure correct alignment of a wearer's medial longitudinal arch without causing discomfort. The anti-pronation element 33 is made from a cushioning and stabilising material such as polyurethane memory foam, preferably anti-bacterial and air-permeable polyurethane memory foam. On assembly, the lining sock 29 and the arch portion 27 attached thereto are secured to the cushioning layer 32 and anti-pronation element 33 respectively with adhesive. The edges of the lining sock 29, shown as a hatched section, are skived to ensure a comfortable fit of the shoe. Further, the contour of the cushioning layer is also skived. Once the insole 27,29 is secured to the cushioning layer 32 and anti-pronation element 33, the cushioning layer and anti-pronation element are secured to the middle layer and lasting sock 39.

Referring now to Figure 6, the cushioning 32, middle 34 and base 36 layers of the midsole 30 are made of a shock absorbent and resilient material which is preferably also anti-bacterial and air-permeable. A suitable material is, for example, urethane memory foam, preferably anti-bacterial and air-permeable. In this embodiment, said layers are made of PORON (RTM) Urethanes from Rogers Corporation, Inc. The materials used allow the midsole 30 to adapt to the individual foot shape and return to the original shape when the shoe 20 is not in use. The portion arranged to receive the ball of a foot is the thickest part of the forefoot portion of the midsole 30 and has a thickness of 7 mm. Further, it combines the properties of the three different layers 32, 34, 36 to ensure maximum shock absorption and cushioning under the ball of a foot. As mentioned above, the anterior front portions of the base and middle layers 34, 36 are skived and therefore have a truncated shape to increase comfort under the toes by maximising space in the anterior portion of the toe box. The hind foot and midfoot portion of the midsole, which is formed solely by the cushioning layer 32, has a thickness of 3 mm and provides cushioning as described in more detail below. The midsole 30 does not significantly alter the appearance of the shoe 20.

The cushioning layer 32 is provided under the lining 29. In this embodiment the cushioning layer 32 is made of PORON (RTM) Plus Cushioning memory foam having a thickness of 3 mm. This cushioning layer 32 is lightweight and flexible and combines a cushioning effect with energy return to protect joints and soft tissue. The cushioning layer 32 is adhered to the length of the leather lining 29 and its outline is contoured to provide a cut-out portion arranged to receive the anti-pronation element 33. Further, the contoured shape of the cushioning layer 32 provides clearance over the front and back sections of the lasting sock 39a and 39b. The edge of the anterior portion of the cushioning layer is

skived to maximise space for the wearer's toes in the toe box. The contoured edges of the cushioning layer 32 are also skived. In this example the shoe 20 comprises a heel 42 and therefore the base of the foot bed corresponds to the ball of a wearer's foot. The middle layer 34 is contoured to provide additional cushioning for the ball of a foot. The memory foam used in this instance is PORON (RTM) Slow Rebound Soft. This memory foam has lower compression force deflection and resilience properties than those of the memory foam used for the cushioning layer 32. As a result, the middle layer 34 provides additional stability and improves balance of a wearer. The middle layer 34 has a thickness of 2 mm and, in use, is adhered to the base layer 36 as described below. The anterior edge of the toe portion of the middle layer 34, defined by the broken line shown in Figure 6, has a truncated shape and is skived to ensure a comfortable fitting. The cushioning layer 32 is secured to the middle layer 34 with adhesive. The base layer 36 is contoured to the shape of the middle layer 34 and is sandwiched between the middle layer 34 and the lasting sock 39. In this embodiment, said base layer 36 is made of PORON (RTM) Performance material. This particular type of memory foam is highly shock absorbent and resilient thereby providing protection from walking impact to a wearer. Further, it also provides energy return. The base layer 36 used in this example has a thickness of 2 mm. The anterior portion of the base layer 36 is longer than the anterior portion of the middle layer 34 and also has a truncated shape. The anterior edge of the base layer 36 is additionally skived to provide a comfortable fitting. When assembled, the base layer 36 is adhered to the front portion of the lasting sock 39a.

By combining a base 36 and a middle layer 34 on the front portion of the lasting sock 39a, the shoe 20 of the present invention allows the properties of both layers 34, 36 to merge thus providing excellent shock absorption, stability and comfort for joints and soft tissue. The combined layers 34, 36 distribute pressure evenly thereby improving support and stability. Further, each material of the midsole 30 returns to its original shape after use and moulds to a foot when worn; therefore the shoe 20 provides a customised fit every wear. It should be noted that although the middle 34 and base layers 36 of the midsole 30 in this embodiment are provided as a double layer, either layer could be absent or both layers could be integral.

As mentioned above, hallux valgus is typically worsened by over-pronation, whether to account for the deviated bones, due to pes planus (flat feet) or both. In a preferred embodiment, the present invention comprises an element 33 arranged to prevent over-pronation. As shown in Figure 7, the anti-pronation element 33 is formed by a pad made from polyurethane memory foam. Preferably, the polyurethane memory foam

has low-density and is therefore breathable and resistant to bacterial and fungal growth. In use, the anti-pronation element 33 is arranged to provide additional support, keep a wearer's foot in the correct alignment and prevent the foot from rolling inwards when walking, i.e. over-pronating. In this particular embodiment the anti-pronation element 33 measures 6.2 cm in length (l), 3.3 cm in width (w) and 0.5 cm at the highest point (h). The edges and surfaces of the element are contoured to abut the cut-out portion of the cushioning layer 32 and adapt to a foot when the shoe 20 is worn. Thus, the anti-pronation element 33 is large enough to improve the position of a foot but not large enough to increase pressure on the medial longitudinal arch of a wearer's foot. As a result, the anti-pronation element 33 provides support to over-pronators and is comfortable for shoe wearers who do not suffer from over-pronation.

Although the article of footwear described above comprises an elastic panel arranged to cover the first metatarsophalangeal joint of a user, it should be obvious to the skilled person that a second panel could be arranged to cover the fifth metatarsophalangeal joint of a user. Further, it should also be apparent that an article of footwear may comprise a single elastic panel arranged to cover the fifth metatarsophalangeal joint. Moreover, it should also be clear that an article of footwear may include a lining made from polychloroprene or a toe box lining made from polychloroprene, in this case, the lining would be the elastic panel.

It should be apparent to the skilled person that materials other than polychloroprene or the specific polychloroprene described above could be used to manufacture the elastic panel. For example, NEOGREEN (TM), Guayule, THERMOCLINE (TM) material from Fourth Element Limited or ARIAPRENE (TM) synthetic rubber material.

Additionally, it should also be apparent that the elastic modulus of the material used could be different to that described above and that an elastic modulus lower than 50 MPa (0.05 GPa) could be suitable.

Moreover, it should be clear that the pattern for the elastic panel could have a universal size or could be sized in accordance with numerical sizes and/or half sizes.

In addition, it should be obvious that the midsole described above could have one integral layer comprising two layers of memory foam or two instead layers of the three layer construction described above.

It should also be apparent that any suitable alternative to the urethane memory foams described above could be used.

Although specific dimensions for an anti-pronation element have been defined, it should be clear to a skilled person that an anti-pronation element could be manufactured in a range of different sizes comprising a length of 5 to 7.5 cm, a width of 3 to 4 cm and a height of 2 to 8 mm.

Further, the last and article of footwear described above have a specific heel elevation and a heel gradient; however, it should be obvious that both heel elevation and gradient can be varied to produce, for example, a flat shoe having no heel elevation or gradient or a minimal heel elevation and gradient. It should also be apparent to a skilled person that the last length mentioned above is an example and is variable depending on heel elevation and heel gradient. In addition, the lasting sock construction described could be replaced with any other suitable lasting sock construction.

Although the shoe described in relation to the above figures has a pointed toe, it should be clear to a skilled person that this is not necessary and that the toe box may have any shape, for example almond toe, round toe or peep toe. Further, it should also be clear that the invention could be applied to any other type of footwear such as boots, slingbacks, mules, sandals, flat shoes, etc. It should also be obvious that types of shoes that do not have a closed heel construction, such as slingbacks or mules may not include an anti-pronation element, depending on the shoe design. Further, the elastic panel may be cut or split in sandals and other types of shoe.

Claims

1. An article of footwear for a hallux valgus sufferer, the article of footwear comprising:

an upper having an outer layer and an inner layer, the inner layer comprising an elastic panel arranged to cover the first and/or fifth metatarsophalangeal joint of a user;

a midsole comprising a first layer and a second layer, wherein the first layer is arranged to line the footbed of the shoe and the second layer is arranged to provide a shock absorbing layer; and

an outer sole arranged to engage the ground, the outer sole being secured to the upper on assembly to complete the article of footwear.

2. An article of footwear according to claim 1, wherein the elastic modulus of the elastic panel is between two and three orders of magnitude lower than the elastic modulus of a material of the outer layer.

3. An article of footwear according to claim 1 or claim 2, wherein the elastic panel is made from a layer of polychloroprene.

4. An article of footwear according to claim 3, wherein the polychloroprene is foamed polychloroprene.

5. An article of footwear according to any preceding claim, further comprising a third layer located between the first and second layers, which third layer is arranged to provide additional support for a ball of a foot.

6. An article of footwear according to any preceding claim, the midsole further comprising an anti-pronation element.

7. An article of footwear according to claim 6, wherein the anti-pronation element is made from polyurethane memory foam.

8. An article of footwear according to any one of claims 5 to 7, wherein the first, second and third layers are made from urethane memory foam.

9. An article of footwear according to claim 8, wherein the first layer is made of a urethane memory foam having higher compression force deflection properties and resilience properties than the compression force deflection properties and resilience properties of the urethane memory foam of the second layer.

10. An article of footwear according to any one of claims 5 to 9, wherein the third layer is made of a urethane memory foam harder than the urethane memory foam of the first layer and higher resilience properties than the urethane memory foam of the second layer.

11. An article of footwear according to any preceding claim, further comprising an insole having a lining arranged to accommodate a foot.

12. An article of footwear according to any preceding claim, further comprising a shock resistant heel-piece.

13. An article of footwear according to any preceding claim, wherein said article of footwear is a slingback, a court shoe, a boot, a peep toe shoe or a ballerina flat.

14. A footwear last comprising a hind foot section and a forefoot section joined by a midfoot section; the forefoot section is defined by a first, second and third reference points having a reference point circumference; wherein the hind foot section is equivalent to a predetermined shoe size determined by using the Paris point footwear sizing system and the forefoot section has a reference point circumference equivalent to a shoe size between 2 and 3 sizes determined by using the Paris point footwear sizing system larger than said predetermined shoe size.

15. A footwear last according to claim 13, wherein the reference point circumference of a European size 37 as determined by using the Paris point footwear sizing system last measures between 217 mm and 260 mm.

16. A footwear last according to claim 14 or claim 15, wherein the reference point circumference of the last measures between 9 mm and 20 mm more than the reference point circumference of a standard last.

17. A footwear last according to claim 16, wherein the reference point circumference the last measures between 9 mm and 16 mm more than the reference point circumference of a standard last.

18. A footwear last according to any one of claims 14 to 17, wherein a European size 37 as determined by using the Paris point footwear sizing system has a reference point circumference of between 230 mm and 235 mm and reference point circumference increases or decreases by 2 mm to 2.5 mm per half size.

19. A footwear last according to any one of claims 14 to 18, wherein footwear last comprises a tread surface, which tread surface measures between 79 mm and 85 mm.

20. A footwear last according to claim 19, wherein the tread surface measures between 79 mm and 82.5 mm.

21. A footwear last according to any one of claims 14 to 20, wherein the footwear last has a toe depth of between 20 mm and 25 mm.

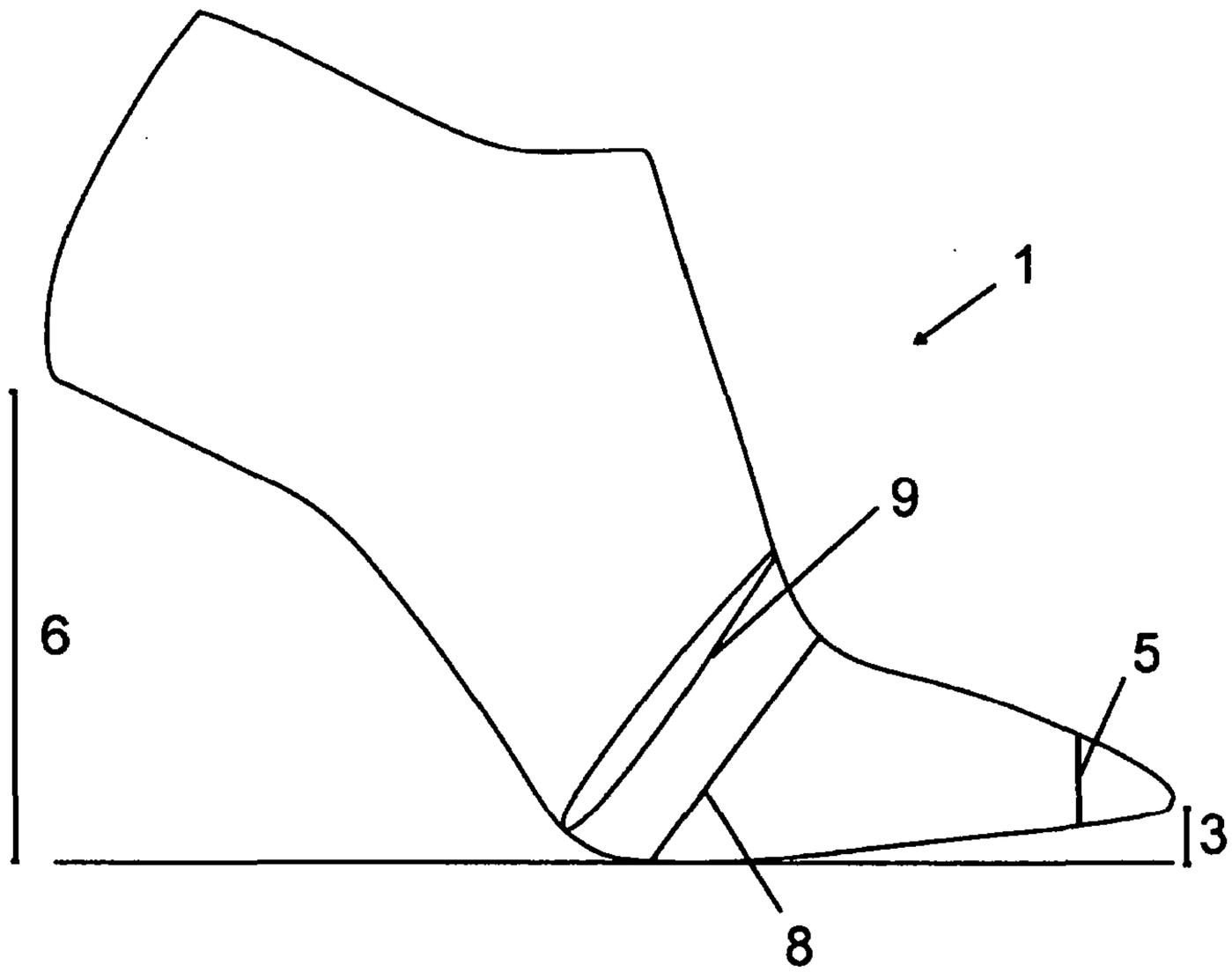

Figure 1

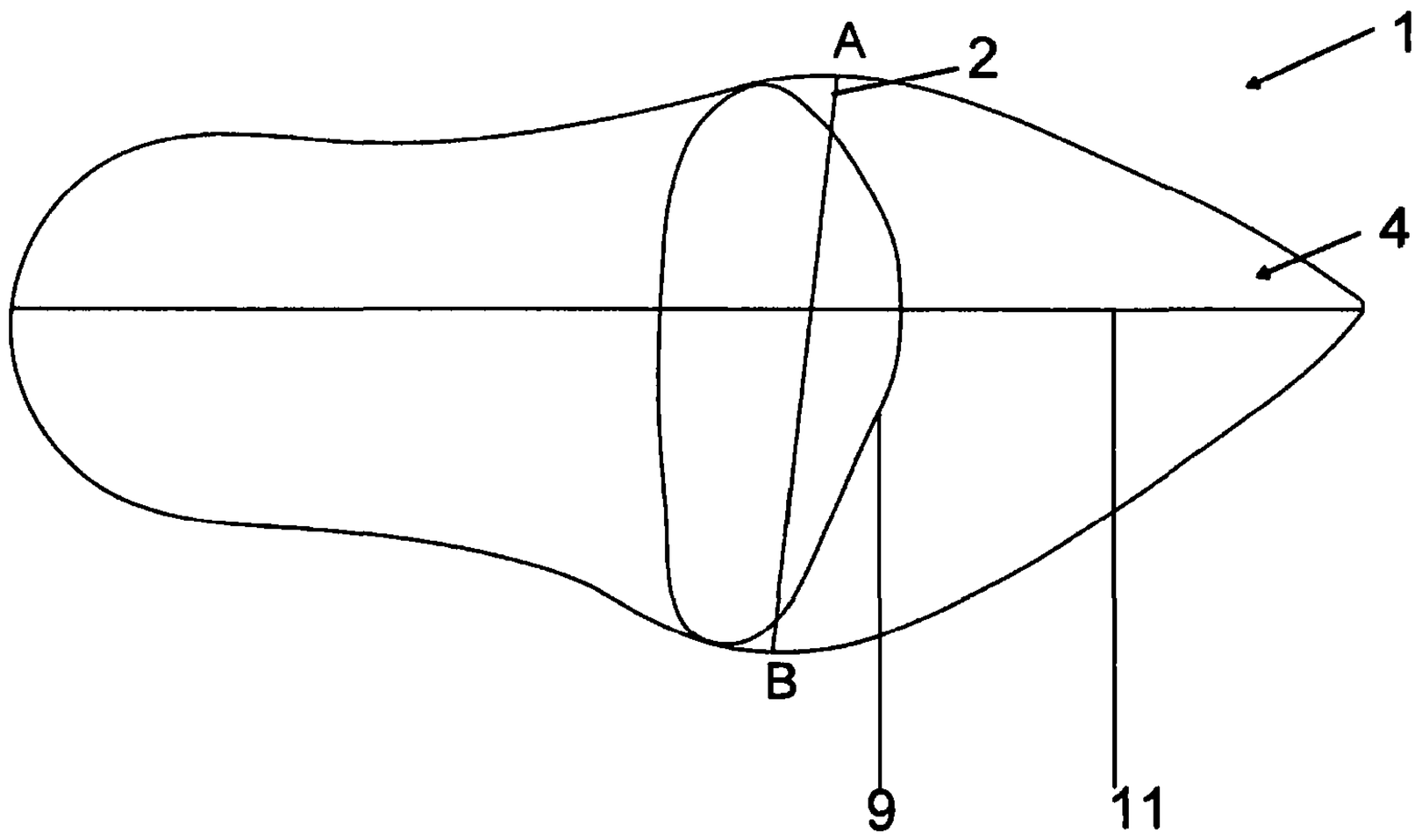

Figure 2

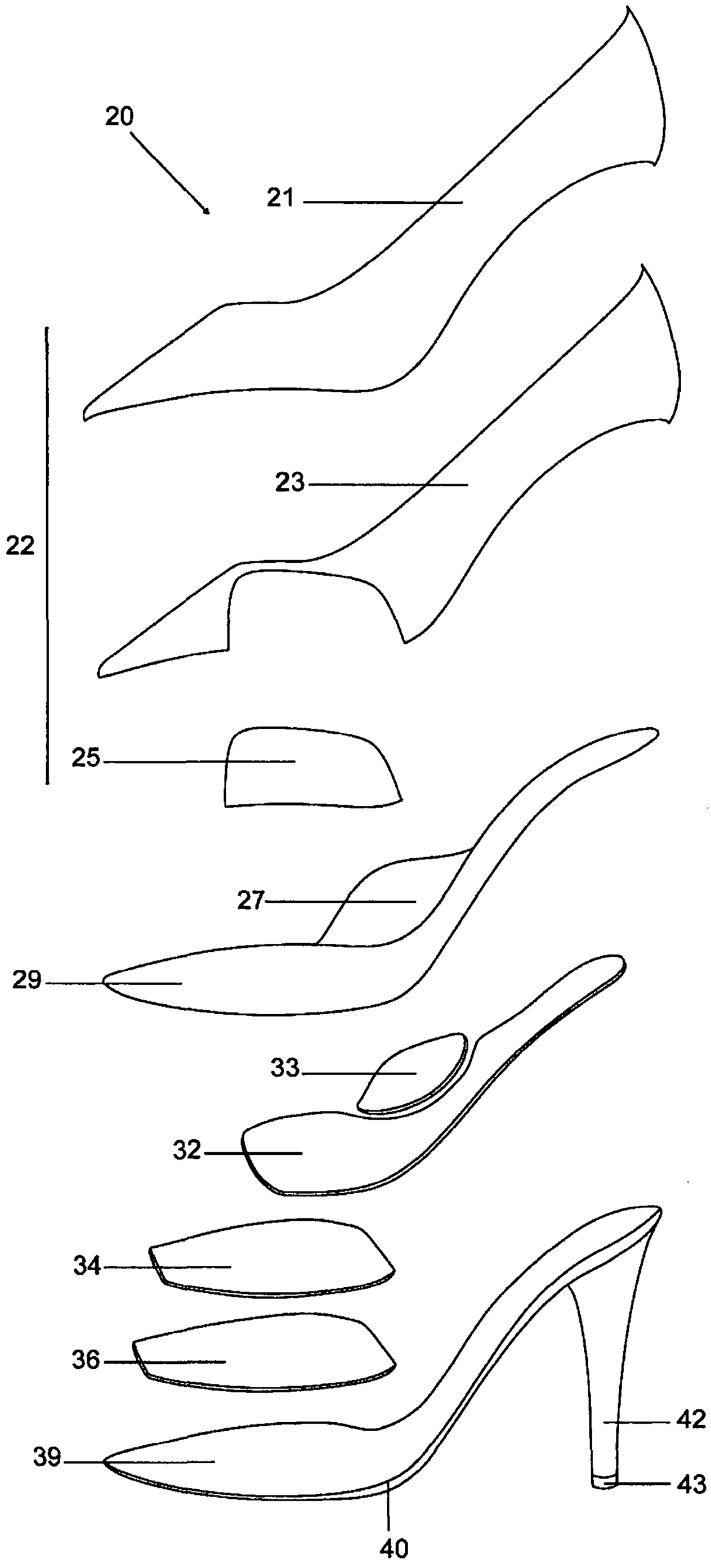

Figure 3

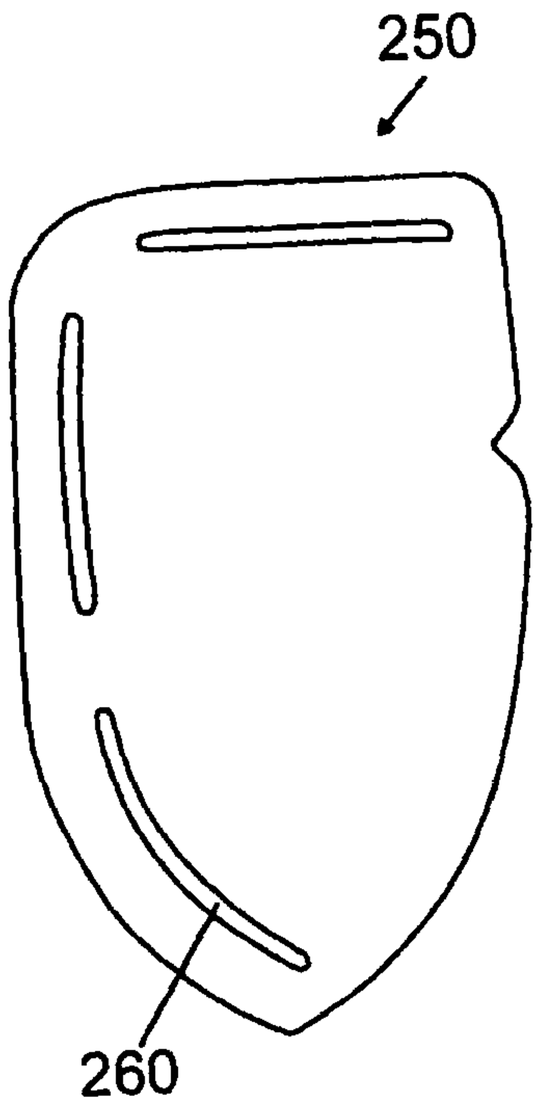

Figure 4a

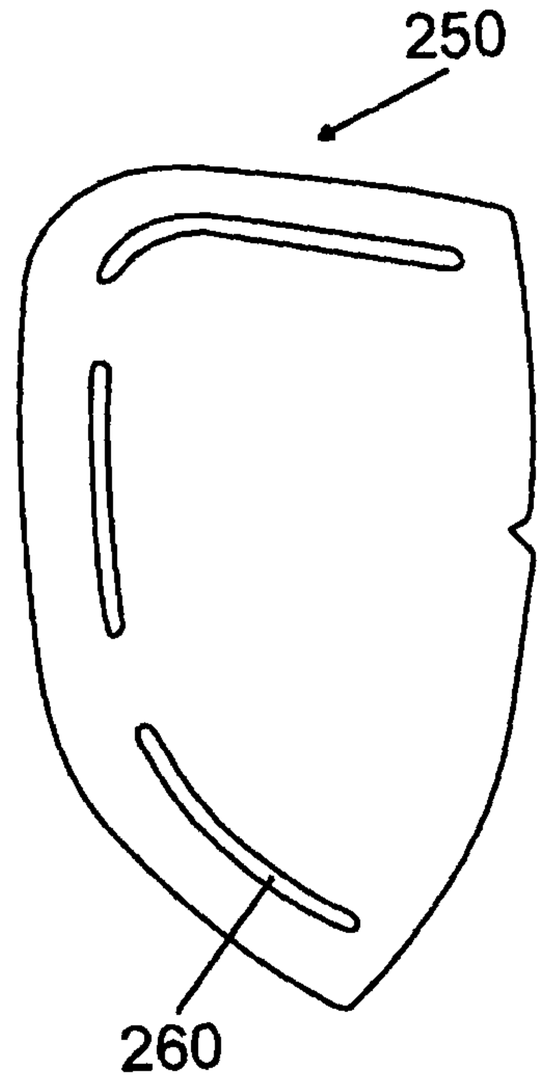

Figure 4b

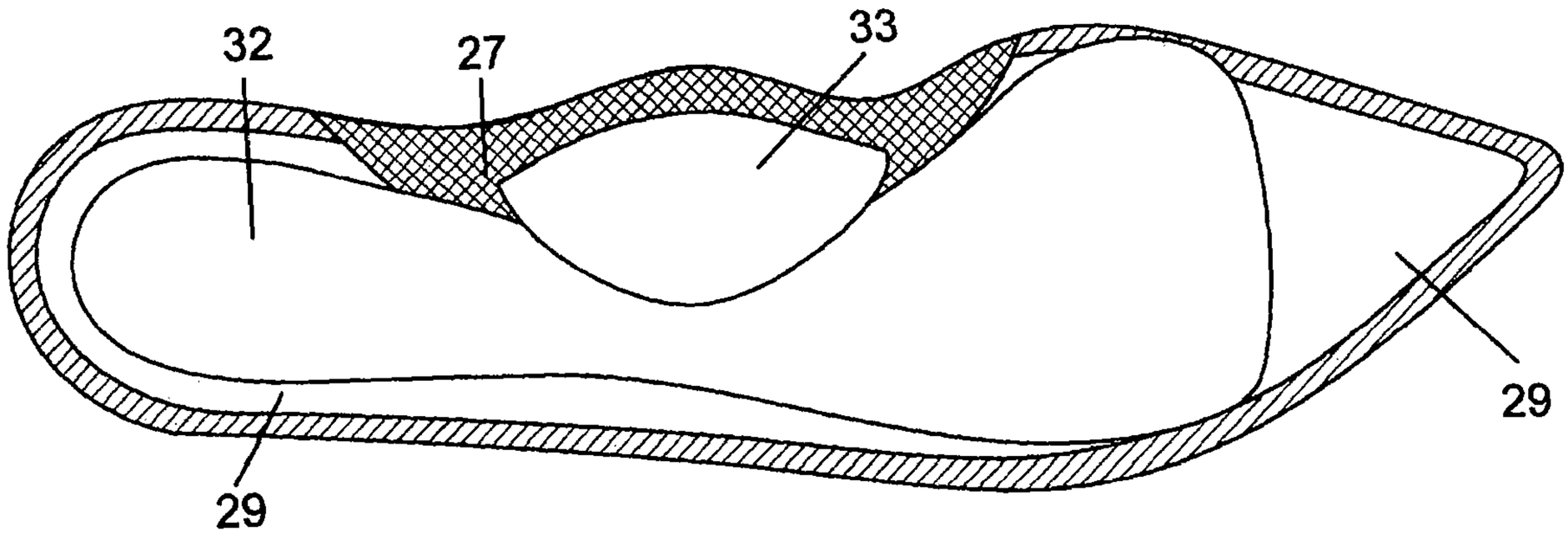

Figure 5

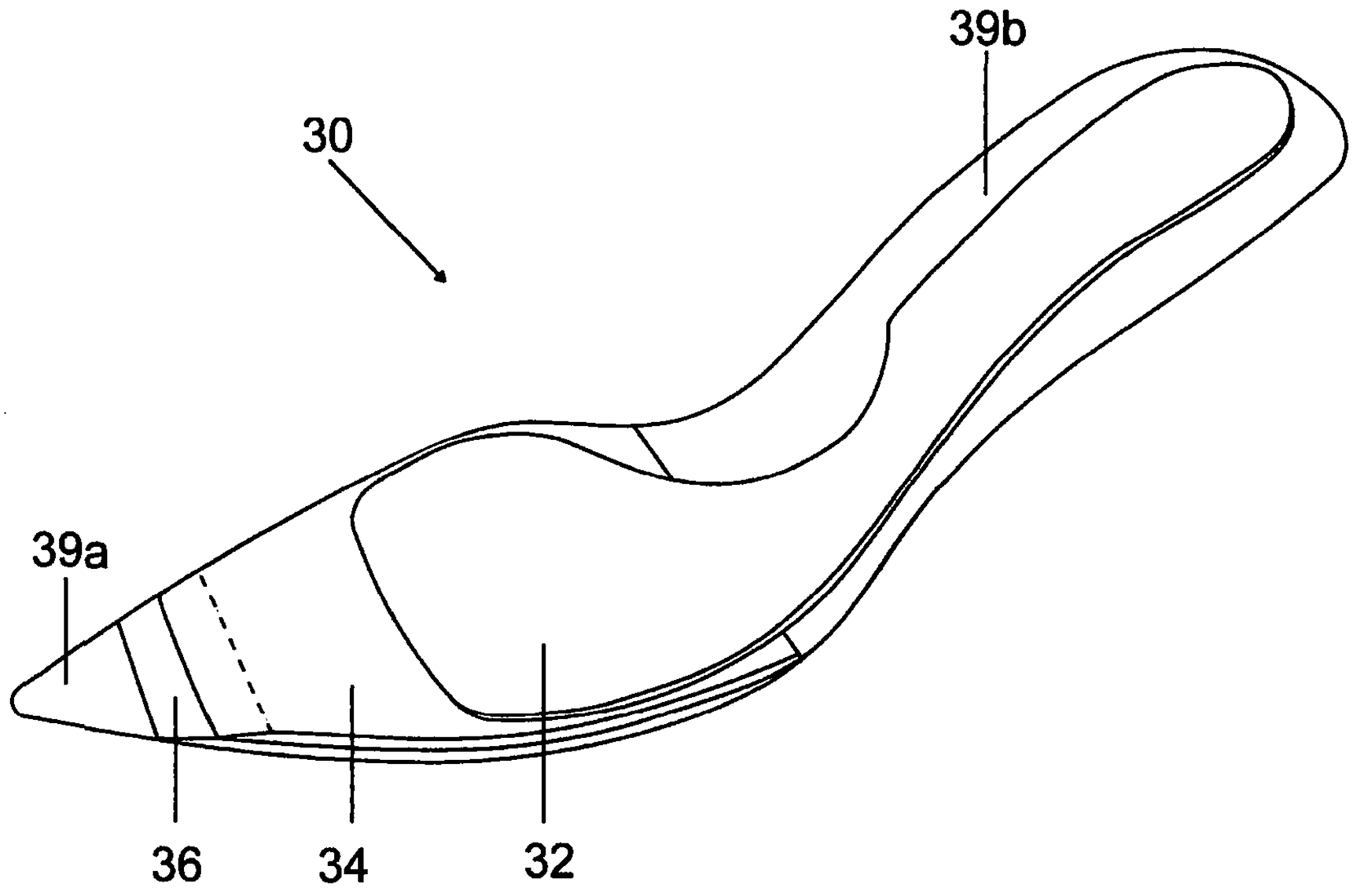

Figure 6

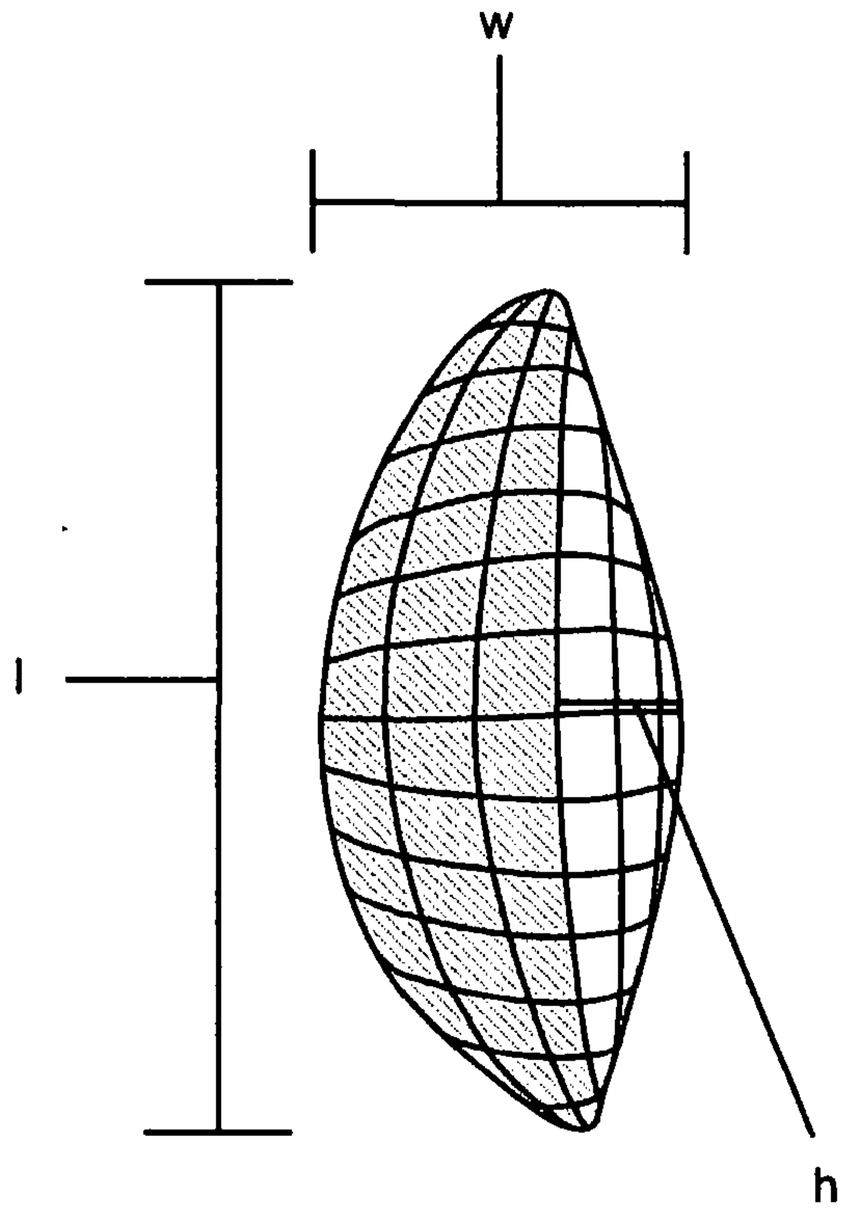

Figure 7

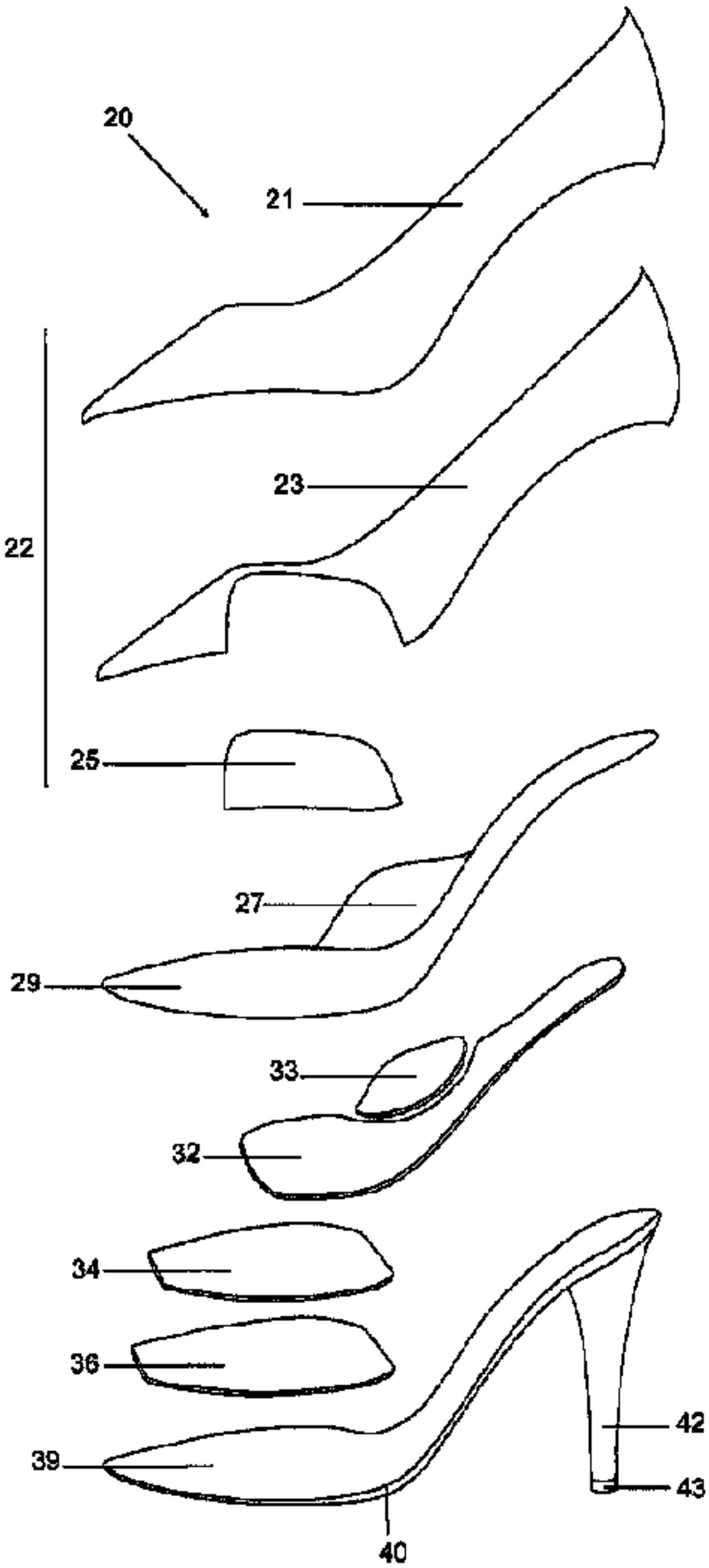

Figure 3