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(54) **PROPER POSTURE HIGH-HEELED SHOES**

HOCHHACKIGE SCHUHE FÜR KORREKTE KÖRPERHALTUNG

CHAUSSURES À TALONS HAUTS POUR POSTURE CORRECTE

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EP 3 091 865 B1

Description**Field of the Invention**

5 **[0001]** The present invention relates to high-heeled shoes and particularly to those which enable wearers to assume and maintain anatomically suitable postures while standing and walking.

Background

10 **[0002]** US 2009/193683 discloses a flexible contoured footbed insole for footwear for providing an anatomically correct foot support to a wearer of the footwear. The flexible contoured footbed insole comprises a heel section and a support system extending anteriorly from the heel section. The heel section comprises a cup shaped structure for accommodating a heel of a foot of the wearer. The support system comprises an inner longitudinal arch support, an outer longitudinal arch support, a transverse arch support, a metatarsal arch support, and a toe support for supporting an inner longitudinal arch, an outer longitudinal arch, a transverse arch, a metatarsal arch, and toes of the foot of the wearer respectively. The flexible contoured footbed insole may further comprise a flexible structure disposed within the support system.

15 **[0003]** US 5782 015 describes a high-heel shoe design applicable to varying heel heights.

20 **[0004]** Shoes and particularly those known as high-heeled shoes, generally exceeding 50.8 mm (2 inches), are adapted to be worn on a human foot. Though comfort is a primary consideration of footwear, it is often secondary to style, particularly with respect to the aforementioned high-heel shoes, which are most often specifically worn because of style considerations.

25 **[0005]** Anatomically, the human foot is comprised of twenty six different bones, which are connected to each other by approximately thirty joints and held in their respective places by ligaments and joint capsules. Thirty tendons, in addition to the lower muscles of the leg and the tendons of the foot muscles, have a role in foot movement.

30 **[0006]** The ankle joint is responsible for the dorsiflexion (raising the toes and standing only on the heels) and plantar-flexion (lowering the toes and standing only on the toes) movements of the feet. Below the ankle joint, there are five bones called tarsal bones, and these bones may become a very resistant or rigid structure, when necessary, by movement as a group, depending on the nature of the surface, which they are in contact, via the joints there between. The tarsal bones are the five long bones, which are located at the front part of the foot. At the end of these tarsal bone structures, there are knuckles, which consist of phalanges, required for normal walking. The toes are connected with the tarsal bones via metatarsophalangeal (MTP) joints with the most important one being the first MTP joint, belonging to the big toe.

35 **[0007]** A foot structure may be divided into three recognizable parts. Starting from the rear, a first part, i.e. the heel, is comprised of talus and calcaneus. The second or middle part is comprised of the navicular bone, metatarsal bones and other bones (cuboid bone and three cuneiform bones). Five toes comprise the third or front part of the foot. The big toe has two phalanges just like the thumb of a hand and the other toes have three phalanges. When a load is exerted on the toes, during a time when the big toe presses the ground, the other four toes assume a grabbing movement positioning.

40 **[0008]** There are two arch systems in the foot; one is the transverse arch at the front part of the foot. The second or other longitudinal arch starts from the calcaneus and follows the inner part of the foot until the base joint of the big toe. The arch at the front part is shaped by the ligaments, which maintain the form of the arch when no load acts on the foot and the stretches as it is pressed to the ground when a load is exerted on the foot. The plantar aponeurosis (arch ligament) that extends from the calcaneus to the toes also stretches. The more the load is exerted on the arch, the more the ligaments stretch. Many movements of the foot and the toes are controlled by the muscles which start from the lower part of the leg and whose tendons adhere to the foot.

45 **[0009]** Muscles control finer movements of the foot, which muscles begin and are adhered on the foot itself. Many movements of the foot are provided by the muscles at the bottom part of the leg, via ligaments. Standing, walking and running functions of the foot are made possible by contraction of these muscles. Many small muscles, apart from the above, produce a base at the sole of the foot with their positions between the bones.

50 **[0010]** It is evident from the very multiplicity of interactive components of the structure of a typical human foot that support and positioning of some components must be concomitantly related to support and positioning of other foot components in order to provide an interactive level of comfort. Extreme distortion of support and positioning of foot parts complicates the achievement of comfort.

55 **[0011]** It is known that the function of high-heeled women shoes used today is not health or comfort but is almost solely for appearance purposes of the shoe. Considerations of appearance are often at odds with proper foot support, particularly with foot movement. The situation arising from the incorrect degree calculation in nearly all of current high-heeled shoes primarily causes the center of gravity of the person wearing such shoes to shift towards the front part of the feet, i.e. towards the metatarsal bones. Thus, the walking with such shoes is in a deformed and unnatural manner. This may cause deformation of the Achilles tendon, pain in all parts of the body starting with the stretching of the tendons

(including headache), meniscus, hip dislocation and may lead to the waist and neck, i.e. "Columna vertebralis" spine to assume an "S-shape" with spinal curvature greater than normal. Wearing such shoes all the time increases the S-shape of the spine, thereby increasing the possibility of the wearers suffering herniated discs and cervical disc hernias.

[0012] As is often the case when incorrect arc tangent values or incorrect heel - toe angle values are used in the high-heeled shoe structure, a person wearing the high-heeled shoes becomes uncomfortable and often, after a short period of time suffers a serious pain in the soles of the feet. Even when the angle of the heel is set at lower values than the minimum degree values, pain in the sole of the foot results because the center of gravity falls back more than necessary and the foot is forced to assume a greater arc than it is supposed to assume.

[0013] Various expedients have been used in the past, in various countries, with numerous different styles, in order to provide high-heeled shoes with anatomically correct support and increased comfort. However, there have been few, if any, of such expedients, which provide any high degree of proper support and comfort without affecting aesthetic appearances.

SUMMARY OF THE INVENTION

[0014] It is accordingly an objective of the present invention to provide a high-heeled shoe with minimal or no discernible appearance changes, yet which enables the person wearing it, usually a woman (though similarly applicable to men's footwear with reference hereinafter to female wearers) to stand and walk in an anatomically correct (suitable) position, i.e. to walk just like when she walks with heelless flat shoes.

[0015] Another objective of the present invention is to provide a high-heeled shoe, which enables the body of the wearer to stand in correct balance and the foot to rest on all points.

[0016] A further objective of the present invention is to provide a high-heeled shoe, which enables the wearer to assume and maintain anatomically suitable straight body posture with a high degree of comfort not normally obtainable with high-heeled shoe configurations particularly of the stylish type.

[0017] These objectives are achieved by a high-heeled shoe according to the invention as defined by claim 1. Further embodiments of the invention are defined by the dependent claims.

[0018] Generally, the present invention comprises high-heeled shoes of heel heights in excess of 50.8 mm (two inches) configured with component elements in an interrelational angular and length of proper configuration structure, wherein foot stress and discomfort is minimized while retaining aesthetic appearance thereof.

[0019] In accordance with the invention, anatomically suitable straight body posture and concomitant comfort can be achieved in high heeled shoes by adjusting the arctangent values, as described hereinafter, with substantially exact conformity. This can be made possible only by adjusting the center of gravity such that it will be on the rear or middle part of the foot. In other words, straight body posture can be achieved by bringing the body to a position suitable to a healthy anatomy.

[0020] Foot support in high-heel shoe construction and components involved therewith entails understanding and definition of the parts thereof. A first part, which is normally in contact with the bottom of the foot is the "Insole Board". This is a firm part of the shoe that is directly under the entire back part of the foot in most footwear. It usually starts from the back portion of the shoe (heel section) and often extends until either the toe section or until the end of the curvature of the bottom of the foot. The insole board usually has another layer of cushion and/or a layer of insole lining on top of it. This thickness of the lining may and often does vary.

[0021] The "Shank" is a support (often metal such as steel, or it can be made of fiberglass or other strong materials) that is placed at some point under the insole board to support the shape of the insole board and the weight that is placed on the insole by the wearer. It has no fixed placement position; but its curve needs to match the curve of the insole board at the position that it is placed under (or sometimes over) the insole board. As used herein the "curvature" is normally that of the "insole board", or anything else in the shoe that is directly under the wearer's foot and which starts from the back of the foot and extends forward till it reaches the point of no further descent (i.e., essentially plateaus). In this latter regard it is noted that the insole board usually has another layer of cushion and/or a layer of insole lining on top of that. The thickness of the lining may vary and thus affect parameters of curvature. In instances where there is a meaningful thickness and due to the firmness of the cushion material the foot rests on a curvature other than the insole plane, then the curvature as specified herein is one that is attained when the wearer places her/his weight on the shoe and the shape that remains directly under his foot after repeated wearings of the shoe (after the cushioning has settled after some initial use, or in case of strong cushioning that retains its shape- at the first wearing) is the "curvature" as used herein.

[0022] When the angles (arctangent values) of the insole board in a high-heeled shoe, are adjusted in conformity with anatomy, each and every point of the protrusions and grooves on the sole of the feet exactly rests on the insole board. Since various shoe parts may directly support a wearer's foot, the term "insole board", as used herein, refers specifically to the portion of the shoe and curvature thereof, which directly supports and is in contact with the wearer's foot. It also includes the same type of upper structure in a wedge type high-heeled shoe.

[0023] The insole board of a high-heeled shoe generally follows a shape similar to an arctan ($k \cdot x$) function.

[0024] In order to obtain the shape of the functions in this structure and how they exhibit the desired curvature, "Equation 1" was initially used to obtain a y value for the points on the insole board with a desired curvature:

$$y = (5/\arctan(10k)) \cdot \arctan(k \cdot x) \dots \dots \dots \text{(Equation 1)}$$

wherein, with an x-y coordinate plane being superimposed relative to the lateral position of the high heel shoe insole board with a vertex at the initial point of upward inclination of the insole board, the x coordinate value denotes the length which extends from the vertical part of the coordinate plane to the point where the insole board is positioned. The value of k is empirically determined and as determined, varies in accordance with heel height with various values being set forth in Table 4 below (with extrapolation and variations thereof being determined for other heel heights and operable ranges for the specific heel heights).

[0025] The k_2 factor (as used in a correction factor set forth below) denotes, for a curvature factor, a constant value of 300, obtained as a result of experimental studies in determining anatomically correct position and maximum comfort in accordance with the present invention. The y coordinate value denotes the length, which extends from the horizontal part of the coordinate plane to the point where the insole board is positioned.

[0026] The x and y values given in the equations are each a value of length, with the y value varying in accordance with the change of x distance along the insole board position.

[0027] A desired insole board curvature K derived from the y value of equation 1 was computed by using "equation 2".

$$K = y'' / (1 + (y')^2)^{3/2} \dots \dots \dots \text{(Equation 2)}$$

wherein K denotes a value that changes with respect to the first derivative of y (y') and the second derivative of y (y'') given in equation 2.

[0028] The form of equation 2 for the K value expressed in terms of values for x and the constant k is shown as "equation 3" which equation is used for the determined curvature.

$$K = \frac{-2k^3 x \cdot (5/\arctan(10k)) \cdot (1 + k^2 x^2)^{-2}}{[1 + k^2 \cdot (5/\arctan(10k))^2 \cdot (1 + k^2 x^2)^{-2}]^{(3/2)}} \dots \dots \dots \text{(Equation 3)}$$

[0029] The high-heeled shoe configuration relative to heel and platform height of a particular high-heeled shoe, which enables anatomically suitable body posture and walking, and has orthopedic inclination and high heels in accordance with the present invention, comprises the elements and parameters of:

- at least one insole board, which is configured such that a toe angle of the shoe (β) and concomitantly the heel angle (α) provides the correct straight body posture and, which is sized with the curvature K, as obtained as a result of multiplication of $y = (5/\arctan(10k)) \cdot \arctan(k \cdot x)$ with a correction coefficient $1/(1 + (x - x_j)^2/k_2)$ relating to the actual configuration of a human foot and is calculated with the factors of x (and concomitant y values) by taking any insole board distance x value from zero to one hundred, and the height of a heel which can be varied, as desired, by a selected height ranging from about 50.8 mm to 114.3 mm (2-4.5 inches) of height differential (with possible variation of end points of up to 10%) between the front of the foot to the heel of the person (and up to 203.2 mm (8 inches) with a front platform up to about 88.9 mm (3 1/2 inches) to maintain the about 114.3mm (4.5 inch) maximum differential),
- at least one front platform which is formed to raise the foot above the ground by a selected height, and- at least one toe which is located at the place where the tip of the foot is placed and whose angle can be changed by a desired amount between about 7° to 26° (with a possible 10% deviation).

[0030] The above and other objectives, features, advantages of the present invention will become more apparent from the following discussion and drawings in which:

SHORT DESCRIPTION OF THE DRAWINGS

[0031]

Figure 1 is a side view of a high-heeled shoe depicting areas of modification affecting posture and comfort levels; Figure 2 is a side view of the insole board of the high-heeled shoe of Figure 1 indicating angles of modification and

x-y components of angular gradients of the insole board elevation;

Figure 3 is the side view of another embodiment of the high-heeled shoe of Figure 1, with a reduced width heel;

Figure 4 is the graphical representation of the route followed by the function y depending on the change of k in function $y = (5/\arctan(10k)) * \arctan(k*x)$ originally used in determining comfort level modifications based on variations in the x, y components of Figure 2;

Figures 5 is a graphical representation of the curvature change of the A_1 , A_2 , A_3 , A_4 , A_5 , A_6 insole boards of high-heeled shoes of different heel heights (representing hereinafter heel heights of 50.8 mm(2"), 63.5 mm(2 1/2"), 76.2 mm(3"), 88.9 mm (3 1/2 "), 101.6 mm (4") and 114.3 mm (4.5") respectively), which can be produced with different curvatures with respect to x and y axes at different points of the insole board curve;

Figure 6 is an insole board and a graphical representation of the insole board, which provides the x-y inclination parameter in accordance with the present invention for a 101.4 mm (4 inch) heel;

Figure 7 is a left side view of a high-heeled shoe of the invention showing heel angles (α) and heel support configurations, as shown in Figure 2, for a shoe with a heel ranging from about 50.8 - 114.3 mm (2-4.5 inches);

Figures 8A and 8B depict the differences in position of a human leg while wearing a high heeled shoe of the prior art (8A) and the present invention (8B); and:

Figure 9 shows a wedge type embodiment of a high-heeled shoe in which the parameters of the present invention of appropriate sole curvature have been embodied.

DETAILED DESCRIPTION

[0032] The components shown in the figures are each given the common component reference numbers as follows:

1. High heeled shoe
2. Insole board as measured from the point at which the insole board in contact with the foot rises and extending to the back or rear of the shoe.
3. Heel as part of the insole board and supporting the rear or heel of the wearer.
4. Front platform extending forward from the rising point of the insole board.
5. Toe as the front of the shoe.

[0033] Table 1 provides the sole alignments where the proper "curvature" is realized and is computed by using the "equation":

$$K = 4/i \dots\dots\dots(\text{Equation 4})$$

whereby i is K, given in Equation 2, divided by 4.

[0034] Table 1 shows the sole alignments (x values) where the greatest "curvature" takes place by using equation 4 is as follows:

i	1	2	3	4	5	6	7	8	9	10
x	0.88	1.22	1.47	1.68	1.86	2.02	2.18	2.32	2.46	2.59

i	11	12	13	14	15	16	17	18	19	20
x	2.73	2.86	3.00	3.13	3.27	3.41	3.55	3.68	3.82	3.97

Table 1

[0035] In the light of these data, it is appears that in order to reach the alignment where the greatest bending takes place when k is decreasing, k should be minimized. When the obtained figure is examined, it is observed that the insole

(2) angle and the heel (3) angle increase more than expected as k value decreases. A factor function is required in order to shift the bending alignment backwards without increasing the heel (3) angle very much.

EXAMPLES

[0036] Ten different sole trials are made by calculation, with heels of varying heights ranging from 50.8 mm to 101.6mm (2" to 4") to obtain sole or insole board curvatures complying with "equation 1" and the correction coefficient, with the ideal forms of the A_1 , A_2 , A_3 , A_4 , A_5 , A_6 insole boards for use with heels of 50.8 mm (2"), 63.5 mm (2 ½"), 76.2 mm (3"), 88.9 mm (3 ½"), 101.6 mm (4") and 114.3 mm (4.5") being obtained (or derived). The suitable correction factor used with equation 1 is the below given "equation 5" as calculated using parameters of the MatLab software program.

$$1/(1 + (x - x_j)^2/k_2), \quad x \in [0, 100] \dots\dots\dots \text{(Equation 5)}$$

wherein the variable x_j for the heel sizes of A_1 , A_2 , A_3 , A_4 , A_5 , A_6 are given in Table 4 below, with: x_j , being the variable used for changing the effect of the factor function in the formula so that the insole board is more suitable to the human foot anatomy. And variable k_2 is the variable used for changing the effect of the factor function in the formula so that the insole board is more suitable to the human foot anatomy and which has been determined to be 300.

[0037] With the corrected formula that is obtained, the A_2 , A_3 , A_4 , A_5 , and A_6 insole boards, are formed and these models are observed experimentally (as direct foot supports) and are seen to be successful in providing both anatomically correct support and increased comfort for the wearers.

[0038] Table 2 shows that A_1 , A_2 , A_3 , A_4 , A_5 , and A_6 inboard soles can be produced in high heeled shoes without front platforms, with a height ranging from about 50.8 mm (2") to 114.3 mm (4.5") and as high heeled shoes, with appropriately sized front platforms with a height ranging from about 0 mm (0") to 76.2 mm (3.5") provided that the elevation distance between the front of the foot wearing the shoe to the heel is no more than about 114.3 mm (4.5"), i.e. with appropriate platforms ranging from 0 mm (0") to 76.2 mm (3.5") for the aforementioned heels.

[0039] The high heeled shoes (1) toe angles (β) and heel angles (α) shown in the Figures vary relative to the insole board (2) so as to ensure a straight body posture. The heel angle (α) corresponding to the toe angle (β) of each high-heeled shoe (1) is given in Table 2. As seen in Table 2, shoe heels that range from 50.8 mm (2 inches) to about 203.2 mm (8 inches) preferably have (α) heel angle values in the range of about 5° to 26° (with a 10% possible deviation) as shown in Figure 7. The variation of heel angles is a function of one or two factors. The first one being the difference of the varying heel heights (cm/inch), and the second being the differences exhibited by the materials used in manufacturing the high heeled shoe such as the lasting process. The best results (posture and comfort) are obtained when the toe angle (β) of the high-heeled shoe (1) is at angles varying between 7° and 26°. The heel angle (α) is a function of insole board curvature calculation with the heel being the rear terminus thereof but with variations thereof, in the given range, being functionally determined by the manufacturing process.

[0040] Generally, a typical heel section distance ranges between 35 to 50 mm from the rear of the shoe with a heel angle being measured therefrom such as with wedge shoes and may be smaller with respect to very narrow stiletto heels. Calculations of heel angles and ranges thereof as made herein are generally determined with a length of between 35 to 50mm from the rear of the shoe along the foot support.

[0041] The distances provided for the following Table 2 for the insole boards with heel heights, as indicated for A_1 - A_6 , begin at the rear of the shoe and end of the insole board and extend along the length of the insole board.

Table 2

Heel Height	Distance Along the Insole Board from Rear of Shoe										HeelAngle (α)	Toe Angle (β)
	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm		
A₁ (2")	42.96°	41.97°	38.66°	33.89°	28.43°	22.83°	17.41°	12.36°	7.78°	3.75°	5° - 9°	7° - 26°
A₂ (2½")	45.63°	44.02°	39.84°	34.11°	27.75°	21.42°	15.49°	10.17°	5.53°	1.59°	12° - 16°	7° - 26°
A₃ (3")	49.61°	46.92°	41.20°	33.86°	26.16°	18.93°	12.54°	7.10°	2.60°	0.27°	14° - 18°	7° - 26°
A₄ (3½")	51.72°	48.40°	41.77°	33.51°	25.11°	17.46°	10.91°	5.50°	1.14°	0.00°	16° - 20°	7° - 26°
A₅ (4")	56.13°	51.32°	42.52°	32.18°	22.35°	14.03°	7.38°	2.20°	0.00°	0.00°	18° - 22°	7° - 26°
A₆ (4½")	58.43°	52.74°	42.63°	31.10°	20.60°	12.07°	5.48°	0.51°	0.00°	0.00°	22° - 26°	7° - 26°

[0042] It is understood that insole board models obtained by the aforementioned formula 1 with correction factor, as described are suitable for proper posture and comfort though there may be deviation of a few degrees for either the toe angles (β) and heel angles (α) within the aforementioned range parameters. Ranges of deviation with deviations in comfort levels, at their outer limits, are defined by the values for adjacent heel heights in the table. Thus, for example, at the 90-100mm distance point the degree curve value for A_1 can range from 42.96° to the 45.63° of A_2 . For A_2 the value ranges from 42.96° of A_1 to the 49.61° of A_3 from the values of A_1 to A_3 . Similarly for A_3 the value ranges from the 45.63° of A_2 to the 51.72° of A_4 and for A_4 the value ranges from the 49.61° of A_3 to the 56.13° of A_5 . The range for A_5 is from the 51.72° of A_4 to the 58.43° of A_6 . The value for A_6 is from the 56.13° of A_5 to the 58.43° of A_6 . The values for A_1 and A_6 are respective minimums and maximums with possible deviation. The range is extended similarly over the various distance points.

[0043] In an analogous manner the heel angles α may vary in the ranges between adjacent heel heights A_1 to A_6 as given in the table for the specific heel heights with heels angles for A_1 being between 5°-16°, for A_2 being between 5°-18°, for A_3 being between 12°-20°, for A_4 being between 14°-22°, for A_5 being between 16°-26°, and for A_6 being between 18°-26° with the values for A_1 and A_6 being respective minimums and maximums (with possible deviations of up to 10%).

[0044] Determination of curve angles at specific positions and curve values for operable ranges for heel heights which fall within to 50.8 mm - 114.3 mm (2"-4.5") range and different from the specific A_1 to A_6 heights, the x_j and k values of Table 4 are used to provide the extrapolation of range values between the adjacent A_1 to A_6 values.

[0045] Accordingly, modelling can be effectively applied to many different insole boards by using the formula for intermediate heel height values, by interpolating with use of the values of the A_1 - A_6 model insole boards in the Tables 2 and 3. Insole boards made with the intermediate heel heights are acceptable from a proper posture comfort consideration. Insole boards made with the intermediate values can be used in the production of successful shoes similarly without being affected by deviations of few degrees. The intermediate values of the A values are provided in the below given Table 3.

Table 3

	Distance Along the Insole Board from Rear of Shoe									
	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm
Heel m& A_1 (2") - A_2 (2½")	42.96° - 45.63°	41.97° - 44.02°	38.66° - 39.84°	33.89° - 34.11°	28.43° - 27.75°	22.83° - 21.42°	17.41° - 15.49°	12.36° - 10.17°	7.78° - 5.53°	3.75° - 1.59°
A_2 (2½") - A_3 (3")	45.63° - 49.61°	44.02° - 46.92°	39.84° - 41.20°	34.11° - 33.86°	27.75° - 26.16°	21.42° - 18.93°	15.49° - 12.54°	10.17° - 7.10°	5.53° - 2.60°	1.59° - 0.27°
A_3 (3") - A_4 (3½")	49.61° - 51.72°	46.92° - 48.40°	41.20° - 41.77°	33.86° - 33.51°	26.16° - 25.11°	18.93° - 17.46°	12.54° - 10.91°	7.10° - 5.50°	2.60° - 1.14°	0.27° - 0.000
A_4 (3½") - A_5 (4")	51.72° - 56.13°	48.40° - 51.32°	41.77° - 42.52°	33.51° - 32.18°	25.11° - 22.35°	17.46° - 14.03°	10.91° - 7.38°	5.50° - 2.20°	1.14° - 0.00°	0.00° - 0.00°
A_5 (4") - A_6 (4½")	56.13° - 58.43°	51.32° - 52.74°	42.52° - 42.63°	32.18° - 31.10°	22.35° - 20.60°	14.03° - 12.07°	7.38° - 5.48°	2.20° - 0.51°	0.00°	0.00°

[0046] When the $A_1, A_2, A_3, A_4, A_5, A_6$ insole boards are being formed, the variables x_j, k and k_2 given in Table 4, are used as described above, with k being a variable function of the MatLab algorithm. k_2 given in this table is the variable used for changing the effect of the factor function in the formula so that the insole board is more suitable to foot anatomy and which has been empirically determined to be 300.

Table 4

	x_j	k	k_2
A_1	60	114.3	300
A_2	50	1/4.25	
A_3	40	1/3-75	
A_4	35	1/3.5	
A_5	25	1/3	
A_6	20	1/2.75	

[0047] With reference to the drawings, as shown in Figures 1 and 3, typical high-heeled shoes 1 comprise a toe section 5, a sole or platform section 4 which can provide an elevated rest for the front of the foot, as shown in Figure 1, or may be of minimal thickness as shown in Figure 3. The insole board or direct foot support section 2 extends from and is usually integrated with sole or platform section 2 and begins at the elevation point shown, for insole board 2 in Figure 2. The insole board 2 rises, usually as a curved section toward the rear or heel of the shoe where a portion thereof is supported by heel 3, shown in different configurations in Figures 1 and 3. The heel of a wearer of the shoe 1, shown in Figures 8A and 8B rests on and is supported by heel 3 in both the prior art shoe of Figure 8A and that of the present invention of Figure 8B. The heel angle (α) of the shoes of the present invention, shown in Figure 2 and Figure 7, are at relatively low levels of 5-26°, generally considerably below those of heel angles in high-heeled shoe of the prior art. Though toe angles can be flush with the ground, such as with the shoe of Figure 1, for better posture and increased comfort, the front toe angle (β) should be slightly elevated with an angle ranging from 7° to 26° with little or no variation from this range.

[0048] The curve of the insole board 2 of both prior art shoes and that of the present invention is defined by an x, y axis coordinate system superimposed on the insole board with a point of origin at the point of the insole board 2 where the insole board begins to rise as shown in Figure 2. Each point on the insole board is defined by the interrelated x and y parameter values. The curvature of the insole board is determined by a function k , as shown in Figure 4 which can range from limited curvature with low k values to highly curved shapes with the various curvatures providing different degrees of support and or comfort/discomfort and proper foot and positioning and posture.

[0049] As shown in the x-y graph of Figure 5, five insole boards, A_1 - A_5 are made in accordance with the present invention with utilization of equation 1, as corrected with the correction factor of equation 5, for every x, y value of the curve and with a k_2 constant value being 300 and as represented by different curves. The A_1 - A_6 insole boards were made for heel heights of 50.8 mm (2"), 63.5 mm (2 1/2"), 76.2 mm (3"), 88.9 mm (3 1/2"), 101.6 mm (4") and 114.3 mm (4.5") respectively. Figure 6 depicts in detail the curve for the A_5 insole board with a 101.6mm (4") heel.

[0050] Figures 8A and 8B show the position and posture bearing of a wearer of a prior art shoe 1' (Figure 8A) and a shoe of the present invention 1 (Figure 8B) wherein the proper upright axis A for the prior art shoe wearer shows a front leaning deviation from a proper posture, a lack of full support and a resultant forward toe pressure engendering typical high heel shoe pain. There is also a lack of support in the arch area 9. In contrast the shoe 1 in Figure 8B provides full support throughout the arch and with the heel being fully support such that the wearer is erect along axis A with a more aesthetic and statuesque appearance, with the shows of Figures 8A and 8B showing very little discernible difference in stylish appearance.

[0051] Figure 9 shows a high-heeled shoe embodiment known as a wedge shoe wherein a fully supported sole is used in place of a steel insole board as used in the other embodiments. The curvature of sole 2 is substantially identical to that of the embodiments with the insole board.

[0052] It is understood that the above disclosure and examples are merely exemplary of the present invention and that changes in materials, structures, configurations and the like such as additional cushioning at pressure or normal pain sites on the shoe insole especially at or near the heel are possible without departing from the scope of the present invention as defined by the following claims.

Claims

1. A high-heeled shoe (1) for a human foot which enables a human to assume and maintain anatomically suitable body posture for standing and walking, and which has an orthopedic inclination, the high-heeled shoe (1) comprising a toe (5) section and a heel (3) section separated by and connected with a sole section, the high-heeled shoe (1) being configured for the respective support of a toe, heel and sole of a human foot wherein a vertical distance between support of the toe and support of the heel is between 50.8 mm and 114.3 mm (2 and 4.5 inches) and wherein the sole section which directly supports a human sole and heel comprises a curved inclination, as superimposed on an x-y coordinate system having a point of origin at the point at which the sole section begins to rise from a base of the toe (5) section, **characterized in that** the curved inclination configuration is determined according to values of x and y along the sole section according to the formula:

$$y_{\text{initial}} = (5/\arctan(10k)) \cdot \arctan(k \cdot x)$$

wherein x is the x coordinate of a point on the sole section and k is an empirical value ranging between about 1 / 4.5 and 1 / 2.75, and wherein the y_{initial} value is multiplied by a human foot correction factor formula of:

$$1/(1+ (x - x_j)^2/k_2)$$

to give a y coordinate of a point on the sole section, the y value indicating the vertical distance from a plane extending from the base of the toe (5) section, wherein k_2 is 300 and x_j is a function of the vertical distance between toe (5) section and heel (3) section and ranges from about 20 to 60 for vertical distances ranging between about 50.8 mm and 114.3 mm (2 and 4.5 inches), wherein, for A_1 representing a vertical distance of 50.8 mm (2 inches), A_2 representing 63.5 mm (2.5 inches), A_3 representing 76.2mm (3 inches), A_4 representing 88.9 mm (3.5 inches), A_5 representing 101.6mm (4 inches), and A_6 representing 114.3 mm (4.5 inches), the values of x_j are given in the following table, and for vertical distances different from the values of A_1 , A_2 , A_3 , A_4 , A_5 , and A_6 , the x_j values of the table are used to provide the extrapolation of range values between the adjacent A_1 to A_6 values:

	x_j
A_1	60
A_2	50
A_3	40
A_4	35
A_5	25
A_6	20

2. The high-heeled shoe (1) of claim 1, wherein the sole section and heel (3) section are comprised of a continuous curved sole.
3. The high-heeled shoe (1) of claim 2, wherein the toe section comprises an inclination β rising from the base of toe (5) section at an angle between about 7° to 26°.
4. The high-heeled shoe (1) of claim 2, wherein the heel (3) section comprises an inclination α rising from a base of the heel (3) section at an angle between about 5° to 26°.
5. The high-heeled shoe (1) of claim 1, wherein the toe section is elevated from a base section of the high-heeled shoe (1) with a platform up to about 88.9 mm (3½ inches) in height.
6. The high-heeled shoe (1) of claim 1, wherein the toe (5) section, sole section and heel (3) section are configured as a solid wedge with an upper part of the wedge providing direct support for the toe (5), sole and heel (3) of the human foot.

7. The high-heeled shoe (1) of claim 1, wherein the following table comprises angular curvature at positions, as measured from a rear of the shoe (1), at the terminus of the heel (3), along the sole and wherein angular curvatures for vertical distances other than the 12.7 mm (half inch) increments between the about 50.8 mm to 114.3 mm (two to four and half inches) are extrapolated therefrom, and wherein the range of angular curvature values for each position A_1 extends from values from A_1 to A_2 ; for A_2 the angular curvature values extends from values from A_1 to A_3 ; for A_3 the angular curvature values extends from values from A_2 to A_4 ; for A_4 the angular curvature values extends from values from A_3 to A_5 ; and for A_5 the angular curvature values extends from values from A_4 to A_6 ; and for A_6 the angular curvature values extends from values from A_5 to A_6 ;

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Distance Along the Insole Board from Rear of Shoe										
Heel Height	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm
A₁ (2") - A₂ (2½")	42.96° - 45.63°	41.97° - 44.02°	38.66° - 39.84°	33.89° - 34.11°	28.43° - 27.75°	22.83° - 21.42°	17.41° - 15.49°	12.36° - 10.17°	7.78° - 5.53°	3.75° - 1.59°
A₂(2½") - A₃ (3")	45.63° - 49.61°	44.02° - 46.92°	39.84° - 41.20°	34.11° - 33.86°	27.75° - 26.16°	21.42° - 18.93°	15.49° - 12.54°	10.17° - 7.10°	5.53° - 2.60°	1.59° - 0.27°
A₃ (3") - A₄ (3½")	49.61° - 51.72°	46.92° - 48.40°	41.20° - 41.77°	33.86° - 33.51°	26.16° - 25.11°	18.93° - 17.46°	12.54° - 10.91°	7.10° - 5.50°	2.60° - 1.14°	0.27° - 0.00°
A₄(3½") - A₅ (4")	51.72° - 56.13°	48.40° - 51.32°	41.77° - 42.52°	33.51° - 32.18°	25.11° - 22.35°	17.46° - 14.03°	10.91° - 7.38°	5.50° - 2.20°	1.14° - 0.00°	0.00° - 0.00°
A₅(4") - A₆ (4½")	56.13° - 58.43°	51.32° - 52.74°	42.52° - 42.63°	32.18° - 31.10°	22.35° - 20.60°	14.03° - 12.07°	7.38° - 5.48°	2.20° - 0.51°	0.00°	0.00°

EP 3 091 865 B1

8. The high-heeled shoe (1) of claim 1, wherein the following table comprises angular curvature as measured from a rear of the shoe (1) at the terminus of the heel (3) along the sole and wherein angular curvatures for vertical distances other than the 12.7 mm (half inch) increments between the about 50.8 mm and 114.3mm (two to four and a half inches) are extrapolated therefrom:

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Distance Along the Insole Board from Rear of Shoe										
Heel Height	90-100 mm	10-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm
A₁(2")-A₂(2½")	42.96° - 45.63°	41.97° - 44.02°	38.66° - 39.84°	33.89° - 34.11°	28.43° - 27.75°	22.83° - 21.42°	17.41° - 15.49°	12.36° - 10.17°	7.78° - 5.53°	3.75° - 1.59°
A₂(2½")-A₃(3")	45.63° - 49.61°	44.02° - 46.92°	39.84° - 41.20°	34.11° - 33.86°	27.75° - 26.16°	21.42° - 18.93°	15.49° - 12.54°	10.17°-7.10°	5.53° - 2.60°	1.59° - 0.27°
A₃(3")-A₄(3½")	49.61° - 51.72°	46.92° - 48.40°	41.20° - 41.77°	33.86° - 33.51°	26.16° - 25.11°	18.93° - 17.46°	12.54° - 10.91°	7.10°-5.50°	2.60° - 1.14°	0.27° - 0.00°
A₄(3½")-A₅(4")	51.72° - 56.13°	48.40° - 51.32°	41.77° - 42.52°	33.51° - 32.18°	25.11° - 22.35°	17.46° - 14.03°	10.91°-7.38°	5.50°-2.20°	1.14° - 0.00°	0.00° - 0.00°
A₅(4")-A₆(4½")	56.13° - 58.43°	51.32° - 52.74°	42.52° - 42.63°	32.18° - 31.10°	22.35° - 20.60°	14.03° - 12.07°	7.38°-5.48°	2.20°-0.51°	0.00°	0.00°

9. The high-heeled shoe (1) of claim 7, wherein the heel section comprises an inclination α rising from a base of the heel (3) section and an inclination β rising from the base of toe (5) section wherein the value ranges for α and β for varying vertical distances are set forth in the following table:

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Distance Along the Insole Board from Rear of Shoe													
Heel Height	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm	HeelAngle (α)	Toe Angle (β)	
A₁ (2")	42.96°	41.97°	38.66°	33.89°	28.43*	22.83°	17.41°	12.36°	7.78°	3.75°	5° - 9°	7° - 26°	
A₂ (2½")	45.63°	44.02°	39.84°	34.11°	27.75°	21.42°	15.49°	10.17°	5.53°	1.59°	12° - 16°	7° - 26°	
A₃ (3")	49.61°	46.92°	41.20°	33.86°	26.16°	18.93°	12.54°	7.10°	2.60°	0.27°	14°-18°	7° - 26°	
A₄ (3½")	51.72°	48.40°	41.77°	33.51°	25.11°	17.46°	10.91°	5.50°	1.14°	0.00°	16°-20°	7° - 26°	
A₅ (4")	56.13°	51.32°	42.52°	32.18°	22.35°	14.03°	7.38°	2.20°	0.00°	0.00°	18°-22°	7° - 16°	
A₆ (4½")	58.43°	52.74°	42.63°	31.10°	20.60°	12.07°	5.48°	0.51°	0.00°	0.00°	22°-26°	7° - 26°	

10. The high-heel shoe (1) of claim 1, wherein the values of k are given in the following table:

	k
A ₁	114.5
A ₂	1/4.25
A ₃	1/3.75
A ₄	1/3.5
A ₅	1/3
A ₆	1/2.75

11. The high-heel shoe (1) of claim 10, wherein for vertical distances different from the values of A₁, A₂, A₃, A₄, A₅, and A₆, the k values of the table are used to provide the extrapolation of range values between the adjacent A₁ to A₆ values.

Patentansprüche

1. Hochhackiger Schuh (1) für einen menschlichen Fuß, der es einem Menschen ermöglicht, eine anatomisch geeignete Körperhaltung zum Stehen und Gehen einzunehmen und beizubehalten, und der eine orthopädische Neigung aufweist, wobei der hochhackige Schuh (1) einen Zehenabschnitt (5) und einen Fersenabschnitt (3) umfasst, die durch einen Sohlenabschnitt getrennt und mit diesem verbunden sind, wobei der hochhackige Schuh (1) für die jeweilige Unterstützung einer Zehe, Ferse und Sohle eines menschlichen Fußes konfiguriert ist, wobei ein vertikaler Abstand zwischen einer Unterstützung der Zehe und einer Unterstützung der Ferse zwischen 50,8 mm und 114,3 mm (2 und 4,5 Zoll) beträgt und wobei der Sohlenabschnitt, der eine menschliche Sohle und Ferse direkt stützt, eine gekrümmte Neigung umfasst, wie sie einem x-y-Koordinatensystem überlagert ist, das einen Ursprungspunkt an dem Punkt aufweist, an dem der Sohlenabschnitt beginnt, sich von einer Basis des Zehenabschnitts (5) zu erheben, **dadurch gekennzeichnet, dass** die Konfiguration der gekrümmten Neigung gemäß Werten von x und y entlang des Sohlenabschnitts gemäß der folgenden Formel bestimmt wird:

$$y_{\text{initial}} = (5/\arctan(10k)) \cdot \arctan(k \cdot x)$$

wobei x die x-Koordinate eines Punktes auf dem Sohlenabschnitt ist und kein empirischer Wert ist, der zwischen ungefähr 1/4,5 und 1/2,75 liegt, und wobei der Wert y_{initial} mit einer folgenden Formel für den Korrekturfaktor des menschlichen Fußes multipliziert wird:

$$1/(1+(x-x_j)^2/k_2),$$

um eine y-Koordinate eines Punktes auf dem Sohlenabschnitt zu ergeben, wobei der y-Wert den vertikalen Abstand von einer Ebene angibt, die sich von der Basis des Zehenabschnitts (5) weg erstreckt, wobei k_2 300 ist und x_j eine Funktion des vertikalen Abstands zwischen einem Zehenabschnitt (5) und einem Fersenabschnitt (3) ist und im Bereich von ungefähr 20 bis 60 für vertikale Abstände zwischen ungefähr 50,8 mm und 114,3 mm (2 und 4,5 Zoll) liegt, wobei für A₁, das einen vertikalen Abstand von 50,8 mm (2 Zoll) darstellt, A₂ 63,5 mm (2,5 Zoll) darstellt, A₃ 76,2 mm (3 Zoll) darstellt, A₄ 88,9 mm (3,5 Zoll) darstellt, A₅ 101,6 mm (4 Zoll) darstellt und A₆ 114,3 mm (4,5 Zoll) darstellt, die Werte von x_j in der folgenden Tabelle angegeben sind und für vertikale Abstände, die sich von den Werten von A₁, A₂, A₃, A₄, A₅ und A₆ unterscheiden, die x_j -Werte der Tabelle verwendet werden, um die Extrapolation von Bereichswerten zwischen den benachbarten A₁- bis A₆-Werten bereitzustellen:

	x_j
A ₁	60
A ₂	50

(fortgesetzt)

	x_j
A_3	40
A_4	35
A_5	25
A_6	20

2. Hochhackiger Schuh (1) nach Anspruch 1, wobei der Sohlenabschnitt und der Fersenabschnitt (3) aus einer durchgehenden gekrümmten Sohle bestehen.
3. Hochhackiger Schuh (1) nach Anspruch 2, wobei der Zehenabschnitt eine Neigung β umfasst, die von der Basis eines Zehenabschnitts (5) in einem Winkel zwischen ungefähr 7° und 26° ansteigt.
4. Hochhackiger Schuh (1) nach Anspruch 2, wobei der Fersenabschnitt (3) eine Neigung α umfasst, die von einer Basis des Fersenabschnitts (3) in einem Winkel zwischen ungefähr 5° und 26° ansteigt.
5. Hochhackiger Schuh (1) nach Anspruch 1, wobei der Zehenabschnitt von einem Basisabschnitt des hochhackigen Schuhs (1) mit einer Plattform mit einer Höhe von bis zu ungefähr 88,9 mm (3,5 Zoll) angehoben ist.
6. Hochhackiger Schuh (1) nach Anspruch 1, wobei der Zehenabschnitt (5), der Sohlenabschnitt und der Fersenabschnitt (3) als ein massiver Keil konfiguriert sind, wobei ein oberer Teil des Keils eine direkte Unterstützung für die Zehe (5), die Sohle und die Ferse (3) des menschlichen Fußes bereitstellt.
7. Hochhackiger Schuh (1) nach Anspruch 1, wobei die folgende Tabelle eine Winkelkrümmung an Positionen, gemessen von einer Rückseite des Schuhs (1), am Ende der Ferse (3), entlang der Sohle umfasst und wobei Winkelkrümmungen für andere vertikale Abstände als die 12,7 mm- (Halbzoll)-Inkrementen zwischen den ungefähr 50,8 mm und 114,3 mm (zwei bis viereinhalb Zoll) daraus extrapoliert werden, und wobei der Bereich von Winkelkrümmungswerten für jede Position A_1 sich von Werten von A_1 bis A_2 erstreckt; für A_2 die Winkelkrümmungswerte sich von Werten von A_1 bis A_3 erstrecken; für A_3 die Winkelkrümmungswerte sich von Werten von A_2 bis A_4 erstrecken; für A_4 die Winkelkrümmungswerte sich von Werten von A_3 bis A_5 erstrecken; und für A_5 die Winkelkrümmungswerte sich von Werten von A_4 bis A_6 erstrecken; und für A_6 die Winkelkrümmungswerte sich von Werten von A_5 bis A_6 erstrecken;

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Abstand entlang des Einlegesohlenbretts von der Rückseite des Schuhs									
Absatzhöhe	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm
A ₁ (2") - (2,5")	42,96° - 45,63°	41,97° - 44,02°	38,66° - 39,84°	33,89° - 34,11°	28,43° - 27,75°	22,83° - 21,42°	17,41° - 15,49°	12,36° - 10,17°	7,78° - 5,53°
A ₂ (2,5") - A ₃ (3")	45,63° - 49,61°	44,02° - 46,92°	39,84° - 41,20°	34,11° - 33,86°	27,75° - 26,16°	21,42° - 18,93°	15,49° - 12,54°	10,17° - 7,10°	5,53° - 2,60°
A ₃ (3") - A ₄ (3,5")	49,61° - 51,72°	46,92° - 48,40°	41,20° - 41,77°	33,86° - 33,51°	26,16° - 25,11°	18,93° - 17,46°	12,54° - 10,91°	7,10° - 5,50°	2,60° - 1,14°
A ₄ (3,5") - A ₅ (4")	51,72° - 56,13°	48,40° - 51,32°	41,77° - 42,52°	33,51° - 32,18°	25,11° - 22,35°	17,46° - 14,03°	10,91° - 7,38°	5,50° - 2,20°	1,14° - 0,00°
A ₅ (4") - A ₆ (4,5")	56,13° - 58,43°	51,32° - 52,74°	42,52° - 42,63°	32,18° - 31,10°	22,35° - 20,60°	14,03° - 12,07°	7,38° - 5,48°	2,20° - 0,51°	0,00°

EP 3 091 865 B1

8. Hochhackiger Schuh (1) nach Anspruch 1, wobei die folgende Tabelle eine Winkelkrümmung umfasst, die von einer Rückseite des Schuhs (1) am Ende der Ferse (3) entlang der Sohle gemessen wird, und wobei Winkelkrümmungen für andere vertikale Abstände als die 12,7 mm- (Halbzoll)-Inkremente zwischen den ungefähr 50,8 mm und 114,3 mm (zwei bis viereinhalb Zoll) daraus extrapoliert werden:

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Abstand entlang des Einlegesohlenbretts von der Rückseite des Schuhs									
Absatzhöhe	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm
A ₁ (2") - A ₂ (2,5")	42,96° - 45,63°	41,97° - 44,02°	38,66° - 39,84°	33,89° - 34,11°	28,43° - 27,75°	22,83° - 21,42°	17,41° - 15,49°	12,36° - 10,17°	7,78° - 5,53°
A ₂ (2,5") - A ₃ (3")	45,63° - 49,61°	44,02° - 46,92°	39,84° - 41,20°	34,11° - 33,86°	27,75° - 26,16°	21,42° - 18,93°	15,49° - 12,54°	10,17° - 7,10°	5,53° - 2,60°
A ₃ (3") - A ₄ (3,5")	49,61° - 51,72°	46,92° - 48,40°	41,20° - 41,77°	33,86° - 33,51°	26,16° - 25,11°	18,93° - 17,46°	12,54° - 10,91°	7,10° - 5,50°	2,60° - 1,14°
A ₄ (3,5") - A ₅ (4")	51,72° - 56,13°	48,40° - 51,32°	41,77° - 42,52°	33,51° - 32,18°	25,11° - 22,35°	17,46° - 14,03°	10,91° - 7,38°	5,50° - 2,20°	1,14° - 0,00°
A ₅ (4") - A ₆ (4,5")	56,13° - 58,43°	51,32° - 52,74°	42,52° - 42,63°	32,18° - 31,10°	22,35° - 20,60°	14,03° - 12,07°	7,38° - 5,48°	2,20° - 0,51°	0,00°

9. Hochhackiger Schuh (1) nach Anspruch 7, wobei der Fersenabschnitt eine von der Basis des Fersenabschnitts (3) ausgehende Neigung α und eine von der Basis des Zehenabschnitts (5) ausgehende Neigung β umfasst, wobei die Wertebereiche für α und β für unterschiedliche vertikale Abstände in der folgenden Tabelle dargelegt sind: Abstand entlang des Einlegesohlenbretts von der Rückseite des Schuhs

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Absatz höhe		Fersenwinkel (α)		0-10 mm		30-40 mm		40-50 mm		50-60 mm		60-70 mm		70-80 mm		80-90 mm		90-100 mm		Zehenwinkel (β)
A ₁ (2")		5° - 9°		3,75°		17,41°		22,83°		28,43°		33,89°		38,66°		41,97°		42,96°		7° - 26°
A ₂ (2,5")		12° - 16°		1,59°		15,49°		21,42°		27,75°		34,11°		39,84°		44,02°		45,63°		7° - 26°
A ₃ (3")		14° - 18°		0,27°		12,54°		18,93°		26,16°		33,86°		41,20°		46,92°		49,61°		7° - 26°
A ₄ (3,5")		16° - 20°		0,00°		10,91°		17,46°		25,11°		33,51°		41,77°		48,40°		51,72°		7° - 26°
A ₅ (4")		18° - 22°		0,00°		7,38°		14,03°		22,35°		32,18°		42,52°		51,32°		56,13°		7° - 26°
A ₆ (4,5")		22° - 26°		0,00°		5,48°		12,07°		20,60°		31,10°		42,63°		52,74°		58,43°		7° - 26°

10. Hochhackiger Schuh (1) nach Anspruch 1, wobei die Werte von k in der folgenden Tabelle angegeben sind:

	k
A ₁	1/4,5
A ₂	1/4,25
A ₃	1/3,75
A ₄	1/3,5
A ₅	1/3
A ₆	1/2,75

11. Hochhackiger Schuh (1) nach Anspruch 10, wobei für vertikale Abstände, die sich von den Werten von A₁, A₂, A₃, A₄, A₅ und A₆ unterscheiden, die k-Werte der Tabelle verwendet werden, um die Extrapolation von Bereichswerten zwischen den benachbarten A₁- bis A₆-Werten bereitzustellen.

Revendications

1. Chaussure à talon haut (1) pour un pied humain qui permet à un humain d'adopter et de maintenir une posture du corps anatomiquement correcte pour se tenir debout et marcher, et qui présente une inclinaison orthopédique, la chaussure à talon haut (1) comprenant une section orteil (5) et une section talon (3) séparées par et reliées avec une section semelle, la chaussure à talon haut (1) étant configurée pour le support respectif d'un orteil, d'un talon et d'une semelle d'un pied humain, dans laquelle une distance verticale entre un support de l'orteil et un support du talon se situe entre 50,8 mm et 114,3 mm (2 et 4,5 pouces) et dans laquelle la section semelle qui supporte directement une semelle humaine et un talon humain comprend une inclinaison courbée, telle que superposée sur un système de coordonnées x-y présentant un point d'origine au niveau du point au niveau duquel la section semelle commence à monter à partir d'une base de la section orteil (5), **caractérisée en ce que** la configuration d'inclinaison courbée est déterminée selon des valeurs x et y le long de la section semelle selon la formule :

$$y_{\text{initial}} = (5/\arctan(10k)) \cdot \arctan(k \cdot x)$$

dans laquelle x est la coordonnée x d'un point sur la section semelle et k est une valeur empirique s'étendant entre environ 1/4,5 et 1/2,75, et dans laquelle la valeur y_{initial} est multipliée par une formule de facteur de correction de pied humain de :

$$1/(1+(x-x_j)^2/k_2)$$

pour donner une coordonnée y d'un point sur la section semelle, la valeur y indiquant la distance verticale à partir d'un plan s'étendant à partir de la base de la section orteil (5), dans laquelle k_2 est égal à 300 et x_j est une fonction de la distance verticale entre une section orteil (5) et une section talon (3) et s'étend d'environ 20 à 60 pour des distances verticales s'étendant entre environ 50,8 mm et 114,3 mm (2 et 4,5 pouces), dans laquelle, pour A₁ représentant une distance verticale de 50,8 mm (2 pouces), A₂ représentant 63,5 mm (2,5 pouces), A₃ représentant 76,2 mm (3 pouces), A₄ représentant 88,9 mm (3,5 pouces), A₅ représentant 101,6 mm (4 pouces) et A₆ représentant 114,3 mm (4,5 pouces), les valeurs de x_j sont données dans le tableau suivant, et pour des distances verticales différentes des valeurs de A₁, A₂, A₃, A₄, A₅ et A₆, les valeurs x_j du tableau sont utilisées pour fournir l'extrapolation de valeurs de plage entre les valeurs de A₁ à A₆ adjacentes :

	x_j
A ₁	60
A ₂	50

EP 3 091 865 B1

(suite)

	x_j
A_3	40
A_4	35
A_5	25
A_6	20

2. Chaussure à talon haut (1) selon la revendication 1, dans laquelle la section semelle et la section talon (3) sont constituées d'une semelle courbée continue.
3. Chaussure à talon haut (1) selon la revendication 2, dans laquelle la section orteil comprend une inclinaison β montant à partir de la base d'une section orteil (5) selon un angle compris entre environ 7° et 26° .
4. Chaussure à talon haut (1) selon la revendication 2, dans laquelle la section talon (3) comprend une inclinaison α montant à partir d'une base de la section talon (3) selon un angle compris entre environ 5° et 26° .
5. Chaussure à talon haut (1) selon la revendication 1, dans laquelle la section orteil est élevée à partir d'une section de base de la chaussure à talon haut (1) avec une plate-forme allant jusqu'à environ 88,9 mm (3,5 pouces) de haut.
6. Chaussure à talon haut (1) selon la revendication 1, dans laquelle la section orteil (5), la section semelle et la section talon (3) sont configurées en tant que cale solide avec une partie supérieure de la cale fournissant un support direct pour l'orteil (5), la semelle et le talon (3) du pied humain.
7. Chaussure à talon haut (1) selon la revendication 1, dans laquelle le tableau suivant comprend une courbure angulaire au niveau de positions, telle que mesurée depuis un arrière de la chaussure (1), au niveau du bout du talon (3), le long de la semelle et dans laquelle des courbures angulaires pour des distances verticales autres que les incréments de 12,7 mm (demi-pouce) entre les environ 50,8 mm et 114,3 mm (deux à quatre pouces et demi) sont extrapolées à partir de ceux-ci, et dans laquelle la plage de valeurs de courbure angulaire pour chaque position A_1 s'étend à partir de valeurs de A_1 à A_2 ; pour A_2 les valeurs de courbure angulaire s'étendent à partir de valeurs de A_1 à A_3 ; pour A_3 les valeurs de courbure angulaire s'étendent à partir de valeurs de A_2 à A_4 ; pour A_4 les valeurs de courbure angulaire s'étendent à partir de valeurs de A_3 à A_5 ; et pour A_5 les valeurs de courbure angulaire s'étendent à partir de valeurs de A_4 à A_6 ; et pour A_6 les valeurs de courbure angulaire s'étendent à partir de valeurs de A_5 à A_6 ;

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Distance le long de la semelle intérieure depuis l'arrière de la chaussure											
Hauteur de talon	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm	
- A ₁ (2") - A ₂ (2,5")	42,96° - 45,63°	41,97° - 44,02°	38,66° - 39,84°	33,89° - 34,11°	28,43° - 27,75°	22,83° - 21,42°	17,41° - 15,49°	12,36° - 10,17°	7,78° - 5,53°	3,75° - 1,59°	
A ₂ (2,5") - A ₃ (3")	45,63° - 49,61°	44,02° - 46,92°	39,84° - 41,20°	34,11° - 33,86°	27,75° - 26,16°	21,42° - 18,93°	15,49° - 12,54°	10,17° - 7,10°	5,53° - 2,60°	1,59° - 0,27°	
A ₃ (3") - A ₄ (3,5")	49,61° - 51,72°	46,92° - 48,40°	41,20° - 41,77°	33,86° - 33,51°	26,16° - 25,11°	18,93° - 17,46°	12,54° - 10,91°	7,10° - 5,50°	2,60° - 1,14°	0,27° - 0,00°	
A ₄	51,72° -	48,40° -	41,77° -	33,51° -	25,11° -	17,46° -	10,91° -	5,50° -	1,14° -	0,00° -	
(3,5") - A ₅ (4")	56,13°	51,32°	42,52°	32,18°	22,35°	14,03°	7,38°	2,20°	0,00°	0,00°	
A ₅ (4") - A ₆ (4,5")	56,13° - 58,43°	51,32° - 52,74°	42,52° - 42,63°	32,18° - 31,10°	22,35° - 20,60°	14,03° - 12,07°	7,38° - 5,48°	2,20° - 0,51°	0,00°	0,00°	

EP 3 091 865 B1

8. Chaussure à talon haut (1) selon la revendication 1, dans laquelle le tableau suivant comprend une courbure angulaire telle que mesurée à partir d'un arrière de la chaussure (1) au niveau du bout du talon (3) le long de la semelle et dans laquelle des courbures angulaires pour des distances verticales autres que les incréments de 12,7 mm (demi-pouce) entre les environ 50,8 mm et 114,3 mm (deux à quatre pouces et demi) sont extrapolées à partir de ceux-ci :

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Distance le long de la semelle intérieure depuis l'arrière de la chaussure										
Hauteur de talon	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm
A ₁ (2") - A ₂ (2,5")	42,96° - 45,63°	41,97° - 44,02°	38,66° - 39,84°	33,89° - 34,11°	28,43° - 27,75°	22,83° - 21,42°	17,41° - 15,49°	12,36° - 10,17°	7,78° - 5,53°	3,75° - 1,59°
A ₂ (2,5") - A ₃ (3")	45,63° - 49,61°	44,02° - 46,92°	39,84° - 41,20°	34,11° - 33,86°	27,75° - 26,16°	21,42° - 18,93°	15,49° - 12,54°	10,17° - 7,10°	5,53° - 2,60°	1,59° - 0,27°
A ₃ (3") - A ₄ (3,5")	49,61° - 51,72°	46,92° - 48,40°	41,20° - 41,77°	33,86° - 33,51°	26,16° - 25,11°	18,93° - 17,46°	12,54° - 10,91°	7,10° - 5,50°	2,60° - 1,14°	0,27° - 0,00°
A ₄ (3,5") - A ₅ (4")	51,72° - 56,13°	48,40° - 51,32°	41,77° - 42,52°	33,51° - 32,18°	25,11° - 22,35°	17,46° - 14,03°	10,91° - 7,38°	5,50° - 2,20°	1,14° - 0,00°	0,00° - 0,00°
A ₅ (4") - A ₆ (4,5")	56,13° - 58,43°	51,32° - 52,74°	42,52° - 42,63°	32,18° - 31,10°	22,35° - 20,60°	14,03° - 12,07°	7,38° - 5,48°	2,20° - 0,51°	0,00°	0,00°

9. Chaussure à talon haut (1) selon la revendication 7, dans laquelle la section talon comprend une inclinaison α montant à partir d'une base de la section talon (3) et une inclinaison β montant à partir de la base de la section orteil (5) dans laquelle les plages de valeur pour α et β pour des distances verticales variées sont présentées dans le tableau suivant :

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Distance le long de la semelle intérieure depuis l'arrière de la chaussure													
	Hauteur de talon	90-100 mm	80-90 mm	70-80 mm	60-70 mm	50-60 mm	40-50 mm	30-40 mm	20-30 mm	10-20 mm	0-10 mm	Angle de talon (α)	Angle d'orteil (β)
5	A ₁ (2")	42,96°	41,97°	38,66°	33,89°	28,43 °	22, 83 °	17,41°	12,36°	7,78°	3,75°	5°-9°	7°-26°
10	A ₂ (2,5")	45,63°	44,02°	39,84°	34,11°	27,75°	21,42°	15,49°	10,17°	5,53°	1,59°	12°-16°	7°-26°
15	A ₃ (3")	49,61°	46,92°	41 , 20°	33,86°	26,16°	18 , 93°	12,54°	7,10°	2,60°	0,27°	14°-18°	7°-26°
20	A ₄ (3,5")	51,72°	48,40°	41,77°	33,51°	25,11°	17,46°	10,91°	5,50°	1,14°	0,00°	16°-20°	7°-26°
25	A ₅ (4")	56,13°	51,32°	42,52°	32,18°	22,35°	14,03°	7,38°	2,20°	0,00°	0,00°	18°-22°	7°-26°
30	A ₆ (4,5")	58,43°	52,74°	42,63°	31,10°	20,60°	12,07°	5,48°	0,51°	0,00°	0,00°	22°-26°	7°-26°

EP 3 091 865 B1

10. Chaussure à talon haut (1) selon la revendication 1, dans laquelle les valeurs de k sont données dans le tableau suivant :

	k
A_1	1/4,5
A_2	1/4,25
A_3	1/3,75
A_4	1/3,5
A_5	1/3
A_6	1/2,75

11. Chaussure à talon haut (1) selon la revendication 10, dans laquelle pour des distances verticales différentes des valeurs de A_1 , A_2 , A_3 , A_4 , A_5 et A_6 , les valeurs de k du tableau sont utilisées pour fournir l'extrapolation de valeurs de plage entre les valeurs de A_1 à A_6 adjacentes.

Figure 1

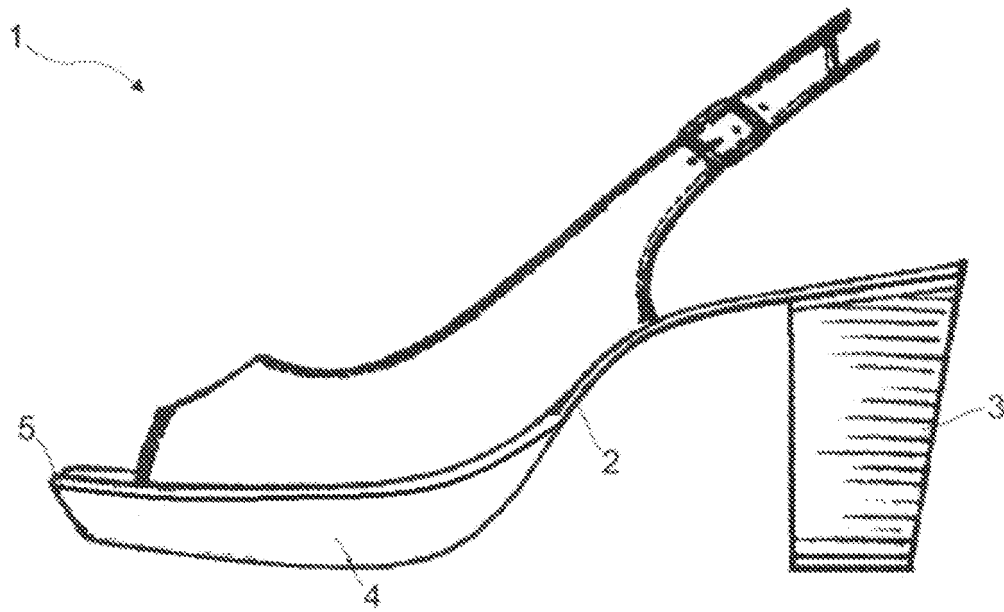


Figure 2

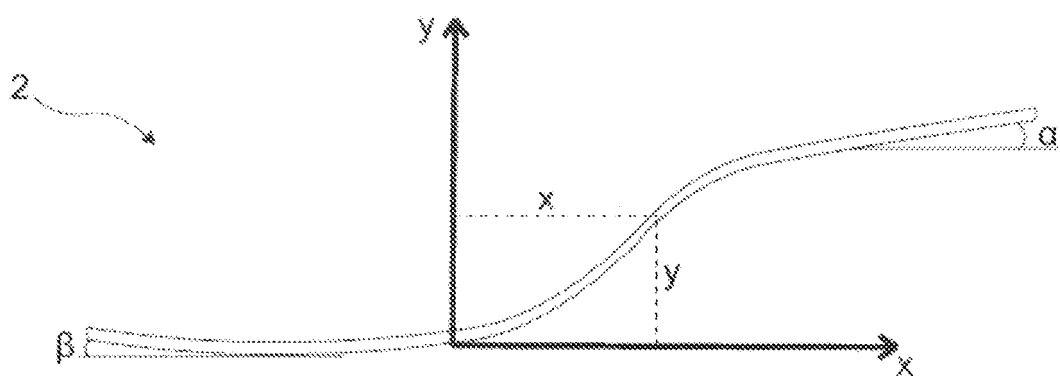


Figure 3

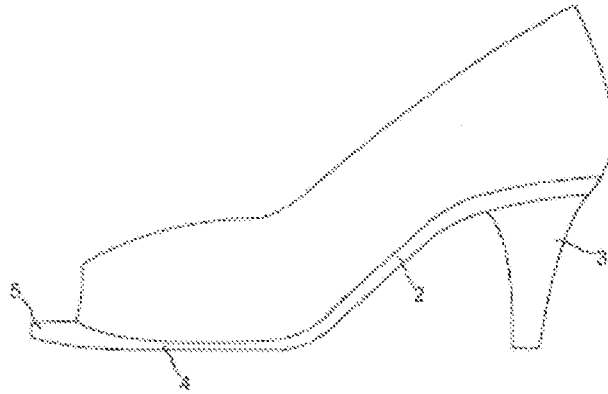
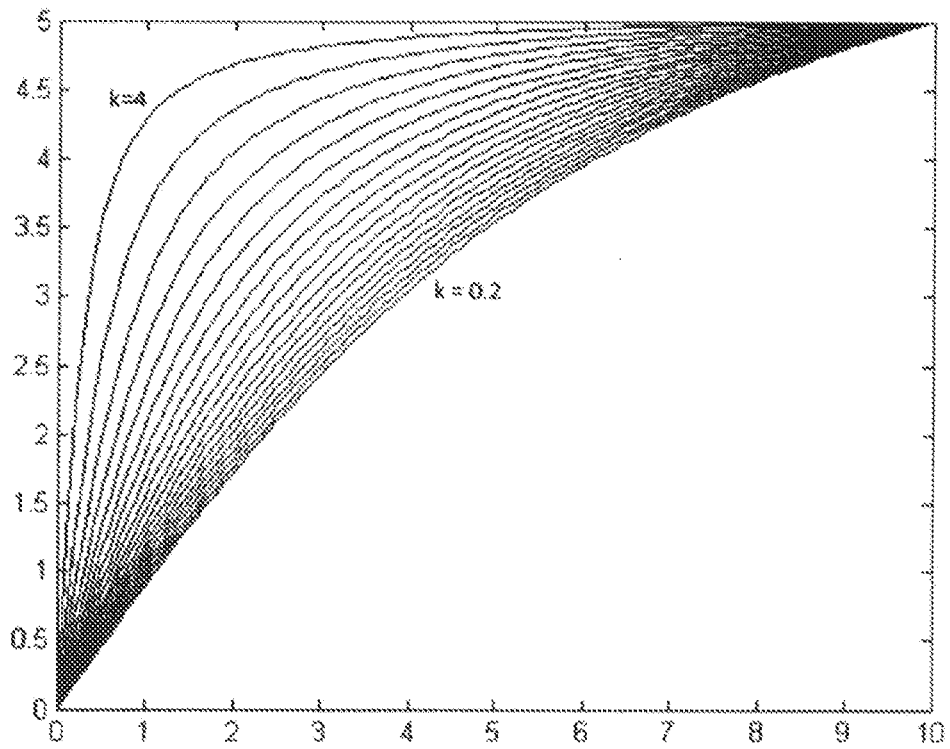


Figure 4



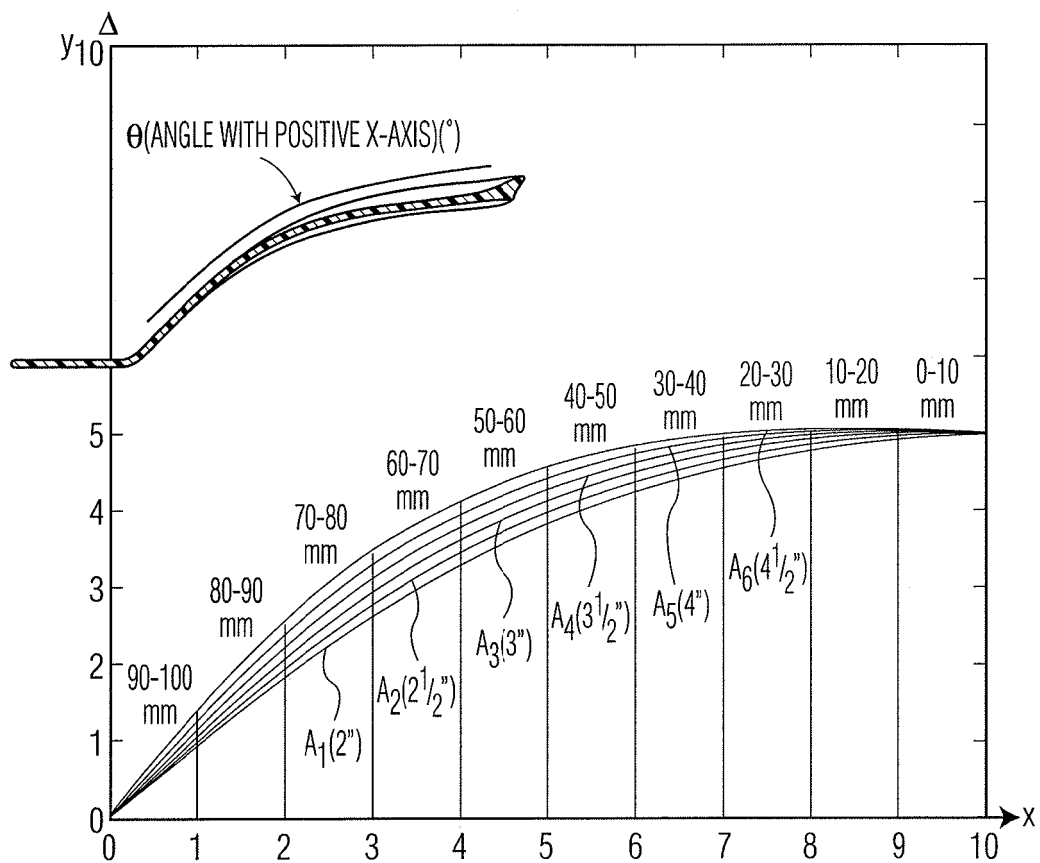


FIG. 5

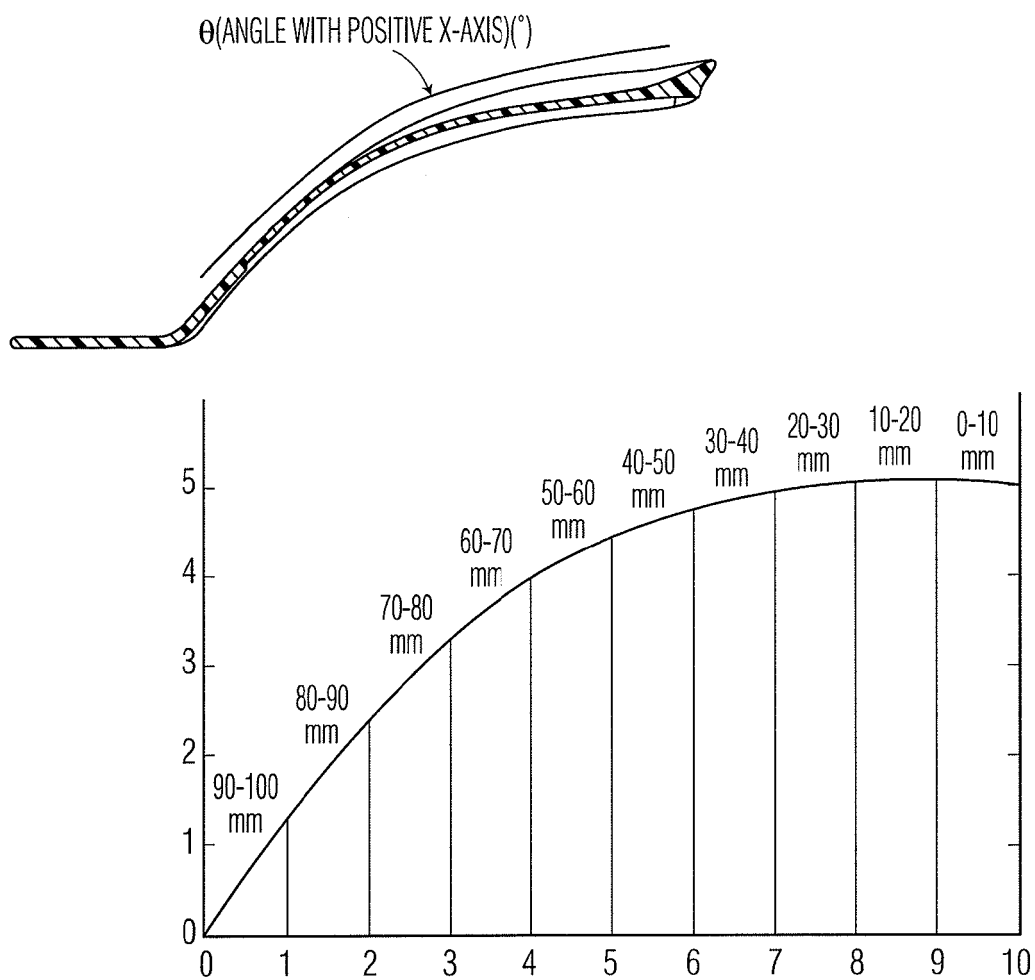


FIG. 6

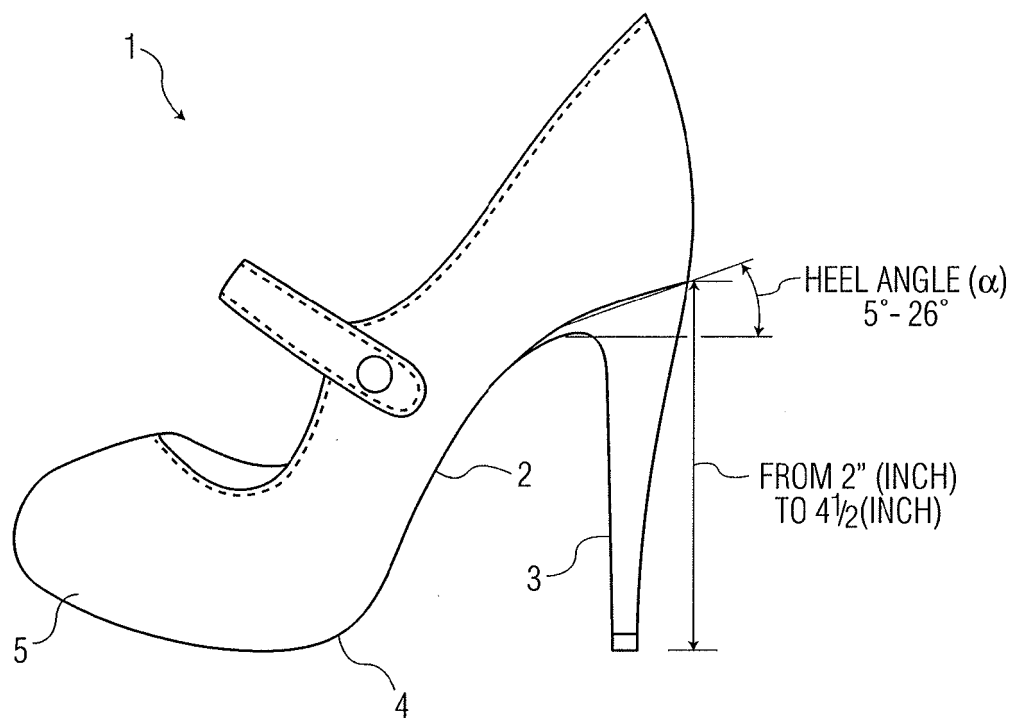


FIG. 7

Figure 8A

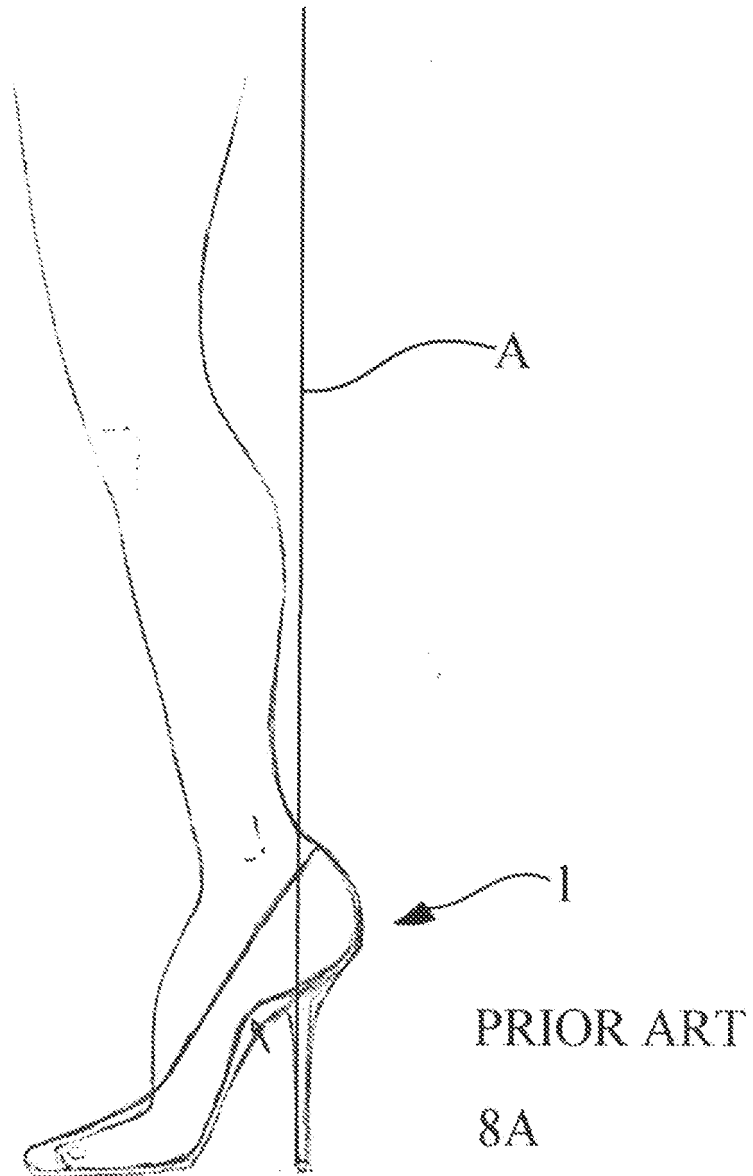


Figure 8B

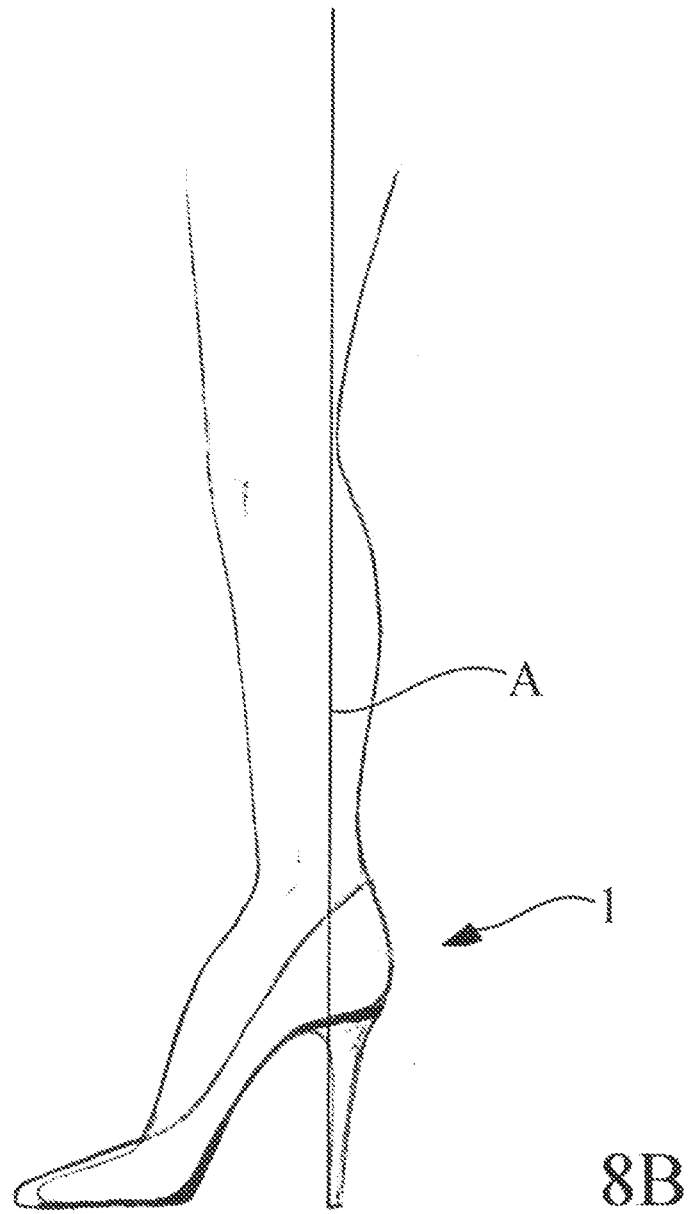
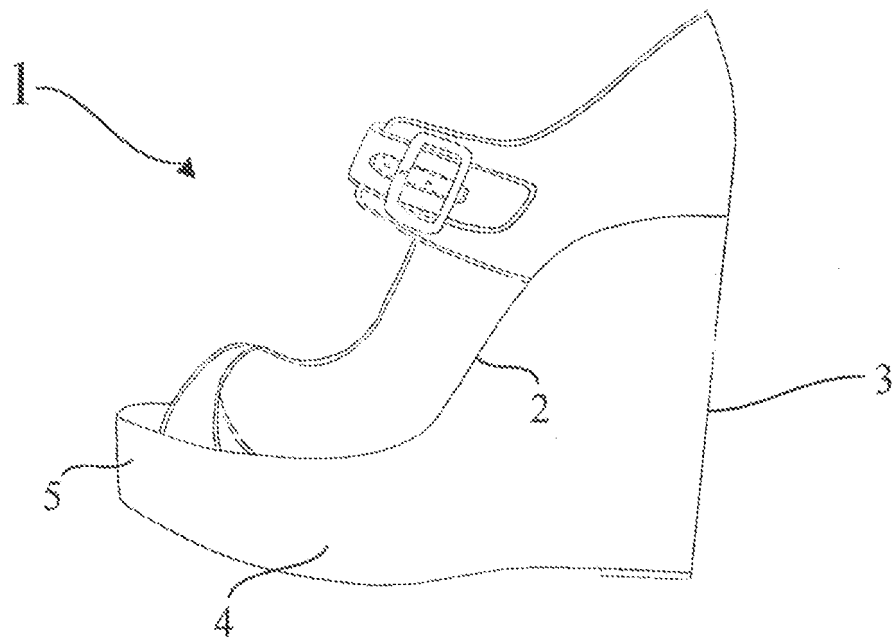


Figure 9



REFERENCES CITED IN THE DESCRIPTION

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