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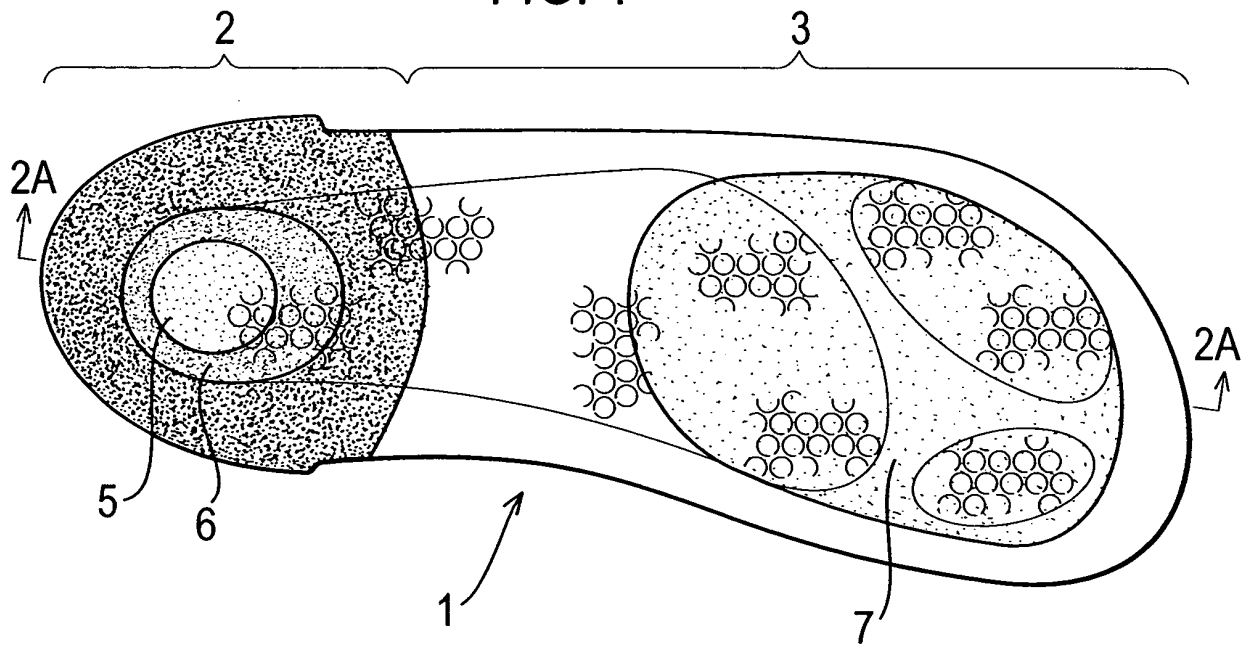
(54) Shoe sole product and method

(57) There is described a shoe sole product (1), which may be a sole, an insole or a midsole. The shoe sole product is formed from elastomeric material of a predetermined hardness, and at the heel part has a central region (5) formed from relatively softer material, the central region being surrounded by a ring (6) of material whose hardness is intermediate the hardness of the sole product and the central region.

The forepart of the sole product may also have a region (7) of softer material inset into the relatively harder material of the sole product, so as to underlie the ball of the foot of a user. The region of softer material may have a forward extension (58a) to underlie the user's big toe, or a separate toe region may be provided.

FIG. 1



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Description

[0001] The present invention relates to footwear, and is particularly concerned with soles and components for shoe soles which provide cushioning to the wearer's heel.

[0002] During walking or running, impact with the ground generates pressures beneath the wearer's heel. Due to the bone structure within the wearer's foot, a concentration of pressure occurs in a central area beneath the wearer's heel, with peripheral regions of the heel experiencing lower peak pressures than the central region.

[0003] Since excessively high peak pressures may cause discomfort or even injury to the wearer, it has been proposed to provide shoe soles of cushioning material such as elastomeric materials or foams which deform under pressure, with the areas subjected to the highest pressure having the greatest deformation.

[0004] A concern of the present invention is to provide a shoe sole structure which provides a controlled redistribution of force to the wearer's foot, in order to distribute the forces over a larger area and avoid the high peak pressures which may cause discomfort or injury.

[0005] In a first aspect, the present invention provides a method for forming a shoe sole product, the method comprising the steps of forming a sole component having a recess at the heel part, placing within the recess at least one ring of material and a central plug, wherein the hardness of the material of the rings reduces towards the central plug, and fixing the plug and ring or rings within the recess.

[0006] In a particular embodiment, the plug and ring or rings are fixed by placing the assembled sole component, plug and rings in a mould, and applying heat and pressure to the assembly to form the sole component, plug and rings into a unitary shoe sole product by compression moulding.

[0007] Alternatively, the plug and rings may be fixed by adhesive, or may be retained by a flexible sheet extending over the recess and fixed to the sole component.

[0008] In an alternative method, the sole component, ring and plug may be injection moulded by simultaneous or successive injections of materials of appropriate hardnesses into different regions within a mould cavity.

[0009] A second aspect of the invention provides a shoe sole product for use in the manufacture of shoes or shoe structures, the shoe sole product comprising a sole component having a recess at the heel part, at least one ring of material and a central plug retained within the recess, wherein the hardness of the material of the rings reduces towards the central plug.

[0010] In a particular embodiment, the sole component has an upwardly-open blind recess at its heel part, and the recess is filled by a central plug and one or more rings of material surrounding the central plug, the central plug being formed of a relatively soft material compared to the materials of the rings and the sole component, and wherein the ring or rings is or are formed of materials harder than that of the plug and softer than that of the sole component.

[0011] In an alternative embodiment, the recess accommodating the plug and rings is formed in the undersurface of the sole component.

[0012] In a further alternative embodiment, the heel part of the sole component is formed with an opening penetrating from its upper surface to its lower surface, and the depth of the plug and the rings is substantially equal to the depth of the sole component at the heel part so that the opening is filled.

[0013] The shoe sole product may be a unitary sole, to which an upper can be attached to form a shoe. Alternatively, the shoe sole product may be a midsole to which an upper and an outer sole are attached in order to from a shoe.

[0014] In a further alternative embodiment, the shoe sole product may be an insole either removably or fixedly mountable in a shoe.

[0015] Further aspects of the invention provide a shoe and a shoe structure incorporating the shoe sole product. The shoe may be a closed shoe or boot, or an open design such as a sandal or a "flip-flop".

[0016] Embodiments of the present invention will now be described in detail with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a shoe sole embodying the invention;

Figure 2A is a longitudinal sectional view of the shoe sole of Figure 1;

Figure 2B is a sectional view similar to Figure 2A showing an alternative embodiment;

Figure 3A is a sectional view similar to Figure 2 illustrating a further alternative embodiment of the shoe sole;

Figure 3B is a partial sectional view similar to Figure 2B, illustrating yet a further embodiment of the invention;

Figure 4 is a plan view, to an enlarged scale, of the heel part of a shoe sole incorporating the invention;

Figure 5 is a schematic perspective view of the heel part of the shoe sole of Figure 4;

Figure 6 is a schematic perspective view of the heel part of a shoe sole component embodying the invention;

Figure 7A is a longitudinal sectional view of the shoe sole of Figure 4;

Figure 7B is a sectional view similar to section 7A of an alternative embodiment of the invention;

Figure 8A is a longitudinal sectional view illustrating a midsole incorporating the features of the invention;

Figure 8B is a partial sectional view similar to Figure 8A illustrating the further alternative embodiment;

Figure 9 is a side view of a shoe incorporating the shoe sole of the present invention;

Figure 10 is an exploded view of the elements of the shoe sole component;

Figures 11 and 12 are perspective and longitudinal sectional views, respectively, of an insole embodying the invention;

Figures 13 and 14 are perspective and sectional views, respectively, of a sandal embodying the invention; and

Figure 15 is a plan view of an alternative embodiment of the shoe sole component, illustrating a configuration for a sporting shoe.

[0017] Referring now to the drawings, Figure 1 shows in plan view a shoe sole embodying the invention. The sole 1 comprises a heel part 2 and a forepart 3. The sole is made from resilient flexible foam material such as EVA (ethylenevinylacetate) or any other suitable material.

[0018] In the sole illustrated in Figure 1, the heel part 2 has a higher Asker scale hardness than the forepart 3. At the central region of the heel part 2, the heel part 2 is formed with a recess 4 which is oval in shape in plan view, and extends downwardly into the heel part. The recess 4 may extend downwardly to a depth of from 20 to 90% of the depth of the heel part 2, and preferably extend to about 70% of the depth.

[0019] The recess 4 is filled by a substantially cylindrical plug 5 and a "ring" 6 whose radially outer surface fits closely within the recess 4, and whose radially inner surface closely surrounds the plug 5.

[0020] The plug 5 is formed from a material whose hardness is substantially less than the hardness of the heel part 2, and the ring 6 is formed from a material which is harder than the material of the plug, and softer than the material of the heel part 2. Typically, the heel part 2 will be formed from material of Asker C hardness from about 50 to about 70, preferably 55 to 65, typically about 63. The ring 6 is advantageously formed from material having a Asker C hardness of from about 40 to about 60, preferably between 45 and 55, and more preferably about 50, and the central plug 5 is typically formed from a material having a Asker C hardness of from about 30 to about 50, preferably from 35 to 45, with a preferred value being about 40.

[0021] The forepart 3 of the sole in Figure 1 is of similar hardness to the heel part 2, typically of Asker C hardness of from about 50 to about 70, preferably 60 to 65, typically about 63. In the sole of Figure 1, the forepart 3 has a cushioning area provided by a recess 8 in the upper surface of the forepart 3 into which a cushioning material 7 is set. The cushioning material 7 is softer than the material of the forepart 3, typically having an Asker C hardness of from about 30 to about 55, preferably between 35 and 50, more preferably from about 40 to 45.

[0022] The sole illustrated in Figures 1 and 2A is preferably formed by a combination of die-cutting and compression moulding methods. Initially, a sole component comprising the heel part 2 and forepart 3 is formed by cutting or otherwise forming the component from a sheet of foamed EVA material, including forming the recesses 4 and 8 in the heel part 2 and forepart 3, respectively.

[0023] The cushioning insert 7, the ring 6 and the plug 5 are also separately formed by cutting or other forming techniques from materials of the appropriate hardness. The materials of the various parts of the sole may be in different shades or colours, or all of the components of the sole may be formed from material of the same colour, yet of different hardnesses. The cushioning insert 7, the ring 6 and the plug 5 are preferably made from resilient flexible foam material such as EVA (ethylenevinylacetate) or any other suitable material compatible with the material of the sole component. The insert 7 is then placed in the recess 8 in the forepart 3 of the sole component, and is secured in place. Likewise, the ring 6 and plug 5 are placed in the recess 4, and secured in position.

[0024] The insert 7, ring 6 and plug 5 may be secured by adhesive into their respective recesses.

[0025] Alternatively, once the ring and plug have been placed in the recess 4 and the insert 7 has been placed in the recess 8, then assembled structure may be placed in a mould and subjected to heat and pressure to form, by compression moulding, the finished sole 1. The compression moulding is preferably effected by raising the temperature within the mould to from 100 to 300 degrees C, preferably to about 160 degrees C, and exerting a pressure of from 2 to 10 bar, preferably about 5 bar, for a period of from 5 to 15 minutes, preferably about 8 minutes.

[0026] The finished sole is then removed from the mould, and allowed to cool, before the attachment of an upper to the sole to form a shoe. Alternatively, straps may be attached to the sole to form a sandal.

[0027] In an alternative method, the sole component, the plug and the ring may be formed by injection moulding from, for example, polyurethane foam material and cemented together to form the finished sole product.

[0028] In a further alternative, the sole component may be formed in a first mould cavity by injection moulding from, for example, polyurethane foam material, and the sole component may then be placed in a second mould cavity into which is injected a softer material to form the ring 6. The assembly may then be transferred to a third mould cavity and an even softer material injected to form the plug 5, to form the finished sole product.

[0029] In a yet further alternative, the materials for the

sole component, the ring 6 and the plug 5 may be simultaneously injected into a mould cavity, and by positioning the injection gates and controlling the injection timings and pressures appropriately the sole product may be formed in a single moulding operation.

[0030] Figure 2B shows an alternative arrangement for the recess in the heel part 2 of the sole 1. In Figure 2B, a recess 4a is formed in the underside of the sole, the recess extending upwardly into the sole almost as far as the upper surface 9. The recess 4a may extend up to within about 1mm or less of the surface 9, so that the strength of the material bridging the recess 4a is reduced.

[0031] A central plug 5a and a ring 6a are secured within the recess 4a, to fill the recess 4a. As in the previous case, the plug 5a and ring 6a may be secured by adhesive, or by compression-moulding techniques. As before, the plug 5a is of a material significantly softer than the material of the heel part 2, and the ring 6a has a hardness greater than that of the plug 5a, but less than that of the heel part 2.

[0032] Figure 3A shows a further alternative embodiment of the sole, in which the recess 4b extends from the upper surface 9 to the lower surface 10 of the heel part 2. The recess 4b is filled by a ring 6b and a plug 5b, the ring 6b being softer than the material of the heel part 2, and the plug 5b being of a material softer than that of the ring 6b.

[0033] In the examples shown in Figures 1 to 3A, the plug 5, 5a, 5b is a substantially cylindrical element of circular cross-section. Likewise, the ring 6, 6a, 6b is substantially tubular having a lumen of circular cross-section to receive the plug 5, and having an external surface closely corresponding to the side wall of the recess 4, 4a, 4b and being of substantially constant cross-section. Figure 3B, however, illustrates an alternative arrangement similar to that of Figure 3A but wherein the plug 5c is a truncated conical element, and the ring 6c is a tapering tube whose cross-section reduces in the upward direction towards the surface 9 of the sole. To assemble the structure of Figure 3B, the sole is formed with a recess 4c having an upwardly-tapering side wall, and the ring 6c and plug 5c are inserted from the underside of the sole and secured in position either by bonding or by a compression-moulding operation.

[0034] In all of the above examples, the ring 6 and plug 5 are preferably dimensioned so that they are either an exact fit within the recess 4, or a slight interference fit in the recess 4.

[0035] In the above examples, the plug 5 has a substantially circular shape when viewed in plan, and is positioned approximately on the centre line of the sole. It should be appreciated that the plug 5 may be of any desired shape in plan, such as an ellipse, an oval, or a polygonal shape such as a hexagon or octagon. Likewise, in the embodiment illustrated in Figure 1 the ring 6 has an oval exterior profile and a circular lumen to receive the plug 5. It will be understood that the external outline of the ring 6, when viewed in plan, may be any convenient regular or irregular curved or polygonal shape. The internal outline of the ring 6 will of course correspond to the external profile of the plug 5 which fits therein.

[0036] Although the plug and ring are positioned substantially symmetrically with respect to the longitudinal centreline of the sole, it is foreseen that the plug and/or the ring may be shaped or positioned so as to be asymmetrical with respect to the longitudinal centreline of the sole. The plug may be positioned off-centre, and/or the ring may surround the plug with a varying radial extent.

[0037] Figure 4 shows, in plan view, the heel part of an alternative sole embodying the invention. In the sole of Figure 4, the plug 15 is of non-circular shape in plan, and is slightly elongated in the longitudinal direction of the sole.

[0038] The plug 15 is surrounded by a ring 16 which itself is asymmetrical relative to the longitudinal axis of the shoe, in that the ring 16 is broadened at the rear lateral side so as to extend towards the rear outside of the foot. In the illustration in Figure 4, the ring 16 is made form the same colour material as the heel part 2 of the sole, but it is of course possible to make the ring 16 from a differently-coloured material.

[0039] Figure 5 is a schematic perspective view of the heel part shown in Figure 4, from which it is clear that the ring 16 is asymmetric in relation to the longitudinal axis of the shoe, being radially broadened towards the rear lateral or outer part of the heel.

[0040] In the embodiment illustrated in Figures 5 and 6, between the heel part 2 and the forepart 3 are two transversly-extending intermediate regions 17 and 18. The regions 17 and 18 are curved so as to be concave at their front edges, and extend downwardly and rearwardly. Region 17 is in contact with the heel part 2 at a boundary surface 19 which is concave toward the rear of the shoe, and is obliquely angled downwardly and rearwardly. At its forward surface, the region 17 contacts the intermediate region 18 at a boundary surface 20. The boundary surface 20 also extends in a rearwardly-concave arc, and extends obliquely downwardly and rearwardly.

[0041] The forward surface of the intermediate region 18 contacts the forepart 3 of the sole, again in a rearwardly-concave surface 21 which extends substantially vertically downwards.

[0042] Figure 6 is a schematic view showing the heel part of Figures 4 and 5 sectioned so as to present a horizontal upper surface. Figure 6 illustrates the angled boundary surface 19 between the heel part 2 and the region 17.

[0043] The angled boundary surface 20 between the region 17 and the region 18, and the boundary surface 21 between the region 18 and the forepart 3 of the sole. As is clear from Figure 6, the angle F_1 between the boundary surface 21 and the forward horizontal direction is approximately 90°, the angle F_2 between the boundary surface 20 and the forward horizontal is a obtuse angle of approximately 120°, and the angle F_3 between the

boundary surface 19 and the forward horizontal is an obtuse angle of approximately of 150°. This curvature of the boundary surfaces 19, 20 and 21 results in the three boundary surfaces being substantially spherical surfaces which are substantially concentric with the centre of the upper surface of the plug 15.

[0044] Figures 7A and 7B show longitudinal vertical sections of alternative embodiments of the sole seen in Figures 4 to 6.

[0045] In the embodiment shown in Figure 7, the ring 16 is received in a recess 14 in the heel part 2, and is formed in a "cup" shape having a side wall and a bottom wall to contact the internal surfaces of the recess 14. The ring 16 thus has a central void bounded by its sidewalls and bottom wall, to receive the plug 15. As in the embodiments 4 to 6, intermediate regions 17 and 18 extend transversely across the sole between the heel part 2 and the forepart 3, with the boundary surfaces inclined rearwardly.

[0046] In an alternative embodiment, indicated by the dotted lines in Figure 7, the ring 16 and plug 15 may be of the same configuration as is shown in Figure 3, and may extend from the upper surface to the lower surface of the sole.

[0047] Figure 7B shows a further alternative embodiment of the sole illustrated in Figures 4 to 7, in which the side wall of the recess 14 is tapered inwardly and downwardly, the ring 16 and the plug 15 being of inverted conical form.

[0048] Figure 8 illustrates the shoe sole product of the present invention in an embodiment as a midsole, to the underside of which a wear-resistant outsole 30 is attached. The midsole comprises a heel part 2 and a forepart 3, the heel part 2 of the midsole being formed with an opening 34 extending through the heel part from top to bottom. The forepart 3 of the midsole is formed with an upwardly-open blind recess 8 to receive a cushioning element 7. As is indicated by dotted lines in Figure 8, the recess 8 may be arranged to extend through the forepart 3 of the midsole from top to bottom, and the cushioning element 7 will then have a thickness substantially equal to the thickness of the midsole at the forepart region, with the undersurface of the cushioning element 7 being in contact with the upper surface of the outsole 30 within the recess 8.

[0049] The opening 34 in the heel part 2 in Figure 8 is filled by a central plug 25, an inner ring 26a and an outer ring 26b. The materials of the plug 25 and rings 26a, 26b are selected so that the outer ring 26b is harder than the inner ring 26a, and the inner ring 26a is harder than the plug 25. The outer ring 26b is softer than the material of the midsole which forms the heel part 2 and forepart 3. Typically, the plug 25 will have a Asker C hardness of from about 30 to about 50, preferably from 35 to 45, and more preferably about 40. The rings 26a and 26b will typically have a Asker C hardness of from about 40 to about 60, preferably between 45 and 55, with the outer ring 26b slightly harder than the inner ring 26a. The heel part 2 and forepart 3 of the midsole are typically formed from material having a Asker C hardness of from about 50 to about 70, preferably between 55 and 65, preferably about 60 to about 63.

[0050] The embodiment illustrated in Figure 8 is a shoe sole comprising a midsole formed from the heel part 2 and forepart 3 and an outsole 30. The outsole 30 may be joined to the midsole by adhesive bonding, or alternatively the sole may be produced by assembling the outsole 30 and the midsole assembly (including the plug 25, rings 26a and 26b and cushioning element 7) in a mould cavity and applying heat and pressure. The compression moulding technique may be used to apply decorative patterns to the exterior surfaces of the sole.

[0051] The midsole illustrated in Figure 8 has its heel part 2 and forepart 3 of substantially the same material. In an alternative embodiment (not illustrated) the intermediate regions 17 and 18 may be formed in the midsole between the heel part and the forepart.

[0052] In a further alternative embodiment illustrated in Figure 8B, the heel part 2 of the midsole has a substantially conical through opening into which a ring 36 and a plug 35 are received. As is clear from the illustration, the wall thickness of the ring 36 reduces from bottom to top, so that a conical plug 35 can be closely received within the interior of the ring 36. The conical plug 35 tapers in the opposite direction to the taper of the external surface of the ring 36.

[0053] In the embodiment shown in Figure 8A, the rings 26a, 26b and the plug 25 may be inserted into the midsole component opening 34 from above or from below prior to fixing them in position. In the embodiment shown in Figure 8B, the ring 36 is preferably inserted into the midsole from below, and the outsole 30 is then applied to retain the ring in position. The plug 35 is then inserted from above (as seen in the drawing). As previously described, the plug 35 and ring 36 may be retained in position by adhesive, or by compression moulding techniques.

[0054] Figure 9 is a side view of a shoe incorporating the sole of Figures 4 to 8, and an upper 40. The boundary surfaces 19, 20 and 21between the regions 17 and 18 and the forepart 3 and heel part 2 being shown.

[0055] Figure 10 is a schematic exploded view of the heel part of the sole shown in Figures 1 and 2, illustrating the plug 5, the ring 6 and the recess 4 in the heel part 2 of the sole.

[0056] Figure 11 and Figure 12 illustrate a further shoe sole product according to the invention. The product shown in Figures 11 and 12 is an insole which is positioned between the wearer's foot and the sole of a shoe, either incorporated as an integral part of a shoe, or provided as a separate removable and replaceable insole.

[0057] The insole of Figures 11 and 12 is formed from a sheet of elastomeric material having a thickness t of from 1 to 5mm, preferably about 3mm. The insole may be cut to shape from a larger sheet, and may be provided with trimming lines on its upper or lower surface to enable

the use to trim the insole to fit his or her particular shoe size. The insole 50 has a heel part 51 which has an opening 52. Within the opening 52 is secured a ring 53 of cushioning material softer than that of the insole 50. The ring 53 has a central opening 54 and central plug 55 fills the opening 54. The plug 55 is formed from a material which is softer than that of the ring 53.

[0058] As before, the central plug 55 and the ring 53 may be asymmetrically shaped and/or positioned in relation to the centre line of the insole 50. It is preferred that at least the ring 53 should be elongated towards the rear lateral side of the heel part of the insole 50. The position and shape of the plug 55 relative to the insole 50 may also be displaced rearwardly and laterally in relation to the longitudinal centre line.

[0059] At the fore part 56 of the insole 50 the insole if formed with a further cut out 57 in which is secured a cushioning insert 58 of a material softer than that of the insole 50. The cut out 57 and the cushioning insert 58 are shaped, in the illustrated embodiment, so that the main part of the cushioning element 58 is positioned below the ball of the wearer's foot, and a toe cushion 58a is provided to extend forwardly from the medial side of the front edge of the cushioning element, beneath the wearer's big toe. The insole 50 may be of constant thickness t, or may be slightly thicker in the heel part 51 than in the fore part 56.

[0060] Likewise, the thickness t may be increased in the peripheral regions of the insole, to provide a slightly concave upper surface which conforms to the profile of the wearer's foot.

[0061] In a further alternative embodiment (not illustrated) the ring 53 at the heel part 51 of the insole 50 may be replaced by two or more ring structures surrounding the central plug 55. In a yet further embodiment, the cushioning element 58 may be provided with a central opening in which a further cushioning element of a material softer than the cushioning element 58 is received.

[0062] Figure 13 and Figure 14 illustrate the shoe sole product of the present invention embodied as a sandal. The sandal 60 of Figures 13 and 14 comprises a sole part 61 having a first recess 62 at its heel region, and a second recess 63 corresponding in position to the ball of the wearer's foot. Straps 64 are secured adjacent the edges of the sandal and at a point intermediate the positions of the wearer's toes, to secure the sole 61 to the wearer's foot.

[0063] In the recess 62 at the heel part of the sandal a ring 65 of a material softer than that of the sole 61 is fixed. The ring 65 has a central opening 66, and the central opening 66 is filled by a central plug 67 softer than that of the ring 65.

[0064] The recess 63 positioned below the ball of the wearer's foot is filled by a cushioning insert 68, then recess 63 and the insert 68 being extended forwardly below the position of the wearer's big toe to form a toe cushion 68a. In an alternative embodiment, the toe cushion 68a may be formed as a separate region of the shoe sole product from the cushioning insert 68. In a yet further embodiment, the shoe sole product may be provided only with the toe cushion 68a.

[0065] In the embodiment shown, the recesses 62 and 63 do not penetrate through the sole 61 to its undersurface, in order to protect the softer materials of the ring 65, the plug 57 and the cushioning insert 68 from abrasion due to wear. It is, however, foreseen that the sandal of Figure 13 may include a further wear-resistant layer on the undersurface of the sole 61, and in that case the recesses 62 and 63 may be formed so as to penetrate the sole 61.

[0066] Figure 15 illustrates, in plan view, a shoe sole product suited for sports shoes, particularly for badminton shoes. The shoe sole product may be formed, as described above, by compression moulding an assembly of plastics components together to form a unitary shoe sole product which may be a midsole, and insole, or an outsole. Alternatively, a number of the components may be compression-moulded together and assembly of the sole product may be completed by bonding the remaining component or components in place.

[0067] In many indoor racket sports, particularly badminton, a player will perform lunging manoeuvers very frequently. During the lunging manoeuver, the first point of contact with the floor is the heel, whereupon the foot rotates forward so that the entire shoe sole comes to contact the floor. During this manoeuver, the centre point of the pressure distribution on the shoe sole moves longitudinally forward, starting from the initial contact point at the heel.

[0068] The sole 70 of figure 15 comprises a main part 71 extending around the periphery of the sole, and joined at the rearmost heel section to a heel insert 72 formed from a material of similar hardness to the main part 71 but with greater shock-absorbing properties, i.e. a lower resilience. The heel insert 72 may be of cellular polyurethane, viscoelastic non-cellular polyurethane or compression moulded EVA. A relatively hard TPR (thermoplastic rubber) material may also be used for the heel insert 72. Spaced forwardly from the heel insert 72 is a plug 73 of inverted V shape. The plug 73 is formed of relatively soft material. Surrounding the plug 73, and fitting closely at the boundary of the plug 73, is a central part 75 of the sole. The central part 75 of the sole is formed from a material which is harder than that of the plug 73, but softer than that of the main part 71 of the sole.

[0069] The central part 75 of the sole extends longitudinally forward from the heel, forming a central softer region of the shoe sole. This longitudinally-extending softer region urges the centre of pressure beneath the wearer's foot to move along a line represented by a locus joining the forward apices of the heel insert 72, the plug 73 and the central part 75 of The sole.

[0070] At the forward end of the central part 75 of the sole, the forepart of the sole is formed with a central, low-hysteresis "energy return" area 76, whose hardness is intermediate the harnesses of the main part 71 and the

central part 75. The central area 76 extends beneath the toe joints of the wearer's foot, may extend forward beneath the wearer's toes. Again, the presence of the softer area 76 between the lateral longitudinally-extending harder areas of the main part 71 urges the centre of pressure to remain laterally central beneath the wearer's foot.

[0071] During a lunging maneuver, therefore, the centre of pressure moves forwardly, from the initial heel strike point beneath the heel insert 72, following the midline of the central part 75, and finally following the midline of the energy return area 76. The pressure exerted below the wearer's foot is thus stably distributed with its centroid on the centre line of the foot, enhancing the stability of the wearer's foot placement.

[0072] In one embodiment, the hardnesses of the components of the sole of Figure 15, on the Asker C scale, may be as follows:

Part	Hardness (Asker C)
Main part 71	50-70, preferably 55 - 65
Central part 75	40-60, preferably 45 - 55
Plug 73	30-50, preferably 40 - 45
Central area 76	30-55, preferably 35 - 50
Heel insert 72	50-70, preferably 55 - 65

[0073] In all of the embodiments described above, it has been found advantageous to arrange the hardnesses of adjoining regions of the shoe sole products so that the difference in hardness between two adjacent regions is no more than 15 on the Asker C scale. For example, if the plug 73 of the sole of figure 15 is made to have a hardness value of 40, then the hardness of the central part 75 should be no more than 55 and the hardness of the main part 71 should be no more than 15 more than that of the central part 75 on the Asker C scale.

[0074] In one aspect, the present invention thus provides a cushioning structure below the wearer's heel which has a central softest region surrounded by regions of progressively harder materials. The effect of this structure is to distribute pressure forces exerted by the wearer's heel away from the central part of the heel.

[0075] In another aspect, the present invention provides a structure for aid badminton shoe sole in which the longitudinal movement of the centre of pressure point during lunging is made to follow the centre line of the shoe, promoting stability and efficiency.

[0076] The invention is applicable either as a sole for the production of shoes, or as a midsole to which an outer sole and an upper are attached for the production of a shoe, or as an insole component for fixing to a shoe sole, or finally as a removable insole enabling the cushioning structure of the present invention to be provided in a conventional shoe.

Claims

1. A shoe sole product, comprising:

   a sole component formed from a resilient material of predetermined hardness and having a recess at the heel part;
   a central plug being fixed within the recess;
   a ring filling the recess and closely surrounding the central plug;
   wherein the hardness of the material of the central plug is less than the hardness of the ring, and the hardness of the material of the ring is less than the hardness of the material of the sole component.

2. A shoe sole product according to claim 1, wherein the ring and the plug are received in a blind recess in the upper surface of the sole component.

3. A shoe sole product according to claim 1, wherein the ring and the plug are received in a blind recess in the lower surface of the sole component.

4. A shoe sole product according to claim 1, wherein the ring and the plug are received in a recess extending from the upper surface of the sole component to the lower surface thereof.

5. A shoe sole product according to any preceding claim, wherein the recess at the heel part of the sole component is extended rearwardly and laterally.

6. A shoe sole product according to any preceding claim, wherein the hardness of sole component is Asker C 50 to 70.

7. A shoe sole product according to any preceding claim, wherein the hardness of plug is Asker C 30 to 50.

8. A shoe sole product according to any preceding claim, wherein the hardness of ring is Asker C 40 to 60.

9. A shoe sole product according to any preceding claim, wherein the ring comprises more than one ring part.

10. A shoe sole product according to claim 9, wherein the ring comprises an outer ring part and an inner ring part, the hardness of the inner ring part being Asker C 40 to 50 and the hardness of the outer ring part being Asker C 50 to 60.

11. A shoe sole product according to any preceding claim, wherein the ring and/or plug are cylindrical.

12. A shoe sole product according to any of claims 1 to 10, wherein the ring and/or plug taper downwardly.

13. A shoe sole product according to any of claims 1 to 10, wherein the ring and/or plug taper upwardly.

14. A shoe sole product according to any of claims 1 to 10, wherein the ring or rings and/or the plug taper in opposing axial directions.

15. A shoe sole product according to any preceding claim, wherein regions having different hardnesses extend across the shoe sole component between the heel part and the forepart of the shoe sole component, the regions being defined by boundary planes.

16. A shoe sole product according to claim 15, wherein the boundary planes are angled backward at obtuse angles (Φ) to the forward horizontal direction.

17. A shoe sole product according to claim 16, wherein the angle of the boundary plane (Φ) is less steep (Φ more obtuse) for boundary planes nearer the rear end of sole.

18. A shoe sole product according to any preceding claim, wherein the sole component is formed with a further recess in forepart of sole component; and a second insert of lesser hardness than the sole component is received and fixed within the further recess.

19. A shoe sole product according to claim 18, wherein the second insert is positioned beneath the ball of a wearer's foot, and has an extension at its forward edge to underlie the wearer's big toe.

20. A shoe sole product according to claim 18, wherein the second insert is positioned to underlie the wearer's big toe.

21. A shoe sole product according to any preceding claim which is a shoe sole.

22. A shoe sole product according to any of claims 1 to 20 which is a midsole to which an outsole is attachable to form a shoe sole.

23. A shoe sole product according to any of claims 1 to 20 which is an insole.

24. A shoe sole product according to claim 23, which is an insole or liner which can be removably fitted to an existing shoe.

25. An insole according to claim 24 having a thickness of from 2-5mm, and a recess in the heel part in which a ring and a plug are fixed.

26. A method of forming a shoe sole product, comprising the steps of:

forming a sole component from a resilient material of predetermined hardness, the sole component having a recess at the heel part;
placing within the recess a central plug;
placing within the recess a ring of material filling the recess and closely surrounding the central plug, the hardness of the material of the central plug being less than the hardness of the ring and the hardness of the material of the ring being less than the hardness of the sole component; and
fixing the plug and ring in the recess.

27. A method of forming a shoe sole product according to claim 26, wherein the plug and/or the ring are fixed in the recess by adhesive bonding.

28. A method of forming a shoe sole product according to claim 26 by compression moulding, comprising the steps of:

placing the assembled sole component, plug and ring in a mould; and
applying heat and pressure to the assembly to form the component, the plug and the ring into a unitary shoe sole product by compression moulding.

29. A method of forming a shoe sole product according to any of claims 26 to 28, wherein the hardness of the sole component is Asker C from 50 to 70, the hardness of the ring is Asker C 40 and 60, and the hardness of the plug is Asker C 30 to 50.

30. The method according to claim 29, wherein the hardness of the sole component is Asker C 63, the hardness of the ring is Asker C 50, and the hardness of the plug is Asker C 40.

31. A method of forming a shoe sole product according to any of claims 26 to 29, wherein a second ring is arranged in the recess to surround the first ring, the second ring being of a harder material than the first ring.

32. A method of forming a shoe sole product according to claim 31, wherein the hardness of the first ring is Asker C 40 to 50 and the hardness of the second ring is Asker C 50 to 60.

33. A method of forming a shoe sole product according to any of claims 26 to 32, wherein the ring or rings and the plug are received in a blind recess in the upper surface of the sole component.

34. A method of forming a shoe sole product according to any of claims 26 to 32, wherein the ring or rings and the plug are received in a blind recess in the lower surface of the sole component.

35. A method of forming a shoe sole product according to any of claims 26 to 32, wherein the ring or rings and the plug are received in a recess extending from the upper surface of the sole component to the lower surface thereof.

36. A method of forming a shoe sole product according to any of claims 26 to 35, wherein the plug is cylindrical.

37. A method of forming a shoe sole product according to any of claims 26 to 35, wherein the ring or rings and/or the plug taper toward the underside of the sole.

38. A method of forming a shoe sole product according to any of claims 26 to 35, wherein the ring or rings and/or the plug taper toward the upper side of the sole.

39. A method of forming a shoe sole product according to any of claims 26 to 35, wherein the ring or rings and/or the plug taper in opposing axial directions.

40. A method of moulding a shoe sole product according to claim 28, wherein the compression moulding temperature is from 100 to 300 degrees C.

41. A method of moulding a shoe sole product according to claim 28, wherein the compression moulding pressure is from 2 to 10 bar.

42. A method of moulding a shoe sole product according to claim 28, wherein the heat and pressure are applied for a period of from 5 to 15 minutes.

43. A method of forming a shoe sole product according to any of claims 26 to 42, wherein the shoe sole product is a shoe sole.

44. A method of forming a shoe sole product according to any of claims 26 to 42, wherein the shoe sole product is a midsole element.

45. A method of forming a shoe sole product according to any of claims 26 to 42, wherein the shoe sole product is an insole or liner.

FIG. 1

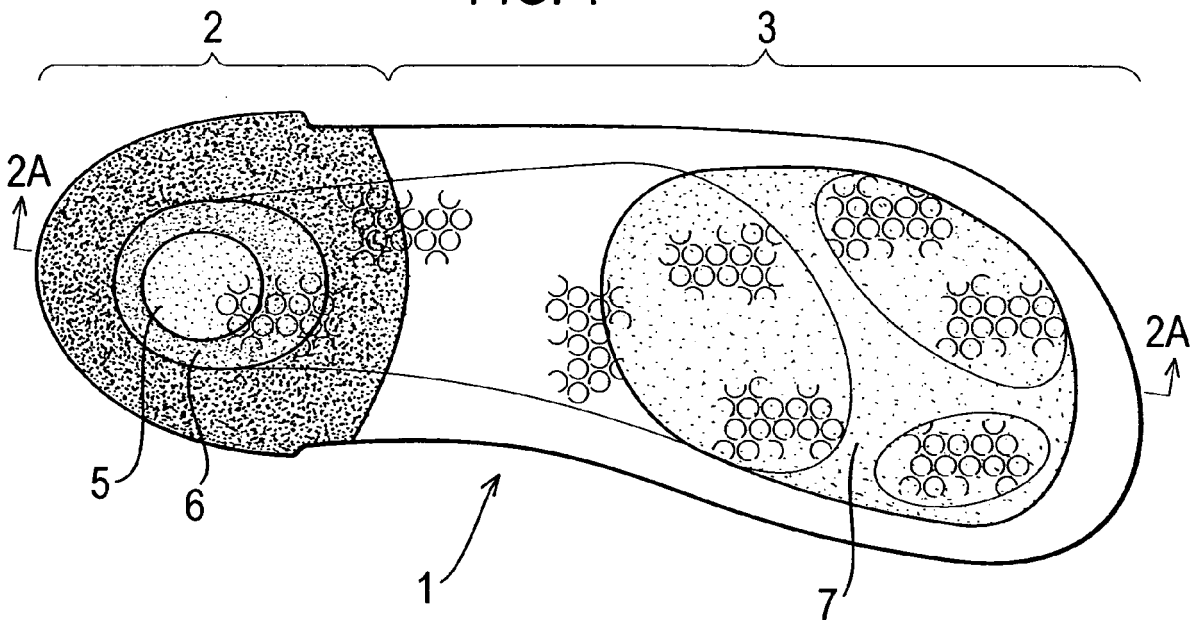


FIG. 2A

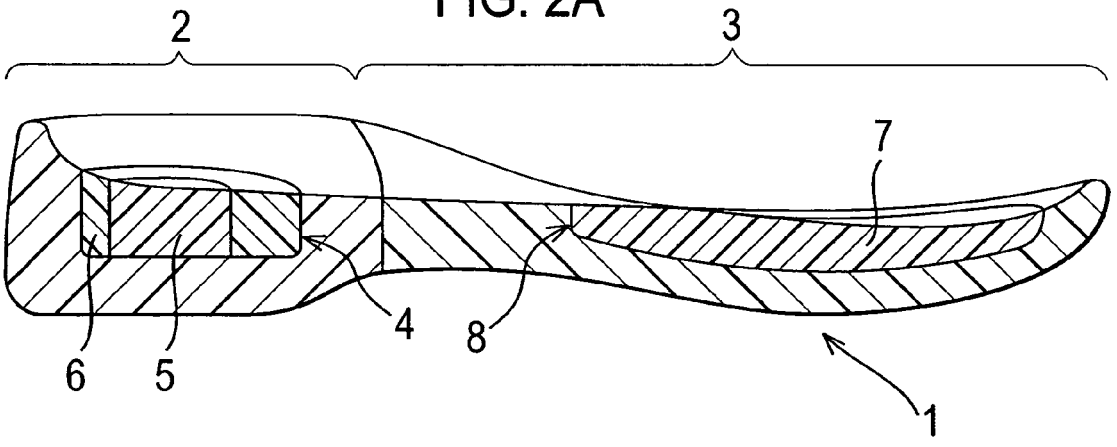


FIG. 2B

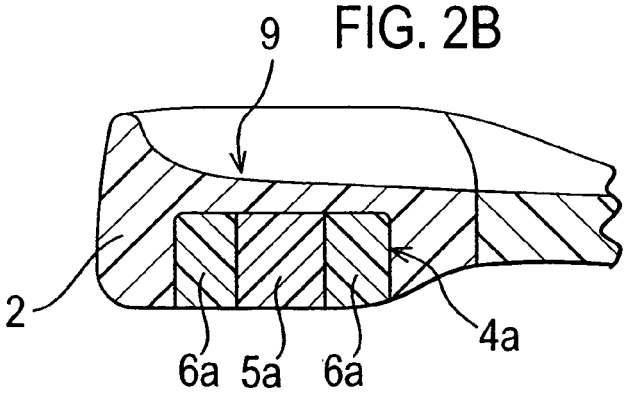


FIG. 3A

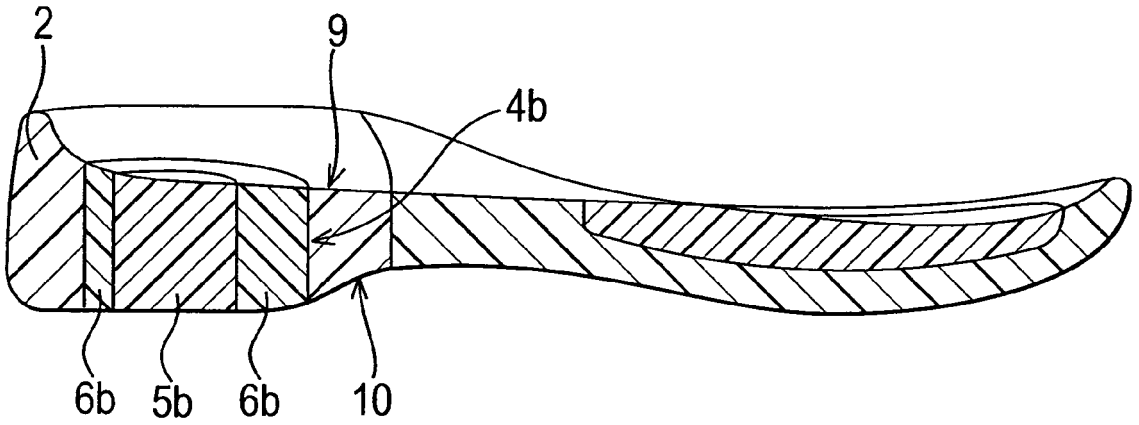


FIG. 3B

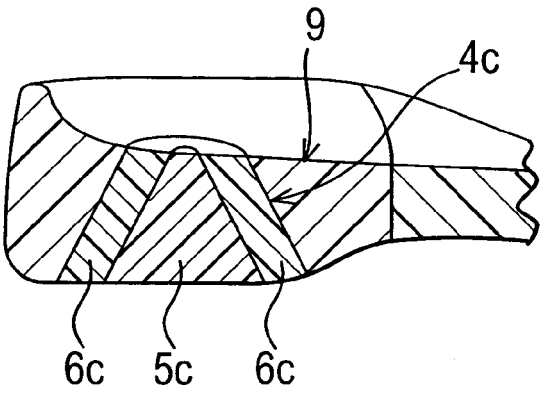


FIG. 4

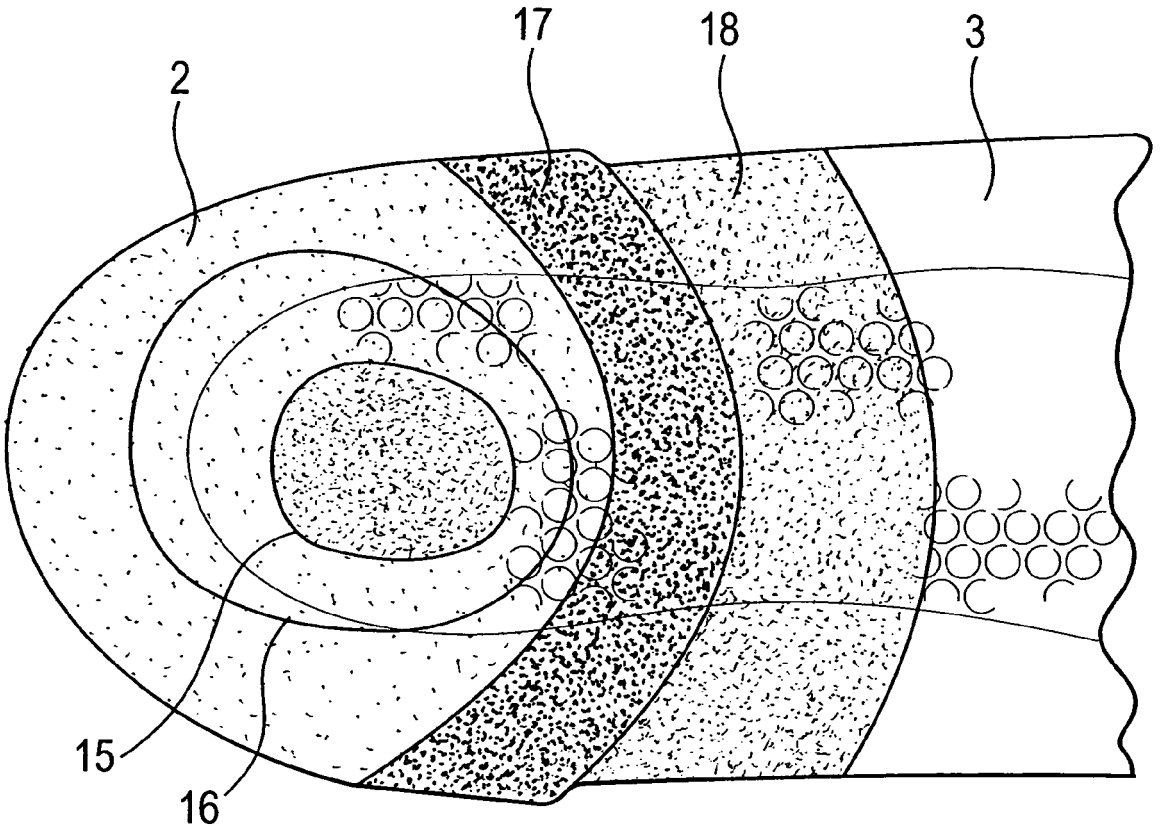


FIG. 5

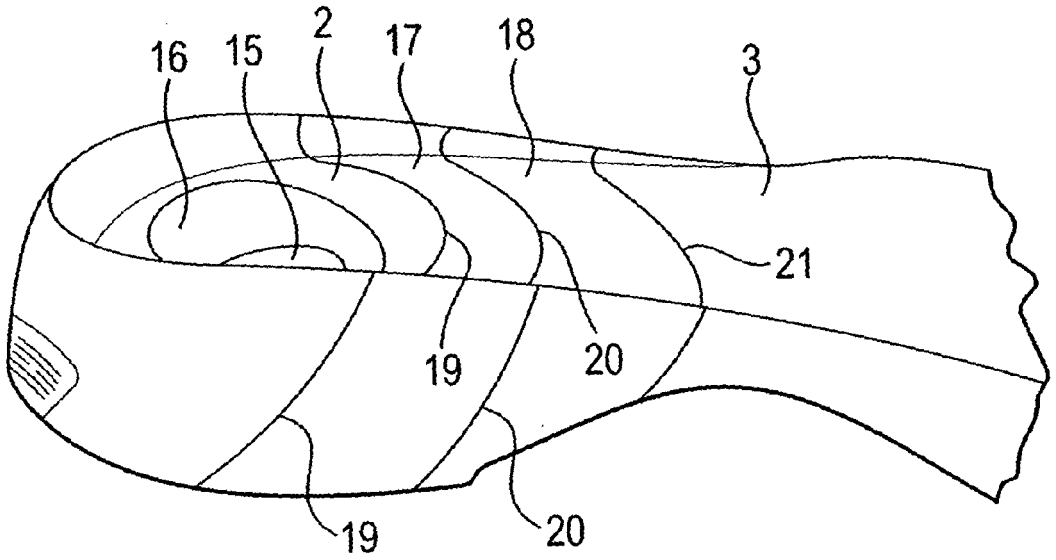


FIG. 6

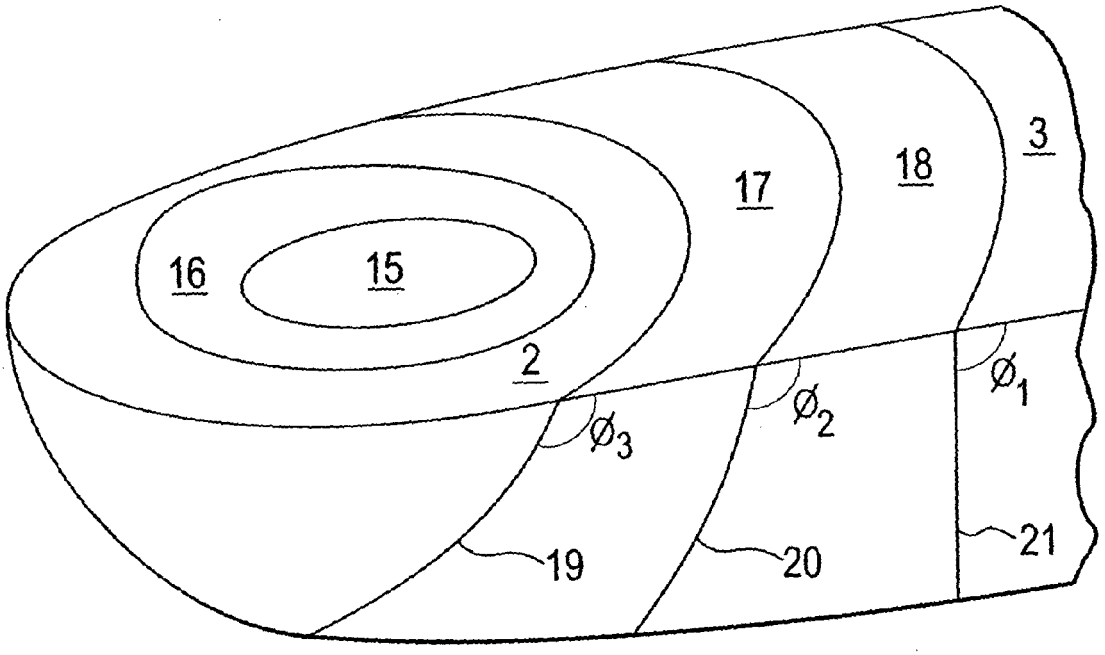


FIG. 7A

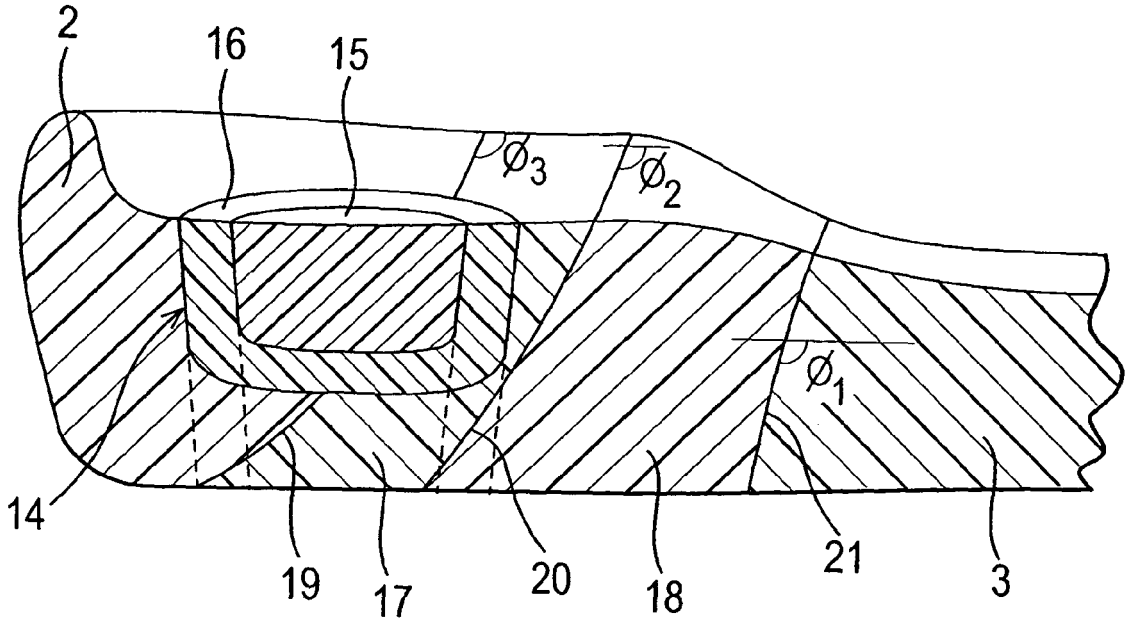


FIG. 7B

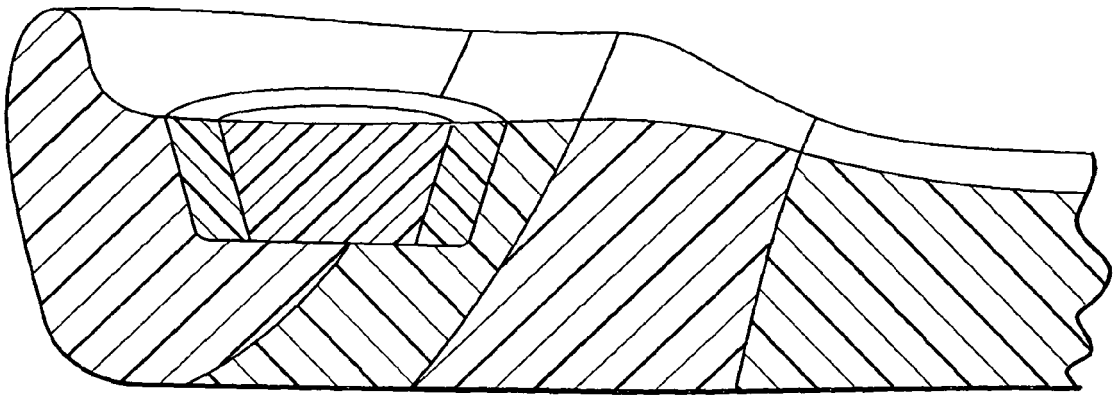


FIG. 8A

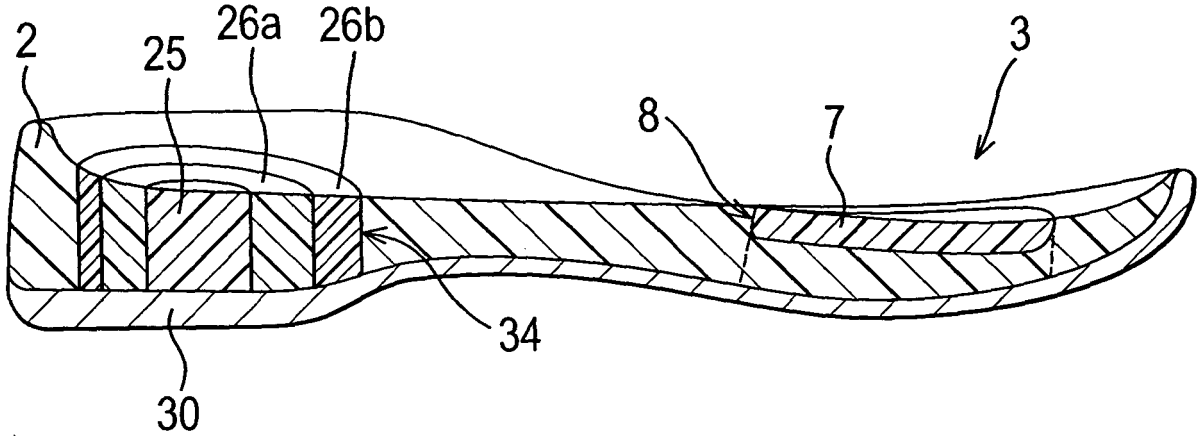


FIG. 8B

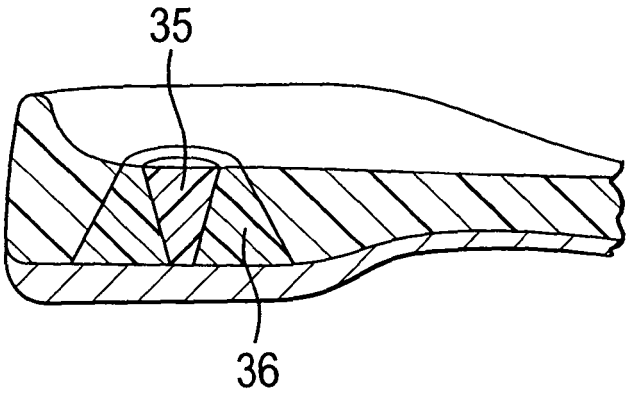


FIG. 9

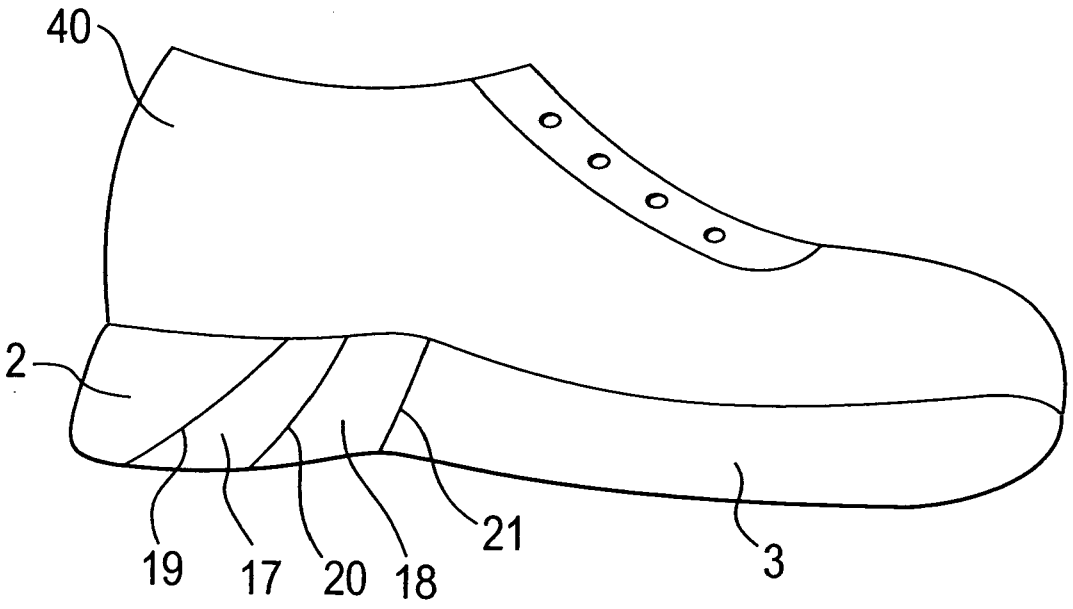


FIG. 10

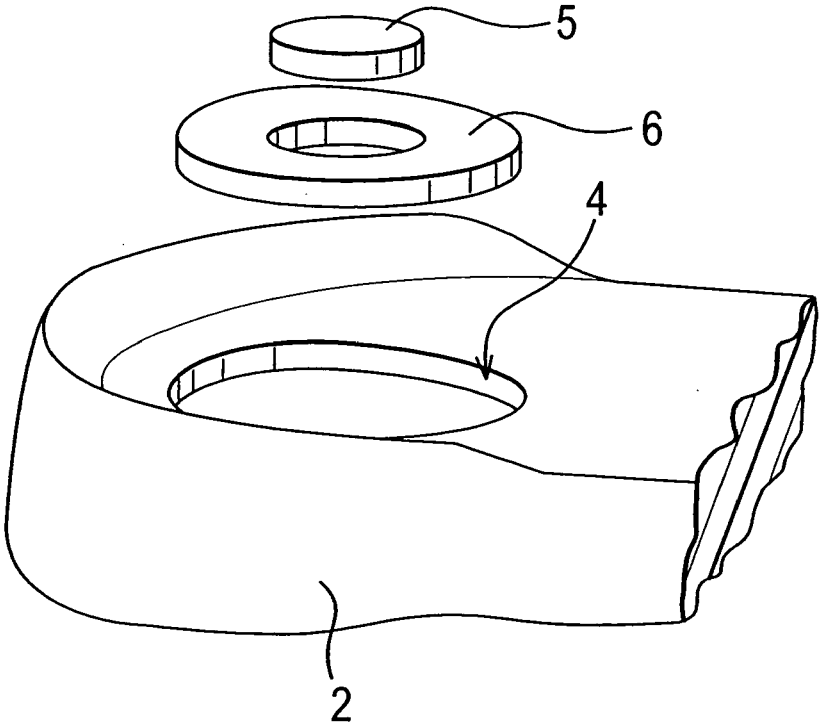


FIG. 11

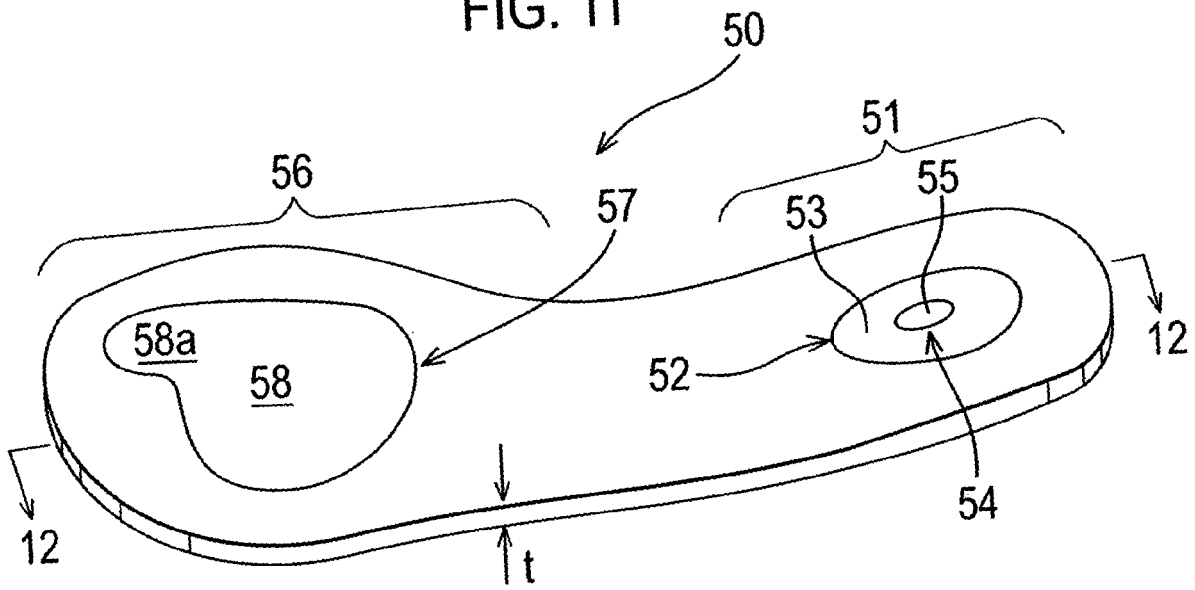


FIG. 12

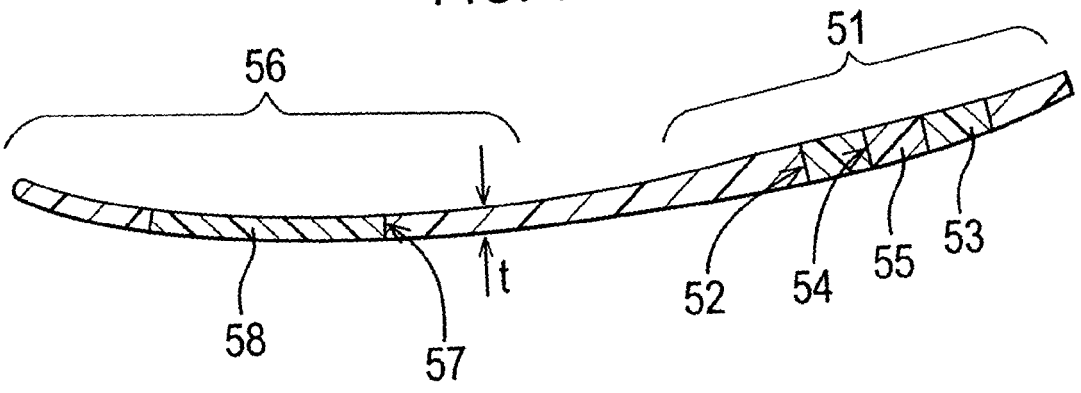


FIG. 13

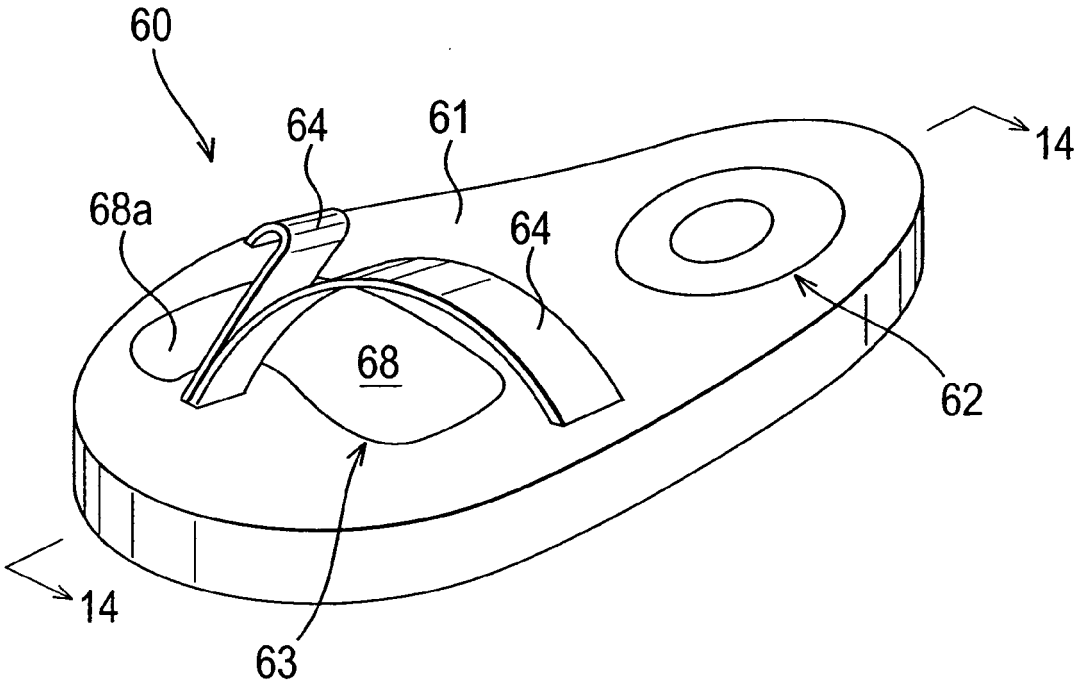


FIG. 14

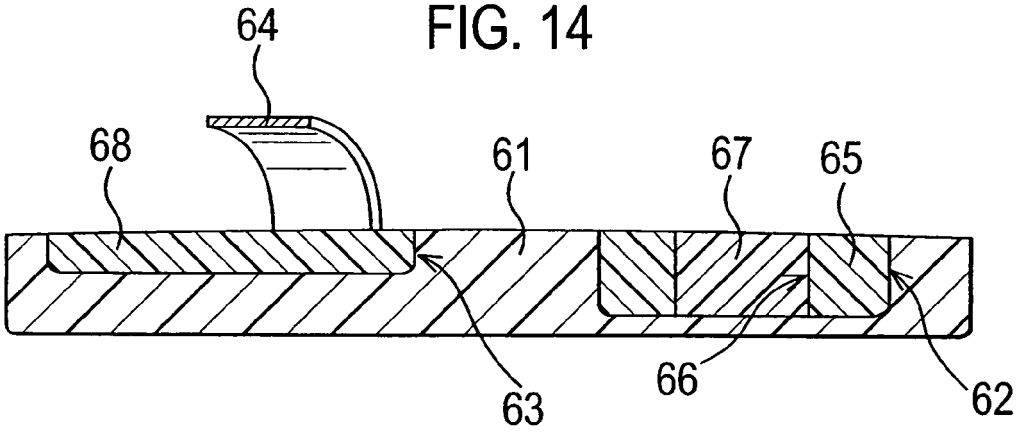
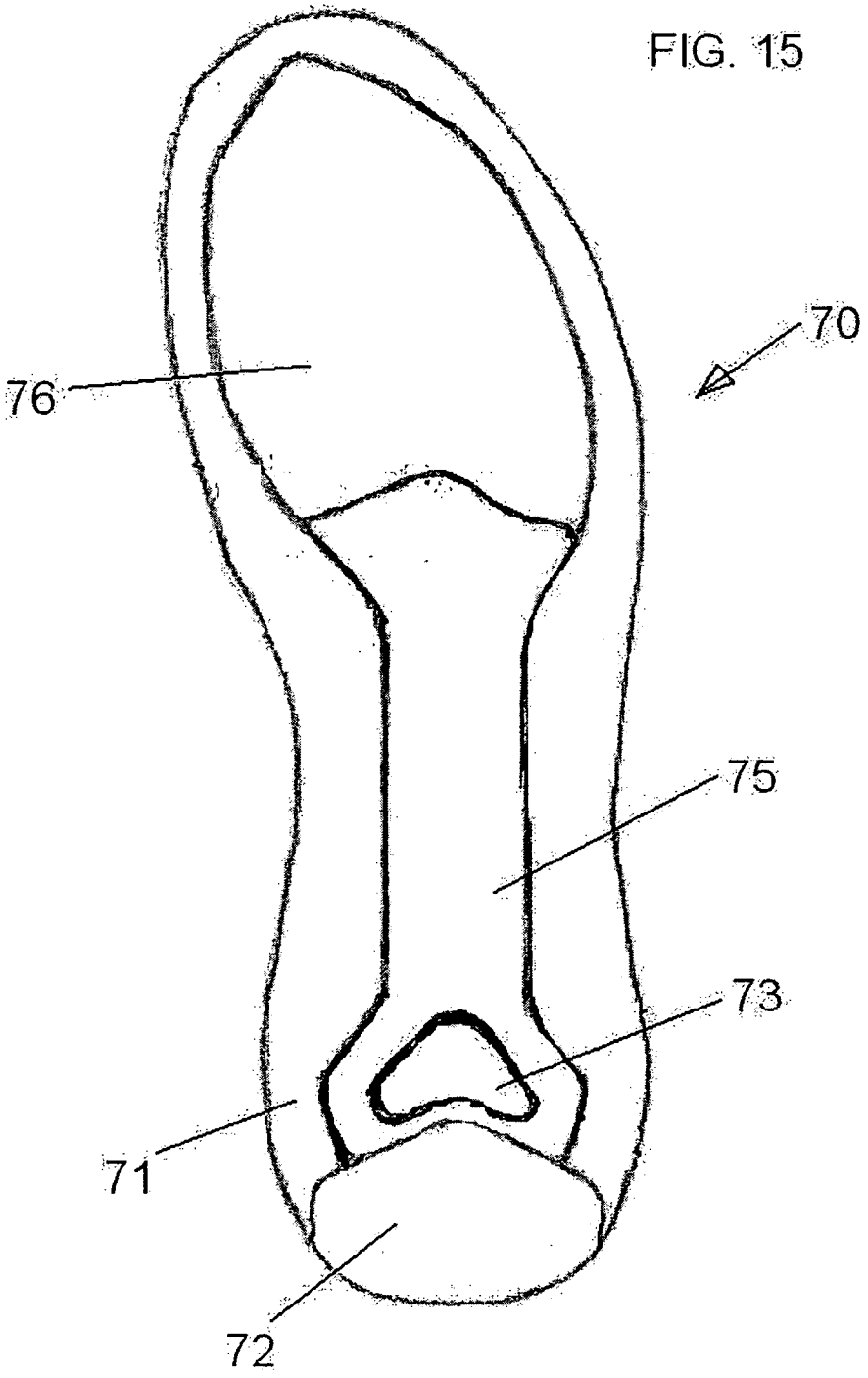


FIG. 15



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EUROPEAN SEARCH REPORT

Application Number
EP 06 25 2182

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 038 790 A (PYLE ET AL) 21 March 2000 (2000-03-21) * column 3, line 19 - column 4, line 12; figures * -----	1,3,6-9, 11-14, 18,21, 22, 26-30, 34,36-44	INV. A43B13/18 A43B17/02 A43B13/40
X	US 6 408 543 B1 (ERICKSON JOHN J ET AL) 25 June 2002 (2002-06-25) * column 3, line 3 - column 7, line 32; figures * -----	1,2,4-9, 11,15, 18, 23-26, 29,30, 33,35,45	
A	EP 1 352 579 A (WOLVERINE WORLD WIDE, INC) 15 October 2003 (2003-10-15) * paragraph [0018] - paragraph [0023]; figures 1-4 * -----	1-45	TECHNICAL FIELDS SEARCHED (IPC) A43B
A	US 4 730 402 A (NORTON ET AL) 15 March 1988 (1988-03-15) * column 5, line 34 - column 8, line 11; figures * -----	1,26-45	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 July 2006	Schölvinck, T.S.

CATEGORY OF CITED DOCUMENTS

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