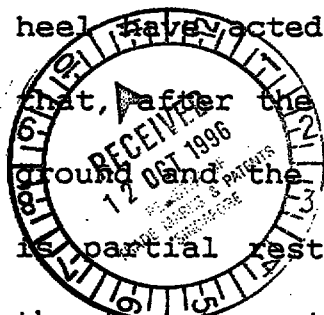


SPORTS SHOE HAVING AN ELASTIC INSERT WITH CONCAVE SURFACE

The present invention relates to a sports shoe having an insert at least in the heel region of the shoe, the insert including an airtight flexible casing enclosing a series of interconnected elastically deformable bodies.

Athletic footwear is required to provide a stable support region while simultaneously being comfortable for the user. This solves the problem of allowing for comfort while providing stable support and also achieving a counterthrusting effect, i.e., partial recovery of the thrust as the footwear separates from the ground, plus absorption of the impact against the ground. In response to this need, solutions of the type described in the following paragraph have been proposed.

Known prior inserts positioned at the footwear heel have acted primarily as a complex spring so that, after the impact of the footwear against the ground and the simultaneous damping effect, there is partial restitution of the energy absorbed by the insert on impact. While all the known inserts offer comfort, stability and adequate damping and energy recovery within a given range of loading and



impact velocity, they can prove partially unsatisfactory outside predetermined parameters. As an example, footwear provided with an insert can satisfy the requirements of slow movement but not of fast movement, whereas an insert designed for fast movement could prove too rigid for slow movement. In addition to this, for equal footwear sizes, the weight of the wearer can vary within extremely wide limits, so that the same insert can prove either too rigid or excessively yielding.

Also known are the inserts shown in U.S. 5,369,896; 5,092,060 and 5,384,977.

An object of the present invention is to provide an improved sports shoe or footwear.

Another object is to provide a sports shoe or footwear having greater stability and comfort for the user's foot during use of the shoe.

A further object is to provide a sports shoe or footwear allowing an improved recovery of the thrust generated on the ground by the user's foot as the footwear separates from the ground plus absorption of the impact against the latter.

Another object is to provide a sports shoe which can satisfy the requirements of both slow and fast movement.

These and further objects of the present invention are attained by a sports footwear according to the characterising portion of claim 1.

Said objects are also attained by the method according to the corresponding independent claim.

According to the present invention, it is provided a sports shoe with an insert having an air-tight casing wherein a plurality of elastically deformable elements are located. The casing has a top surface and a bottom surface, both in contact with the upper and lower ends of the deformable elements, the latter being very strongly soldered, bonded or made to adhere to such surfaces so as to remain fixed to them during use of the shoe. At least a majority of the elements are tapered toward opposing free ends thereof and have a major cross-section in a central region thereof. To each of the elements there are fastened arms, the arms joining adjacent elements so that the combination of three elements is positioned so as to form a triangle, as viewed from the top or bottom of the casing.

The deformable elements have different heights extending from the perimeter edge of the casing to a central zone of the casing. In particular, the shape of the elements allows at least the casing

top surface to be concave so as to create a seat for the user's heel. However, thanks to such different heights, both the top and bottom surfaces of the combined deformable elements can form a concave surface region so as to allow easier mounting of the insert inside the sole and also permit improved stability for the user during use of the sports shoe.

Due to such different heights which increase from the central zone to the periphery of the insert, the rigidity of the insert correspondingly increases and thus is beneficial to the stability of the user during use of the sports shoe.

According to another aspect of the present invention, at least a majority of the elements is shaped so that substantially all horizontal plane cross-sections of each of the elements taken along a longitudinal axis of the shoe form a polygonal figure. These elements are also provided in the casing so as to form a plurality of coaxial rows, though in it these inserts can instead be located so as to form polygonal rows.

The present invention provides greater stability for the user's foot during use of the shoe due to the particular shape of the deformable elements,

this shape enabling the foot to be held in a substantially fixed position inside the shoe.

The invention also provides better elastic energy return to the user's foot during the use of the shoe due, in particular, to the triangular grouping or connection of the deformable elements, the deformable elements providing good response to stresses which are perpendicular to the ground over which the user moves or which are parallel to the ground (which movement is generated, for example, during sliding action by the user).

A more complete appreciation of the invention and of its many advantages will be readily clear as the same becomes better understood from the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 is an exploded view of the lower support part of a sports shoe according to the present invention;

Figure 2 is a bottom view of the sports shoe according to the invention;

Figure 3 is a sectional view taken along line 3-3 of Figure 2;

Figure 4 is a top view of the casing and the deformable elements;

Figure 5 is a view taken along line 5-5 of Figure 4;

Figure 6 is a perspective view of the present invention as appears in a second embodiment of the present invention;

Figure 7 is a partial sectional view taken along line 7-7 of Figure 6;

Figure 8 is a right-side elevational view of the insert, the left side view being a mirror image of the side shown; and

Figure 9 is a top, front and left side perspective view of the insert.

Referring to the figures, the sports shoe of the present invention includes a vamp A and a lower support part 1 which includes a sole 2 made, for example, of synthetic rubber to which a wedge 3, made, for example, of thermoplastic polyurethane, is fixed in a known manner. The wedge includes a recess 4, bounded by a raised edge 10, carrying a mounting insole I made for example made of cork, having an opening O formed therein and on which there is positioned a further insole I', made, for example, of fabric (not shown in Figure 3). The sole 2 is preferably made of rubber and includes notches 7 and recessed portions 8 in its lower

surface. It also includes a raised front edge 11 and a lateral edge 12 which extends along the entire remaining perimeter of the sole.

While only a sports shoe is referred to above, it is understood that any type of shoe using the insert of the present invention is within the scope of the invention claimed and is within the meaning of the terms "sports shoe" or "footwear". In accordance with the present invention, in the lower part of the shoe there is positioned an insert 13 comprising elastically deformable elements 14 made of a thermoplastic material and enclosed in an airtight casing 15 made of a plastic material such as polyurethane or a similar material. Preferably, casing 15 is made of transparent material. Within casing 15 there is present air that has a pressure less than or equal to atmospheric pressure. In the examples shown, insert 13 is positioned in seats 16, 16A provided in wedge 3 and the insole I respectively, the seats being spaced apart as shown in Figure 1. Alternatively, seat 16A can be omitted, and insert 13 will be located only in seat 16 of wedge 3 so that insole I is superimposed and covers seat 16. Elements 14 of insert 13 are formed by molding any desirable synthetic high-elastic

material and are substantially polygon-shaped when viewed in vertical cross-section, i.e., they are tapered at their opposed free ends 5 and 6 and have the larger cross-sections thereof located substantially in a central region 20 in which the elements are joined together by arm members forming an integral bridging portion 20A. As can be appreciated from a review of Figure 3, at least a majority of the elements 14 are polygonal shaped in the sense that all vertical cross-sections taken along the vertical or horizontal axes thereof are in the shape of a polygon. Due to the manufacturing requirements of insert 13, free ends 5, 6 of elements 14 are connected to casing 15. This is actually the preferred embodiment of insert 13 wherein in a first phase elements 14 are obtained by means of molding and subsequently are encased inside thermo-soldering plastic sheets which constitute casing 15. Elements 14 are encased by the sheets when they are at a relatively high temperature so that welding or bonding of free ends 5, 6 of the elements with the sheets occurs. The connection between casing 15 and elements 14 has the advantage of anchoring the elements inside the casing, thereby preventing the casing and the

elements from moving during use of the shoe according to the invention and thus contributing, together with the mutual connection of elements 14, to good multidirectional stability and flexibility of the resulting shoe. This also affords greater stability for the insert within the shoe and permits better performance in terms of the function for which it is intended, said function being described further hereinbelow.

The shape of elements 14, as shown and described by way of example, allows considerable absorption of the stresses caused by the user's foot upon movement, and at the same time allows a large part of the absorbed energy to be rapidly retransmitted to the foot. Each element 14 may be shaped as illustrated, e.g. polygon shaped or else shaped as so to be circular shaped when viewed in the direction of the horizontal cross-section thereof.

In order to secure insert 13 within seats 16, 16A, on face 21, facing insole I, insole I' comprises a projection 22 of a shape corresponding to that of seat 16 and arranged to cooperate with it and with insert 13. In the alternative embodiment described above, projection 22 can, however, be omitted.

Casing 15 of insert 13 includes a flange 23 located at a midportion of the side of the casing which, when insert 13 has been positioned in the lower part of the shoe, rests on a step 24 provided between insole I and the inner surface 25 of the wedge 3. In the alternative embodiment where hole or seat 16A is omitted, flange 23, which is very thin, rests on wedge seat 16.

During use of the sole and in accordance with the present invention, each time the user presses the lower part of the shoe with his foot, insert 13 is pressed toward the sole. Specifically, the pressing action exerted by the foot depresses elements 14 which deform and increase the pressure within the airtight casing 15 which is constricted by the surrounding wall portion of its seat. When the user's heel ceases the pressing action, elements 14 return to their initial configuration so as to transmit a large part of the energy acquired during the pressing action to the user's foot which therefore receives a gradual thrust as the heel (or other part of the foot, e.g., the metatarsus) of the user separates from the ground. To said thrust exerted on the user's foot by elements 14 there must be added the thrust exerted by the air inside

casing 15, this air being under pressure due to the action of the user's foot. These combined thrusts help transfer to the user's foot part of the energy transmitted by the user to the ground during movement.

Elastic inserts like the one described above can be located in other regions of support part 1, in particular near the frontal region of sole 2 and wedge 3, and more specifically in the metatarsal zone 3A as shown by dotted lines in Figure 1, where the seat is referenced by number 17 and insert 13A is utilized, thus allowing the user, and in particular an athlete, to obtain increased pick-up during acceleration or during changes in the rate of movement.

With reference to Figures 4 and 5, casing 15 has a top surface 15' and a bottom surface 15", both in contact with upper and lower surface elements 5, 6, the latter being very strongly soldered or connected to such surfaces so as to remain secured to them during use of the shoe. Each element 14 is tapered towards opposing free ends 5, 6 and has a larger cross-section in the central region thereof. These elements are therefore substantially diamond-shaped in vertical cross-section as shown in these

figures. To the latter there are secured arms 20A, these arms joining each element 14 to adjacent elements 14. More specifically, three adjacent elements are respectively located at each vertex of a triangle as viewed from the top or bottom of casing 15.

Elements 14 have heights decreasing from the perimeter of the casing towards a central zone of the casing so that the rigidity of the insert increases from the center to the periphery of the insert. In particular, the shape of the elements allows at least the casing top surface 15' to be concave so as to create a seat for the user's heel. However, due to the different heights, both the top and bottom surfaces of the combined elements, or only the top one, are concave so as to allow easier mounting of the insert inside the sole. This also permits improved stability for the user during use of the support shoe. However, each element 14 is preferably shaped so that substantially all the horizontal plane cross-sections thereof taken along the longitudinal axis of the shoe are polygonal figures. In the preferred embodiment shown, the elements 14 are located in the casing in a plurality of a coaxial rows. However, these

elements can be located so as to form a plurality of polygonal rows.

The advantages provided by the present invention are: greater stability for the user's foot provided during the use of the shoe due to the particular different heights and shapes of the deformable elements. The shape enables the foot to be kept in a substantially fixed position inside the shoe. In addition, better elastic energy return to the user's foot during use of the shoe is provided. Due to the particular "triangular" connection of elements 14, the elastically deformable elements have an acceptable response to stresses which are perpendicular to the ground over which the user moves or which are parallel to the ground (which may be generated, for example, during sliding over the ground).

In Figures 6 and 7 showing a second embodiment of the present invention which utilizes the structure described hereinabove with regard to the casing and to elastomeric elements 14, in the sole, and in a position corresponding with the user's heel, there is provided a housing containing an insert as described above and formed by an elastically deformable cellular structure of thermoplastics

material enclosed in an airtight casing 106 of relatively thin flexible plastic material such as polyurethane or the like. Specifically, although non-limitatively shown, deformable elements 114 are similar to elements 14 described in Figures 1-5. Elements 114 are connected to the casing as shown in Figures 1-5. Casing 106 is formed by two parts welded or connected together and obtained, for example, by vacuum-forming.

Before joining the parts of casing 106 together, elastic deformable members 114 are placed on one of these parts. The other part of casing 106 is then placed thereon and the parts are joined together, by welding, along the superposed regions so as to enclose the elements 114. A duct or tube Z is formed which communicates with the interior of the casing located as shown in Figure 6. Such tube is formed by superimposing two appendices of parts of the casing (106).

A seat and a channel 116 are provided in the sole (103). The seat is provided at the heel as shown in Figs. 1-3 and contains an insert 113 of a corresponding shape, whereas tube Z is positioned inside channel 116 which directs it to an outer lateral appendix 124 on the sole where it

terminates in an aperture to which it is secured by a tubular appendix 115 of a plastic block 126 welded to the outside of appendix 124 and including a chamber 117 in which the valve member (118) of a bleed valve 119 is slidably mounted. Valve member 118 is frusto-conically shaped and is mounted at the end of a stem (120) having a smaller cross-section. The stem passes loosely through a hole (121) and has a head (123). A compression spring 122 positioned between block 126 and head 123 prevents chamber 117, and hence the interior of the insert, from being connected to the atmosphere, whereas if head 123 is pressed and thus withdraws valve member 118 from hole 121, the interior of the insert becomes connected to the atmosphere through the space between stem 120 and hole 121 which guides it.

Block 126 comprises a hollow lateral appendix 134 in which there is inserted a multidirectional valve 125 of elastic material comprising a seal flange 126, a tubular part 127 and two flat lips 128 which diverge so as to allow air to flow in the direction of arrow R when pressure is applied to a bellows 129 of elastic material which, by means of a lateral hollow appendix 130, is sealedly connected

to appendix 134. For this purpose, appendix 130 comprises an inner flange 131 which is housed in a corresponding annular groove in appendix 134 of block 126. The bellows has a flat wall 129 by which it is fixed (welded) to the outer lateral appendix 124 of the sole.

Bellows 129 comprises a second tubular appendix 135, opposite the preceding one, in which there is mounted an intake valve 136 comprising a tubular member 137 with a groove 138 into which an inner flange of the appendix 135 elastically clamps. Tubular member 137 comprises a narrow passage 139 which can be intercepted by a plastic disc 149 which moves between this passage and a series of radially arranged spaced-apart teeth 141 which prevent disc 140 from becoming dislodged from tubular member 137. Both the bleed valve 119 and the pumping means (bellows 129, intake valve 136 and delivery valve 125) are enclosed in an elastically cover (not shown in the drawings).

When the person wearing the sports footwear wishes to stiffen insert 113, bellows 129 is repeatedly pressed. During the pressing action, the air contained in the bellows is transferred to the insert 113 via the delivery valve 125 (the intake

valve 136 obviously being closed) so as to stiffen it. When the user releases the bellows, due to its elasticity this reverts to its initial position thus drawing air into its interior via intake valve 136 (the delivery valve remaining shut). On achieving the required rigidity, the user ceases the pumping action. If the user wishes to reduce the rigidity, the user discharges pressure from the insert by pressing head 123 of bleed valve 119 so as to connect the insert 113 to the atmosphere.

As can be seen in Figure 6, the footwear can also comprise a second insert 200 positioned in a seat 201 provided in the front part of the sole (103). A tube 202, similar to tube Z, pneumatically connects insert tube 200 to tube Z, thus allowing the rigidity of the second insert to be simultaneously modified.

Obviously, numerous modifications and variations of the present invention are possible in the light of the above teachings. For example, each insert 13, 13A can be provided with a plurality of layers of elastically deformable elements 14 joined together in their central region having the largest cross-section. It is therefore to be understood that, within the scope of the appended claims, the

invention may be implemented otherwise than as specifically described herein.

CLAIMS

1) A sports footwear which comprises:

a vamp (A); and

a lower support part (1) connected to said vamp (A) and comprising a sole (2), a wedge (3) arranged on said sole (2) and housing, mutually superposed, a mounting insole (I) and an insole (I') for contacting a user's foot;

at least one insert (13) mounted in said lower support part (1) including a plurality of elements (14) which are substantially uniformly spaced and are elastically deformable, said plurality of elements (14) being enclosed in an airtight flexible casing (15) located in a corresponding seat (16) provided in the wedge (3) in a position corresponding at least to the heel of a user's foot, characterised in that said elastically deformable elements (14) have different heights so that at least one of opposite surface portions (15,15') of said insert (13) forms a concave seat for contacting the heel portion of the user's foot.

2. A sports footwear as claimed in claim 1, wherein the deformable elements (14) are interconnected by a plurality of arm members (20A) positioned in a substantially horizontal plane.



3. A sports footwear according to claims 1 and 2, wherein said arm members (20A) and deformable elements (14) form triangular shaped groupings as viewed from above said horizontal plane.

4. A sports footwear according to claim 1, wherein the elastically deformable elements (14) are shaped in such a way that a substantially horizontal plane cross section of each of said elastically deformable elements (14) taken along a longitudinal axis of the shoe has a polygonal shape.

5. A sports footwear according to claim 1, wherein said elastically deformable elements (14) are enclosed within a single airtight flexible casing (15).

6. A sports footwear according to claim 4, wherein free ends (5,6) of the elastically deformable elements (14) are fixed to the flexible casing (15).

7. A sports footwear according to claim 6, wherein the free ends (5,6) of the deformable elements (14) are bonded to the flexible casing (15).

8. A sports footwear according to claim 1, wherein the height of the deformable elements (14)



increases towards the periphery of the insert (13) so as to form the concave seat.

9. A sports footwear according to claim 1, wherein the elastically deformable elements (14) extend vertically substantially throughout the entire height of the heel portion of the shoe.

10. A sports footwear according to claim 1, wherein the elastically deformable elements (14) are tapered towards the opposite free ends and have their largest cross-section in their central region (20).

11. A sports footwear according to claim 2, wherein the arm members (20A) lie in a single substantially horizontal plane and interconnect a central portion (20) of each of the deformable elements (14).

12. A sports footwear according in claim 1, wherein the insert (13) comprises a concave bottom portion.

13. A sports footwear according to as claim 1, wherein at least one additional insert (13A) is located in a different seat of said wedge (3), said additional insert (13A) including an airtight casing and a plurality of elements which are elastically deformable under pressure and are



enclosed in said airtight casing, said elastically deformable elements being tapered towards their opposite free ends and having their largest cross-section in their central region.

14. A sports footwear according to claim 1 or 10, wherein the airtight casing is made of transparent material.

15. A sports footwear according to claim 1 or 10, wherein each insert has at least one layer of said elastically deformable elements (14) joined together at their central region (20), said elastically deformable elements (14) being tapered toward their opposite free ends and having their largest cross-section at their central region (20).

16. A sports footwear according to claims 1 or 10 wherein each insert (13,13A) comprises a casing fastened to the free ends (5,6) of the elastically deformable elements (14) located in it.

17. A sports footwear according to claim 1, wherein there is provided:

a pump mechanism;

a tube (Z) mounted at least partially in the sole (103), said tube (Z) causing the pump mechanism to communicate with the casing (106) enclosing the plurality of elastically deformable elements (114)



and having at least its top-surface portion concave so as to offer a concave seat for the heel portion of the user foot, said pump mechanism allowing the user to vary the air pressure within said casing (106) so as to modify the elastic features of the insert (113) and including an intake valve (136), a delivery valve (125) increasing said pressure through said tube (Z), and bleed mechanism (119) suitable for decreasing said pressure by causing an air flow from said casing (106) through said tube (Z), said pump mechanism having a bellows (129) located on an exterior portion (124) of the shoe and having a first and second opening, said intake valve (136) being positioned in said first opening and said delivery valve (125) being located in said second opening.

18. A sports footwear according to claim 14, wherein said delivery valve (125) includes a block member (126) located outside said bellows (129) and a chamber (117) connected to said bellows (129), said bleed mechanism (119) being connected to said chamber (117) of said block (126) downstream from said delivery valve (125); said air-impermeable casing (106) includes at least two parts, each part comprising an integral appendix and wherein the



appendix of each part forms a tube (Z) for passage of air to and from the insert.

19. A sports footwear according to claim 17, wherein the pump and the bleed mechanism (119) are both positioned outside the shoe and are rigidly connected therewith.

20. A sports footwear according to claim 19, comprising an elastically deformable cover connected to the shoe wherein the pump and the bleed mechanism are contained within said elastically deformable cover.

21. A sports footwear according to claim 17, wherein said bleed mechanism (119) comprises a pusher-type valve.

22. A method of assembling an insert of a sports footwear as claimed in claim 1 and consisting of:

forming a plurality of polygonal shaped deformable members (14;114) so as to be interconnected respectively by a plurality of arm members (20A);

placing the plurality of deformable members (14;114) into a casing (15;106) and connecting the free end portions (5,6) of the deformable members (14;114) to the casing (15;106); and

placing said casing into the heel portion of a



shoe.

23. A method according to claim 22, wherein said deformable members (14;114) are interconnected at their maximum cross sections (20).

24. A method according to claim 22, wherein the forming of the deformable members (14;114) includes varying the height of said deformable members (14;114) so that one of the top (15') and bottom (15'') portions of the insert is concave.

25. A method according to claim 22, wherein the forming of the deformable members (14;114) so as to be interconnected by the plurality of arm members (20A) comprises forming the deformable members (14,114) into a plurality of triangularly shaped groupings of deformable members as viewed from above the deformable members.

26. A method according to claim 22 which includes connecting the casing to an air-pressure source (129) connected to the shoe and controlling the air pressure in the casing (106).



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