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(54) **Cushioning system for footwear**

(57) A midsole for footwear includes at least one solid or hollow cushioning tube positioned therein for improving the cushioning of the midsole. Preferably, the midsole includes a plurality of cushioning tubes fabricated of an

elastomeric material. The tubes may vary in diameter and/or wall thickness relative to one_another for varying the cushioning and stability characteristics of the system. Each tube may also vary in diameter and/or wall thickness along its length.

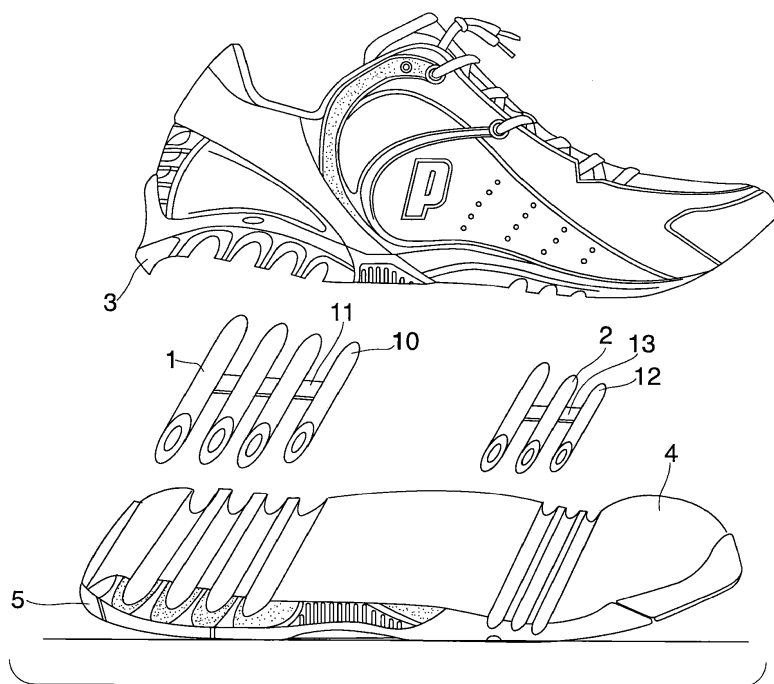


FIG. 2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a cushioning means for the midsole of an athletic shoe, and more particularly, where the design of the device can be altered in such a way as to provide different amounts of cushioning in different locations along the midsole of the shoe.

[0002] This invention relates to an improved footwear cushioning system. In particular, it is made from tubular shaped inserts located within the midsole of the shoe, for example, in the forefoot and/or heel areas. These tubular inserts provide a variance in the cushioning and stability of the midsole, and can be altered in such a way to provide specific cushioning, or if desired, more stability in specific locations.

[0003] Stability of an athletic shoe is very important in preventing the rolling over of the foot, called pronation or supination. The cushioning means should not jeopardize the stability of the shoe. With the present design, stability is not sacrificed and cushioning is enhanced.

[0004] In addition, there are distinctively different cushioning and stability needs in different areas of the midsole of the shoe. The present invention is designed to provide the preferred amount of cushioning and stability to the midsole of a shoe in the forefoot and heel areas.

Description of the Prior Art

[0005] Footwear cushioning is one of the most important features of an athletic shoe where constant striking of the foot to the ground can cause discomfort and injury. There have been numerous designs to improve cushioning, most of which have focused on the materials below the foot known (in descending order) as the sock liner, insole, midsole, and outsole. The first part directly below the foot is the sock liner, which can be made from a softer, more shock absorbent material like a resilient foam or elastomeric material. Below this is the insole, which is a more firm platform to which the upper, consisting of fabric, leather, etc., is stitched. Directly below this is the midsole, which is typically the thickest portion and commonly uses a resilient foam material and therefore offers the most alternatives to cushioning technology. Finally, below the midsole is the outsole, which is the portion which contacts the ground and needs to be harder with a tread pattern to offer traction and durability.

[0006] An alternative midsole design is disclosed in U.S. Pat. No. 6,898,870 to Kita, who describes a corrugated sheet inside the midsole which can vary in stiffness to provide varying cushioning and stability means. This design is limited in that it cannot vary the cushioning to particular areas, and is less effective in the forefoot area where the midsole is of a minimal thickness.

[0007] Another alternative cushioning means is de-

scribed by U.S. Pat. No. 6,898,870 to Rohde, who achieves cushioning by using columnar support elements, each with an aperture to control the compliance or cushioning of each support element, with the option of using plugs inserted into the apertures to further control the compliance of the support elements. This design is limited by the requirement of using these columnar support elements, which limit the direction of the cushioning and stability means to basically a vertical up and down action.

[0008] Still another alternative design for improving the cushioning of an athletic shoe is shown by U.S. Pat. No. 5,787,509 to Wu, who describes a shoe sock liner design which incorporates a resilient material with a plurality of cavities to provide shock absorption means. This design is again limited by the thickness of the sock liner, which traditionally is much thinner than the midsole of a shoe.

[0009] The shoe cushioning system according to the present invention substantially departs from the conventional concepts and designs of the prior art and in doing so provides an apparatus primarily developed for the purpose of improved cushioning while maintaining stability as well as improved appearance.

[0010] Therefore, it can be appreciated that there exists a continuing need for an improved athletic shoe cushioning systems. In this regard, the present invention substantially fulfills this need.

SUMMARY OF THE INVENTION

[0011] In view of the foregoing commonality inherent in the known types of cushioning for footwear of known designs and configurations now present in the prior art, the present invention provides an improved footwear cushioning system. As such, the general purpose of the present invention, which will be described subsequently in greater detail, is to provide a new and improved footwear cushioning system which has all the advantages of the prior art and none of the disadvantages.

[0012] There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject matter of the claims attached.

[0013] In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of descriptions and should not be regarded as limiting.

[0014] As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

[0015] The present invention provides a new and improved cushioning for footwear which has all of the advantages of the prior art of known designs and configurations and none of the disadvantages.

[0016] The present invention provides a new and improved cushioning for footwear which may be easily and efficiently manufactured and marketed.

[0017] The present invention provides a new and improved cushioning for footwear which is of durable and reliable construction.

[0018] The present invention provides a new and improved cushioning for footwear which is susceptible of a low cost of manufacture with regard to both materials and labor, and which accordingly is then susceptible of low prices of sale to the consuming public, thereby making such footwear economically available to the buying public.

[0019] The present invention provides a footwear cushioning system that can provide specific stability means to various locations of the heel and forefoot areas.

[0020] The present invention provides an improved footwear cushioning system that can be adapted to athletic shoes for court sports as well as to running and walking shoes.

[0021] Lastly, the present invention provides a new and improved cushioning for footwear made with numerous tubes and/or rods inserted between two portions of the midsole to provide desired cushioning and stability means in the heel and forefoot areas.

[0022] For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Figure 1 is a front elevational view of the lateral side of an article of footwear, constructed in accordance with the principles of the present invention.

Figure 2 is an exploded view showing the various individual components of the footwear shown in Figure 1.

Figure 3 is an isometric view of the heel tubes.

Figure 4 is an isometric view of the forefoot tubes.

Figures 5a-d are detailed views showing the tubes varying in diameter along their length.

Figures 6a-d are detailed views of the tubes showing

the variance of wall thickness along their length.

Figures 7a-b are detailed views showing the tubes being solid for at least a portion of their length.

Figures 8a-b are detailed views showing the option of inserts being placed inside the tubes.

Figures 9a-c are isometric views of various alternatives of tube orientations to achieve different cushioning and stability means.

[0024] The same reference numerals refer to the same parts throughout the various Figures.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] With reference now to the drawings, and in particular to Figures 1 through 9 thereof, the preferred embodiments of footwear according to the invention, generally designated by the reference numeral 10, will be described.

[0026] The present invention uses pre-molded hollow tubes whose function is to vary the amount of cushioning of the shoe. The tubes, being circular or oval in cross section, are preferably fabricated using resilient plastic or elastomeric materials, and act as arches or springs to absorb the force of impact. The amount of cushioning desired depends on the material, geometry, location, and orientation of each tube.

[0027] The material used for the tubes can vary the amount of cushioning achieved. For example, if a high degree of cushioning is desired, then the material should be an elastomeric grade material with a Shore A hardness of 30 - 50 such as Thermoplastic Polyurethane (TPU), or Thermoplastic Rubber (TPR), or Thermoplastic Elastomer (TPE). An example would be GLS Dynaflex. If less cushioning and more stability is needed, the material should be stiffer with a Shore A hardness value between 50 - 90 such as Dupont Hytrel series or BASF Elastollan series.

[0028] The geometry and dimension of the tubes can vary to provide more or less cushioning. For example, if more cushioning is desired, the diameter of the tube can be increased along with a reduced wall thickness to increase flexibility to allow more compression of the tube during impact. If less cushioning is desired, the diameter of the tube can be decreased, or the wall thickness of the tube increased in order to increase the stiffness of the tube.

[0029] Where the tubes are located will also determine the amount of cushioning. Within each of the heel and forefoot areas, there are many options on where to locate each tube, as well as the number of tubes, the spacing between the tubes, the vertical positioning of the tubes, and the orientation of the tubes.

[0030] The orientation of the tubes will also affect the cushioning and stability of the shoe. For example, the tubes can be positioned 90 degrees to the axis of the shoe to provide selective cushioning along the length of

the shoe by varying the size, dimension, and stiffness of each tube. The tubes may also be oriented parallel to the axis of the shoe, or be positioned in a radial fashion in order to provide specific cushioning or stability in selected forefoot and heel areas.

[0031] The tubes are manufactured in a separate molding operation, prior to molding the shoe midsole. Preferably, each tube will be injection molded separately in order to produce the exact geometry and material properties desired. High pressure injection molding can produce a very strong and reliable structure which can withstand repeated impact loadings without breaking down and losing integrity, which is common among typical foam materials used in midsoles.

[0032] Once the tubes are molded, it can be positioned in the midsole one of several ways. One option is to mold two separate portions of the midsole, one above and one below the centerlines of the tubes, each with a cavity molded in which is the exact shape of the portion of the tubes to be placed in the respective part of the midsole. In this example, the tubes are bonded to both the lower and upper midsole portions as they are bonded to each other. This option provides the alternative of using different foam materials for each of the midsole portions. For example, using different densities or even using different materials where one portion could be made with a lighter weight ethyl vinyl acetate(EVA) foam and the other portion comprised of a more dense and more durable polyurethane(PU)foam.

[0033] A second option is to position the tubes in the opened midsole mold, then pour the premixed foam in liquid form into the mold, close the mold and the foam will expand and encapsulate the tubes. This requires an accurate positioning of the tubes, for example using pins to locate the tubes in place, and then when the liquid foam is injected into the mold and begins to expand, the locating pins are retracted leaving the tubes suspended and accurately located within the midsole. With this method it is more economical but does not allow different density midsole portions.

[0034] Using either the two piece midsole concept or the one piece midsole concept provides options on the vertical positioning of the tubes within the midsole. The tubes do not need to be centered within the vertical thickness of the midsole. The tubes can be positioned higher or lower as desired within the midsole. In addition, the tubes can be positioned at an angle, for example, with the height of the tubes higher in the rear and lower toward the front of the shoe. Another option is to have the tube height vary from the medial side to the lateral side.

[0035] It is also possible to locate the tubes so they are outside the midsole. This would be most common in the forefoot area where the midsole is the thinnest, and there may not be space to embed tubes inside the midsole. There also may be advantages to locating the tubes on the upper side of the midsole in the heel area. When done this way, attention must be given to the contour of the upper surface of the tubes so they are not felt by the

foot. In this case, the tubes could have a flatter, horizontal top surface or the sock liner and insole could have some relief designed in the underneath side to accommodate the tubes.

[0036] The footwear cushioning system of the present invention provides a unique solution to footwear cushioning because the tubes act like springs to absorb the force of impact. For example, when the heel strikes the ground, the force of impact tends to compress the tubes, changing them from a circular cross section to an oval cross section. In doing so, the outside walls of the tubes press against the foam, which, depending on its density and resiliency, can affect the amount of cushioning provided.

[0037] In addition, the tubes do not need to be circular in cross section. The tubes can be oval, with the major axis oriented either vertical or horizontal or at an angle, to provide unique cushioning alternatives never before achieved. With this option, the tubes can rotate as well as compress to achieve desirable cushioning levels.

[0038] In addition, the tubes do not need to be cylindrical. The tubes can be conical or parabolic, meaning that the diameter changes in a nonlinear fashion along the length of the tubes. For example, the tubes could have a large diameter with a thicker wall near the outside of the shoe to provide more stability and a more unique look to the shoe.

[0039] In addition, the tubes can accept inserts of various hardnesses, which when placed in the tubes, can affect the amount of cushioning and stability.

[0040] In addition, the tubes can be solid or a portion of the tube be solid to provide specific cushioning or stability characteristics as desired.

[0041] In addition, the tubes could be connected together, e.g., by a web, to form a cartridge. This would facilitate the molding and handling of the tubes, as well as positioning them in the midsole mold.

[0042] Furthermore, the tubes could act as a continuous air bladder, allowing flow between tubes to provide greater cushioning where needed.

[0043] Another advantage of the tube concept is aesthetics. The tubes can be open ended at the edge of the midsole to provide maximum visibility, or enclosed inside a transparent material so debris doesn't collect inside the tubes. The tubes can also be positioned like an automobile's exhaust pipes, with two tubes coming out of the rear portion of the shoe to give the shoe a sports car look.

[0044] As mentioned before, the tubes can be molded individually and located separately within the midsole of the shoe, or molded as an interconnected cartridge. In either option, it is possible to vary the material, hardness, and geometry of each tube and along the length of each tube to achieve specific cushioning performance characteristics.

[0045] The footwear cushioning system of the present invention is not limited to court sports shoes. It can be applied to running shoes, hiking shoes, walking shoes, and even dress shoes.

[0046] With greater reference to Figures 1 through 4 of the drawings, a first embodiment of the present invention features elastomeric tubes 10 connected by an optional web or strip 11 for improving the cushioning of the midsole in the heel area, and similar but thinner tubes 2 to improve the cushioning in the forefoot area. The midsole is produced in two portions: an upper portion 3 and a lower portion 4. The lower midsole is bonded to the outsole 5.

[0047] Figure 2 shows an exploded view of the individual components of the midsole. The heel tubes 10 can comprise any number, and may or may not be connected to one another. In the preferred embodiment, the heel tubes 10 are comprised of four elastomeric tubes 10, and each tube is the exact width of the midsole so they are visible in the final product on both the lateral and medial sides. The forefoot uses three solid tubes 12 in the preferred embodiment. As used in the present specification, the term "tube" includes solid rods as well as hollow tubes.

[0048] In this case, preferably only the lateral side of the tubes 12 is visible in the final product. Both the lower midsole portion 4 and upper midsole portion 3 have cavities molded in with the exact shape of the portion of the embedded tubes. The assembly procedure is to apply an adhesive to the tubes and the midsole portions, then assemble together with compression to form a complete midsole assembly.

[0049] Figure 3 shows a detailed view of an alternative embodiment with the heel tubes connected to form a cartridge 1. In this embodiment, the wall thickness of the tubes is greater on the top side than on the bottom side. The tubes are also oval in shape and the major axis is oriented at an angle relative to vertical. In the cartridge 1 of Figure 3, outside air is allowed to enter and leave the holes through the tubes 10. In addition, if desired, the strip 11 connecting the tubes can provide a passageway between adjacent tubes 10, so that air can pass between tubes 10.

[0050] Figure 4 shows a detailed view of an alternative embodiment of the forefoot tubes connected to form a cartridge 2. In this embodiment, the tubes 12 are solid forming rods to enhance the stability of this area. In addition, the tubes 12 are oval in cross section and their major axis is oriented at an angle similar to the heel tube cartridge 1.

[0051] Figures 5a, 5b, 5c, and 5d show examples of variations in tube diameters that are possible. It should be known that the amount of options in tube diameters is numerous, and only limited by the thickness of the midsole in that area.

[0052] Figures 6a, 6b, 6c, and 6d show examples of variations in wall thickness that are possible, where the broken lines depict the inner wall of the tube. It should be known that the amount of options in wall thickness is numerous, and only limited by the diameter of the tube in that area.

[0053] Figure 7 shows 2 examples of how the tubes

vary between a hollow tube and solid portion along their lengths, where the broken lines again depict the inner wall of the tubes in the hollow portions. The amount of the tubular portion versus the solid portion can vary depending on the cushioning or stability desired in each area.

[0054] Figure 8 shows examples of how inserts 14, 15 could be used to change the amount of cushioning and stability in the tubes. Figure 8a shows a cylindrical insert 14 designed to insert into a cylindrical hole in the tube. Another option is shown in Figure 8b, where a conical shaped insert 15 is designed to insert into a conical shaped hole.

[0055] Finally, Figure 9 shows some examples of variations of tube orientation to achieve different cushioning amounts in different areas. There are unlimited options on how the tubes 10a, 10b, 10c can be oriented. For example, in Figure 9c, the tubes 10c run continuously the entire length of the midsole to provide cushioning everywhere. This design would be best suited to a running or walking shoe, where the motion is predominantly in a forward direction. Figures 9a and 9b show tube orientations that would be best suited for motions in all directions.

[0056] As to the manner of usage and operation of the present invention, the same should be apparent from the above description. Accordingly, no further discussion relating to the manner of usage and operation will be provided.

[0057] With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, would be evident to one skilled in the art from the foregoing description, and all equivalents to the examples illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

[0058] Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

Claims

1. A footwear cushioning system comprising a midsole which contains at least one cushioning tube formed of an elastomeric material for absorbing shock, wherein said cushioning tube is at generally horizontally oriented.
2. The system as set forth in claim 1, wherein said midsole contains at least two tubes connected to one

another to form a cartridge.

3. The system as set forth in claim 1, wherein said midsole contains at least two cushioning tubes located in different locations. 5
4. The system as set forth in claim 1, wherein the at least one cushioning tube has a diameter that varies along its length. 10
5. The system as set forth in claim 1, wherein the at least one cushioning tube has a wall thickness which varies along its length.
6. The system as set forth in claim 3, wherein the at least two tubes vary in length relative to one another. 15
7. The system as set forth in claim 3, wherein the at least two tubes have cross sectional shapes which differ from one another. 20
8. The system as set forth in claim 1, wherein the cushioning tube has a solid portion along its length.
9. The system as set forth in claim 3, wherein the at least two cushioning tubes are oriented at different angles relative to the longitudinal axis of the shoe. 25
10. The system as set forth in claim 1, wherein the cushioning tube has an outer surface which is sealed within the midsole and a hollow interior that allows air or other fluids to pass through the tube. 30
11. The system as set forth in claim 2, wherein said tubes are connected to one another with a member that permits air to pass between said tubes. 35
12. The system as set forth in claim 3, wherein the midsole has a cross-sectional height, and the at least two cushioning tubes are located at different heights within the midsole. 40
13. The system as set forth in claim 1, wherein the midsole has a top surface, and wherein the cushioning tube is located on the top surface of the midsole. 45
14. The system as set forth in claim 1, wherein the midsole has a bottom surface, and wherein the cushioning tube is located on the bottom surface of the midsole. 50
15. The system as set forth in claim 1, wherein the midsole is molded in two portions. 55

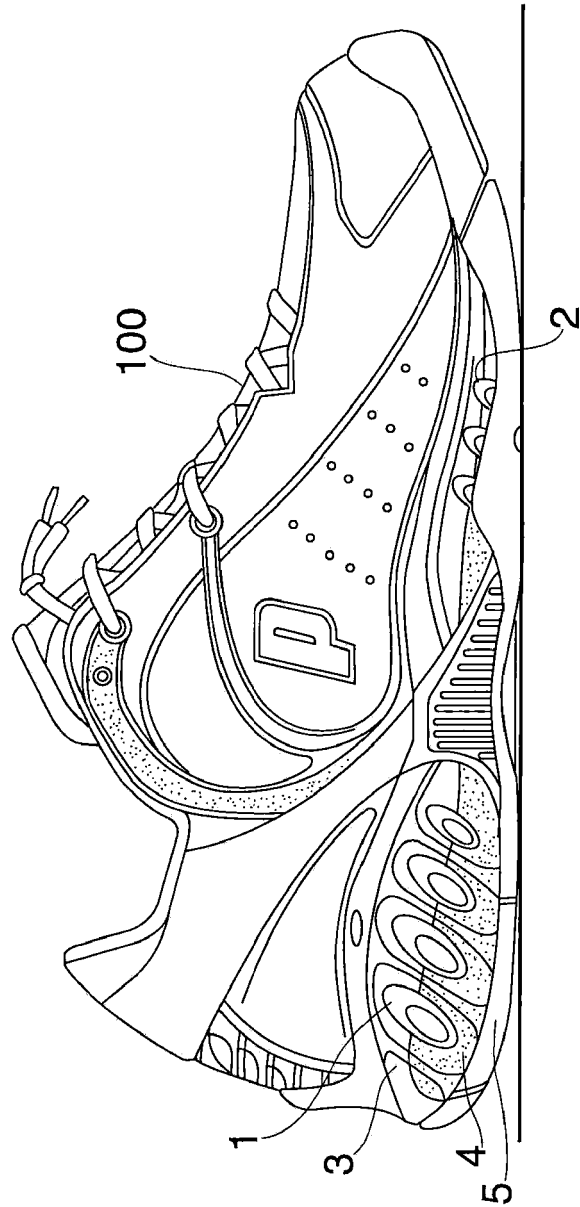
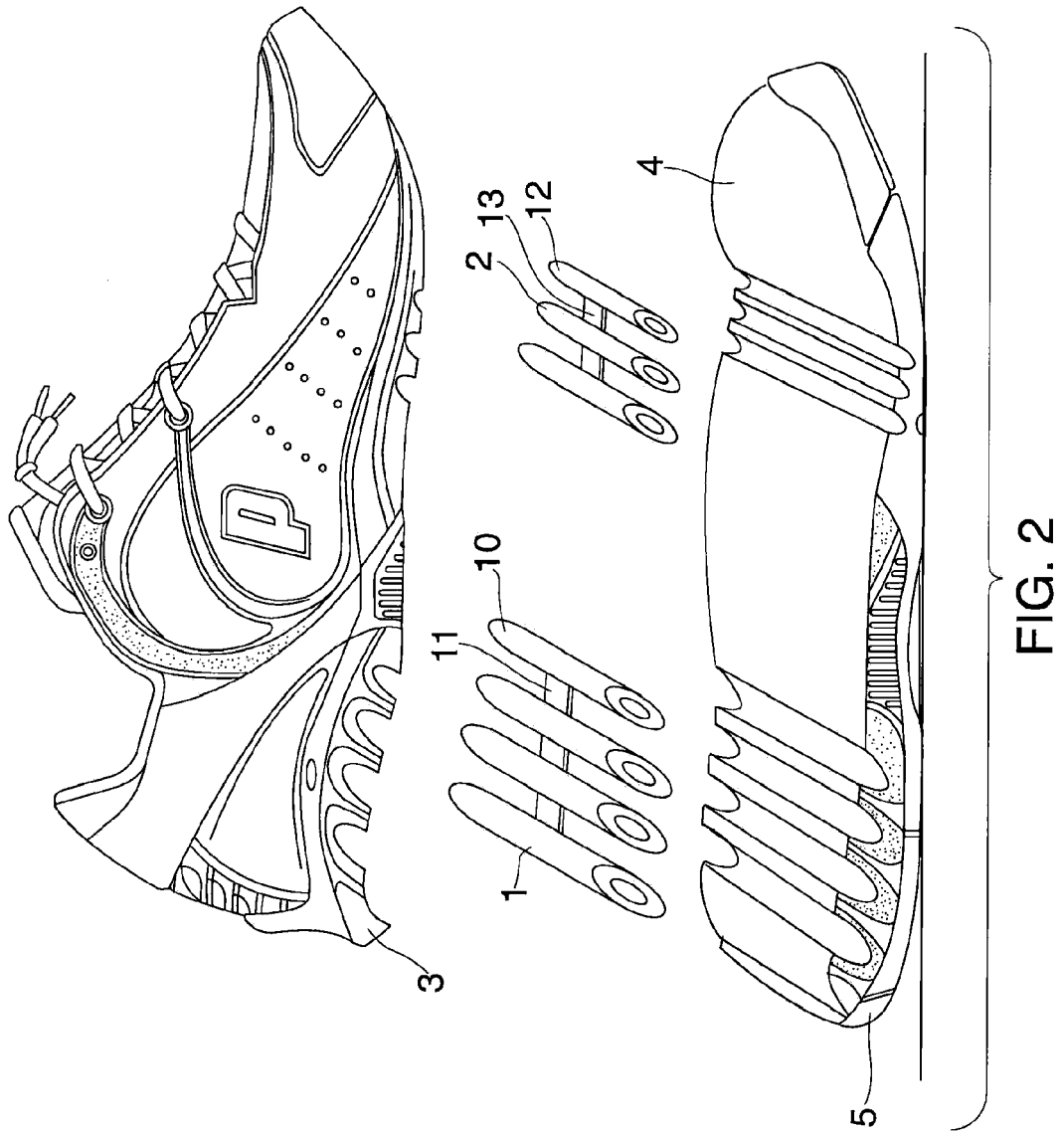


FIG. 1



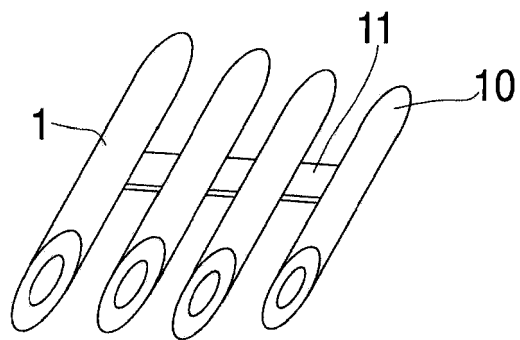


FIG. 3

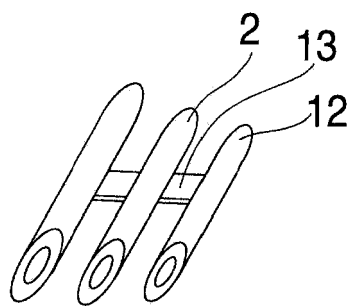


FIG. 4

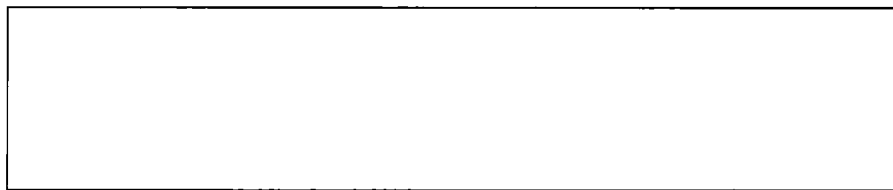


FIG. 5a

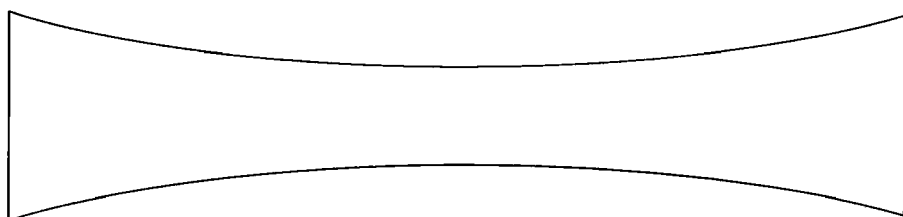


FIG. 5b

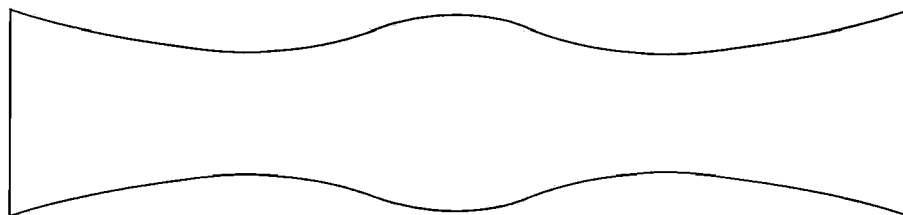


FIG. 5c

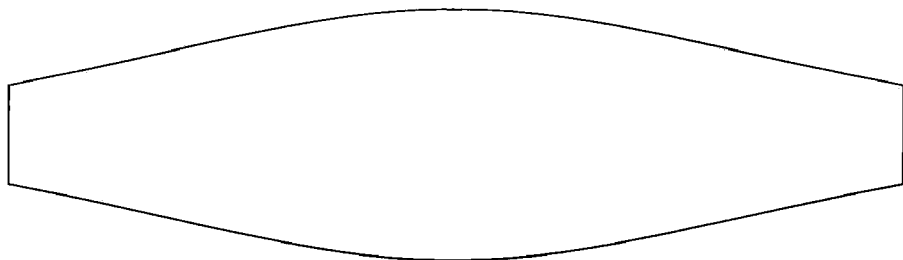


FIG. 5d

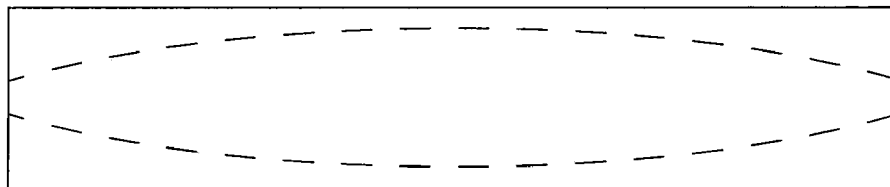


FIG. 6a

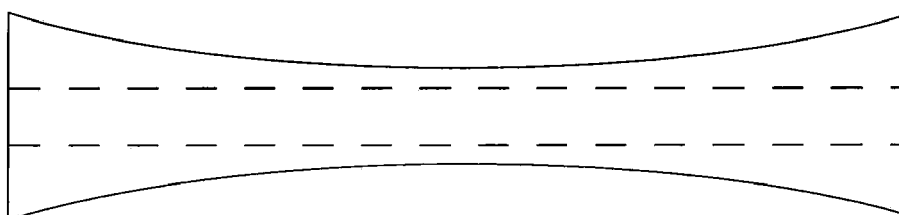


FIG. 6b

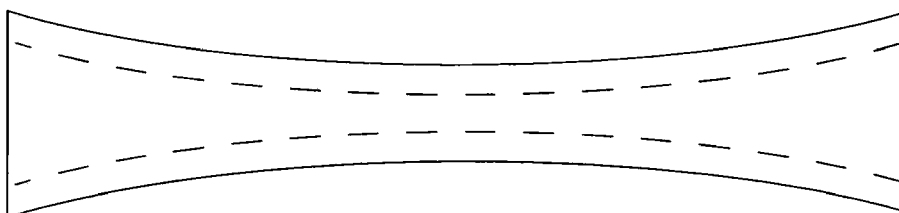


FIG. 6c

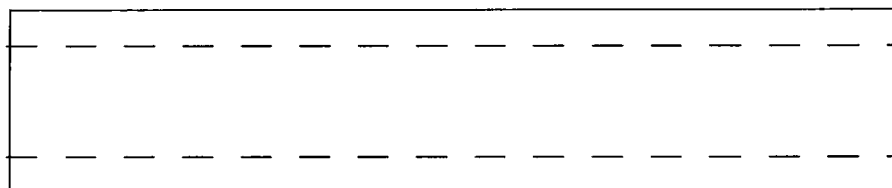


FIG. 6d

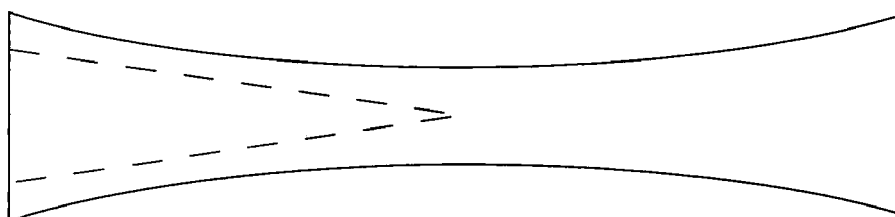


FIG. 7a

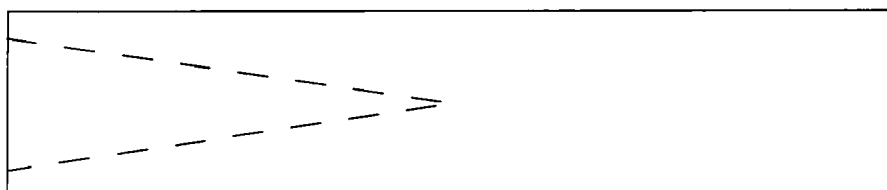
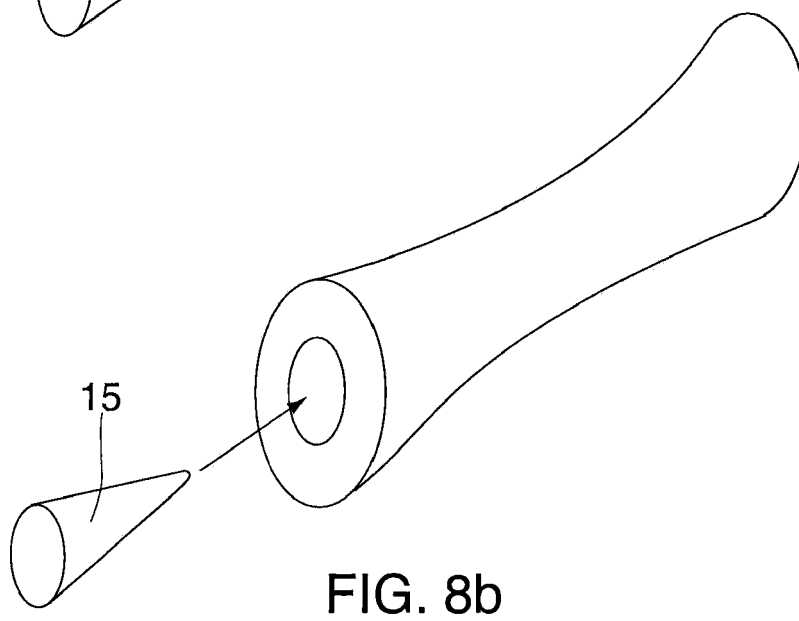
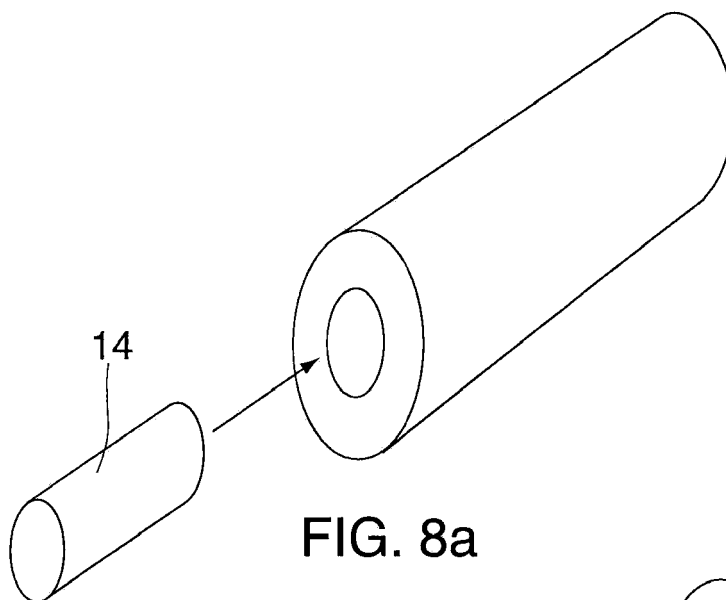


FIG. 7b



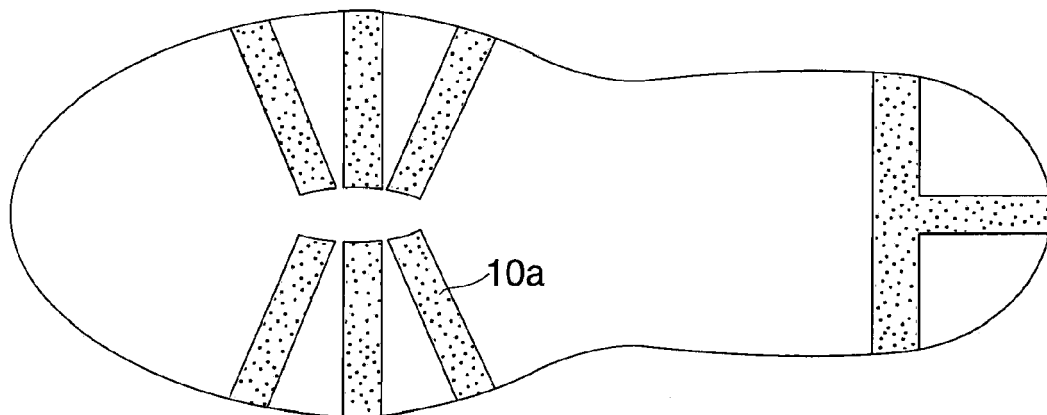


FIG. 9a

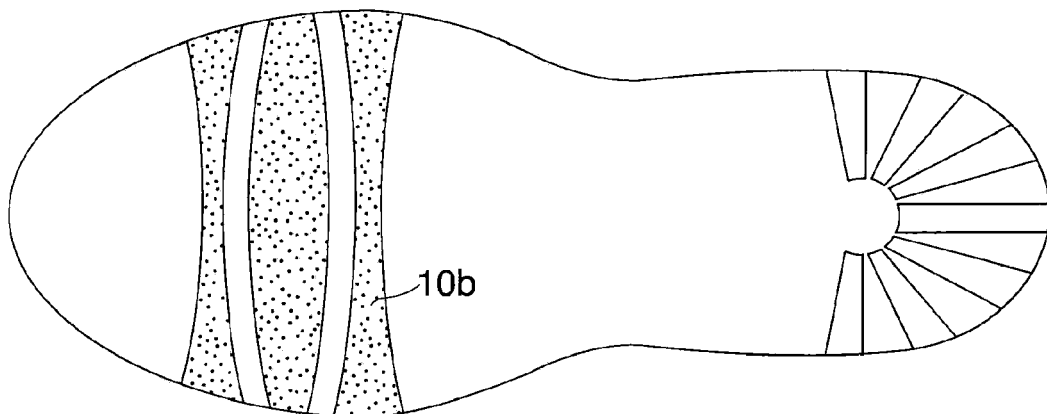


FIG. 9b

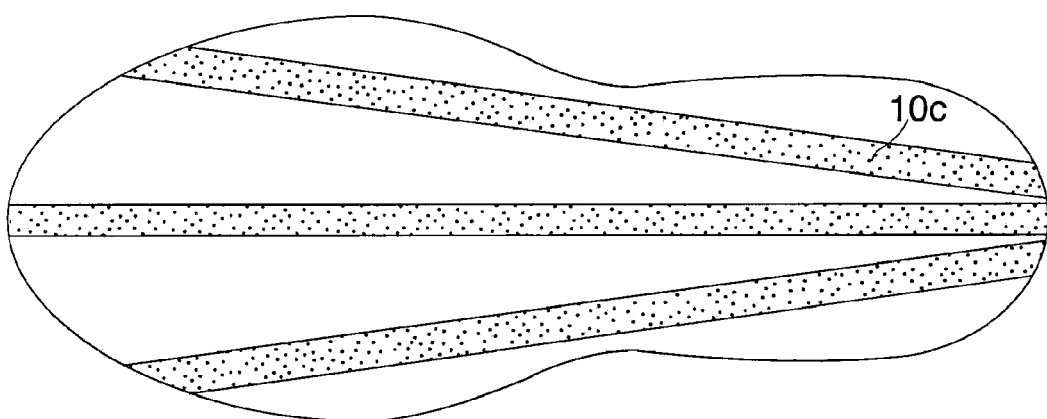


FIG. 9c



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 864 738 A1 (HOROVITZ ZVI [US]) 12 September 1989 (1989-09-12) * claims; figures *	1-15	INV. A43B13/20
X	US 6 122 785 A1 (BONDIE PHILIP [US] ET AL) 26 September 2000 (2000-09-26) * claims; figures *	1-15	
X	US 5 987 780 A1 (LYDEN ROBERT M [US] ET AL) 23 November 1999 (1999-11-23) * claims; figures *	1-15	
X	US 5 117 566 A1 (LLOYD AMIE J [US] ET AL) 2 June 1992 (1992-06-02) * claims; figures *	1-15	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			A43B
Place of search		Date of completion of the search	Examiner
The Hague		14 March 2007	Claudel, Benoît
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 11 7186

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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14-03-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4864738	A1	NONE	
US 6122785	A1	NONE	
US 5987780	A1	NONE	
US 5117566	A1	NONE	

REFERENCES CITED IN THE DESCRIPTION

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