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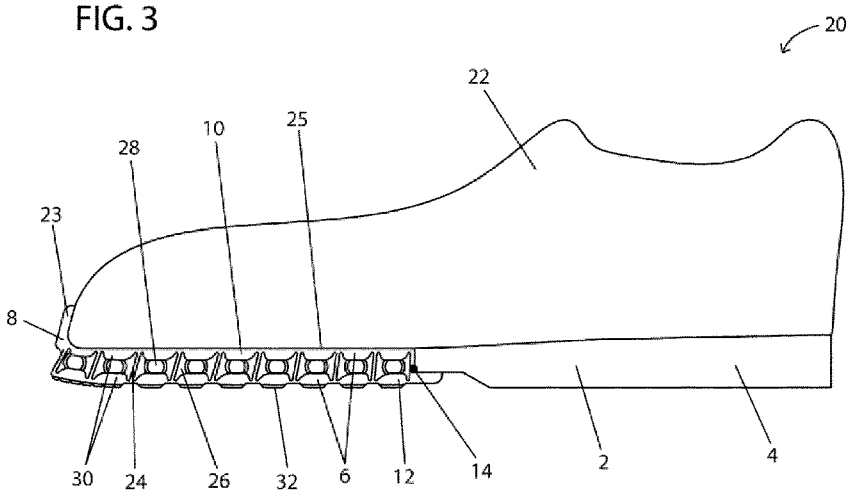
FIG. 3



(57) Abstract: The invention provides an outsole for a shoe and a shoe comprising the outsole. The forefoot portion of the outsole comprises a first plate, and, parallel with the first plate, a second plate. The second plate extends between the front end of the forefoot portion and a location of the forefoot portion where the second plate is fixedly attached to the first plate. At least a portion of the second plate outside the said location is connected to the first plate, such that second plate outside the said location is movable along the first plate.

AN OUTSOLE AND A SHOE

The present invention relates to an outsole for a shoe, and to a shoe comprising the outsole.

Over times shoes, and in particular the outsole of shoes, have undergone many technical developments in order to make the shoes more comfortable to the wearer or more suitable for the particular circumstances of the use by the wearer. This is certainly the case for athletic shoes.

For example, US 2009/0241377-A1 discloses a sole structure in which an upper plate, a lower plate and longitudinally separated connecting portions disposed between the upper plate and the lower plate form voids between the upper plate and the lower plate. Each time when the shoe impacts the ground during walking or running, the connecting portions shearing-deform moderately to the front side and the upper plate thus sways to the front side. As a result a smooth ride feeling can be achieved during walking or running.

As another example, US 2012/0096741-A1 discloses an athletic shoe which comprises an upper, an outsole, a pair of hinged plates, and a spring. The pair of hinged plates are attached between the outsole and the upper in the forefoot portion of the shoe, and the spring biases the plates apart, so that energy is stored and returned during a propulsion stage of a gait cycle in a human step. This provides the wearer with a launch factor equal to a release of torque from the spring means due to the two plates being moved apart by the spring as the foot is being lifted.

The present invention provides an outsole for a shoe which outsole comprises a heel portion and a forefoot portion, wherein

- the forefoot portion comprises a first plate, and, parallel with the first plate, a second plate,
- the second plate extends between the front end of the forefoot portion and a location of the forefoot portion where the second plate is fixedly attached to

the first plate, and

- at least a portion of the second plate outside the said location is connected to the first plate, such that second plate outside the said location is movable along the first plate.

The present invention also provides a shoe comprising

- an outsole in accordance with this invention, and
- an upper which is attached to the outsole,

wherein the first plate of the outsole is attached to a portion of the upper and the second plate is located outside of the space enclosed by the upper and the outsole.

The invention may be illustrated by means of FIGS. 1 and 3 – 7 hereinafter. FIG. 2, hereinafter, illustrates a conventional outsole, that is for a shoe not in accordance with this invention. The advantages of the present invention can be explained by viewing and comparing FIG. 1 with FIG. 2. FIGS. 3 – 7 illustrate a preferred embodiment of this invention. Throughout the FIGURES, the same objects will have the same reference numbers.

FIG. 1 provides a schematic cross sectional view of an outsole for a shoe in accordance with this invention, in a first position, that is a position wherein no forces are exerted on the outsole (FIG. 1A), and in a second position, that is a position wherein forces are exerted on the outsole such that the forefoot portion of the outsole is bent in a manner occurring when the wearer of the shoe initiates a step (FIG. 1B).

FIG. 2 provides, for comparison, a schematic cross sectional view of a conventional outsole, in a first position, that is a position wherein no forces are exerted on the outsole (FIG. 2A) and in a second position, that is a position wherein forces are exerted on the outsole such that the forefoot portion of the outsole is bent in a manner occurring when the wearer of the shoe initiates a step (FIG. 2B).

FIG. 3 provides a side view of a preferred embodiment of a shoe in accordance with this invention.

FIGS. 4 and 5 provide perspective views of the forefoot portion of a preferred embodiment of the outsole in accordance with this invention, taken from the shoe shown in FIG. 3.

FIG. 6 provides a cross sectional view of the forefoot portion shown in FIGS. 4 and 5, in the longitudinal direction in the centre of the outsole. The cross sectional view is taken in the longitudinal direction of the outsole and perpendicular to the plane of the outsole.

FIG. 7 provides an enlarged cross sectional view of a fragment of the forefoot portion shown in FIG. 6, in a first position, that is a position wherein no forces are exerted on the outsole (FIG. 7A), and in a second position, that is a position wherein forces are exerted on the outsole such that the forefoot portion of the outsole is bent in a manner occurring when the wearer of the shoe initiates a step (FIG. 7B).

FIGS. 8 and 9 provides enlarged cross sectional views of the forefoot portions of further preferred embodiments of a shoe in accordance with this invention. The cross sectional views are taken in the transverse direction of the outsole and perpendicular to the plane of the outsole.

The advantages of the present invention can be explained by comparing FIG. 1 with FIG. 2. FIG. 1 shows outsole 2 having heel portion 4 and forefoot portion 6 with front end 8. Forefoot portion 6 comprises first plate 10, and second plate 12. Second plate 12 extends between front end 8 and a location which extends as a narrow region in the transverse direction the forefoot portion 6 where second plate 12 is fixedly attached to first plate 10. In the cross sectional views of FIG. 1 this location is depicted by the point indicated by reference 14. Portion 16 of second plate 12 outside location 14 is connected to first plate 10, such that portion 16 is movable along first plate 10.

The connection between first plate 10 and second plate 12 is not visible in FIG. 1.

Upon bending forefoot portion 6, first plate 10 and second plate 12 are bent in accordance with bend lines 18. Because bend lines do not change in length during bending, portion 16 of second plate 12 moves along first plate 10 during the bending to the effect that in the proximity of front end 8 first plate 10 shifts over a distance D relative to second plate 12.

FIG. 2 shows the conventional outsole, which differs from outsole 2 (FIG. 1) only in being provided with a single plate in its forefoot portion, instead of two plates. Upon bending the forefoot portion, the single plate is bent in accordance with a single bend line, and there is no shift according to distance D.

The present invention provides several unexpected advantages. The wearer's toes are supported, directly or indirectly, by outsole 2 at or near front end 8, which is, directly or indirectly, in contact with the ground. Therefore, every time the wearer initiates a step, that is at the push-off phase of every step, the wearer's toes are moved in the forward direction over the shifting distance D, as provided by the inventive outsole. This moving forward increases the length of every step made by the wearer. At the same stepping frequency, a faster run can then be made by the wearer of a shoe provided with the inventive outsole, relative to the run that can be made when the wearer wears a shoe provided with the conventional outsole. Moreover, when the inventive outsole and the conventional outsole are taken as to have equal total thicknesses, the simultaneous bending of the first and second plates of the inventive outsole requires less force than the bending of the single plate of the conventional outsole. Therefore, running becomes less tiring to the wearer of a shoe provided with the inventive outsole than to the wearer of a shoe provided with the conventional outsole.

As used in this patent document, the term "front end" indicates the end of the shoe or the outsole which is intended to fit or support, respectively, the toes of the wearer, and the term "back end" indicates the opposite end of the shoe or the outsole. As used in this patent document, the term "longitudinal direction" indicates the direction along a notional line connecting the front end and the back end of the outsole, and the term "transverse direction" indicates the direction perpendicular to the transverse direction in a notional plane of the outsole. The term "longitudinal side" indicates a side which extends in the notional plane of the outsole between the front end and the back end. The skilled reader will understand that, in general, the portions of a shoe and an outsole may be shaped along curved lines, so that frequently the longitudinal direction, the transverse direction and the notional plane of the outsole can not exactly be assigned.

The outsole of this invention comprises the forefoot portion towards its front end and the heel portion towards the back end of the outsole. The forefoot portion and the heel portion may be distinct parts of the outsole, and they may or may not be made of different materials, in which case they may be attached to each other. Typically, the forefoot portion and the heel portion may be fixedly attached to each other, for example, by means of a glue or they may be welded together. As an alternative, the forefoot portion and the heel portion may have been produced as, and may represent together, a single part.

The forefoot portion comprises the first plate, and, parallel with the first plate, the second plate. The skilled person will appreciate that in the art of soles for shoes, the term "layer" may be used instead of the term "plate". In the context of this patent document these terms are considered to be synonymous terms. The first plate and the second plate may be distinct parts of the forefoot portion, and they may or may not be made of different materials, in which case they may be fixedly attached to each other, for example by means of a glue or they may be welded together. As an

alternative, the first plate and the second plate may have been produced as, and may represent together, a single part.

The location of the forefoot portion where the second plate meets the first plate and is fixedly attached thereto may typically be a narrow region, in particular a straight narrow region, more in particular having the shape of a straight line. Preferably, the narrow region extends in the transverse direction of the outsole, and in particular the narrow region extends from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion. The location where the second plate meets the first plate may be positioned in the proximity of the location where the forefoot portion meets the heel portion. The second plate extends between the location where the second plate meets the first plate and the front end of the outsole.

At least a portion of the second plate outside the location where the second plate meets the first plate is connected to the first plate, such that the portion of the second plate is movable along the first plate. Alternatively, the movability along the first plate may be described as movability parallel to the first plate. The movability along, or parallel with the first plate may be achieved, for example, by disposing a plurality of pillar shaped supports, or preferably walls, between the first plate and the second plate, which pillar shaped supports or walls connect at least a portion of the second plate to the first plate, and allow movement of the second plate along the first plate. Preferably, the second plate outside the location where the second plate meets the first plate is connected to the first plate, such that the portion of the second plate is movable along the first plate. When walls are applied, they are preferably disposed in the transverse direction of the outsole, in which case the movability of the second plate along the first plate in the transverse direction is decreased and, therefore, the stability of the shoe in the transverse direction is increased, which is advantageous in view of the comfort to the wearer.

Preferably, the walls extend in the transverse direction from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion.

The pillar shaped supports or walls may be or may not be distinct parts of the outsole, and they may or may not have been made of different materials as the first and second plates. When they are made as distinct parts, they may be formed from rods or strips, respectively, fixedly attached to the first and second plates, for example by means of a glue or by welding. As an alternative, the first plate and the second plate, including the pillar shaped supports or walls, may have been produced as, and may represent together, a single part.

To increase the movability of the second plate along the first plate it is preferred to dispose a plurality of rollers between the first plate and the second plate. As used in this patent document, the term "roller" indicates a cylindrical or spherical body which can role or rotate. In this embodiment, the rollers may function in a similar manner as they function in a ball bearing or roller bearing. When pillar shaped supports or walls are applied, an additional advantage of disposing rollers between the first plate and the second plate resides in that it is less likely that the pillar shaped supports or walls collapse under the weight of the wearer because the rollers can disperse the weight of the wearer from the first plate to the second plate. The number of rollers may typically be in the range of from 3 to 100, inclusive, in particular in the range of from 5 to 50, inclusive, for example 9.

Preferably, the pillar shaped supports or walls, if any, are disposed between the first plate and the second plate in such a manner that they form, together with the first plate and the second plate, channels in which one or more of the rollers may be placed. Typically, such channels may be straight channels. Preferably, such channels extend in the transverse direction of the outsole and more preferably such channels extend from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion. It is also

preferred that the distance between the first plate and the second plate is equal to the diameter of the rollers. In some preferred embodiments the distance between the first plate and the second plate may be slightly less than the diameter of the rollers, to get a tight fit of the rollers between the first and the second plates. In such cases the distance between the first plate and the second plate may be in the range of from 0.05 to 0.5 mm, for example 0.2 mm, less than the diameter of the rollers. Typically, the width of the channels as determined by the distance between the pillar shaped supports or walls is larger than the diameter of the rollers. The number of channels may typically be in the range of from 3 to 30, inclusive, in particular in the range of from 5 to 25, inclusive, for example 9.

The rollers may be solid objects, but preferably they are hollow in order to reduce weight. The rollers may typically have a spherical shape. It is preferred that the rollers have a cylindrical shape. Hollow cylindrically shaped rollers may or may not have one or both ends closed. Preferably, the cylindrically shaped rollers are disposed in the channels with their axis in the transverse direction of the sole. In this manner the rollers are the most effective in increasing the movability of the second plate along the first plate in the longitudinal direction of the shoe, while decreasing the movability in the transverse direction. When the channels extend from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion, it is preferred that in each channel one cylindrically shaped roller is inserted which cylindrically shaped roller has a length equal to the length of the channel or less. Alternatively, a plurality of rollers, independent of their shape, may be inserted in each such channel with a total length which is equal to the length of the channel or less. For example, the roller or the plurality of rollers may occupy from 80 to 100 % of the length of the channel concerned.

Preferably, the channels may be provided with means which can prevent the rollers from escaping from the channels during use of the shoe of

this invention. For example, the first plate and/or the second plate may be provided with protrusions which form restrictions at the ends of the channels. Alternatively, cylindrically shaped rollers may be provided with a ring shaped protrusion located around the cylindrical shape and the channels may be provided with grooves which can receive the ring shaped protrusion when the cylindrically shaped rollers are in place. As another alternative, the channels may be provided with protrusions and the cylindrically shaped rollers may be provided with a ring shaped groove around the cylindrical shape which groove can receive a protrusion when the cylindrically shaped rollers are in place. Preferably such protrusions and grooves have dimensions such that the rollers can be inserted into the channels, for example by applying some force, while they prevent escape of the rollers from the channels. Protrusions provided at the ends of the channels may advantageously be maximized in size so that they can diminish the ingress of dirt into the channels.

The outsole of this invention, and portions of the outsole of this invention may typically be made from a flexible material, as a solid body, as a hollow body, as a foam body, as a fibre reinforced body, or as a multi-layer body comprising one or more reinforcing layers. Preferably, the flexible materials are also high in wear resistance and/or low in density, and/or they provide high friction, for example with the ground. The flexible materials may suitably be selected from flexible polymeric materials. Such flexible polymeric materials may be readily commercially available. Applicable flexible polymeric materials for use in the outsole outside the rollers, if any are present, may be selected from thermoplastic polymers, such as thermoplastic styrene - butadiene rubber, natural rubber, thermoplastic polyurethane, poly(vinyl chloride), (ethylene - vinyl acetate) copolymer and polyamide elastomer. (Ethylene - vinyl acetate) copolymer may also be referred to as “EVA” or “EVA polymer”. Alternatively, applicable flexible polymeric

materials may be selected from thermosetting resins, such as, for example, epoxy resin and unsaturated polyester resin.

Depending on the material chosen, the outsole of this invention, and portions of the outsole of this invention may be made by using a suitable conventional technique. For example, suitable techniques may be casting processes, such as injection moulding and resin casting; machining; and three dimensional printing, also referred to as 3D printing or additive manufacturing.

The rollers referred to hereinbefore may typically be made as solid bodies, as hollow bodies, as foam bodies, or as fibre reinforced bodies. Preferably, the rollers are made of a shock absorbing, bendable, low-fatigue, and/or light weight, flexible material. Suitable flexible materials for use in the rollers may be selected from thermoplastic polymers or thermosetting resins. The thermoplastic polymers are preferred and they may be selected from, for example, high density polyethylene, nylons, polyesters, and (ethylene - vinyl acetate) copolymers.

In a particular embodiment of this invention, the rollers are hollow objects made from a fibre reinforced flexible material, and filled with a pressurised gas or gas mixture, preferably having a low rate of diffusion in the flexible material, such as air, nitrogen, carbon dioxide, helium or argon. The fibre reinforcement may preferably be a glass, carbon, polyaramide, or wood, for example bamboo, reinforcement. This particular embodiment is advantageous because the presence of the hollow, gas filled rollers between the first and the second plates contribute to the resilience of the outsole and provides shock absorbing properties, which add to the comfort of the wearer. In another particular embodiment of this invention, the rollers are foam objects made from, for example, an (ethylene - vinyl acetate) copolymer. In the latter embodiment, the foam rollers provide improved resilience and shock absorbing properties.

The dimensions of the first plate and the second plate may independently be selected according to the size of the shoe. The first plate and the second plate may or may not have the same length or the same width. Typically, the length of the first plate and the length of the second plate may independently be selected in the range of from 2 to 20 cm, in particular in the range of from 5 to 15 cm. For example, the first plate may have a length of 12.9 cm and the second plate may have a length of 13 cm.

Typically, the width of the first plate and the width of the second plate may independently be selected in the range of from 2 to 15 cm, in particular in the range of from 5 to 13 cm. For example, the first plate may have a width of 10.6 cm and the second plate may have a width of 11.3 cm.

The thickness of the first plate and the thickness of the second plate may chosen depending from the mechanical characteristics of the flexible material. The thickness of the first plate and the thickness of the second plate may independently be in the range of from 1 to 10 mm, in particular in the range of from 1.5 to 7 mm. For example, the first plate may have a thickness of 2.6 mm and the second plate may have a thickness of 3.6 mm.

The pillar shaped supports or walls may have dimensions, in particular their thickness, which may be chosen depending from the mechanical characteristics of the flexible material. The thickness of the pillar shaped supports or walls may independently be chosen in the range of from 0.2 to 3 mm, in particular in the range of from 0.5 to 2.5 mm. For example, the pillar shaped supports or walls may have a thickness of 1.2 mm.

When rollers are applied, the diameter of the rollers determines to an extent the distance between the first plate and the second plate. The diameter of the rollers may independently be chosen in the range of from 2 to 20 mm, in particular in the range of from 5 to 15 mm. For example, the diameter of the rollers may be 8 mm. The rollers may all have the same diameter, however, it is conceivable that the rollers inserted in different channels have different

diameters, depending on the desirability to provide variations in the distance between the first plate and the second plate. When hollow rollers are applied, they may have a wall thickness in the range of from 0.1 to 5 mm, in particular in the range of from 0.2 to 3 mm, for example 1 mm. The rollers may be positioned such that the distance between the centres of the rollers in neighbouring channels is in the range of from 5 to 50 mm, in particular in the range of from 10 to 30 mm, for example 13.6 mm.

The surface of the second plate which faces away from the first plate, hereinafter referred to as "lower surface", may be designed as to accommodate contact with the ground. The lower surface may be designed such that its profile increases the friction with the ground. The profile is typically characterised by the presence of protruding parts and grooves. The profile may be extended to the portions of the outsole outside the second plate. If desirable, the second plate is a multi-layer system, typically a bi-layer system, and the profile is included in the layer of the second plate which is in contact with the ground. In an embodiment, the profile may be designed in a manner that protruding parts in the profile coincide with the presence of channels, in which case the protruding parts contribute to the strength of the second plate at locations where otherwise the second plate would be less strong due the presence of the channels. In another embodiment, the profile may be designed in a manner that grooves in the profile coincide with the presence of channels, in which case the grooves further weakens the second plate at locations where the second plate is less strong due the presence of the channels to the effect that at such locations the flexibility and resilience of the second plate increases.

The outsole of this invention may be provided with conventional features which may contribute to the comfort of the wearer. For example, one or both of the heel portion and the forefoot portion, and the first plate and/or second plate thereof, may be provided with hollow spaces which may act as

shock absorbing cushions. Such hollow spaces may or may not be filled with a pressurized gas or gas mixture, as referred to hereinbefore.

The shoe of this invention comprises an upper which is directly or indirectly attached to the outsole of this invention, for example by means commonly known in the art, in particular by using an adhesive or by sewing. A portion of the upper is directly or indirectly attached to the first plate. The outsole may be provided with a rim around the perimeter or portions of the perimeter of the outsole, rounding the surface of the outsole which faces away from the second plate and extending into the direction away from the second plate. The presence of such a rim lowers the peeling force on a bonding between the outsole and the upper and prevents, during use of the shoe, a foot from sliding in the transverse direction relative to the outsole. The second plate is located outside of the space enclosed by the upper and the outsole. The upper may be a conventional upper and may be provided, for example, with laces and/or straps, an internal lining, or cushioning. The shoe may or may not be provided with an insole and, if desired, a midsole. For more resilience, the insole and/or the a midsole, if present, may be made of an (ethylene - vinyl acetate) copolymer foam. A pair of shoes provides for a left shoe and a right shoe, configured to be worn at the left foot and the right foot, respectively. The shoe of this invention may preferably be an sports shoe, in particular suitable for use in athletic sports, such as running and jumping, or other sports in which running is an important element, such as football, baseball or rugby.

Conventional features, methods of manufacture and materials which may or may not be applied in connection of the shoe or outsole of this invention may be as disclosed in, for example, US 2009/0241377-A1, US 2012/0096741-A1, US 3087261, US 2710461, US D713134-S, CN 102132980-A, US 2004/0221483-A1, US 6402879-B1, WO 2013/022850-

A1, US 2015/0230549-A1, US 2014/0259748-A1, US 2014/0259743-A1, US 2011/0138652-A1, US 2008/0271342-A1, and US 2008/0155861-A1.

Now turning to the preferred embodiment of this invention as shown in FIGS. 3 to 7, FIG. 3 provides shoe 20 comprising upper 22 which is attached to outsole 2 having heel portion 4 and forefoot portion 6. Forefoot portion 6 comprises first plate 10, and, parallel with first plate 10, second plate 12. First plate 10 is attached to a portion of upper 22. Second plate 12 is located outside of a space (not visible in FIG. 3) enclosed by upper 22 and outsole 2. Second plate 12 extends between front end 8 of forefoot portion 6 and the location of forefoot portion 6 where second plate 12 is fixedly attached to first plate 10. This location is a narrow region extending in the transverse direction of outsole 2 from one longitudinal side of forefoot portion 6 to the opposite side of forefoot portion 6. In the side view of FIG. 3 this narrow region is depicted by the point indicated by reference 14. Outsole 2 is provided with rim 23 rounding surface 25 of outsole 2 facing away from second plate 12 and extending into the direction away from second plate 12, that is into the direction of upper 22. Rim 23 may be located in the proximity of front end 8, as drawn in FIG. 3. In an alternative, rim 23 may extend around larger portions of the perimeter of outsole 2 or may surround the perimeter of outsole 2 completely.

Walls 24 are disposed between first plate 10 and second plate 12 in such a manner that they form, together with first plate 10 and second plate 12, channels 26. Channels 26 extend in the transverse direction of outsole 2 from one longitudinal side of forefoot portion 6 to the opposite side of forefoot portion 6. Hollow cylinders 28 are placed in channels 26. The ends of channels 26 are provided with protrusions 30 which can prevent hollow cylinders 28 from escaping from channels 26 during the use of shoe 20. Protrusions 30 have dimensions such that hollow cylinders 28 can be inserted

into channels 26 by applying some force. Lower surface 32 of second plate 12 is provided with a profile which increases the friction with the ground.

FIGS. 4, 5 and 6 show forefoot portion 6 of the inventive outsole, having first plate 10, and, parallel with first plate 10, second plate 12. Second plate 12 extends between front end 8 of forefoot portion 6 and the location of forefoot portion 6 where second plate 12 is fixedly attached to first plate 10. This location is a narrow region extending in the transverse direction of outsole 2 from one longitudinal side of forefoot portion 6 to the opposite side of forefoot portion 6. In the views of FIGS. 4, 5 and 6 this narrow region is depicted by the point indicated by reference 14. Walls 24 are disposed between first plate 10 and second plate 12 in such a manner that they form, together with first plate 10 and second plate 12, channels 26. Channels 26 extend in the transverse direction of the outsole from one longitudinal side of forefoot portion 6 to the opposite side of forefoot portion 6. Hollow cylinders 28 are placed in channels 26. The ends of channels 26 are provided with protrusions 30 (not visible in FIG. 6) which can prevent hollow cylinders 28 from escaping from channels 26 during the use of the shoe. Protrusions 30 have dimensions such that hollow cylinders 28 can be inserted into channels 26 by applying some force. Lower surface 32 of second plate 12 is provided with a profile which increases the friction with the ground.

FIG. 7 shows fragment 34 of the forefoot portion of the inventive outsole, first plate 10, and second plate 12. Walls 24 are disposed between first plate 10 and second plate 12 in such a manner that they form, together with first plate 10 and second plate 12, channels 26. Channels 26 extend in the transverse direction of the outsole from one longitudinal side of forefoot portion 6 to the opposite side of forefoot portion 6. Hollow cylinders 28 are placed in channels 26. The distance between first plate 10 and second plate 12 is slightly less than the diameter of hollow cylinders 28 and the width of channels 26 determined by walls 24 is larger than the diameter of hollow

cylinders 28. Lower surface 32 of second plate 12 is provided with a profile which increases the friction with the ground. As shown in FIG. 7A, hollow cylinders 28 may be locked between first plate 10, second plate 12 and protrusions 36.

It is shown in FIG. 7B that upon bending the forefoot portion, portions of second plate 12 and first plate 10 move relative to each other as indicated by arrows 38, while the distance between first plate 10 and second plate 12 is maintained by walls 24 and hollow cylinders 28. The movement is facilitated by a rotation and movement of hollow cylinders 28, which rotation and movement are no longer blocked by protrusions 36. Grooves 40 increase the effective height of walls 24, thereby facilitating the rocking of walls 24 from the slightly backwards leaning positions as drawn in FIG. 7A towards the slightly forward leaning positions as drawn in FIG. 7B. The depth of grooves 40 may be in the range of from 0.5 to 2 mm, for example 0.9 or 1.1 mm.

The angle at which walls 24 lean backwards, as drawn in FIG. 7A, may or may not be the same for all walls 24. In a preferred embodiment, as shown in FIGS. 3 and 6, the angle is variable in that the angle is relatively small for walls 24 located in proximity of the location of the forefoot portion where second plate 12 is fixedly attached to first plate 10, and relatively large for walls 24 located in the proximity of the front end of the forefoot portion. The reason for such variability may be that, upon bending of the forefoot portion of the outsole as drawn in FIG. 1B, the shift of the second plate relative to the first plate is relatively small in the proximity of the location of the forefoot portion where second plate 12 is fixedly attached to first plate 10 and relatively large in the proximity of the front end of the forefoot portion.

The skilled person will understand that during the rocking of the walls from the slightly backwards leaning position as drawn in FIG. 7A towards the slightly forward leaning position as drawn in FIG. 7B, there may be an

intermediate position in which the walls adopt a slight S-shape and that in the position as drawn in FIG. 7B the walls may become slightly stretched.

FIG. 8 show a fragment 40 of the forefoot portion of the outsole of a further embodiment of this invention, comprising first plate 10 and second plate 12. Walls (not visible in FIG. 8) are disposed between first plate 10 and second plate 12 in such a manner that they form, together with first plate 10 and second plate 12, channels 26. Channels 26 extend in the transverse direction of the outsole from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion. Hollow cylinders 28 are placed in channels 26. Hollow cylinders 28 are provided with ring shaped protrusions 42 located around the cylindrical shapes. Channels 26 are provided with grooves 44 located in first plate 10 and second plate 12, which grooves 44 receive ring shaped protrusions 42. Ring shaped protrusions 42 and grooves 44 prevent hollow cylinders 28 from escaping from channels 26 during use of the shoe.

FIG. 9 show a fragment 46 of the forefoot portion of the outsole of again a further embodiment of this invention, comprising first plate 10 and second plate 12. Walls (not visible in FIG. 9) are disposed between first plate 10 and second plate 12 in such a manner that they form, together with first plate 10 and second plate 12, channels 26. Channels 26 extend in the transverse direction of the outsole from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion. Solid cylinders 48 are placed in channels 26. Solid cylinders 48 are provided with ring shaped grooves 50 around the cylindrical shapes. Channels 26 are provided with protrusions 52 located in first plate 10 and second plate 12. Ring shaped grooves 50 receive protrusions 52. Ring shaped grooves 50 and protrusions 52 prevent solid cylinders 48 escaping from channels 26 during use of the shoe.

CLAIMS

1. An outsole for a shoe which outsole comprises a heel portion and a forefoot portion, wherein

- the forefoot portion comprises a first plate, and, parallel with the first plate, a second plate,

- the second plate extends between the front end of the forefoot portion and a location of the forefoot portion where the second plate is fixedly attached to the first plate, and

- at least a portion of the second plate outside the said location is connected to the first plate, such that second plate outside the said location is movable along the first plate.

2. An outsole according to claim 1, wherein the location of the forefoot portion where the second plate is fixedly attached to the first plate is a straight narrow region extending in the transverse direction of the outsole.

3. An outsole according to claim 1 or 2, wherein the outsole further comprises a plurality of rollers between the first plate and the second plate.

4. An outsole according to any of claims 1 - 3, wherein the outsole comprises a plurality of pillar shaped supports or walls disposed between the first plate and the second plate, which pillar shaped supports or walls connect at least a portion of the second plate to the first plate, and allow movement of the second plate along the first plate.

5. An outsole according to claim 4, wherein the outsole comprises a plurality of walls disposed between the first plate and the second plate in the transverse direction of the outsole.

6. An outsole according to claim 4 or 5, wherein the outsole comprises a plurality of walls disposed between the first plate and the second plate in the transverse direction of the outsole and extending from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion.

7. An outsole according to any of claims 3 - 6, wherein the walls are disposed between the first plate and the second plate in such a manner that they form, together with the first plate and the second plate, channels in the transverse direction of the outsole, and wherein the outsole further comprises a plurality of rollers disposed in the channels.

8. An outsole according to claim 7, wherein the channels extend from one longitudinal side of the forefoot portion to the opposite side of the forefoot portion and wherein the one or more rollers disposed in a channel occupy from 80 to 100 % of the length of the channel concerned.

9. An outsole according to claim 7 or 8, wherein the rollers have a cylindrical shape and the rollers are disposed in the channels with their axis in the transverse direction of the outsole.

10. An outsole according to claim 7 or 8, wherein the rollers have a spherical shape.

11. An outsole according to any of claims 7 - 10, wherein the channels are provided with means which can prevent the rollers from escaping from the channels during use of the shoe.

12. An outsole according to claim 11, wherein the means which can prevent the rollers from escaping from the channels during use of the shoe comprise protrusions protruding from the first plate and/or the second plate and forming restrictions at the ends of the channels.

13. An outsole according to any of claims 1 - 12, wherein the first plate, the second plate and the pillar shaped supports or walls, if present, represent together a single part.

14. An outsole according to any of claims 1 - 13, wherein the outsole or a portion of the outsole is made from a flexible material.

15. An outsole according to claim 14, wherein the flexible material of the outsole or a portion of the outsole is selected from thermoplastic polymers.

16. An outsole according to claim 15, wherein, outside the rollers, if present, the flexible material of the outsole or a portion of the outsole is selected from thermoplastic styrene - butadiene rubbers, natural rubbers, thermoplastic polyurethanes, poly(vinyl chloride), (ethylene - vinyl acetate) copolymers and polyamide elastomers, and wherein the flexible material of the rollers, if present, is selected from high density polyethylene, polyamides, polyesters, and (ethylene - vinyl acetate) copolymers.

17. An outsole according to any of claims 1 - 16, wherein the outsole or a portion of the outsole is a solid body, a hollow body, a foam body, a fibre reinforced body, or a multi-layer body comprising one or more reinforcing layers.

18. An outsole according to claim 17, wherein one or more rollers, if present, are made of a flexible material as a solid body, as a hollow body, as a foam body, or as a fibre reinforced body.

19. An outsole according to claim 18, wherein one or more rollers, if present, are hollow objects made from a fibre reinforced flexible material, and filled with a pressurised gas or gas mixture.

20. A shoe comprising

- an outsole according to any of claims 1 - 19, and
- an upper which is attached to the outsole,

wherein the first plate of the outsole is attached to a portion of the upper and the second plate is located outside of the space enclosed by the upper and the outsole.

21. A shoe according to claim 20, wherein the shoe is a shoe for sports, in particular athletic sports.

FIG. 1

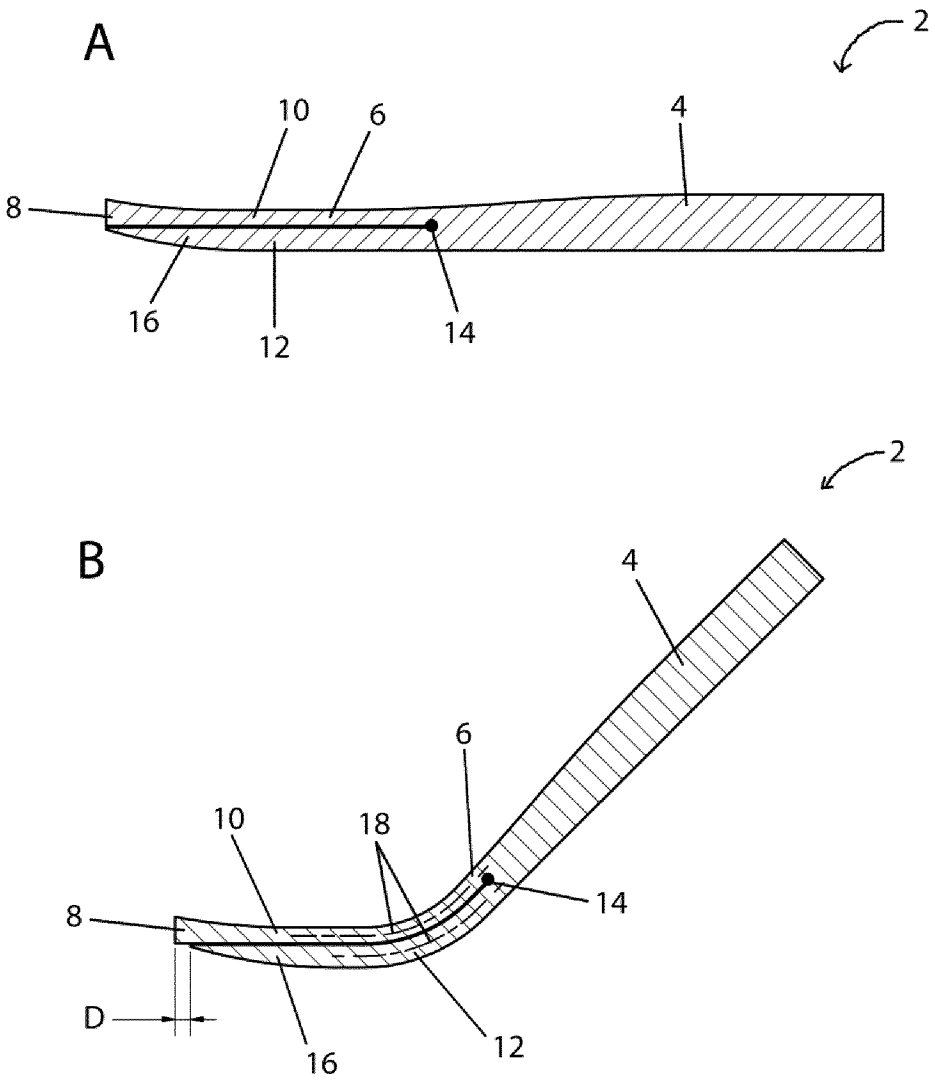


FIG. 2

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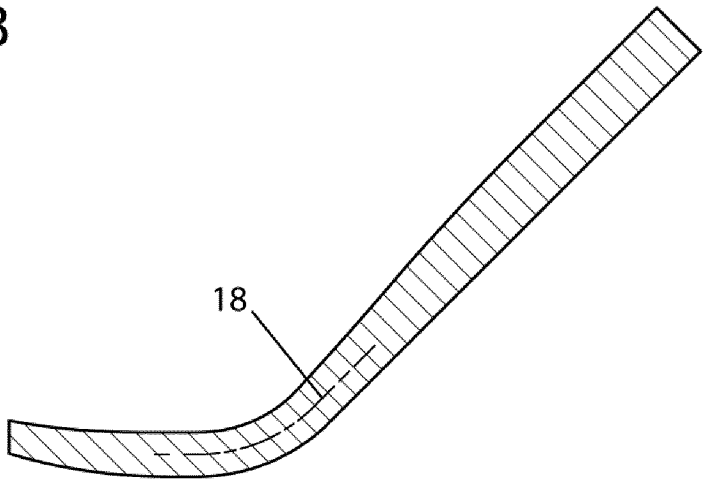

FIG. 3

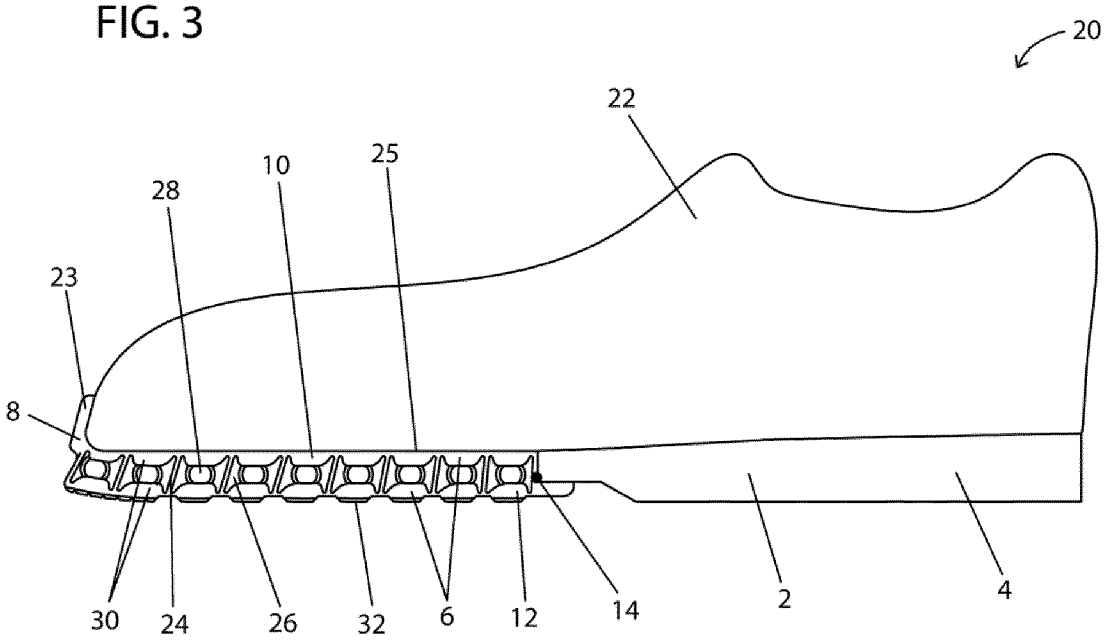

FIG. 4

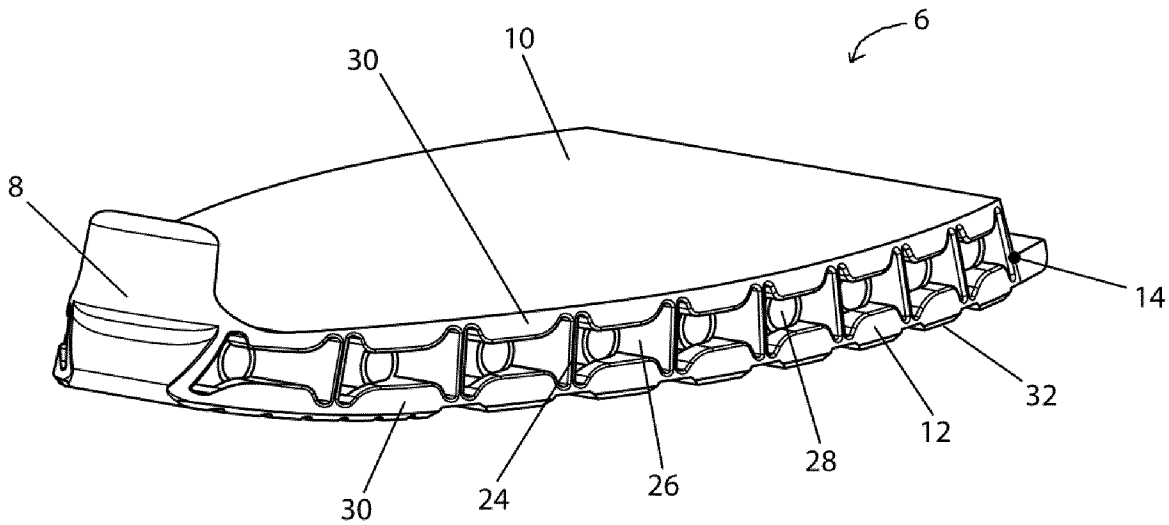

FIG. 5

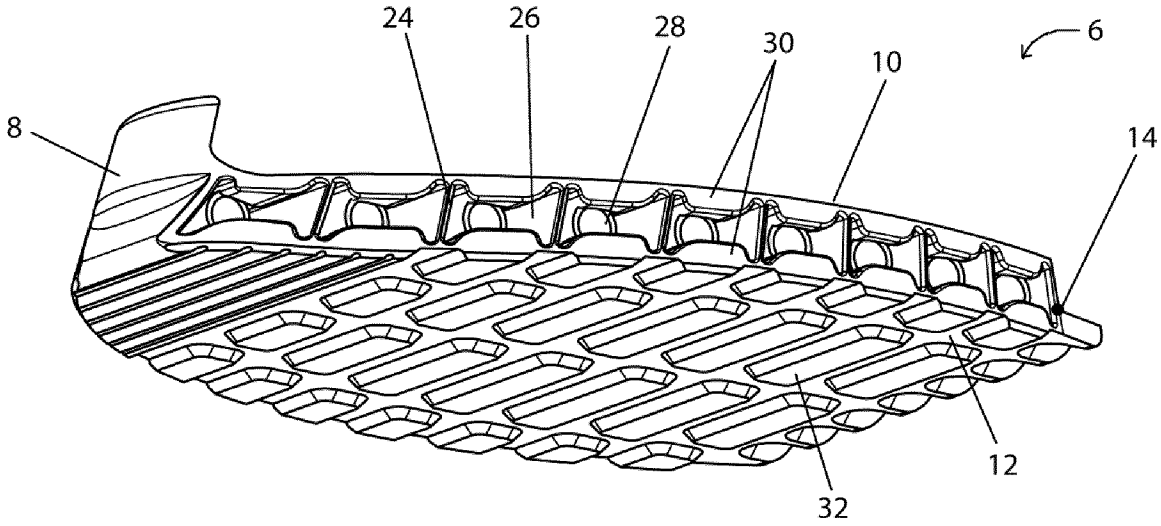

FIG. 6

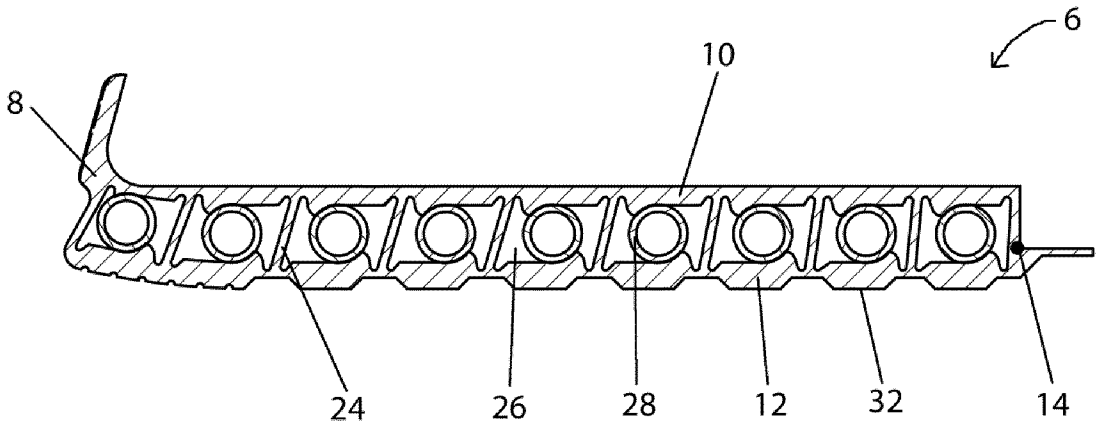

FIG. 7

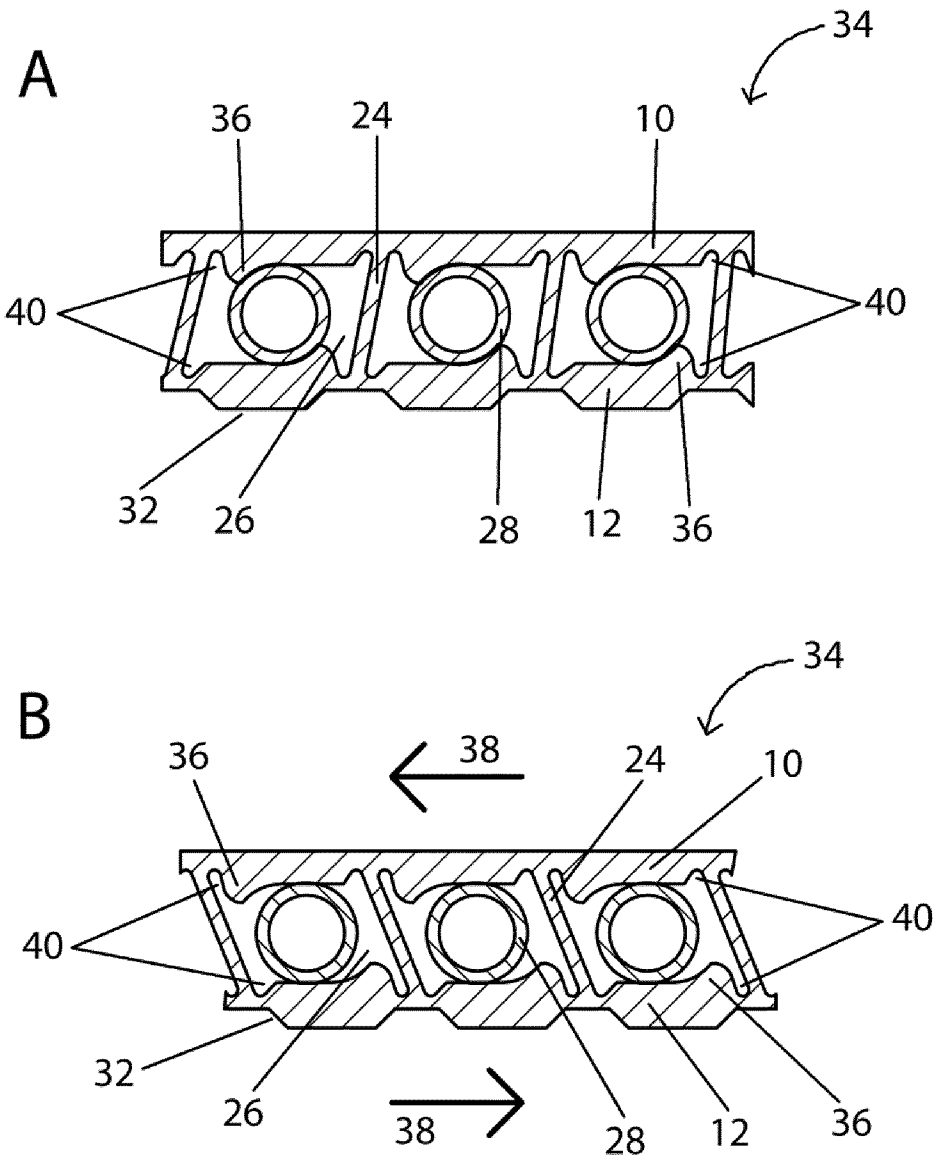
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FIG. 8

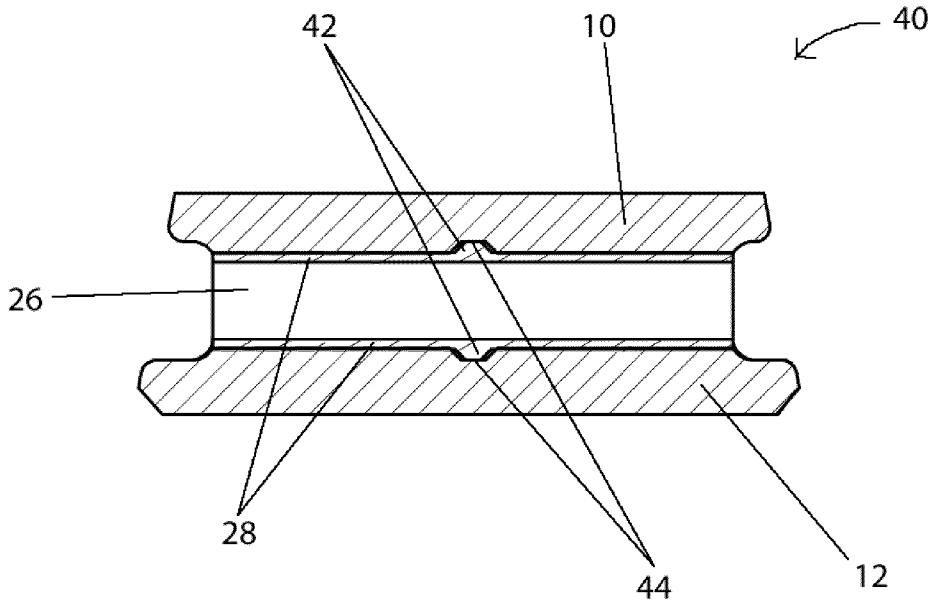
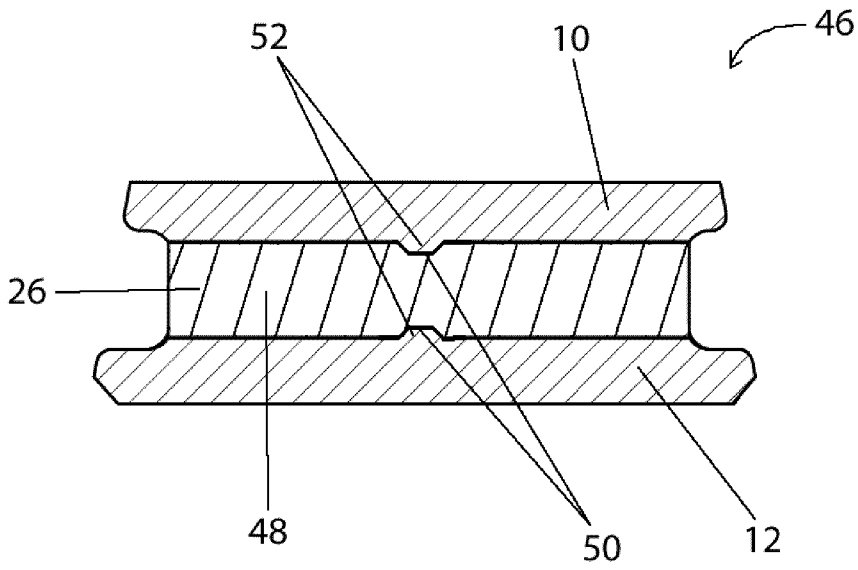


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/079168

A. CLASSIFICATION OF SUBJECT MATTER
INV. A43B13/12 A43B13/14 A43B13/18 A43B13/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A43B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 2007/062524 A1 (1493707 ONTARIO LTD [CA]; LEKHTMAN DAVID [CA]; LEKHTMAN LEON [CA]) 7 June 2007 (2007-06-07) figure *	1,2,4-6, 13-17, 20,21
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2017	24/02/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Duquénoy, Alain

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INTERNATIONAL SEARCH REPORT

International application No
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