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(54) **Studded Shoe**

(57) The invention relates in one aspect to a studded shoe having at least one stud 200, wherein the at least one stud 200 has an asymmetric shape which provides resistance against rotary motions of the studded shoe with respect to a ground surface. The at least one stud 200 is attached to the studded shoe so that it can perform translatory and / or rotary motions with respect to a first surface 130 determined by a sole 100.

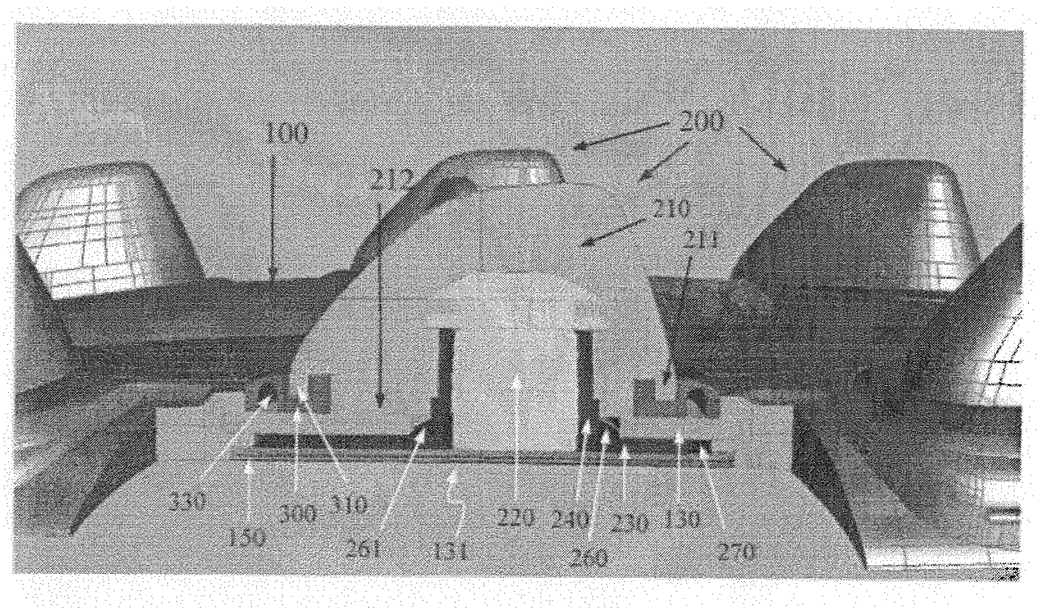

Fig. 2

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Description

1. Technical Field

[0001] The present invention relates to a studded shoe and a stud for a studded shoe.

2. The Prior Art

[0002] Studded shoes, which are in particular used for football, primarily have to provide good grip with a soft ground such as lawn. To this end, studded shoes are equipped with studs which penetrate the ground and prevent slipping of the studded shoe across the ground.

[0003] Rotationally symmetric studs have been known for this purpose for a long time. When such a stud penetrates the ground, the movement of the studded shoe is completely stopped within a fraction of a second. This causes enormous ground reaction forces which act on the body and in particular on the feet of the player. The ground reaction forces arise in particular during changes of the direction of movement and/or the speed and depend on the softness of the ground. They may lead to an early exhaustion of joints and muscles and may in the worst case cause injuries. Measurements in other sports such as basketball and tennis have shown that for example side cuts may cause forces in transversal directions of up to 1000 N.

[0004] Therefore, different attempts have been made in the prior art to reduce the ground reaction forces acting on the foot and the body by providing the rotationally symmetric studs with a certain elasticity. This increases the time taken to stop movement of the studded shoe so that the transferred momentum and the resulting forces are reduced.

[0005] To solve this problem, DE 23 13 646 describes screw-in studs having various damping elements and springs which enable an elastic movement of the stud vertical to the sole as well as in transversal direction and in tangential direction.

[0006] A similar approach can be found in DE 41 23 302 which describes a stud whose movement is dampened in particular in the direction vertical to the sole by arranging a damping element inside the stud.

[0007] EP 0 356 637 A1 further relates to a sports shoe whose outsole comprises integrally formed lobes with a deformable ring body. The elastic material of the deformable ring body enables a deflection of the lobe.

[0008] However, rotationally symmetric studs do not provide a secure grip of the studded shoe in the ground in all situations, in particular in connection with rotary motions. In an extreme situation, for example during a direction change, there may be only a single stud penetrating the ground while rotary forces act on the studded shoe. A rotationally symmetric stud does not provide resistance against these rotary forces so that the studded shoe turns and the player may not be able to perform the intended change of directions, and he may even lose his/her balance.

[0009] For these reasons asymmetric studs have been developed which provide increased resistance against rotary forces on the studded shoe and whose shape is in particular adjusted to the strains arising in football. For example, DE 198 50 449 B4 of applicant describes such a stud which has an elongate shape and which can effectively prevent turning of the shoe in the ground. Asymmetric studs, i.e. studs which do not have a rotationally symmetric shape but which have, for example, an elongate shape which is optimized for the respective purpose are also known in other sports.

[0010] However, the increased resistance of asymmetric studs against turning causes a new problem, since, similar to a sudden stop of a linear movement, also suddenly stopping a turning movement after the stud penetrates the ground leads to enormous rotational forces which add to the previously described ground reaction forces. The rotational forces act in particular on the joints, for example the ankle and the knee and may cause severe injuries.

[0011] US 5,377,431 and US 5,505,012 describe studs which are deformed, laterally deflected or translated in transversal direction when lateral forces act on the shoe in transversal direction of the sole. US 5,617,653 relates to studs which are releasably coupled to the base assembly in response to lateral forces for reducing injuries.

[0012] Further, US 5,361,518 describes a shoe with a damping element between sole and stud. The stud is both axially moveable and slightly tiltable laterally without being able to rotate.

[0013] The above-described studded shoes have the disadvantage that the moveability of the stud consists primarily in that the stud is moveable vertically with respect to the sole or can be deflected from its axis which is vertical to the sole. This contributes little to damping horizontal ground reaction forces which act parallel to the ground and which are insufficiently dampened by tilting or axial movement of a stud.

[0014] The rotationally symmetric stud described in fig. 4 of DE 2 313 646 is intended to enable elastic translations, rotations and tilt; however, according to the description these movements are only small and therefore enable only insufficient damping. Similarly, the stud described in US 5,377,431 and US 5,505,012 is limited in that the stud is only moveable in a transversal direction of the sole.

[0015] None of the mentioned document describes in particular a studded shoe which not only provides a good grip with the ground during rotary motions but also damping of the ground reaction forces resulting therefrom.

[0016] The present invention is therefore based on the problem to provide a studded shoe and a stud which not only provide good grip with the ground but which also dampen the ground reaction forces resulting therefrom to prevent injuries more effectively than the solutions known from the prior art.

3. Summary of the Invention

[0017] The present invention solves this problem according to a first aspect with a studded shoe having at least one stud, wherein the at least one stud has an asymmetric shape which provides resistance against rotary motions of the studded shoe with respect to the ground. The at least one stud is attached to the studded shoe so that it can perform translatory and / or rotary motions with respect to a first surface determined by a sole.

[0018] In contrast to the solutions known from the prior art, the claimed studded shoe comprises at least one asymmetric stud which is dampened against linear and rotational ground reaction forces by performing translatory motions or rotary motions or both with respect to the first surface. Translatory motions of the stud alone provide protection against linear ground reaction forces. In addition, they provide partial protection against rotational ground reaction forces whose rotation axis is located away from the rotational axis of the stud, more particularly against the linear portion of these forces. Further, rotary motions of the stud provide protection against rotational ground reaction forces, and particularly advantageous is a combination of translatory and rotary motions which provide protection against arbitrarily combined linear and rotational ground reaction forces. The studded shoe therefore not only provides a good grip with the ground during various movements, but also protection against overstraining or injuries to bones and muscles which are caused by suddenly stopping these movements during contact with the ground. The moveability of the stud with respect to the first surface can be implemented in different ways which are described in the following. Generally, in all cases a plurality of studs can move independently of each other and thereby react to the ground forces.

[0019] In a preferred embodiment the first surface in which the translatory and rotary motions of the stud are performed is flat. This enables a simple and cost-effective mechanical design of the moveable stud.

[0020] In an alternative embodiment, the first surface with respect to which the translatory and rotary motions of the stud are performed is curved. This facilitates adjustment of the movement of the stud to a curved sole so that a stud which has moved maintains its orientation with respect to the sole. This supports the advantageous effect of a curved sole, i.e. to enable an easier rolling-up of the foot during running or walking.

[0021] It is further preferred that the stud performs the translatory motion both in a first dimension as well as in a second dimension independent therefrom. This enables damping of the ground reaction forces in all directions of the first surface and therefore provides comprehensive protection for the wearer of the studded shoe. A dimension is understood to be a degree of freedom of motion. A two-dimensional motion therefore provides motions in all directions within a plane.

[0022] It is further preferred that a translatory motion in the first dimension and a translatory motion in the second dimension are limited, and it is particularly preferred that they are limited differently. This allows an adaptation to specific requirements. For example, a deflection of the stud in transversal direction of the sole may be larger than in the longitudinal direction of the sole.

[0023] In a preferred embodiment the at least one stud is adapted to perform the rotary motion in a first rotary direction and in a second rotary direction independent of the first rotary direction. In a further embodiment the rotary movement in the first rotary direction and the rotary movement in the second rotary direction are limited to different extents. This enables a flexible adjustment of the requirements for various sequences of movement both with respect to damping (stud rotates) as well as a secure grip with the ground (rotary motion is stopped).

[0024] It is further preferred that the translatory motions and / or the rotary motions of the at least one stud is blocked in an initial state in a blocking direction. This provides additional possibilities for adaptation. For example, it may not be desirable that the stud moves in running direction of the studded shoe since this leads to damping of the acceleration forces during a fast sprint. This problem can be solved by blocking a translatory motion of the stud in running direction.

[0025] In one embodiment the at least one stud comprises an attachment device having a second surface. It is further preferred that the first surface is arranged at the sole of the studded shoe and that the second surface engages behind the first surface. In a further embodiment, the second surface does not engage behind the first surface but is arranged between the stud and the first surface.

[0026] This solution enables a secure attachment of the stud to the studded shoe since the second surface of the attachment device engages the first surface of the sole. In one embodiment, the stud and the second surface of the attachment device of the stud "clamp" the first surface of the sole between the stud and the second surface and thereby enable a robust attachment of the stud to the first surface. Further, this attachment enables two-dimensional movements of the stud with respect to the sole. This solves the problem that an asymmetric stud (in contrast to a rotationally symmetric stud) has to have a particular orientation while enabling rotary motions. This problem cannot be solved by a simple screw-in stud.

[0027] In a further embodiment, the second surface is slideably arranged on the first surface. This provides a secure and solid guidance for the movements of the stud.

[0028] It is further preferred that the attachment device of the at least one stud extends through an opening in the first surface. This provides a particularly solid attachment of the at least one stud to the first surface by centrally fixing the stud through the opening. Further, different shapes of the attachment device and the opening limit movements of the second surface with respect to the first surface and thereby limit movements of the stud with respect to the sole of the studded shoe. By varying the shapes of the opening and of (the cross section of) the attachment device, various limitations of the movement of the stud can be realized.

[0029] In one example, the opening of the first surface and a cross section of the attachment device comprise an oblong shape. This limits the rotary motions of the stud. In contrast, a circular shape of the cross section of the attachment device would not limit rotary motions of the stud.

[0030] In a further embodiment the studded shoe comprises a damping element which is connected to the studded shoe and the at least one stud.

[0031] Such a damping element fulfils several functions. First, the stud is elastically fixed with respect to the sole of the studded shoe and thereby provides an initial position of the stud. Further, the damping element provides a restoring force towards the initial position and in addition an elastic connection of the studded shoe and the stud.

[0032] It is further preferred that the damping element is arranged on an outside of the first surface. This facilitates manufacture and assembly of the studded shoe by a modular design. The outside is the side (e.g. a surface) which is turned towards the ground and which is simultaneously the side turned away from the foot of the wearer of the shoe.

[0033] This arrangement of the damping element provides in a particularly simple way a connection between the stud and the sole of the studded shoe, so that the damping element not only provides a restoring force, but simultaneously can be used as a seal between the stud and the sole of the studded shoe. In this way, the damping element effectively prevents the intrusion of moisture and dirt into the stud of the studded shoe.

[0034] In one embodiment, the damping element has a spring constant in the range of 60 to 90 N/mm, preferably about 75 N/mm, i.e., the damping element exerts a corresponding restoring force during a specific deflection of the stud. Measurements performed in the laboratories of applicant have shown that this range is particularly advantageous.

[0035] According to a further aspect the present invention relates to a stud for a studded shoe having a stud receptacle, wherein the stud receptacle comprises a first surface. The stud has an asymmetric shape which provides resistance against rotary motions of the studded shoe with respect to a ground surface. The stud comprises an attachment device to which a second surface can be attached, wherein the second surface is formed so as to enable a translational and / or a rotary motion with respect to the first surface.

[0036] This stud provides a good grip with the ground both with linear and rotary motions of the studded shoe and dampens the ground reaction forces resulting therefrom more effectively than the solutions known from the prior art.

[0037] Such a stud can be manufactured independently from the studded shoe for use either as a replacement part (to replace a broken or damaged stud), or it can be used as an exchangeable stud having a different functional property such as a different shape from the original stud. This applies also to the following stud.

[0038] According to a further aspect the present invention relates to a stud for a studded shoe, wherein the stud has an asymmetric shape which provides resistance against rotary motions of the studded shoe with respect to a ground surface. The stud comprises a first surface for attachment to the studded shoe and a second surface. The second surface is adapted to perform translational and / or rotary motions with respect to the first surface.

[0039] Further embodiments are described in further dependent claims.

4. Short Description of the Accompanying Figures

[0040] In the following aspects of the present invention are described with respect to the accompanying figures in more detail. These figures show:

Fig. 1: a schematic representation of the functional principles underlying the present invention;

Fig. 2: a schematic representation with a longitudinal section of a stud of a currently preferred embodiment of a studded shoe with a stud according to the invention;

Fig. 3: a further schematic representation of the embodiment of fig. 2 with a longitudinal section of a stud;

Fig. 4: a perspective view of a currently preferred embodiment of a studded shoe and a stud according to the invention wherein the stud has been partly cut open;

Fig. 5: a further perspective view showing details of the embodiment of fig. 4;

Fig. 6: an exploded view of parts of an embodiment of studded shoe with a stud;

Fig. 7: steps during the manufacture of a currently preferred embodiment of a studded shoe with a stud according to the invention; and

Fig. 8: graph showing the measurements of the force required to move a conventional stud versus a stud according to the invention.

5. Detailed Description of Preferred Embodiments

[0041] In the following, embodiments of the invention are described with respect to a studded football shoe and a stud for football shoes.

[0042] It is to be understood that the present invention is not limited to use in football shoes. The described studded shoe may be advantageously used in other sports and outdoor activities, including for example handball, rugby, American football, baseball, hockey, trekking, hiking and mountain climbing since it provides a good grip with the ground during both linear and rotary motions of the studded shoe and dampens the ground reaction forces resulting therefrom. Further applications could be use in protective footwear and safety footwear.

[0043] The functional principles underlying the present invention are schematically illustrated in fig. 1. Fig. 1 shows a bottom view of a sole of a studded shoe having several asymmetric studs 200. An asymmetric stud is understood to be a stud which is not rotationally symmetric. However, an asymmetric stud may comprise a symmetry axis, for example a mirror symmetry axis along a longitudinal axis.

[0044] The asymmetric stud illustrated in fig. 1 is elongated and provides resistance against rotary motions of the sole when the stud has penetrated the ground. In order to provide damping of rotational ground reaction forces resulting therefrom, stud 200 may perform rotary motions with respect to the sole, as indicated in the right part of fig. 1 by arrows. The rotary motions are performed with respect to a surface which is determined by the sole. The rotational axis is essentially orthogonal to the surface of the sole. A rotary motion is meant to be not only a pure rotation but also a rotation together with a linear translation, as explained in the following.

[0045] In addition, stud 200 enables translatory motions in the surface of the sole, as indicated in the left part of fig. 1 by arrows. This dampens ground reaction forces which are caused by linear movements when stud 200 penetrates the ground.

[0046] The functional principles of translational and / or rotary motions of an asymmetric stud described in fig. 1 can be realized in different ways, some of which will be described in the following.

[0047] A presently preferred embodiment of an asymmetric stud which is adapted to perform such rotary and / or translatory motions is illustrated in fig. 2. This figure shows a perspective view of a sole 100 of a studded shoe having multiple asymmetric studs 200, wherein a stud 200 is illustrated in a cross section.

[0048] As can be recognized in the longitudinal section in fig. 2, stud 200 comprises a stud body 210 which has an asymmetric shape. Stud body 210 may comprise plastic material such as TPU (thermoplastic polyurethane), preferably for a hard ground, or metal or ceramics, preferably for a soft ground. A first attachment device 220 is arranged inside stud body 210, wherein the first attachment device 220 extends below the lower edge of stud body 210 (the lower edge being the edge closest to the sole 100).

[0049] Studs can be manufactured from TPUs of different hardness. Compositions of TPU with a high fraction of rubber are used for the damping element 300 (see fig. 2). In order to provide improved slideability, the surfaces 130, 230 and cover plate 150 (see fig. 7) can be coated either with Teflon, or Teflon (PTFE) can be mixed with the TPU. Multi-component injection molding can be used to form and connect together the single parts. A two-part attachment device 220, 240 is preferably manufactured from metal which provides the highest stability of the stud and an improved fastening between attachment devices 220, 240 (see conical shape of attachment device 220).

[0050] Fig. 2 further shows second surface 230 which extends essentially parallel to sole 100. Second surface 230 is connected to the second attachment device 240 which encloses the first attachment device 220. Both attachment devices 220, 240 form a solid connection and enable a simple modular assembly of the second surface 230 to stud body 210.

[0051] Fig. 2 further illustrates that the lower edge of stud body 210 and second surface 230 enclose a first surface 130 which is connected to sole 100. The second surface 230 of stud 200 engages behind first surface 130 and thereby enables a particularly robust attachment of stud 200 to sole 100. Further, in this arrangement stud 200 is able to move in a plane determined by the first surface 130 in connection with the second surface 230.

[0052] In the embodiment shown in fig. 2, stud 200 engages behind the first surface 130 in that the first attachment device 220 and the second attachment device 240 extend through an opening 131 in the first surface 130. This leads to a robust attachment of stud 200 to sole 100.

[0053] In alternative embodiments (not illustrated), the stud engages behind the first surface in other ways, for example by an alternative connection element for connecting the stud body to the second surface, wherein the alternative connection element partially encloses the first surface. In further embodiments which are also not illustrated, the second surface can be arranged between the first surface and the stud body, wherein the second surface is moveably arranged using appropriate attachment means. For example, these means may comprise a magnetic connection of the first and the second surface which allows the surfaces to shift with respect to each other but not to separate from one another in a direction orthogonal to the surfaces. Further, clip-in mechanisms or a kind of straddling dowel extending through one of the surfaces are conceivable.

[0054] Referring again to fig. 2, the moveability of stud 200 is determined by distance 260 between the second attachment device 240 and the surface 130. Alternatively, the moveability of stud 200 can be determined by distance 270 between second surface 230 and sole 100.

[0055] In other words, the moveability of stud 200 is determined by the different shapes of the opening 131 in the first surface 130 and of the second attachment device 240 (i.e. the cross section along the first surface 130). In one embodiment, opening 131 and a cross section of the second attachment device 240 have an oblong shape. This enables a limitation of rotary motions of stud

200. By contrast, a circular shape of the cross section of the second attachment device 240 would not limit rotary motions of stud 200.

[0056] The described arrangements enable not only translatory motions, i.e. linear motions, of stud 200 in two independent dimensions, but in addition also rotary motions, wherein the rotational axis of the rotary motions is essentially vertical to sole 100.

[0057] In the embodiment of fig. 2, the first surface 130 and the second surface 230 are flat and thereby lead to a corresponding planar movement of stud 200. In other embodiments (not illustrated), the first surface 130 and the second surface 230 are curved and lead to a correspondingly curved movement of stud 200. The movement of stud 200 therefore follows the curved surface and can adapt to complex movements which include, for example, tilting of the studded shoe with respect to the ground and a corresponding tilting of the stud. Thereby the stud remains essentially vertical to the ground and provides optimal ground contact. Further, curved surfaces provide an adaptation of the movement of the stud to a curved sole so that a stud which has shifted its position maintains its vertical orientation with respect to the sole. This provides the advantageous effect of a curved sole which enables easier rolling-up of the foot during running.

[0058] In the described embodiments the first surface 130 glides both on the lower side of stud body 210 and on the second surface 230. In alternative embodiments (not illustrated), the movement of the surfaces with respect to each other is enabled by other means, for example by a ball-bearing which may in addition be supported by teflon-coating.

[0059] Fig. 2 further shows a damping element 300 which connects stud body 210 to sole 100. To this end, damping element 300 comprises a circumferential first groove 310 which engages a corresponding projection of stud body 210. Thereby, stud 200 is held in an initial position. In order to enable elastic movement of stud 200 and to provide a restoring force to the initial position, damping element 300 is preferably made from an elastic plastic material. A circumferential second groove 330 can be compressed during movements of stud 200 and thereby provides additional play.

[0060] Establishing an initial position for the stud provides additional possibilities for specific limitations of the movement of stud 200. As described above, distance 260 between the boundary of the first surface 130 and the second attachment device 240 may determine the play of stud 200. By establishing an initial position of stud 200 so that stud 200 touches the first surface 130, movement of stud 200 is blocked in a particular direction (i.e., orthogonal to the boundary of the first surface 130 at the touch point).

[0061] In this way, an undesired translatory motion of stud 200 in running direction can be blocked which would lead to a damping of the acceleration forces during a fast sprint. In the embodiment of fig. 2 this could be achieved by making distance 261 (on the side of the stud 200 in running direction) zero. This would prevent translation of stud 200 with respect to sole 100 in running direction.

[0062] Fig. 2 further shows that damping element 300 is arranged on the outside of first surface 130, i.e., on the side directed to the outside of sole 100. This enables a simple, modular assembly of a studded shoe. In particular together with the arrangement of damping element 300 between sole 100 and stud 200, damping element 300 can fulfil a further important function as a seal between sole 100 and stud 200. This prevents intrusion of moisture and dirt into the bottom side of stud body 210, i.e., the first surface 130 and the second surface 230. This is necessary to ensure that the stud 200 remains moveable. Preferably, damping element 300 is arranged at the boundary of the first surface 130.

[0063] Finally, fig. 2 shows a cover plate 150 which seals stud 200 with respect to the inside of sole 100. The inside of sole 100 is the side of the sole turned towards the foot of the wearer of the shoe. Also in the case of cover plate it is important to prevent intrusion of moisture and dirt in order to maintain the moveability of stud 200.

[0064] In the embodiment shown in fig. 2, damping element 300 directly rests on the first surface 130. In an alternative embodiment (not illustrated in fig. 2; see, however, fig. 5), there is a distance between the damping element 300 and the first surface 130 so that the bottom side 221 of stud body 200 does not rest on the first surface 130. This enables elastic movements of stud 200 vertical to sole 100, up to the magnitude of the distance.

[0065] Fig. 3 shows a further schematic representation of the embodiment of fig. 2, wherein the illustrated cross section of stud 200 is orthogonal to the cross section shown in fig. 2. In fig. 3, sole 100, cover plate 150 and stud 200 with stud body 210, first attachment device 220, second attachment device 240, and second surface 230 can be recognized. Further, fig. 3 shows the first surface 130 with opening 131 through which the second attachment device 240 extends. Damping element 300 is arranged on the outside of the first surface 130. Damping element 300 comprises a first groove 310 for receiving a corresponding projection 211 of stud body 210 and second groove 330.

[0066] Fig. 4 is a perspective view of details of an embodiment of stud 200, wherein the stud is partially cut open. As can be seen, fig. 4 shows sole 100, damping element 300, and stud 200 with stud body 210, first attachment device 220, second attachment device 240, and second surface 230. The figure illustrates an oblong, oval shape of the second surface 230 which widens in the part not visible in fig. 4.

[0067] Fig. 5 is another view of the stud of fig. 4 from a different perspective. Again, sole 100, damping element 300, and stud 200 with stud body 210, first attachment device 220, second attachment device 240, and second surface 230 can be seen. Further, fig. 5 shows the first surface 130 as a cross section. Only for clarification the second surface 230 does not rest on the first surface 130, as would be the case in a finally assembled state. As can also clearly be seen, in this embodiment there is a distance between the first surface 130 and bottom side 221 of stud body 210. This enables, as already mentioned above, elastic movements of stud 200 vertical to sole 100, up to the magnitude of this distance.

[0068] Fig. 6 is an exploded view of parts of an embodiment of a studded shoe with a stud. The figure shows sole 100, stud 200 with stud body 210, first attachment device 220, second attachment device 240, and second surface 230, first surface 130, and cover plate 150. Further, the figure illustrates an example of an opening 131 of the first surface 130, being essentially a rectangular shape having a semicircular shape at the ends. Cover plate 150 has an oblong, oval shape which is at one end wider than at the other end. This shape essentially corresponds to the shape of the first surface 130 and the second surface 230. Other embodiments deviate from these specific shapes and therefore lead to different limitations of the motion of stud 200.

[0069] Fig. 7 shows steps during the manufacture of a presently preferred embodiment of a studded shoe with a stud 200. In a first step 710, sole 100, first surface 130 and damping element 300 are mounted. In a second step 720, stud body 210 is connected to damping element 300, wherein stud body 210 is already connected to the first attachment device 220. View 730 shows this assembly step from the other side of sole 100, wherein the first attachment device 220 can be recognized. In step 740, the second attachment device 240 is positioned on the first attachment device 220 (not visible). Preferably, the first attachment device 220 has a conical shape so that the first attachment device 220 clamps to the second attachment device 240. Finally, cover plate 250 is mounted in step 740.

[0070] In an alternative method of manufacture, the sole with studs is at least partially manufactured by multi-component injection moulding in a mould. At least the sole, sole body, damping element and first surface can be manufactured by multi-component injection moulding.

[0071] A further embodiment of the invention relates to a stud for a studded shoe having a stud receptacle which comprises a first surface, wherein the stud is due to its shape adapted to provide resistance against rotary motions of the studded shoe with respect to a ground surface. The stud comprises an attachment device to which a second surface can be attached, wherein the second surface is formed so as to enable translatory and / or a rotary motions with respect to the first surface. In one embodiment, the second surface is releasably attached to the attachment device.

[0072] In these embodiments, the stud can be attached to the sole of the studded shoe at a later time, for example by a projection of the stud body with a groove of the damping element or an inverse arrangement or by other appropriate means.

[0073] A further embodiment of the invention relates to a stud for a studded shoe, wherein the stud is due to its shape adapted to provide resistance against rotary motions of the studded shoe with respect to a ground surface. The stud comprises a first surface for attachment to the studded shoe and a second surface. The second surface is adapted to perform translational and / or rotary motions with respect to the first surface.

[0074] Such a stud is adapted to be attached to a sole at a later time, using appropriate mounting means. For example, the sole could comprise a recess to which the sole is attached, for example, by a snap-in or click-on mechanism. In this way, manufacture of a studded shoe with a sole and the manufacture of a moveable stud can be separated which is advantageous for a modular manufacture.

[0075] A further embodiment of the invention which can be applied independently of the previous embodiments relates to a studded shoe with a stud as well as a stud for a studded shoe, wherein the stud has a rotationally symmetric shape. The stud is attached to the studded shoe so that the stud is adapted to perform translatory motions with respect to a first surface determined by a sole. Such translatory motions of the stud provide protection against linear ground reaction forces. In addition, they provide partial protection against rotational ground reaction forces whose rotation axis is located away from the rotation axis of the stud, more particularly against the linear portion of these forces. The studded shoe therefore provides not only good grip with the ground during various movements, but also protection against overstraining or injuries to bones and muscles which are caused by suddenly stopping these movements during contact with the ground. The moveability of the stud with respect to the first surface can be implemented in different ways which are described above.

[0076] In order to demonstrate the usefulness of the invention described herein, applicant has performed experiments in their laboratories. To this end, the applicant measured the forces required to deflect by different amounts a stud described herein. The forces required were compared to those which are required for deflecting a conventional, fixed stud; namely, also a conventional stud can be deflected as a result of the elasticity of the materials used. Such a comparison is illustrated in fig. 8, wherein curve 810 represents a measurement for a moveable stud according to the invention, and wherein curve 820 illustrates a measurement for a conventional, fixed stud. As can be recognized from the two curves, the deflection of the moveable stud at the same exerted force (Y-axis) is 25 % larger (X-axis) than the deflection of the conventional, fixed stud. This means a correspondingly larger damping of the ground reaction forces, since there is a correspondingly greater distance and therefore more time available for a deceleration. The ground reaction forces, which correspond to a change of momentum over time, are therefore correspondingly reduced.

[0077] The damping properties can be influenced and adjusted by the size and the shape of the opening in the first surface and / or the choice of materials. However, a large damping (e.g. very soft materials) provides a bad feeling during running. Increasing the deflection by 25% has turned out to be an optimum - sufficient damping and a good feeling during running.

[0078] As shown by curve 810 of the moveable stud, the damping element exerts, for example, a restoring force of 300 N at a deflection of 4 mm. This corresponds to a spring constant of about 75 N/mm. A preferred spring constant for this embodiment is therefore in the range of 60 to 90 N/mm.

Claims

1. Studded shoe with at least one stud (200), wherein the at least one stud (200) has an asymmetric shape which provides a resistance against rotary motions of the studded shoe relative to a ground surface, **characterized in that**
   the at least one stud is attached to the studded shoe so that the at least one stud (200) is adapted to perform translatory and / or rotary motions with respect to a first surface (130) determined by a sole (100).

2. Studded shoe according to one of the preceding claims, wherein the translatory and / or the rotary motions are limited.

3. Studded shoe according to one of the preceding claims, wherein the at least one stud (200) is adapted to perform the translatory motions in a first dimension and in a second dimension independent from the first dimension.

4. Studded shoe according to the preceding claim, wherein the translatory motions in the first dimension and the translatory motions in the second dimension are limited to different extents.

5. Studded shoe according to one of the preceding claims, wherein the at least one stud (200) is adapted to perform the rotary motions in a first rotary direction and in a second rotary direction independent of the first rotary direction.

6. Studded shoe according to one of the preceding claims, wherein the at least one stud (200) comprises an attachment device (220, 240) with a second surface (230).

7. Studded shoe according to the preceding claim, wherein the first surface (130) is arranged at the sole (100), and wherein the second surface (230) engages behind the first surface (130).

8. Studded shoe according to the preceding claim, wherein the second surface (230) is slideably arranged on the first surface (130).

9. Studded shoe according to one of the claims 6 to 8, wherein the attachment device (220, 240) of the at least one stud (200) extends through an opening (131) in the first surface (130).

10. Studded shoe according to one of the claims 6 to 9, wherein a cross section of the attachment device (220, 240) and the opening (131) in the first surface (130) each have an oblong shape.

11. Studded shoe according to one of the preceding claims, further comprising a damping element (300), wherein the damping element (300) is connected to the studded shoe and the stud (200).

12. Studded shoe according to the preceding claim, wherein the damping element (300) is arranged on an outside of the first surface (130).

13. Studded shoe according to one of the claims 11 to 12, wherein the damping element (300) has a spring constant in the range of 60 to 90 N/mm, preferably 75 N/mm.

14. Stud (200) for a studded shoe according to any of the claims 1 to 13, the studded shoe having a stud receptacle, wherein the stud receptacle comprises a first surface (130), wherein the stud (200) has an asymmetric shape which provides a resistance against rotary motions of the studded shoe with respect to a ground surface, and wherein the stud (200) comprises:

    a. an attachment device (220) to which a second surface (230) can be attached;
    b. wherein the second surface (230) is formed so as to enable translatory and / or rotary motions with respect to the first surface (130).

15. Stud (200) for a studded shoe, wherein the stud (200) has an asymmetric shape which provides a resistance against rotary motions of the studded shoe with respect to a ground surface, wherein the stud (200) comprises:

    a. a first surface (130) for attachment to the studded shoe, and
    b. a second surface (230);
    c. wherein the second surface (230) is adapted to perform translatory and / or rotary motions with respect to the first surface (130).

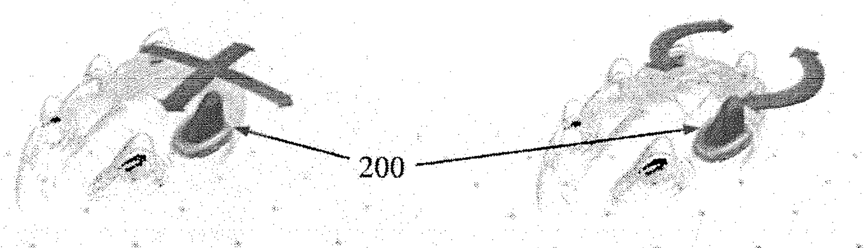

200

Fig. 1

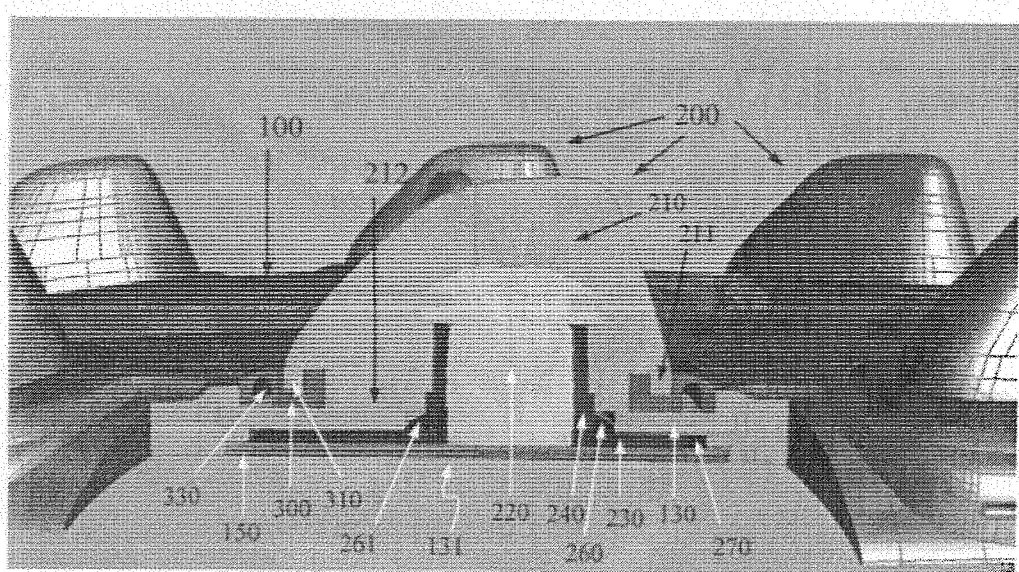

100
200
212
210
211
330
150
300
310
261
131
220
240
260
230
130
270

Fig. 2

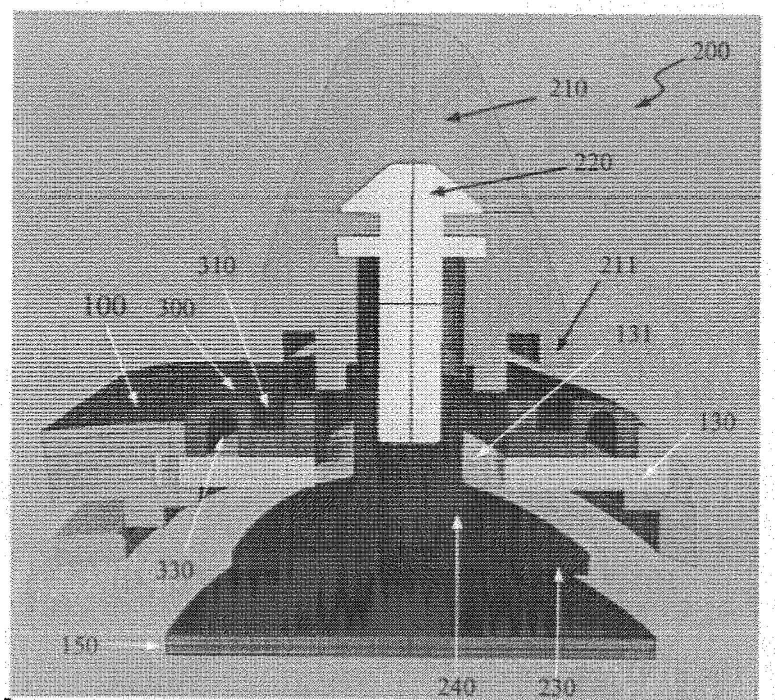

200
210
220
310
211
100
300
131
130
330
150
240
230

Fig. 3

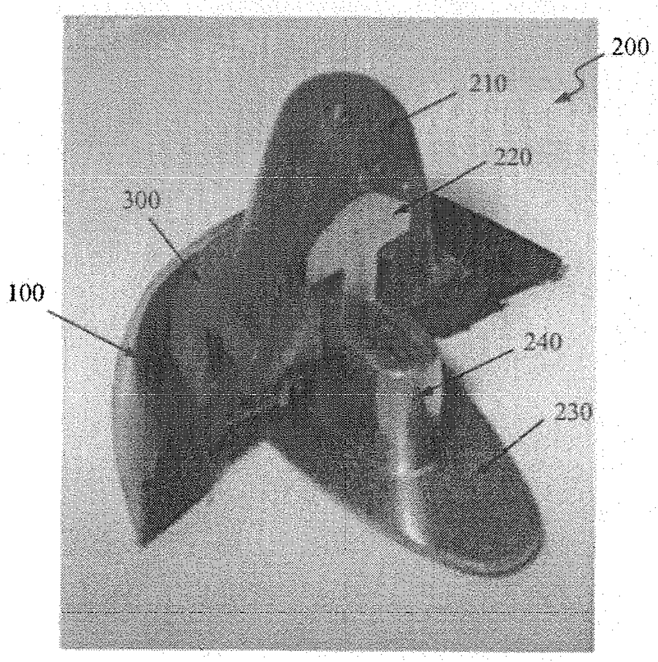
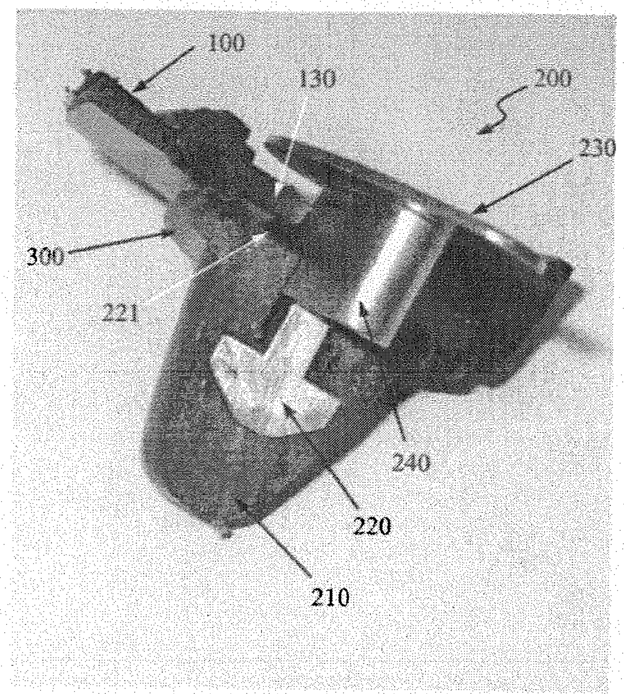

200
210
220
300
100
240
230

Fig. 4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130
200
230
300
221
240
220
210

Fig. 5

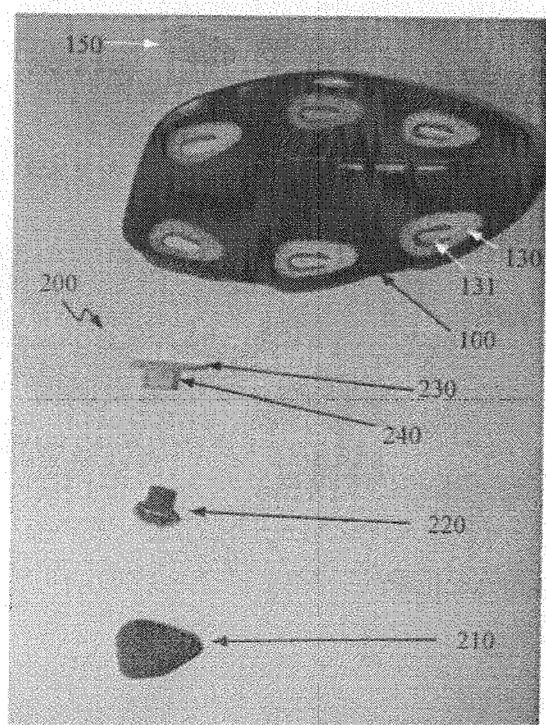
150
130
131
200
100
230
240
220
210

Fig. 6

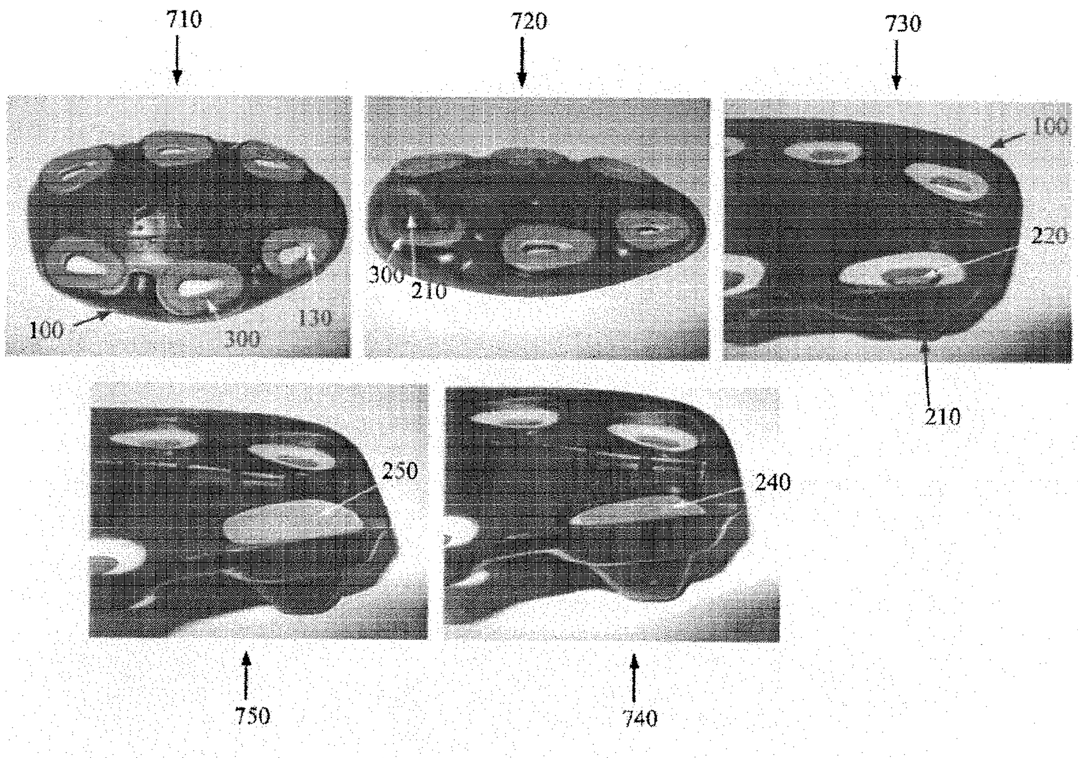
710
720
730
100
300
210
130
100
220
210
250
240
750
740

Fig. 7

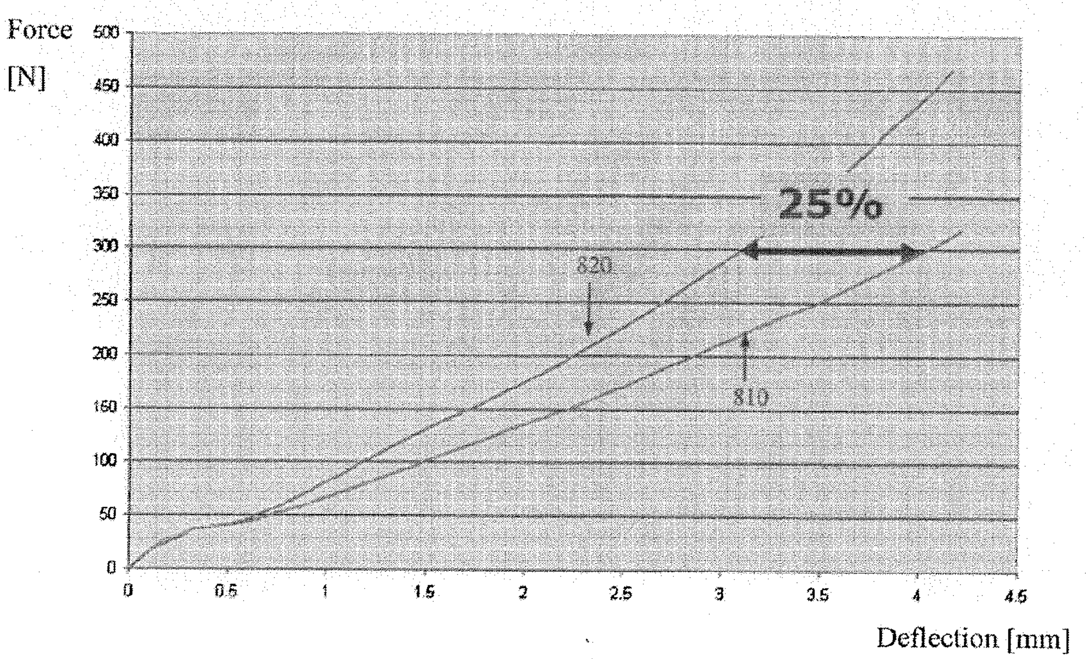
Force
[N]
500
450
400
350
300
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
25%
820
810
Deflection [mm]

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 5465

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Place of search	Date of completion of the search	Examiner
Munich	17 June 2010	Tejada Biarge, Diego

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