

ferably provided FOOTWEAR HAVING A DEFORMABLE INSOLE SUITABLE FOR
 m a cavity 10 adapted to adapt itself to the WEARER'S FOOT-SOLE SHAPE
 A integral with the wedg
 nous flexibility) The present invention concerns a type of footwear
 ing a granular insole indicated in the preamble of the main claim.
 s of preferably between known that the foot sole of a human being
 i the type of footwear shape that varies from individual to
 synthetic or natural. It has also been known for a long time
 or example, that the more shoes (such as those called "walking
 etate (EVA) granular have anatomically shaped insoles, the more
 cork or expanded materials comfortable and stable when the foot
 natively, granular insole ground, thereby preventing micro-traumas
 such materials (at bone or muscular level) for its wearer, in
 ones of cavity particularly those caused by prolonged use.
 med materials possess (or shoes) that have anatomically shaped
 ability, one insoles have been known for a long time;
 lding under the nevertheless, precisely because the shape of the
 as corresponding to the varies from person to person, this insole
 er's foot. In this way, a vaguely anatomical conformation, i.e. it is
 over part 20 it is possible designed to adapt itself to a generic
 s foot in a different insole of a generic user. In other words, the
 ording to the type of shoe insoles of footwear on the market are
 shaped so that they only partially adapt themselves
 e wearer's weight shape of the foot sole of each wearer. As a
 ted manner 25 on consequence, known anatomic footwear often is not,
 operates on the causing the wearer to experience significant
 arked K in figure 2 these in his feet, particularly after long
 i in the metatarsal periods, with obvious drawbacks.

Footwear whose insoles that deform continuously
 rely, for 30 the purpose permanently under the weight of the wearer,
 of insole 6 (and thereby adapt themselves to the shape of
 can be subdivided into foot sole, are widespread known. After use,
 ag zones: the former sole "bounces back" to its initial
 ace with the configuration. These solutions however, do not
 P in figure 3 offer adequate comfort, entail relatively high
 ayer so as to produce costs and are mainly used in footwear
 -rigid arch support special features, such as clogs.
 east partially soft) In addition, with time and use this footwear

loses its capability of adapting themselves to the shape of the foot sole.

An object of the present invention is that of providing an improved anatomic footwear as compared to the known solutions.

In particular, an object of the present invention is that of offering self-modelling anatomic footwear wherein the insole perfectly and permanently adapts itself to the shape of the specific user's foot sole.

A further object is that of offering footwear of the aforementioned type that has low production costs and offers, suitable stability to the foot when placed on the ground under any conditions of use, thus preventing bone or muscle micro-traumas in the wearer's lower limbs.

A further object of the present invention is that of offering footwear of the aforementioned type that, thanks to its anatomic nature, allows to suitably compensate incorrect impact of the foot on the ground.

These and other objects that will be obvious to experts in this field are achieved by footwear according to the attached claims.

The footwear according to this invention can be either a walking or a sports shoe. In the latter case, it could be equipped with known means capable of absorbing the impact with the ground, and at the same time return the maximum amount of the absorbed energy to the wearer's foot, substantially like a spring springing back.

In order to better understanding the present invention, merely as an example but by no means restrictive, the following drawings are attached, wherein:

Fig. 1 represents an exploded perspective view of a shoe according to the present invention;

Fig. 2 represents a bottom perspective view of

part of the shoe in Fig. 1;

Fig. 3 represents a cross-section along the 3-3 line in Fig. 1 but of the assembled shoe;

Fig. 4 represents a cross-section along the 4-4 line of Fig. 3;

Fig. 5 represents a partially exploded perspective view of a variant of the shoe in Fig. 1.

With reference to figures 1 to 4, the sports shoe in the present invention includes uppers A and a lower base or support part 1. The latter includes sole 2, for example, of synthetic rubber to which there is fixed by known methods a wedge 3 made of a known porous material (ethylvinylacetate - EVA) or a polyurethane or low-density rubber. The wedge has an upper recess 4 (with reference to Fig. 1), delimited by protruding edge 4A wherein there may be placed a mounting insole 5 made of, for instance, cork. A further insole 6 made, for instance, of fabric (not shown in Fig. 3) and on which the wearer's foot rests, can be placed on top of insole 5. On its lower surface, sole 2 shows known grooving 8 or parts thereof.

According to this invention, insole or mid-sole 6 on which the wearer's foot rests is permanently deformable after the shoe has been worn at least once. This deformation reflects the shape of the foot sole so as to adapt itself to the latter. In this way insole 6 takes on an anatomic form corresponding to the sole of the wearer's foot.

Deformation of the insole is preferably achieved by ensuring that it directly or indirectly rest on an underlying layer of soft material advantageously joined to wedge 3. This insole can be deformable over its entire surface or only in correspondence with particular zones.

With reference to the cited figures, in order to achieve the aforementioned deformation, the

shoe is provided with a sole 2 having at its bottom a recess 4 by layer 10 and endowed with an outer sole 2 and containing granules having a size of 0.7 and 4 mm, depending on this layer can be made of various materials. The latter, for example, granular ethylvinylacrylate (synthetic or natural), is in granular form. Layer 11 can be a mixture of particles placed in different zones, as the above-mentioned a different deformation layer 11 with varying weight in the various areas of different zones of the sole thanks to the action of the sole to support the wearer's manner, for example according to (walking or sports).

Since the sole is in a differentiated part 1 and principally responding to the heel (where layer 10 is thicker than marked by M in figure 3).

Alternatively of allowing deformation below, if any) layer 10 (several non-communicating instances, in correspondence of the foot's arch (marked by 1) is provided a granular layer 11 which give the wearer semi-rigid sole 3 is in itself at 1.

Therefore, during use layer 11 yields under the weight of the wearer. This yielding allows a corresponding deformation of insole 6. In particular, since this weight is distributed, in a natural way, mainly in certain zones of insole 6 (metatarsal M and heel K), these zones will undergo greater deformation than nearby zones (for example those supporting the side of the foot). The aforesaid deformation consists of the curving the insole towards the sole with the former sinking towards the latter. The granular material in layer 11 moves to the respective cavity 10 so as to allow the insole to yield towards the sole and, at the same time, gives support to the foot at the required spots, i.e. those in which the wearer's weight on the lower part (1) of the shoe is less. This permits greater comfort for the wearer and is less tiring for the foot during use. In addition, the special composition of the shoe in accordance with this invention affords less risk of damage to the wearer's bone and muscle structure during use, such as during sports activity.

It should be noted that, after a first movement of granular material from layer 11, and in any case, after that it reaches a final location inside cavity 10 of wedge 11 (preferably achieved after prolonged use by the wearer), this material is compacted (due to the weight of the wearer) so as to permanently remain in the above-stated location. In doing so, the insole on which the wearer's foot rests can permanently keep the anatomic shape obtained, which corresponds to the sole of the wearer's foot.

In order to further improve the comfort of the shoe, and for the purpose of absorbing the impact of the wearer's foot on the ground and returning to the latter at least part of the energy that would otherwise be lost in impact, at least one insert

13, comprising suitable means for permitting the mentioned dampening and return of energy to the foot, is planned in correspondence with the shoe's heel zone K. This insert could be of a type already
5 described in previous patent applications in the name of the same applicant: for example, it could incorporate an airtight housing in which at least one layer of deformable, barrel-shaped elements (not shown) is placed, these elements being bound
10 to each other at their widest, midway zones, with their opposite edges bound to the opposite surfaces of the housing. According to a variant, always the subject of another patent in the name of the same applicant, this insert could incorporate a housing
15 containing a fluid in the liquid state and one in the gaseous state (not shown) suitable for being absorbed by the liquid when the wearer, stepping on the ground, compresses the aforesaid insert; in this way the absorption of the gas by the liquid
20 generates a dampening effect so as to partially absorb the energy that the wearer transmits to the ground. When the wearer's pressure on the aforesaid insert stops, the gas is expelled by the liquid and, freeing itself inside the housing, generates a
25 kind of elastic thrust on the foot, making it easier to lift it from the ground.

Insert 13 is immersed in granular layer 11 which maintains it in the designated position (zone K). Alternatively, wedge 3 in the latter can
30 incorporate a special housing (bound by physically defined walls) suitable for housing and holding insert 13 in place.

According to a further embodiment of the invention, another insert 13A, of a type identical
35 or equivalent to the above cited one 13, could also be placed in the metatarsal zone M of support part 1, as shown by the broken line in figure 2.

A further embodiment of the invention is

represented in figure 5, where the parts corresponding to those of the already described figures are indicated with the same reference numbers. In this figure, the uppers are shown already joined to wedge 3 (on which at least insole 6, not shown, is positioned). According to the invention in the form under consideration, means suitable for returning energy to the wearer's foot after contact with the ground and subsequent lifting, whilst simultaneously supporting the foot in an adequate manner, are associated with wedge 3. These means, described in a previous patent of the applicant's, include at least one insole 40 made of composite materials and positioned between the wedge's cavity 10 and sole 2. Insole 4 is supplied with a first portion 50 made of a woven composite material (that is, it incorporates weft fibers T and warp fibers O combined together as in a normal fabric); these fibres can be of carbon fibre impregnated with a thermosetting resin (or carbon-resins) and/or carboresins of a fibrous material marketed as Kevlar (aramidic fibres impregnated with thermosetting resin). Where the carbon fibres are coupled with aramidic fibers, a fabric is obtained in which, for example, the weft is of carbon fibre and the warp is of aramidic fibre or Kevlar. The aforesaid weft-T (or warp-O) fibres are all arranged to be mutually parallel and all with a predetermined angle with respect to the shoe's longitudinal axis X (even though the weft fibres are at orthogonal to those of the warp).

A second portion 51 of woven composite material is associated to the first portion 50 in a known manner and is located in correspondence with the arch of the wearer's foot, and a third portion of woven composite material 52 placed in correspondence with wearer's metatarsal zone (which, as in the example shown in the figures

under consideration, can cover the entire part between the shoe's front tip 53 and portion 51). The second portion 51 and the third 52 define a second insole layer 55 made of a composite material. The first portion includes side tongues 50A and 50B.

More specifically first and second portions 51 and 52 have their fibres (carbon, aramidic or similar) arranged to cross each other in order to offer a rather significant torsional rigidity at the corresponding parts of the sole. In other words, weft T and warp O fibres in a portion (50 for example) are arranged at different spatial angles with respect to weft T' and warp O' fibres of the second portion (51). For example, with T are placed at 45° angles with respect to the sole's longitudinal axis X, and fibres T' are placed at 90° angles with respect to said axis X. In particular, the overlapping of portion 50 with portion 51 in the arch-support zone yields an assembly having high torsional rigidity. The arch-support part is moreover rigid also under flexing.

Portion 52 has instead the fibres that form it (weft T" and warp O") arranged in a single direction meaning by this that the weft and warp fibres in this portion are arranged in parallel with respect to a predetermined space orientation, i.e. all have predetermined angles with respect to axis X (though they themselves remain at 90° angles). The T" and O" fibres in portion 52 are parallel to the T and O fibers in portion 50 that are present in the latter's part cooperating with portion 52. The mono-direction fibres in portion 52 and the corresponding part of portion 50 (having the T and T" weft and the O and O" warps mutually parallel) permit metatarsal zone M of the sole to be flexible (in the direction indicated by arrow F), also in the case where portion 52 is associated

with portion 50 so as to allow normal bending in this zone around an axis W which is at right angles in respect of the shoe's longitudinal axis X and is positioned between the tip of shoe 53 and portion 51.

In the embodiment examined, on the shoe's lower part 1, sole 2 (fixed to insole 40) can be subdivided into two portions, 57 and 58, for the purpose of covering the insole at the metatarsal M zone and at the heel K zone respectively. Thus, according to the embodiment under consideration, insole 40 has two clearly separate physical parts, a rigid one corresponding to the shoe's arch support zone (P) and a flexible one positioned between the shoe's front tip 53 and the aforementioned zone P.

During use, the sole produced according to the invention will result sufficiently rigid to adequately support the wearer's foot during its movement; however, since the metatarsal zone is sufficiently flexible, the sole has an adequate "pliability" that does not negatively influence the bone or muscle structure of the wearer's foot, thus preventing micro-fractures that could be quite dangerous, above all when the wearer is an athlete. In addition, the flexibility in zone M, covered by portion 52 that extends from the shoe's tip 53 to portion 51, functions as an element for returning the maximum possible energy that the wearer exerts on the ground during movement, generating a significant thrust (very advantageous in the field of competitions, such as athletics or basketball).

Preferably, between insole 40 and wedge 3, and more precisely between the latter's cavity 10 containing granular layer 11 and the insole of composite materials 40, there should be a layer of pliable material (expanded material or rubber, for example) 60 that effectively closes cavity 10 and

acts as a dampening element for the force of the impact generated by the wearer on the ground during movement.

5 The embodiment of the invention represented in figure 5 permits obtaining a shoe that is anatomically adaptable to the foot of an athlete but without this feature preventing insole 40 from returning the aforementioned energy to the foot after impact with the ground and lifting from it.

10 According to a variant of the invention represented in figure 5, an overhang 59 protrudes from portion 51, spaced out from it so as to be coplanar with it. This overhang (or tongue) 59, preferably made of a composite material woven with
15 its weft and warp fibres oriented the same way as those of portion 50 and parallel to them (that is, mono-directional), penetrates into a corresponding housing 65 of portion 58 of sole 2. This construction form causes the stability of shoe 1,
20 and thus the correctness of support for the wearer's foot on the ground, to be increased.

Different construction forms for the invention have been described. Nevertheless, in view of the above detailed description, still others are
25 possible. For example, insole 6 itself could be made in a pliable manner (incorporating granular material inside it, for example). These other solutions are to be considered as falling within the scope of the present invention.

CLAIMS

1. Footwear incorporating uppers (A) and a lower foot-support part (1) joined to these uppers (A), this part (1) including a sole (2) on which a wedge (3) is positioned, housing at least one internal insole (6) suitable for making contact with the wearer's foot, characterised in that the insole (6) on which the wearer's foot rests can be deformed in a permanent manner after at least the first time the footwear is used, this deformation following the shape of the sole of the aforesaid foot, the said sole thereby taking on an anatomic shape corresponding to that of the sole of the the wearer's foot.

2. Footwear as claimed in claim 1, characterised in that the sole (6) rests, directly or indirectly, on pliable means (11) that yield under the weight of the wearer, these means permitting deformation of the insole, thereby causing the latter to permanently take on the specific shape of sole of the wearer's foot.

3. Footwear as claimed in claim 2, characterised in that the pliable means consist of a layer (11) of granular material arranged in containing means (3) positioned beneath the deformable insole (6).

4. Footwear as claimed in claim 3, characterised in that the granular material is of synthetic origin.

5. Footwear as claimed in claim 4, characterised in that the granular material is granulated ethylvinylacetate.

6. Footwear as claimed in claim 4, characterised in that the granular material is granulated synthetic rubber.

7. Footwear as claimed in claim 4, characterised in that the granular material is a granulated expanded material.



8. Footwear as claimed in claim 3, characterised in that the granular material is of a natural type.

9. Footwear as claimed in claim 8, characterised in that the granular material is granulated natural rubber or cork.

10. Footwear as claimed in claim 8, characterised in that the granular layer (11) contains granules of various materials.

11. Footwear as claimed in claim 3, characterised in that size of the granules making the pliable means's size ranges between 0.5 and 4 mm, the choice of size depending on the type of footwear i.e. on its intended use.

12. Footwear as claimed in claim 3, characterised in that the means housing the granular material is the wedge (3), the latter having a cavity (10) containing said layer.

13. Footwear as claimed in claim 11, characterised in that the cavity (10) containing the granular layer has varying depths in function of the different zones of the wedge, this depth being greater in correspondence to the zone (K) of the wedge (3), corresponding to the heel of the wearer's foot.

14. Footwear as claimed in claim 3, characterised in that the granular layer (11) is continuous, i.e. is arranged along the entire area of the insole (6) on which the wearer's foot rests.

15. Footwear as claimed in claim 3, characterised in that the granular layer (11) is discrete, having various portions that are separate and positioned in correspondence to different zones of the insole (6) on which the wearer's foot rests.

16. Footwear as claimed in claim 1, characterised in that it incorporates means (13, 40 and 60) suitable for absorbing the force of impact of the foot on the ground and returning energy to



the foot when it is lifted off the ground.

17. Footwear as claimed in claim 16, characterised in that the means for absorbing and returning energy (13) are sunk in the layer of granular material (11).

18. Footwear as claimed in claim 16, characterised in that the means for absorbing and returning energy (13) are located in a corresponding site in the wedge (3) between the latter and the sole (2).

19. Footwear as claimed in claim 16, characterised in that the means for absorbing and returning energy (13) incorporate at least one insert (13) having an airtight housing in which a number of barrel-shaped elements are located, these being bound to each other at their middest zones and bound by the envelope at their opposite ends.

20. Footwear as claimed in claim 16, characterised in that the means for absorbing and returning energy incorporate at least one insert (13) having a sealed housing containing at least two fluids, the first one being absorbable by the second so as to absorb the force generated by the wearer upon contact with the ground and store at least part of the energy that the wearer transmits to the ground whilst moving, the first fluid being expelled from the second when the foot is lifted off the ground so as to generate a thrust directed towards the foot itself.

21. Footwear as claimed in claim 16, characterised in that the means for absorbing and returning energy include a layer of pliable material (60), acting as dampening means, placed between the layer of granular material (11) and an element (40) of a composite material operating as a means for returning energy.

22. Footwear as claimed in claim 21, characterised in that the element (40) of composite



material is an insole and includes a rigid part located in correspondence with the arch support zone (P) of the sole, and a second, flexible part located between the shoe's front tip (57) and the arch-support zone (P), this second part being capable of flexing at least around one axis (W) located between the front tip (57) and the arch-support zone (P) of the shoe.

23. Footwear as claimed in claim 22, characterised in that the composite material of the sole (40) incorporates woven fibres, the fibres of the rigid first part being crossed and those of the flexible second part being mono-directional.

24. Footwear as claimed in claim 22, characterised in that the rigid first part of the element of composite material (40) includes at least two layers of woven composite materials, a first layer with weft and warp fibres being on a plane at an angle with respect to the shoe's longitudinal axis (X), the weft and warp fibres in the second layer being on a angled plane with respect to this axis different from that of the fibres in the first layer, thereby crossing to the latter.

25. Footwear as claimed in claim 22, characterised in that the flexible second part of the element of woven composite material (40) includes at least one layer of woven composite material in which the weft or warp fibres are on the same angled plane with respect to the shoe's longitudinal axis (X) i.e. they are mono-directional.

26. Footwear as claimed in claim 22, characterised in that the flexible second part of the element of woven composite material (40) includes a number of superimposed layers of woven composite materials, the weft and warp fibres of all of them being on same angled plane with respect



to the shoe's longitudinal axis (X).

27. Footwear as claimed in claim 22, characterised in that the element of composite material (40) includes an initial portion (50) of
5 woven composite material supporting a second and a third portion (51 and 52), also these being of woven composite materials and placed at least in correspondence with the metatarsal (7A) and arch support (6A) zones of the sole, the aforesaid
10 initial portion (50) having weft and warp fibres on the same plane as the corresponding fibres of the third portion (52), these fibres being on a different plane with respect to the corresponding fibres in the first portion which cross.
- 15 Footwear as claimed in claim 27, characterised in that the first portion (50) extends to all zones (M, P and K) of the shoe's support walls (1).

