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(54) **FOOTWEAR**

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Description

[0001] This invention relates to footwear and is, in particular, concerned with an article of footwear having a ventilated sole.

[0002] GB-A-2 165 439 describes an article of footwear having a resilient (e.g. rubber or plastic) sole, an internal air reservoir arrangement in the sole and a ventilation arrangement for venting the air reservoir arrangement externally.

[0003] There are advantages in constructing footwear from impermeable materials but problems arise in wearing the footwear as such materials interfere in the natural biological functions of the wearer's skin, in particular perfusion of the skin with oxygen and removal of water vapour.

[0004] According to the present invention there is provided an article of footwear in which the sole is formed of a substantially impermeable resilient material, the sole having internally an air reservoir arrangement connected to the interior of the footwear via perforations, at least one (preferably each) said perforation having along its length a relatively wide region open to the interior of the footwear and a relatively narrow region connecting the relatively wide region to the air reservoir arrangement, the sole further having a ventilation arrangement serving for venting the air reservoir arrangement externally of the footwear.

[0005] As used herein the expressions "relatively wide" and "relatively narrow" mean that the respective regions are wide and narrow relative to each other. For the avoidance of doubt it is also to be understood that the term "sole" in the present context includes the heel portion of the sole of an article of footwear.

[0006] The arrangement for venting the air reservoir arrangement externally of the footwear can include ventilation apertures opening to the outside of the footwear adjacent the sole, for example in the toe region of the footwear, or first ventilation apertures (again suitably in the toe region of the footwear) connecting the air reservoir arrangement to a zone between the upper outer of the footwear and a lining therefor, and second ventilation apertures remote from the first ventilation apertures and opening from said zone to the outside of the footwear, suitably at substantially the topmost part of the footwear.

[0007] Furthermore, it is preferred that each perforation itself is so formed as to restrict any tendency for air in the air reservoir arrangement to flow-back into the interior of the footwear through the perforation. Such a restriction of back-flow of air is most suitably provided for by giving the inner surface of the relatively wide region of the perforation a substantially domed or conical configuration closing towards the relatively narrow region at the apex of the dome or cone, creating a structure whereby a back pressure from the air reservoir arrangement may tend to collapse the dome or cone, closing the relatively narrow region at the apex, whereas a

forward pressure from the interior of the footwear tends to open the relatively narrow region of the perforation.

[0008] Each perforation in the sole part of the footwear is preferably generally circular when viewed along its length, and suitably has a minimum internal diameter $D_{\min}$ from about 0.01 mm to about 5 mm (e.g. about 1 mm) and a maximum internal diameter $D_{\max}$ approximately 1.5 to 20 (e.g. about 1.5 to about 5) times greater than $D_{\min}$. The centres of adjacent perforations may suitably be from about 10 mm to about 100 mm, typically approximately 20 mm, apart. The relatively narrow region of the perforation is straight-sided and is preferably no more than about 3 mm in length (more suitably about 0.5 to 2 mm) and each reservoir chamber preferably begins no more than about 5 mm (e.g. about 1 mm to about 4 mm) below the top surface of the sole. The perforations suitably taper in a domed configuration from the relatively wide regions to the relatively narrow regions, so that, for example, each perforation has up to approximately 50% of its length tapering from $D_{\max}$ to $D_{\min}$, and approximately 50% of its length is at $D_{\min}$.

[0009] In some instances it may prove advantageous to construct the sole of the footwear such that the perforation wall in the relatively narrow region is capable of resiliently expanding and contracting in use between a relatively closed condition, in which the perforation is sufficiently closed off to permit air to accumulate in the relatively wide region of the perforation under increased pressure, and a relatively open condition, in which the air accumulated in the relatively wide region can pass through the relatively narrow region into the air reservoir arrangement; it is believed that such an arrangement can lead to enhanced removal of moisture from the interior of the footwear, without significantly compromising the comfort and insulative properties of the footwear.

[0010] In the case of a venting arrangement including first ventilation apertures opening the air reservoir arrangement to a zone between the upper outer of the footwear and a lining therefor, and second ventilation apertures opening therefrom to the outside of the footwear, it is preferred that the lining be composed of a fabric such as is the subject of GB Patent No. 2,242,860, that is a fabric comprising a sheet formed of a substantially impermeable elastomeric (e.g. closed-cell neoprene) material having perforations provided therethrough, each perforation of the sheet (or at least of a portion thereof) having at least one relatively wide region and at least one relatively narrow region along its length to define an internal chamber open to a first side of the sheet (this being the side of the lining directed towards the interior of the footwear) and sufficiently closed to the other side of the sheet (the side of the lining directed towards the zone between the lining and the upper outer of the footwear) to permit air passing from the first to the other side of the sheet to accumulate in the chamber under increased pressure prior to passing to the other side of the sheet (that is into the zone between the lining and the upper outer). Such a fabric is

commercially available under the brand name STOMATEX (TM) (St. Albans Rubber Limited, Stanley, County Durham, England). It will be appreciated that when such a lining is employed, air passing therethrough will thereafter exit from the zone between the lining and the upper outer, together with air from the air reservoir arrangement in the sole of the footwear, via the second ventilation apertures. Such an arrangement is particularly preferred in footwear adapted for cold weather use, since heat exchange will occur as the evacuated warm moist air passes up through the uppers of the footwear, so warming the wearer's foot.

[0011] The air reservoir arrangement preferably comprises a series of interconnected chambers within the sole of the article of footwear, most preferably in the heel, intermediate and toe regions of the article of footwear. Such chambers are compressed in sequence during the rolling motion of walking; the heel chamber(s) first as the walker's weight is initially placed on the heel of the foot, then the intermediate chamber(s) as the walker's weight is placed on the instep and ball of the foot, and finally the toe chamber(s) as the walker's weight is placed on the big toe. This sequential compression forces air in the air reservoir arrangement forwards through the sole, towards the ventilation apertures of the footwear. The chambers are suitably interconnected by air-flow passages of a dimension narrow relative to the chambers but wider than the narrow regions of the perforations connecting the arrangement to the interior of the article of footwear. The perforations suitably connect between the top of each chamber and the upper surface of the sole in the interior of the article of footwear.

[0012] The sequential compression of the reservoir chambers and air-flow passages, in combination with the synchronous sequential occlusion of the perforations by the wearer's foot and the particular configuration of the perforations, restricts or prevents back-flow of moisture laden air within the sole.

[0013] The sole part of the article of footwear is suitably constructed (e.g. by moulding and/or pressing) from conventional resilient materials used for forming footwear soles. The uppers of the article of footwear (or, where appropriate, the outer portion thereof) are suitably constructed from materials conventionally used for footwear uppers. Thus, the article of footwear suitably has similar feel and comfort properties to conventional footwear.

[0014] In use the wearer's foot can "breathe", as will be explained in more detail below, via the perforations and air reservoir arrangement in the sole, and via the lining, and so interference with the natural biological functions of the wearer's skin is minimised.

[0015] For better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example and without limitation, to the accompanying drawing, in which:-

Figure 1 is a diagrammatic perspective view of the inside surface and one side of the sole of a boot, Figure 2 is a diagrammatic perspective sectional view taken on line II-II of Figure 1,

Figure 3 is a horizontal sectional view of the sole, Figure 4 is a diagrammatic longitudinal sectional view of the sole,

Figure 5 is a sectional side view of part of the sole and part of the upper of the boot,

Figure 6 is a sectional side view of a boot similar to the boot of Figures 1 to 5, shown worn on a foot, and Figures 7A, 7B and 7C show the boot of Figure 6 in successive stages of a step.

[0016] Referring first to Figures 1 to 5, the sole 1 is formed of a substantially impermeable resilient material, for example natural or synthetic rubber, with, internally, an air reservoir arrangement consisting of a number (in the form illustrated five) of individual reservoir chambers 2 interconnected by ducts 3 of a ventilation arrangement which, from the reservoir chamber 2 nearest the front of the sole, continue to first ventilation apertures 4 of the ventilation arrangement, this arrangement serving for venting the air reservoirs 2 externally of the boot.

[0017] In the form illustrated, the first ventilation apertures 4 open into a zone 5 between an upper outer 6 of the boot and a lining 7 therefor. In this form the ventilation arrangement is completed by second ventilation apertures 8 in the topmost part of the upper outer 6 that are remote from the first ventilation apertures 4 and which open to the outside of the boot from the zone 5. As will be explained below, the boot illustrated is a thermally insulating one for cold weather use. In an alternative boot or shoe (not illustrated) intended for other uses, the ventilation arrangement consists of the ducts 3 and a single set of ventilation apertures adjacent the sole, for example in the toe region of the boot or shoe, that are open to the outside of the boot or shoe.

[0018] Each air reservoir chamber 2 is open to the interior of the boot via perforations 9, each having a relatively wide region 9A open to the interior of the boot and a relatively narrow region 9B open to the air reservoir 2. Each perforation 9 is preferably generally circular when viewed along its length, and suitably has a minimum internal diameter D_{min} from about 0.01 mm to about 5 mm (e.g. about 1 mm) and a maximum internal diameter D_{max} approximately 1.5 to 20 (e.g. about 1.5 to about 5) times greater than D_{min} . The centres of adjacent perforations may suitably be from about 10 mm to about 100 mm, typically approximately 20 mm, apart. The relatively narrow region of the perforation is straight-sided and is preferably no more than about 3 mm in length (more suitably about 0.5 to 2 mm) and each reservoir chamber 2 preferably begins no more than about 5 mm (e.g. about 1 mm to about 4 mm) below the top surface of the sole 1. The perforations suitably taper in a domed configuration from the relatively wide regions 9A to the relatively narrow regions 9B, so that, for example, each

perforation has up to approximately 50% of its length tapering from $D_{\max}$ to $D_{\min}$, and approximately 50% of its length at $D_{\min}$.

[0019] The air reservoir chambers 2, ducts 3 and perforations 9 are provided in the sole 1 by conventional moulding and/or pressing processes, as will be readily appreciated by one skilled in this art.

[0020] The lining 7, which provides thermal insulation, is composed of any of the fabrics forming the subject of GB Patent No. 2,242,860, to which reference is directed. As GB 2,242,860 contains full description of the fabric, and the nature of its thermal insulating properties, detailed description will not be given herein. Suffice to say that the fabric comprises a sheet 7A formed of substantially impermeable material having perforations 7B provided therethrough, each perforation of the sheet 7A (or at least a portion thereof) having at least one relatively wide region and at least one relatively narrow region along its length to define an internal chamber open to the first side of the sheet (this being the side of the lining 7 directed towards the interior of the boot) and sufficiently closed to the other side of the sheet (the side of the lining 7 directed towards the zone 5 between the lining 7 and the upper outer 6 of the boot) to permit air passing from the first to the other side of the sheet (from inside towards the outside of the boot) to accumulate in the chamber under increased pressure prior to passing to the other side of the sheet (that is into the zone 5 between the lining 7 and the upper outer 6). It is preferred to use the commercially available STOMATEX (TM) closed-cell neoprene fabric, available from St. Albans Rubber Limited, Stanley, County Durham, England.

[0021] The lining 7 is free from attachments to the body of the boot except where it meets the sole 1, that is at 10 in Figure 4, and around the ankle opening.

[0022] In use, in the manner fully described in GB-2,242,860, air laden with moisture from the foot of the wearer constantly passes through the lining 7 into the zone 5. From here it is exhausted to the outside of the boot through the ventilation apertures 8.

[0023] Furthermore, air laden with moisture from the sole of the wearer's foot passes via the perforations 9, air reservoir chambers 2, ducts 3 and ventilation apertures 4 also into the zone 5 to be exhausted therefrom through the ventilation apertures 8. It is in this way that the wearer's foot is allowed to "breathe".

[0024] Referring now to Figure 6 and Figures 7A, 7B and 7C in which the boot shown has its air reservoir chambers 2 shown diagrammatically arranged as a posterior or heel air reservoir chamber 2A, an intermediate or instep air reservoir chamber 2B and a forward or toe air reservoir chamber 2C, but which in practice would be as the boot of Figures 1 to 5, it will be seen that when the foot 11 wearing the boot is clear of the ground (Figure 6), all the air reservoir chambers 2A, 2B and 2C, and all the ducts 3 are fully open. In this condition moisture laden air tends to pass through the perforations 9 into the chamber 2 by virtue of (a) a positive vapour pressure

gradient from the saturated vapour in the boot to the unsaturated wide region 9A of the perforations 9, that is by diffusion, (b) thermal convection from the high temperature region of the interior of the boot to the low temperature region of the chambers 2 and (c) saturated vapour naturally collecting in the wide regions 9A for forced convection into the chambers 2 when the sole is compressed.

[0025] As shown in Figures 7A to 7C, the passage of the moisture laden air to the ventilation apertures 4 is facilitated by the action of normal walking in which, at each step, first the heel is placed on the ground (Figure 7A) and then a progressive contact involving the rest of the foot occurs (Figures 7B and 7C), in the manner of a rolling wave. Once the toe end of the foot is in contact with the ground (Figure 7C) the heel begins to lift off until the whole foot is clear of the ground (Figure 6). Then the process repeats itself. As pressure is thus applied, air in the wide regions 9A of the perforations 9 is first forced into the chambers 2. At the same time the foot in contact with the perforations occludes the wide regions 9A to prevent back-flow into the interior of the boot. Moreover, the rolling wave of the foot causes compression of the posterior or heel air reservoir chamber 2A first (Figure 7A), thus forcing the air contained within it to move forward via the ducts 3 into the intermediate or instep air reservoir chamber 2B (Figure 7B). This process continues with the ducts and the chambers being progressively compressed as the foot progressively bears down on the sole until at the end of the cycle (Figure 7C) substantially all of the moisture laden air is pumped from the air reservoir chambers 2A, 2B and 2C and the ducts 3 into the zone 5 between the upper outer 6 and the liner 7. During this process the construction of the perforations 9 causes the relatively narrow regions 9B of the perforations to constrict against any air pressure in the chambers 2A, 2B and 2C, further to limit back-flow of moist "spent" air into the interior of the footwear.

[0026] During each step as the heel begins to lift off the ground again the posterior air reservoir chamber 2 regains its original shape and volume by elastic recoil.

[0027] As this reservoir chamber expands, more moisture laden air is drawn therein from the boot interior, and into the other chambers 2B and 2C as they regain their original shapes and volumes, to be expelled during the next step, and this process is continuous as normal walking continues. There is a pumping action forcing evacuation of excess water vapour from the boot.

[0028] It is to be noted that the ducts 3, as well as the chambers 2, collapse as downward pressure is applied by the foot, thereby to prevent back-flow from chamber to chamber.

[0029] The construction described is suitable for all types of cold weather boots with a substantial sole, the material selected for the sole being suitable for achieving the necessary compression and expansion of the air reservoir chambers.

[0030] Thermal insulation is not compromised and indeed a heat exchange will be experienced as the evacuated warm, vapour filled air passes up between the upper outer 6 and the lining 7.

[0031] As already stated, in footwear not intended for cold weather use, the lining 7 can be omitted and ventilation apertures to the outside can be provided to replace the apertures 4.

Claims

1. An article of footwear in which the sole (1) is formed of a substantially impermeable resilient material, the sole having internally an air reservoir arrangement (2, 3) connected to the interior of the footwear via perforations (9), the sole further having a ventilation arrangement (4, 5, 8) serving for venting the air reservoir arrangement externally of the footwear; characterised in that at least one said perforation has along its length a relatively wide region (9A) open to the interior of the footwear and a relatively narrow region (9B) connecting the relatively wide region to the air reservoir arrangement.
2. An article of footwear as claimed in claim 1, wherein each said perforation (9) as a said relatively wide region (9A) and a said relatively narrow region (9B).
3. An article of footwear as claimed in claim 1 or 2, wherein the ventilation arrangement (4, 5, 8) for venting the air reservoir arrangement externally of the footwear includes ventilation apertures (4) opening to the outside of the footwear adjacent the sole.
4. An article of footwear as claimed in claim 3, wherein the ventilation apertures open to the outside in the toe region of the footwear.
5. An article of footwear as claimed in claim 1 or 2, wherein the ventilation arrangement (4, 5, 8) for venting the air reservoir arrangement externally of the footwear includes first ventilation apertures (4) connecting the air reservoir arrangement to a zone (5) between the upper outer (6) of the footwear and a lining (7) therefor, and second ventilation apertures (8) remote from the first ventilation apertures and opening from said zone (5) to the outside of the footwear.
6. An article of footwear as claimed in claim 5, wherein said first ventilation apertures (4) are in the toe region of the footwear.
7. An article of footwear as claimed in claim 5 or 6, wherein said second ventilation apertures (8) open to the outside of the footwear at substantially the

topmost part of the footwear.

8. An article of footwear as claimed in any one of the preceding claims, wherein the or each perforation (9) itself is so formed as to restrict any tendency for air in the air reservoir arrangement to flow back into the interior of the footwear through the perforations.
9. An article of footwear as claimed in claim 8, wherein for restricting back-flow of air the inner surface of the relatively wide region (9A) of the perforation is of a substantially domed or conical configuration closing towards the relatively narrow region at the apex of the dome or cone, creating a structure whereby a back pressure from the air reservoir arrangement may tend to collapse the dome or cone, closing the relatively narrow region (9B) at the apex, whereas a forward pressure from the interior of the footwear tends to open the relatively narrow region (9B) of the perforation.
10. An article of footwear as claimed in any one of the preceding claims, wherein the or each perforation (9) is preferably circular when viewed along its length, and suitably has a minimum internal diameter $D_{\min}$ from about 0.01 mm to about 5 mm and a maximum internal diameter $D_{\max}$ approximately 1.5 to 20 times greater than $D_{\min}$.
11. An article of footwear as claimed in claim 9, wherein said minimum internal diameter $D_{\min}$ is about 1 mm and said maximum internal diameter $D_{\max}$ is about 1.5 to about 5 times greater than $D_{\min}$.
12. An article of footwear as claimed in claim 10 or 11, wherein the or each perforation tapers in a domed configuration from the relatively wide region to the relatively narrow region so that up to approximately 50% of its length tapers from $D_{\max}$ to $D_{\min}$, and approximately 50% of its length is at $D_{\min}$.
13. An article of footwear as claimed in any one of the preceding claims, wherein the perforation wall in the relatively narrow region (9B) is capable of resiliently expanding and contracting in use between a relatively closed condition, in which the perforation (9) is sufficiently closed off to permit air to accumulate in the relatively wide region (9A) of the perforation under increased pressure, and a relatively open condition, in which the air accumulated in the relatively wide region (9A) can pass through the relatively narrow region (9B) into the air reservoir arrangement (2, 3).
14. An article of footwear as claimed in any one of the preceding claims, wherein the centres of adjacent perforations are from about 10 mm to about 100 mm apart.

15. An article of footwear as claimed in claim 14, wherein said centres are approximately 20 mm apart.
16. An article of footwear as claimed in any one of the preceding claims, wherein the or each relatively narrow perforation region is straight-sided and is no more than about 3 mm in length.
17. An article of footwear as claimed in claim 16, wherein the or each relatively narrow perforation region is about 3 mm in length.
18. An article of footwear as claimed in claim 5 or any one of claims 6 to 17 as appendant directly or indirectly to claim 5, wherein the lining (7) is a fabric comprising a sheet formed of a substantially impermeable elastomeric material having perforations provided therethrough, each perforation of at least a portion of the sheet having at least one relatively wide region and at least one relatively narrow region along its length to define an internal chamber open to a first side of the sheet (this being the side of the lining directed towards the interior of the footwear) and sufficiently closed to the other side of the sheet (the side of the lining directed towards the zone between the lining and the upper outer of the footwear) to permit air passing from the first to the other side of the sheet to accumulate in the chamber under increased pressure prior to passing to the other side of the sheet (that is into the zone between the lining and the upper outer).
19. An article of footwear as claimed in claim 18, wherein the substantially impermeable elastic material is closed-cell neoprene.
20. An article of footwear as claimed in any one of the preceding claims, wherein the air reservoir arrangement comprises a series of interconnected chambers (2) within the sole of the article of footwear arranged to be compressed in sequence during the rolling motion of walking.

Patentansprüche

1. Fußbekleidungsstück, bei dem die Sohle (1) aus einem im Wesentlichen undurchlässigen elastischen Material besteht, wobei die Sohle im Inneren eine Luftreservoiranordnung (2, 3) aufweist, die über Perforierungen (9) mit dem Inneren des Schuhwerks verbunden sind, und wobei die Sohle außerdem eine Belüftungsanordnung (4, 5, 8) aufweist, die dazu dient, die Luftreservoiranordnung von außerhalb des Schuhwerks zu belüften, dadurch gekennzeichnet, dass mindestens eine Perforierung über ihre Länge einen relativ breiten Bereich (9A) aufweist, der sich zum Inneren des Schuhwerks hin

öffnet, und einen relativ schmalen Bereich (9B), der den relativ breiten Bereich mit der Luftreservoiranordnung verbindet.

2. Fußbekleidungsstück nach Anspruch 1, bei dem jede Perforierung (9) einen relativ breiten Bereich (9A) und einen relativ schmalen Bereich (9B) aufweist.
3. Fußbekleidungsstück nach Anspruch 1 oder 2, bei dem die Belüftungsanordnung (4, 5, 8) zur Belüftung der Luftreservoiranordnung von außerhalb des Schuhwerks Belüftungsöffnungen (4) aufweist, die sich nahe der Sohle zur Außenseite des Schuhwerks hin öffnen.
4. Fußbekleidungsstück nach Anspruch 3, bei dem sich die Belüftungsöffnungen im Zehenbereich des Schuhwerks zur Außenseite hin öffnen.
5. Fußbekleidungsstück nach Anspruch 1 oder 2, bei dem die Belüftungsanordnung (4, 5, 8) zur Belüftung der Luftreservoiranordnung von außerhalb des Schuhwerks erste Belüftungsöffnungen (4) aufweist, die die Luftreservoiranordnung mit einer Zone (5) zwischen dem Obermaterial (6) des Schuhwerks und einer Auskleidung (7) hierfür verbinden, sowie zweite Belüftungsöffnungen (8), die von den ersten Belüftungsöffnungen entfernt sind und sich von der Zone (5) zur Außenseite des Schuhwerks hin öffnen.
6. Fußbekleidungsstück nach Anspruch 5, bei dem die ersten Belüftungsöffnungen (4) sich im Zehenbereich des Schuhwerks befinden.
7. Fußbekleidungsstück nach Anspruch 5 oder 6, bei dem sich die zweiten Belüftungsöffnungen (8) im Wesentlichen am obersten Bereich des Schuhwerks zur Außenseite des Schuhwerks hin öffnen.
8. Fußbekleidungsstück nach einem der vorhergehenden Ansprüche, bei dem die oder jede Perforierung (9) selbst so ausgebildet ist, dass sie jegliche Tendenz der Luft in der Luftreservoiranordnung, durch die Perforierungen in das Innere des Schuhwerks zurückzuströmen, einschränkt.
9. Fußbekleidungsstück nach Anspruch 8, bei dem zur Einschränkung des Zurückströmens von Luft die Innenfläche des relativ breiten Bereichs (9A) der Perforierung im Wesentlichen kuppelförmig oder konisch ausgebildet ist und sich zu dem relativ schmalen Bereich am Gipfelpunkt der Kuppel bzw. des Konus hin schließt, wodurch eine Struktur geschaffen wird, durch die ein nach innen gerichteter Druck in der Luftreservoiranordnung die Kuppel bzw. den Konus zusammenklappen lassen kann

und damit den relativ schmalen Bereich (9B) am Gipfelpunkt verschließen kann, während ein nach außen gerichteter Druck aus dem Inneren des Schuhwerks den relativ schmalen Bereich (9B) der Perforierung öffnen kann.

10. Fußbekleidungsstück nach einem der vorhergehenden Ansprüche, bei dem die oder jede Perforierung (9) in Längsrichtung gesehen vorzugsweise kreisförmig ist und passenderweise einen minimalen Innendurchmesser $D_{\min}$ von etwa 0,01 mm bis etwa 5 mm und einen maximalen Innendurchmesser $D_{\max}$, der annähernd 1,5 bis 20-mal größer ist als $D_{\min}$, aufweist.

11. Fußbekleidungsstück nach Anspruch 9, bei dem der minimale Innendurchmesser $D_{\min}$ etwa 1 mm beträgt und der maximale Innendurchmesser $D_{\max}$ etwa 1,5 bis etwa 5-mal größer ist als $D_{\min}$.

12. Fußbekleidungsstück nach Anspruch 10 oder 11, bei dem die oder jede Perforierung von dem relativ breiten Bereich bis zu dem relativ schmalen Bereich in einer kuppelförmigen Ausführung so konisch zulauft, dass etwa 50% ihrer Länge von $D_{\max}$ bis $D_{\min}$ konisch zulaufen und etwa 50% ihrer Länge bei $D_{\min}$ liegen.

13. Fußbekleidungsstück nach einem der vorhergehenden Ansprüche, bei dem die Perforierungswandung in dem relativ schmalen Bereich (9B) in der Lage ist, sich während des Gebrauchs elastisch auszudehnen und zusammenzuziehen, und zwar zwischen einem relativ geschlossenen Zustand, in dem die Perforierung (9) ausreichend verschlossen ist, um zu ermöglichen, dass sich Luft unter erhöhtem Druck in dem relativ breiten Bereich (9A) der Perforierung ansammelt, und einem relativ offenen Zustand, in dem die Luft, die sich in dem relativ breiten Bereich (9A) angesammelt hat, durch den relativ schmalen Bereich (9B) in die Luftreservoiranordnung (2, 3) strömen kann.

14. Fußbekleidungsstück nach einem der vorhergehenden Ansprüche, bei dem die Mittelpunkte von nebeneinander liegenden Perforierungen zwischen etwa 10 mm und etwa 100 mm voneinander entfernt sind.

15. Fußbekleidungsstück nach Anspruch 14, bei dem die Mittelpunkte etwa 20 mm voneinander entfernt sind.

16. Fußbekleidungsstück nach einem der vorhergehenden Ansprüche, bei dem der oder jeder relativ schmale Perforierungsbereich eine gerade Seite hat und nicht länger als etwa 3 mm ist.

17. Fußbekleidungsstück nach Anspruch 16, bei dem der oder jeder relativ schmale Perforierungsbereich etwa 3 mm lang ist.

18. Fußbekleidungsstück nach Anspruch 5 oder nach einem der Ansprüche 6 bis 17, die direkt oder indirekt auf Anspruch 5 rückbezogen sind, bei dem die Auskleidung (7) ein Stoff ist, der aus einer dünnen Lage aus einem im Wesentlichen undurchlässigen elastomeren Material besteht, das mit Perforierungen versehen ist, wobei jede Perforierung mindestens eines Teilbereichs der dünnen Lage mindestens einen relativ breiten Bereich und mindestens einen relativ schmalen Bereich über ihre Länge hinweg aufweist, wodurch eine innere Kammer definiert wird, die zu einer ersten Seite der dünnen Lage (der Seite der Auskleidung, die zum Inneren des Schuhwerks gerichtet ist) offen ist und zur anderen Seite der dünnen Lage (der Seite der Auskleidung, die zu der Zone zwischen der Auskleidung und dem Obermaterial des Schuhwerks gerichtet ist) ausreichend verschlossen ist, um zu ermöglichen, dass Luft, die von der ersten zur anderen Seite der dünnen Lage strömt, sich unter erhöhtem Druck in der Kammer ansammelt, bevor sie zur anderen Seite der dünnen Lage (das heißt, in die Zone zwischen der Auskleidung und dem Obermaterial) strömt.

19. Fußbekleidungsstück nach Anspruch 18, bei dem das im Wesentlichen undurchlässige elastische Material geschlossenzelliges Neopren ist.

20. Fußbekleidungsstück nach einem der vorhergehenden Ansprüche, bei dem die Luftreservoiranordnung eine Reihe miteinander verbundener Kammern (2) in der Sohle des Fußbekleidungsstücks aufweist, die so angeordnet sind, dass sie während der Abrollbewegung beim Gehen nacheinander zusammengedrückt werden.

Revendications

1. Article formant chaussure dans lequel la semelle (1) est formée en un matériau élastique sensiblement imperméable, la semelle ayant intérieurement une disposition (2, 3) formant réservoir d'air reliée à l'intérieur de la chaussure par l'intermédiaire de perforations (9), la semelle ayant en outre une disposition (4, 5, 8) formant ventilation servant à ventiler l'air dans la disposition formant réservoir d'air à l'extérieur de la chaussure ; caractérisé en ce qu'au moins l'une des perforations le long de sa longueur comporte une région (9A) relativement large ouverte vers l'intérieur de la chaussure et une région (9B) relativement étroite reliant la région relativement large à la disposition formant réservoir d'air.

2. Article formant chaussure suivant la revendication 1, dans lequel chaque perforation (9) a une région (9A) relativement large et une région (9B) relativement étroite. 5
3. Article formant chaussure suivant la revendication 1 ou 2, dans lequel la disposition (4, 5, 8) pour la ventilation pour ventiler la disposition formant réservoir d'air extérieurement à la chaussure comporte des ouvertures (4) de ventilation débouchant à l'extérieur de la chaussure à côté de la semelle. 10
4. Article formant chaussure suivant la revendication 3, dans lequel les ouvertures de ventilation débouchent à l'extérieur dans la région de bout de la chaussure. 15
5. Article formant chaussure suivant la revendication 1 ou 2, dans lequel la disposition (4, 5, 8) de ventilation pour ventiler la disposition formant réservoir d'air extérieurement à la chaussure comporte des premières ouvertures (4) de ventilation reliant la disposition formant réservoir d'air à une région (5) entre l'extérieur (6) supérieur de la chaussure et un revêtement (7) pour celle-ci, et des secondes ouvertures (8) de ventilation à distance des premières ouvertures de ventilation et s'ouvrant à partir de la zone (5) vers l'extérieur de la chaussure. 20 25
6. Article formant chaussure suivant la revendication 5, dans lequel les premières ouvertures (4) de ventilation sont dans la région de pointe ou bout de la chaussure. 30
7. Article formant chaussure suivant la revendication 5 ou 6, dans lequel les secondes ouvertures (8) de ventilation débouchent vers l'extérieur de la chaussure sensiblement à la partie la plus supérieure de la chaussure. 35 40
8. Article formant chaussure suivant l'une quelconque des revendications précédentes, dans lequel la perforation (9) ou chaque perforation (9) soi-même est formée de manière à restreindre toute tendance de l'air dans la disposition formant réservoir d'air à s'écouler en retour vers l'intérieur de la chaussure par les perforations. 45
9. Article formant chaussure suivant la revendication 8, dans lequel pour restreindre le retour d'écoulement d'air, la surface intérieure de la région (9A) relativement large de la perforation est sensiblement de configuration en dôme ou conique se fermant en direction de la région relativement étroite au sommet du dôme ou du cône, créant une structure selon laquelle une pression en retour provenant de la disposition formant réservoir d'air peut tendre à faire s'évanouir le dôme ou le cône, fermant la région (9B) relativement étroite au sommet, tandis qu'une pression vers l'avant provenant de l'intérieur de la chaussure tend à ouvrir la région (9B) relativement étroite de la perforation. 50 55
10. Article formant chaussure suivant l'une quelconque des revendications précédentes, dans lequel la perforation (9) ou chaque perforation (9) est de préférence circulaire lorsqu'on la voit suivant sa longueur, et de manière appropriée a un diamètre $D_{\min}$ interne minimum compris entre environ 0,01 mm et environ 5 mm et un diamètre $D_{\max}$ intérieur maximum compris entre approximativement 1,5 et 20 fois $D_{\min}$.
11. Article formant chaussure suivant la revendication 9, dans lequel le diamètre $D_{\min}$ intérieur minimum est d'environ 1 mm et le diamètre $D_{\max}$ intérieur maximum est compris entre environ 1,5 et 5 fois $D_{\min}$.
12. Article formant chaussure suivant la revendication 10 ou 11, dans lequel la perforation ou chaque perforation est biseautée suivant une configuration en dôme à partir de la région relativement large vers la région relativement étroite de manière que jusqu'à approximativement 50% de sa longueur elle est en forme de biseau à partir de $D_{\max}$ jusqu'à $D_{\min}$, et que, sur approximativement 50% de sa longueur, son diamètre est $D_{\min}$.
13. Article formant chaussure suivant l'une quelconque des revendications précédentes, dans lequel la paroi de perforation dans la région (9B) relativement étroite est capable de s'étendre élastiquement et de se contracter élastiquement en utilisation entre un état relativement fermé, dans lequel la perforation (9) est suffisamment fermée pour permettre à de l'air de s'accumuler dans la région (9A) relativement large de la perforation sous une pression accrue, et un état relativement ouvert, dans lequel l'air accumulé dans la région (9A) relativement large peut passer à travers la région (9B) relativement étroite dans la disposition (2, 3) formant réservoir d'air.
14. Article formant chaussure suivant l'une quelconque des revendications précédentes, dans lequel les centres des perforations adjacentes sont à distance comprise entre environ 10 mm et environ 100 mm les unes des autres.
15. Article formant chaussure suivant la revendication 14, dans lequel les centres sont approximativement à 20 mm de distance les uns des autres.
16. Article formant chaussure suivant l'une quelconque des revendications précédentes, dans lequel la région de perforation ou chaque région de perforation

relativement étroite est à côté droit et n'a pas une longueur supérieure à environ 3 mm.

17. Article formant chaussure suivant la revendication 16, dans lequel chaque région de perforation étroite ou la région de perforation étroite a environ une longueur de 3 mm. 5
18. Article formant chaussure suivant la revendication 5 ou l'une quelconque des revendications 6 à 17 telles que dépendantes directement ou indirectement de la revendication 5, dans lequel le revêtement (7) est un tissu comportant une feuille formée d'un matériau élastomère sensiblement imperméable ayant des perforations formées à travers lui, chaque perforation d'au moins une partie de la feuille ayant au moins une région relativement large et au moins une région relativement étroite le long de sa longueur pour définir une chambre intérieure débouchant vers un premier côté de la feuille (ceci étant le côté du revêtement dirigé en direction de l'intérieur de la chaussure) et suffisamment fermé vers l'autre côté de la feuille (le côté du revêtement dirigé en direction de la zone entre le revêtement et l'extérieur supérieur de la chaussure) pour permettre à de l'air passant du premier côté vers l'autre côté de la feuille de s'accumuler dans la chambre sous une pression accrue avant de passer vers l'autre côté de la feuille (c'est-à-dire dans la zone entre le revêtement et l'extérieur supérieur). 10 15 20 25 30
19. Article formant chaussure suivant la revendication 18, dans lequel le matériau élastique sensiblement imperméable est du néoprène à cellules fermées. 35
20. Article formant chaussure suivant l'une quelconque des revendications précédentes, dans lequel la disposition formant réservoir d'air comporte une série de chambres (2) interconnectées à l'intérieur de la semelle de l'article formant chaussure disposées de manière à être comprimées en séquence pendant le déplacement en roulement de marche. 40

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