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HARTMANN et al.(10) **Pub. No.: US 2020/0022453 A1**(43) **Pub. Date: Jan. 23, 2020**(54) **SHOE, IN PARTICULAR A SPORTS SHOE****Publication Classification**(71) Applicant: **PUMA SE**, Herzogenaurach (DE)(72) Inventors: **Matthias HARTMANN**, Forchheim (DE); **Sabrina ZINNER**, Nürnberg (DE)(21) Appl. No.: **16/481,217**(22) PCT Filed: **Jan. 31, 2017**(86) PCT No.: **PCT/EP2017/000115**

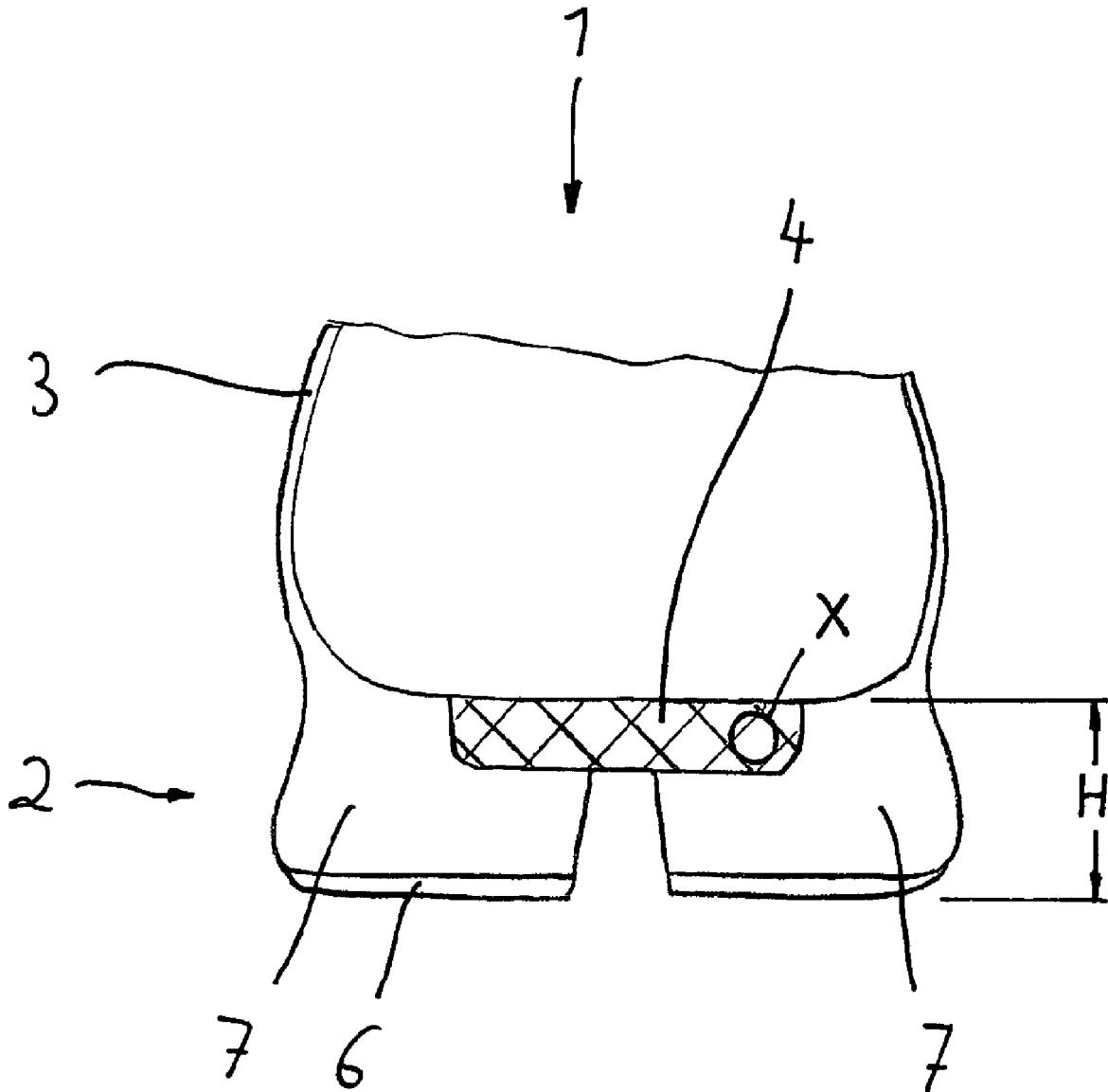
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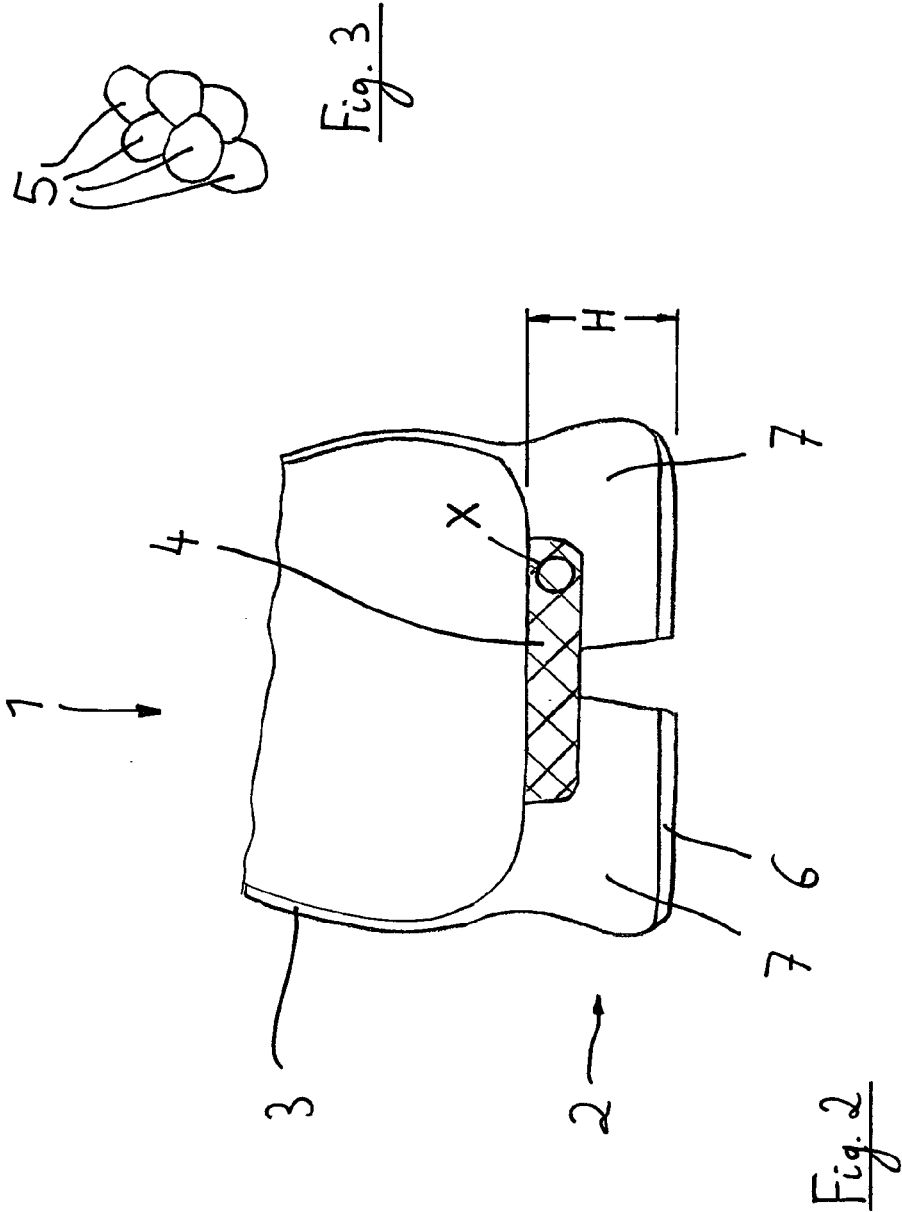
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(57)

ABSTRACT

A shoe, in particular a sport shoe, having a sole and a shoe upper part connected to the sole. In order to improve the use properties of the shoe, the sole is made, at least in sections, from an expanded thermoplastic polyolefin.





SHOE, IN PARTICULAR A SPORTS SHOE

[0001] The invention relates to a shoe, in particular sport shoe, having a sole and a shoe upper part connected to the sole.

[0002] For example, a shoe of the generic type is known from DE 10 2011 108 744 B4. Here an advantageously designed sports shoe is described in which expanded (foamed) thermoplastic polyurethane (E-TPU) is used as the material for the sole of the shoe. WO 2007/082838 A1 also describes that expanded thermoplastic polyurethane (E-TPU) can be advantageously used for shoe soles. This document also contains detailed information on this plastic material; reference is made to this document in this respect. DE 203 20 091 U1 shows another shoe of the generic kind; GB 2 016 259 A1 shows a similar solution.

[0003] Urethane-based thermoplastic elastomer, in particular in expanded form, is also described, for example, in WO 2010/010010 A1, to which reference is made in this respect. EP 2 452 969 A1 discloses a process for the production of expandable thermoplastic particles by post-impregnation. EP 2 565 225 A1 describes coated expandable polymer particles.

[0004] It has turned out that the mentioned material can already be used to achieve very good properties, in particular of a sports shoe, but that there is still a need for further optimisation. This applies in particular to the weight of the sole material, which should be as low as possible, but still have good spring and cushioning properties.

[0005] Therefore, it is an object of the invention to further develop a shoe of the above mentioned kind in such a way that the weight of the shoe and the spring and damping properties of the sole of the shoe can be influenced in a further improved manner. Furthermore, the manufacturability of the shoe should be simple.

[0006] The solution of this object by the invention is characterized in that the sole is made, at least in sections, from an expanded thermoplastic polyolefin (E-TPO), wherein the section of the sole consisting of expanded thermoplastic polyolefin (E-TPO) consists of a plurality of (at first, i.e. in the initial state) spherical or ellipsoidal plastic bodies which are joined to one another in a substance-locking manner, and wherein the dimensions of the single plastic bodies in the three spatial directions are between 0.5 mm and 5.0 mm, wherein the section consisting of expanded thermoplastic polyolefin forms an insert of the sole, wherein further sections of the sole consisting of a material which is not expanded thermoplastic polyolefin, wherein the further section of the sole, which does not consist of expanded thermoplastic polyolefin, consists at least in sections of an ethylene-vinyl acetate copolymer (EVA), of expanded thermoplastic polyurethane (E-TPU), of thermoplastic polyurethane (TPU), of thermoplastic elastomer (TPE), of polyamide (PA), of foamed polyurethane and/or of rubber material.

[0007] For the processing of said plastic bodies, reference is made to the above mentioned DE 10 2011 108 744 B4. The aforementioned shape of the plastic body refers to the initial product, i.e. before the plastic bodies are joined together (welded or glued under pressure); the bond causes the individual bodies to deform so that the spherical or ellipsoidal shape is no longer completely retained.

[0008] The substance-locking bond between the plastic bodies can be achieved by a welding process. The welding process can be carried out in particular by introducing steam

into a mould at a pressure of between 1.0 and 4.0 bar, preferably between 1.0 and 2.0 bar. This enables a precise geometric formation of the sole and a simple manufacturing possibility.

[0009] The substance-locking bond between the plastic bodies can also be achieved by an adhesive process with the addition of an adhesive.

[0010] The plastic bodies preferably have a weight between 5 mg and 10 mg.

[0011] The section of the sole consisting of expanded thermoplastic polyolefin has preferably have a density between 100 and 250 g/l (grams per litre).

[0012] However, it is preferred that the plastic bodies consisting of expanded thermoplastic polyolefin have a density between 70 and 140 g/l before they are joined together.

[0013] The section consisting of expanded thermoplastic polyolefin can form a midsole of the shoe. An outsole can then be placed under this.

[0014] The section consisting of expanded thermoplastic polyolefin can, according to a special embodiment of the invention, not extend over the entire height of the sole or midsole.

[0015] The section consisting of expanded thermoplastic polyolefin is preferably arranged in the heel region of the sole.

[0016] The proposed material, thus E-TPO, is an expanded thermoplastic elastomer based on olefins, wherein here mainly polypropylene (PP) or ethylene-propylene-diene rubber (EPDM) is used. Thermoplastic polyolefin is therefore a mixture of a polyolefin-based plastic (usually PP) and an elastomer such as EPDM.

[0017] TPOs are polymer blends that can be produced hard or soft depending on their composition. Hard TPOs, where PP and talc can make up around 75% of the composition, are often used as impact-reinforced plastics. However, soft TPOs have a significantly higher elastomer content, in some cases up to 70%. The advantage over other thermoplastic elastomers is that TPO is on average much cheaper.

[0018] Advantageous properties that are used in the proposed material selection are a wide temperature range in which the material can be used (-55°C. to $+115^{\circ}\text{C.}$) and a hardness range from 55 Shore A to 70 Shore D. The proposed material is very resistant to ageing.

[0019] In summary, it can be said that the invention provides for at least one section of the sole made of E-TPO, i.e. expanded thermoplastic polyolefin (i.e. an elastomer-based olefin). In terms of material properties, this material lies roughly between EVA and E-TPU and is therefore used advantageously in the sense of the above task.

[0020] The proposed material used is up to 30% lighter than E-TPU, which provides respective benefits. However, the springback property is comparable to that of E-TPU.

[0021] When processing the proposed material, and in particular when joining the individual plastic bodies by steam at the above preferred pressure between 1.0 bar and 4.0 bar (in particular between 1.0 and 2.0 bar), the pressure is advantageous lower than that required one for processing E-TPU for the same purpose. Thus, the manufacturing process is more effective than E-TPU processing.

[0022] Another advantage is a lower degree of yellowing compared to the E-TPU used up to now.

[0023] Due to the preferred use of very small, lightweight plastic bodies (in the preferred weight range between 5 mg and 10 mg), smaller bodies are available than is typically the case with the use of E-TPU. This results in a better forming of the tool shape on the sole and a higher productivity.

[0024] Finally, a higher resistance to hydrolysis compared to E-TPU should also be mentioned.

[0025] The sole can be connected to the upper part of the shoe (shoe upper) by sewing or gluing, which is known as such.

[0026] In the drawings an embodiment of the invention is shown.

[0027] FIG. 1 shows the side view of a sports shoe,

[0028] FIG. 2 shows the section A-B according to FIG. 1 through the sports shoe and

[0029] FIG. 3 shows schematically the detail "X" according to FIG. 2.

[0030] FIG. 1 shows a shoe 1 having a sole 2 and a shoe upper part upper 3. Shoe 1 has a midsole located between shoe upper part 3 and an outer sole 6 which forms the footprint of the shoe on the ground.

[0031] The central approach for the proposed design of the shoe is that the sole 2 consists at least in sections of an expanded thermoplastic polyolefin (E-TPO). FIG. 1 shows a section 4 of sole 2 that is designed as an insert that forms a part of the midsole. This section 4 consists of E-TPO.

[0032] The remaining sole 2, and in particular the midsole between the shoe upper 2 and the outer sole 6, consists of a section 7 which does not consist of E-TPO.

[0033] By doing so the spring and damping properties of the shoe can be beneficially influenced.

[0034] As can be seen from FIG. 2, in the embodiment the section 4 made of E-TPO does not extend over the entire height H of sole 2, but only part of it.

[0035] From the schematic magnification "X" according to FIG. 2, as shown in FIG. 3, it follows that the section 4 made of E-TPO is formed from a plurality of plastic bodies 5 which are substance-locked together. Thereby, individual plastic bodies 5, as advantageously specified above in terms of size and weight or density, are placed in a mould and joined together using steam with a pressure between 1.0 and 2.0 bar, in which the individual plastic bodies 5 melt on their surface and join with other plastic bodies 5.

[0036] The result is a compact material that can be used to form the described section or insert 4.

[0037] This results in a sole that is inexpensive to manufacture and has improved spring and damping properties compared to the solutions already known, especially with regard to those where E-TPU is used.

[0038] In the embodiment, there is a section 4 in the heel area of sole 2, which is particularly advantageous. However, it is also possible to provide that a further section 4 of the form described is used in other areas of the sole, e.g. in the forefoot area.

[0039] Of course, it can also be provided that the complete midsole, which is arranged between the shoe upper part 3 and the outer sole 6, consists of E-TPO, which is not shown in the example.

[0040] Thus not only the spring and damping behaviour of the sole and thus of the shoe can be influenced very advantageously; at the same time, the manufacturing process can be carried out simply and cost-effectively.

REFERENCE NUMERALS

- [0041] 1 Shoe
- [0042] 2 Sole
- [0043] 3 Shoe upper part
- [0044] 4 Section of the sole made of E-TPO
- [0045] 5 Plastic body
- [0046] 6 Outer sole
- [0047] 7 Section of the sole made of non-E-TPO
- [0048] H Height of the sole

1-15. (canceled)

16. A shoe, in particular sport shoe, having a sole and a shoe upper part connected to the sole,

wherein the sole is made, at least in sections, from an expanded thermoplastic polyolefin, wherein the section of the sole consisting of expanded thermoplastic polyolefin consists of a plurality of spherical or ellipsoidal plastic bodies which are joined to one another in a substance-locking manner, and wherein the dimensions of the single plastic bodies in the three spatial directions are between 0.5 mm and 5.0 mm,

wherein the section consisting of expanded thermoplastic polyolefin forms an insert of the sole, wherein further sections of the sole consisting of a material which is not expanded thermoplastic polyolefin,

wherein the further section of the sole, which does not consist of expanded thermoplastic polyolefin, consists at least in sections of an ethylene-vinyl acetate copolymer, of expanded thermoplastic polyurethane, of thermoplastic polyurethane, of thermoplastic elastomer, of polyamide, of foamed polyurethane and/or of rubber material.

17. The shoe according to claim 16, wherein the substance-locking bond of the plastic bodies has been made by a welding process.

18. The shoe according to claim 17, wherein the welding process has been carried out by introducing steam into a mold under a pressure of between 1.0 and 4.0 bar, preferably between 1.0 and 2.0 bar.

19. The shoe according to claim 16, wherein the substance-locking bond of the plastic bodies has been made by an adhesive process with the addition of an adhesive.

20. The shoe according to claim 16, wherein the plastic bodies have a weight between 5 mg and 10 mg.

21. The shoe according to claim 16, wherein the section of the sole consisting of expanded thermoplastic polyolefin has a density between 100 and 250 g/l.

22. The shoe according to claim 16, wherein the plastic bodies consisting of expanded thermoplastic polyolefin have a density of between 70 and 140 g/l before they are joined together.

23. The shoe according to claim 16, wherein the section consisting of expanded thermoplastic polyolefin forms a midsole of the shoe.

24. The shoe according to claim 23, wherein an outer sole is arranged below the midsole.

25. The shoe according to claim 16, wherein the section consisting of expanded thermoplastic polyolefin does not extend over the entire height of the sole or midsole.

26. The shoe according to claim 16, wherein the section consisting of expanded thermoplastic polyolefin is arranged in the heel region of the sole.

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