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# (54) A SHOE SOLE AND A SAFETY SHOE

(57) The shoe sole (10) comprises a heel area and a ball area, an insole (14), an outsole (16) configured to come into contact with the ground, a midsole (15) between the insole and the outsole, an elastic insert (18) embedded into the midsole extending in the heel area of the sole and an anti-puncture sheet (22). The anti-puncture sheet has a front portion (24) locating between the insole and the midsole in the ball area of the sole and a rear portion (26) locating between the outsole and the elastic insert in the heel area of the shoe sole.

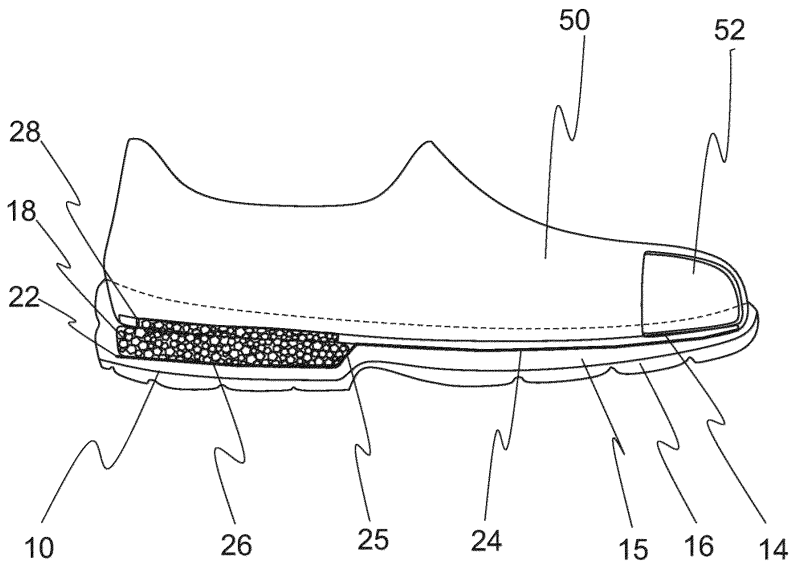


Fig. 2

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## Description

### Technical Field

**[0001]** The invention is related to a shoe sole comprising a heel area and a ball area, an insole, an outsole configured to come into contact with the ground, a midsole between the insole and the outsole, an elastic insert embedded into the midsole in the heel area of the shoe sole and an anti-puncture sheet. The invention is further related to a safety shoe comprising said shoe sole.

### Background Art

**[0002]** Safety shoes, or anti-injury shoes, offer their users a high degree of protection against puncture wounds and crushing injuries. All safety shoes, in order to respect the current standards of the field, comprise an upper provided with a sufficiently rigid protective toe cap to withstand impacts, protecting the user's toes from crushing. Further, the safety shoes are provided with puncture resistant sheet, which prevents sharp objects, such as nails, to penetrate through the shoe sole. Safety shoes are usually used as working shoes, whereby they are intended to be worn by the user for many hours per day in activities, in which the user is in continuous movement. Therefore, the safety shoes must be to be able to ensure a satisfactory level of comfort for the user. For this purpose, many safety shoes are equipped with a layered sole comprising an insert made of elastic material. The elastic insert makes it more comfortable to stand on the floor and it provides a soft and dynamic shock absorption during walking. Although such anti-injury shoes have been successful with users and are currently very common, they are not without drawbacks.

**[0003]** Document EP 3648628 B1 discloses a safety shoe, comprising a layered sole having an upper layer, an intermediate layer and a lower layer adapted to come into contact with the ground. In the intermediate layer an elastic insert is embedded, which extends exclusively at the rear zone of said sole. The upper layer comprises an anti-puncture sheet thoroughly covering the sole and overlapping the elastic insert. The anti-puncture sheet is preferably made of non-metallic, flexible material, apparently to preserve softness and comfort of use offered by the elastic insert. However, soft and flexible anti-puncture sheets do not provide maximum protection against punctures, whereby protection of the user's feet is compromised.

**[0004]** Document KR 20070117233 A discloses a shock absorbing safety shoe comprising an insole, an outsole, a midsole between the insole and the outsole midsole, a protective plate installed in the midsole and a shock-absorbing member. The shock absorbing member includes a coil spring acting as an elastic body. In the heel area of the shoe the protective plate is above the shock absorbing member, which reduces the cushioning effect of the shock-absorbing member.

**[0005]** Document WO 2021124068 A1 discloses a puncture resistant sole comprising a midsole, a shock absorbing insert and a puncture resistant sheet interposed between the insert and midsole. The sole can further comprise an inner insole above the puncture resistant sheet, which inner insole can be equipped with small ventilation holes in the forefoot area of the sole.

**[0006]** An object of the invention is to provide shoe sole and a safety shoe, in which drawbacks relating to the prior art are reduced.

**[0007]** The object of the invention is achieved with a shoe sole and a safety shoe, which are characterized in what is disclosed in the independent patent claims. Some preferred embodiments of the invention are disclosed in the dependent claims.

### Summary of the invention

**[0008]** The shoe sole according to the invention comprises a heel area and a ball area, an insole, an outsole configured to come into contact with the ground, a midsole between the insole and the outsole, an elastic insert embedded into the midsole extending in the heel area of the shoe sole and an anti-puncture sheet. The anti-puncture sheet has a front portion locating between the insole and the midsole in the ball area of the shoe sole and a rear portion locating between the outsole and the elastic insert in the heel area of the shoe sole.

**[0009]** In some embodiments of the shoe sole according to the invention the anti-puncture sheet further comprises a middle portion connecting the front portion and the rear portion, which front portion, middle portion and rear portion are made of same material.

**[0010]** In some embodiments of the shoe sole according to the invention the anti-puncture sheet is a shaped metal plate, preferably a shaped steel plate.

**[0011]** In some embodiments of the shoe sole according to the invention the anti-puncture sheet has an upper surface facing the insole and a lower surface facing the outsole and the front portion of the anti-puncture sheet is attached to the insole and the rear portion of the anti-puncture is attached to the elastic insert. Preferably, the upper surface of the front portion of the anti-puncture sheet is attached to the insole by gluing and the upper surface of the rear portion of the anti-puncture sheet is attached to the elastic insert by gluing.

**[0012]** In some embodiments of the shoe sole according to the invention the midsole is attached to the lower surfaces of the front portion and the rear portion of the anti-puncture sheet. Preferably, the midsole is made of and attached to the anti-puncture sheet by moulded polyurethane material.

**[0013]** In some embodiments of the shoe sole according to the invention the upper surface and the lower surface of the anti-puncture sheet are covered with a primer for enhancing the attachment of the midsole to the anti-puncture sheet.

**[0014]** In some embodiments of the shoe sole accord-

ing to the invention the insole has hole in the heel area of the shoe sole, the hole exposing a major part of the surface of the elastic insert facing the insole.

**[0015]** The safety shoe according to the invention comprises a shoe sole according to any embodiment of the invention explained above and an upper attached to the shoe sole. Preferably, the upper comprises a protective cap covering the tip of the ball area of the shoe sole.

**[0016]** An advantage of the invention is, that the softness of the shoe sole and comfort of use of the shoe is good without compromising the puncture resistance of the shoe sole.

**[0017]** Another advantage of the invention is, that the elastic insert is protected against penetrating of puncturing sharp objects, which ensures, that the integrity and elastic properties of the insert are not weakened.

## Brief Description of the Drawings

**[0018]** In the following the invention will be described in detail, by way of examples, with reference to the accompanying drawings in which,

Fig. 1 depicts an example of an exploded safety shoe according to the invention as a side elevation view and

Fig. 2 depicts the safety shoe of figure 1 as an overall side elevation view.

## Detailed Description

**[0019]** In figure 1 an example of a safety shoe according to the invention is shown as an exploded side elevation view. The safety shoe according to the invention comprises an upper 50 and a layered shoe sole 10 attached to the upper. The upper is equipped with a protective cap 52 satisfying the current safety standards for protecting the user's toes from crushing, when an impact or a pressing force effects on the shoe tip. The shoe sole has a heel area 11 for supporting the heel of the user and a ball area 12 for supporting the forefoot, i.e. the ball and toes of the user when the shoe is worn.

**[0020]** The layered shoe sole 10 comprises an insole 14, an outsole 16 configured to come into contact with the ground and a midsole 15 between the insole and the outsole. The insole, which is configured to face the user's feet, when the shoe is worn, is a flexible sheet-like element, which is preferably made of heavy paper or thick nonwoven fabric. In the heel area 11 of the insole there is hole 28 extending through the insole exposing the elastic insert 18 below the insole as explained later.

**[0021]** The outsole 16 is preferably made of rubber or other similar material. The outer surface of the outsole, which is configured to come into contact with the ground has an uneven surface shaping for providing sufficient friction between the outsole and the ground.

**[0022]** The midsole 15 is made of injection molded polyurethane. An elastic insert 18 is embedded into the midsole in the heel area of the sole during manufacturing phase of the midsole. The elastic insert is a flexible and compressible element which is at least partly, preferably fully, made of foamed thermoplastic polyurethane. The elastic insert extends only to the heel area of the shoe sole covering 30-50 %, preferably 35-40 % of the overall length of the shoe sole 10. The width of the elastic insert is substantially equal to or slightly less than the width the midsole in the heel area 11 of the shoe sole. The lateral dimensions of the elastic insert are slightly larger than the lateral dimensions of the hole 28 in the insole above the elastic insert. The thickness of the elastic insert is between 15-25 mm, preferably substantially 20 mm.

**[0023]** The midsole 15 comprises a window 20 on both side surfaces of the midsole in the heel area of the shoe sole. The elastic insert is partly visible through these windows. The windows allow the elastic insert to slightly protrude outward through the windows assisting the deformation of the elastic insert material during compression. This increased deforming capacity enhances the ability to elastically absorb the forces deriving from the weight of the user during walking. The size and shape of the window is smaller than the side surface of the elastic insert facing the window, whereby only a part of the elastic insert is visible through the windows. Apart from the area of the windows the midsole surrounds the sides of the elastic insert.

**[0024]** The shoe sole further comprises an anti-puncture sheet 22, which extends inside the shoe sole near to the outer edges of the shoe sole for protecting the user's foot sole against protruding sharp objects, such as nails, when the shoe is worn. The anti-puncture sheet 22 has an upper surface facing the insole 14 and a lower surface facing the outsole 16 and it is made of steel sheet having a thickness 0,6-1,0 mm, preferably 0,8 mm. The anti-puncture sheet is shaped from a single metal sheet and it has a front portion 24 covering substantially the ball area 12 of the shoe sole, a rear portion 26 covering substantially the heel area 11 of the shoe sole and a middle portion 25 connecting the front and rear portions. The front and the rear portions are substantially even areas, which lie in different planes and the middle portion is in inclined position in relation to the front and rear portions. The height of the middle portion is substantially equal to the thickness of the elastic insert 18. The upper surface and the lower surfaces of the anti-puncture sheet are covered with a primer for enhancing the attachment of the midsole to the anti-puncture sheet. Preferably the primer has conductive properties, which help the shoe to satisfy the antistatic requirements stated in the safety shoe standards.

**[0025]** In figure 2 the safety shoe of figure 1 is shown as a side elevation view. The front portion 24 of the anti-puncture sheet 22 is attached directly to the insole by gluing and the rear portion 26 of the anti-puncture sheet is attached to the lower surface of the elastic 18 insert also

by gluing. The midsole 15 is attached directly to all surfaces of the anti-puncture sheet, which are not in direct contact with the elastic insert or the insole, these surfaces including the lower surfaces of the front portion and the rear portion of the anti-puncture sheet. The midsole attaches also to the upper 50 with a protective cap 52, the outsole 16 and those parts of the lower surface of the insole 14, which are not in direct contact with the elastic insert or the anti-puncture sheet. The midsole also surrounds the sides of the elastic insert 18 apart from the area of the windows. The midsole is made of polyurethane material by injection moulding, whereby the midsole attaches to the elastic inset, insole, anti-puncture sheet and to the outsole through the adhesive force of the polyurethane material.

**[0026]** When safety shoes are used, a major part of the weight of the user exerts to the heel area of the shoe sole, especially during walking. In the safety shoe according to the invention the front portion of the anti-puncture sheet is locating between the insole and the midsole in the ball area of the sole. In in the heel area of the shoe sole the rear portion of the anti-puncture sheet is locating between the outsole and the elastic insert. Between the outsole and the rear portion of the anti-puncture sheet there is a layer of midsole material, i,e. polyurethane. Thus, in the heel area of the shoe sole 10 there is a cushioning elastic insert 18 between the anti-puncture sheet 22 and the upper surface of the shoe sole facing the user's feet. Therefore, in the heel area, the substantially rigid anti-puncture sheet does not deteriorate the cushioning effect of the elastic insert. Further, in the insole there is a hole 28 in the heel area of the shoe sole, which hole exposes a major part of the upper surface of the elastic insert facing the insole. Thus, in the area of the hole the upper surface of the elastic insert constitutes the uppermost surface of the shoe sole, whereby forces and impacts exerting through the heels of the user affect directly to the elastic insert providing maximal cushioning effect.

**[0027]** The shoe sole must be flexible enough in the longer direction sole to facilitate comfort walking with the shoe. The metallic anti-puncture sheet 22 inevitably makes the shoe sole stiffer. The stiffening effect of the anti-puncture sheet enhances, if the anti-puncture sheet bends in the transverse direction of the shoe sole because of uneven working surface for example. In the shoe sole according to the invention there is a clear angle or fold between the rear portion 26 and the middle portion 25 and between the middle portion and the front portion 24 of the anti-puncture sheet. These angles or folds extend straight from one side of the anti-puncture sheet to the opposing side of the anti-puncture sheet. These straight deformation lines act as integral elastic hinges, which enhance bending of the anti-puncture in the longer direction of the shoe sole.

**[0028]** Some preferred embodiments of shoe sole and the safety shoe has been disclosed above. The invention is not limited to the solutions explained above, but the invention can be applied in different ways within the limits set by the patent claims.

Reference Signs:

**[0029]**

| | |
|---|---|
| 10 | shoe sole |
| 11 | heel area |
| 12 | ball area |
| 14 | insole |
| 15 | midsole |
| 16 | outsole |
| 18 | elastic insert |
| 20 | window |
| 22 | anti-puncture sheet |
| 24 | front portion |
| 25 | middle portion |
| 26 | rear portion |
| 28 | hole |
| 50 | upper |
| 52 | protective cap |

## Claims

1. A shoe sole (10) comprising a heel area (11) and a ball area (12), an insole (14), an outsole (16) configured to come into contact with the ground, a midsole (15) between the insole (14) and the outsole (16), an elastic insert (18) embedded into the midsole (15) in the heel area (11) of the shoe sole (10) and an anti-puncture sheet (22), **characterised in that** said anti-puncture sheet (22) has a front portion (24) locating between the insole (14) and the midsole (15) in the ball area (12) of the shoe sole (10) and a rear portion (26) locating between the outsole (16) and the elastic insert (18) in the heel area (11) of the shoe sole (10).

2. The shoe sole according to claim 1, **characterised in that**, said anti-puncture sheet (22) further comprises a middle portion (25) connecting the front portion (24) and the rear portion (26), which front portion (24), middle portion (25) and rear portion (26) are made of same material.

3. The shoe sole according to claim 1 or 2, **characterised in that**, said anti-puncture sheet (22) is a shaped metal plate, preferably a shaped steel plate.

4. The shoe sole according to any of the claims 1 to 3, **characterised in that**, the anti-puncture sheet (22) has an upper surface facing the insole (14) and a lower surface facing the outsole (16) and the front portion (24) of the anti-puncture sheet (22) is attached to the insole (14) and the rear portion (26) of the anti-puncture sheet (22) is attached to the elastic insert (18).

5. The shoe sole according to claim 4, **characterised in that**, the upper surface of the front portion (24) of the anti-puncture sheet (22) is attached to the insole (14) by gluing and the upper surface of the rear portion (26) of the anti-puncture sheet (22) is attached to the elastic insert (18) by gluing.

6. The shoe sole according to any of the claims 1 to 5, **characterised in that** the midsole (15) is attached to the lower surfaces of the front portion (24) and the rear portion (26) of the anti-puncture sheet (22).

7. The shoe sole according to any of the claims 1 to 5, **characterised in that**, the midsole (15) is made of and attached to the anti-puncture sheet (22) by moulded polyurethane material.

8. The shoe sole according to claim 7, **characterised in that**, the upper surface and the lower surface of the anti-puncture sheet (22) are covered with a primer for enhancing the attachment of the midsole to the anti-puncture sheet.

9. The shoe sole according to any of the claims 1 to 8, **characterised in that**, the insole (14) has hole (28) in the heel area (11) of the shoe sole (10), the hole (28) exposing a major part of the surface of the elastic insert (18) facing the insole (14).

10. A safety shoe comprising a shoe sole (10) according to any of the claims 1 to 9 and an upper (50) attached to the shoe sole (10).

11. A safety shoe according to claim 10, **characterised in that** the upper (50) comprises a protective cap (52) covering the tip of the ball area (12) of the shoe sole (10).

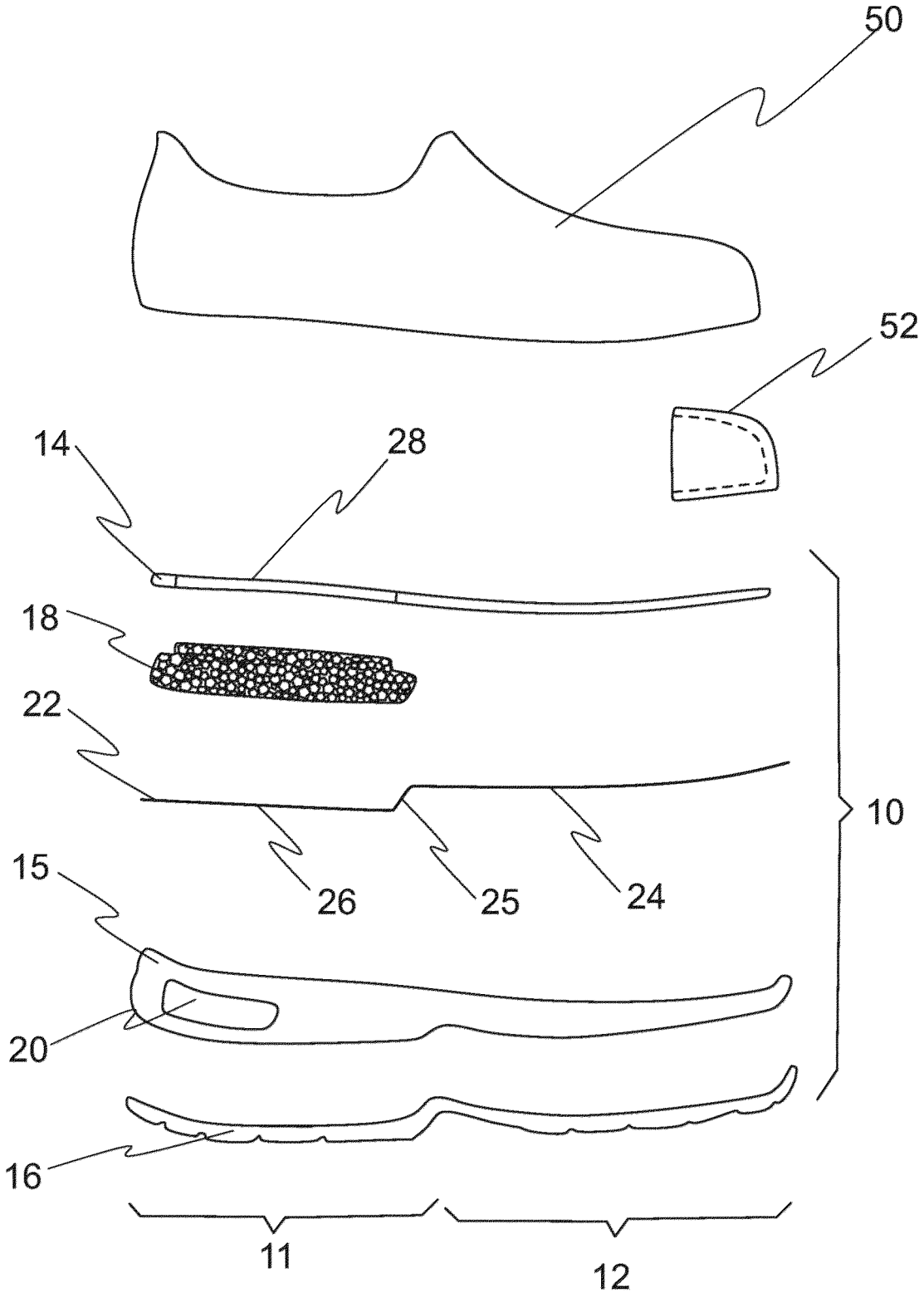


Fig. 1

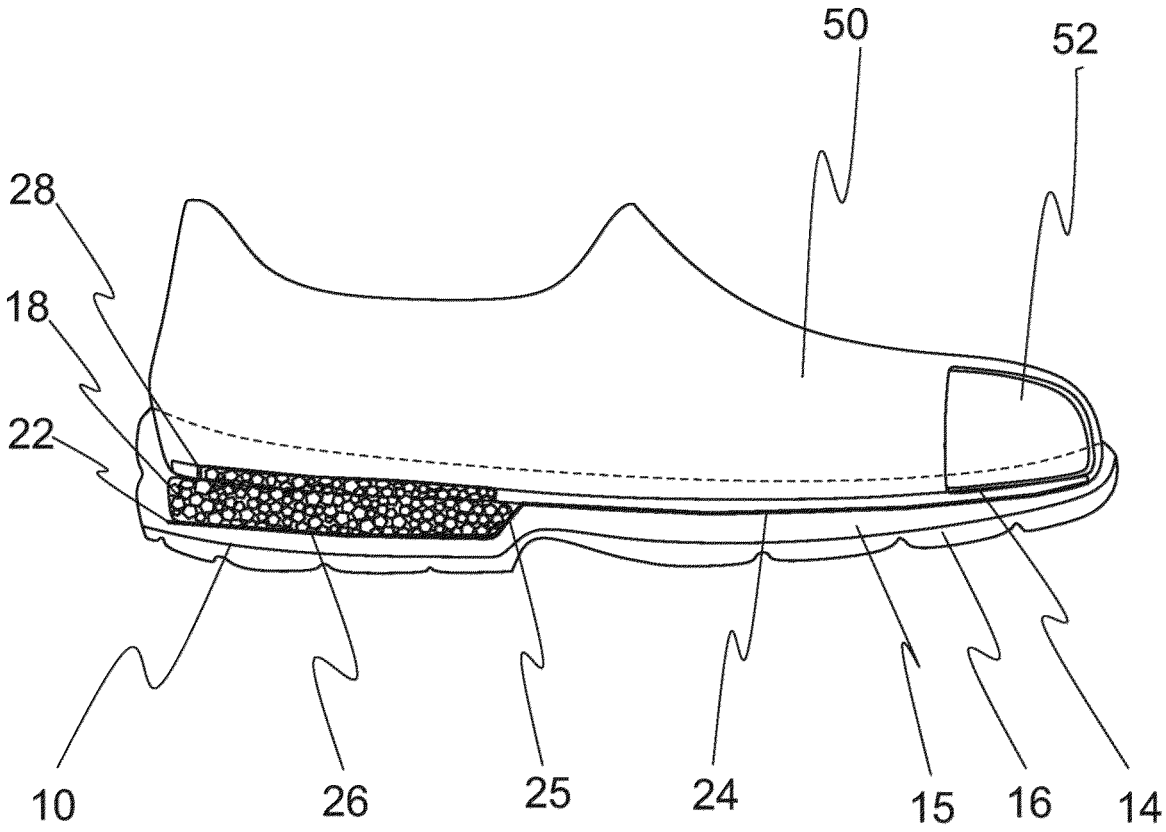


Fig. 2

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# EUROPEAN SEARCH REPORT

Application Number
EP 24 19 6736

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
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TECHNICAL FIELDS SEARCHED (IPC)

A43B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 29 November 2024 | Gkionaki, Angeliki |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 19 6736

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## REFERENCES CITED IN THE DESCRIPTION

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