(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 101 333 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
**14.12.2022 Bulletin 2022/50**

(21) Application number: **22178461.4**

(22) Date of filing: **10.06.2022**

(51) International Patent Classification (IPC):
***A43B 13/02*** *(2022.01)* ***A43B 13/12*** *(2006.01)*
***A43B 13/18*** *(2006.01)* ***A43B 13/20*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
**A43B 13/203; A43B 13/026; A43B 13/127; A43B 13/181**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**KH MA MD TN**

(30) Priority: **11.06.2021 IT 202100015284**

(71) Applicants:
- **OBER ALP S.p.A.**
  **39100 - Bolzano (IT)**
- **Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna**
  **56127 Pisa (IT)**

(72) Inventors:
- **DALVIT, Matteo**
  **I-39100 BOLZANO (IT)**
- **CIANCHETTI, Matteo**
  **I-39100 BOLZANO (IT)**

(74) Representative: **Mitola, Marco**
**Jacobacci & Partners S.p.A.**
**Piazza Mario Saggin, 2**
**35131 Padova (IT)**

(54) **FOOTWEAR PROVIDED WITH A SOLE OF VARIABLE RIGIDITY**

(57) Footwear (4) of variable rigidity, comprising:
- a sole (8) having a tread (12) and an upper face (16) opposite the tread (12),
- an upper (20),
- a midsole (24), sandwiched between the upper (20) and the sole (8),
- a stiffening strut (36), placed between an upper face (28) of the midsole (24), opposite the upper (20), and said upper face (16) of the sole (8), inside a watertight vacuum chamber (40) delimited between the midsole (24) and the sole (8),
- the footwear (4) being provided with a pump (44) configured to create a variable depression inside said vacuum chamber (40).

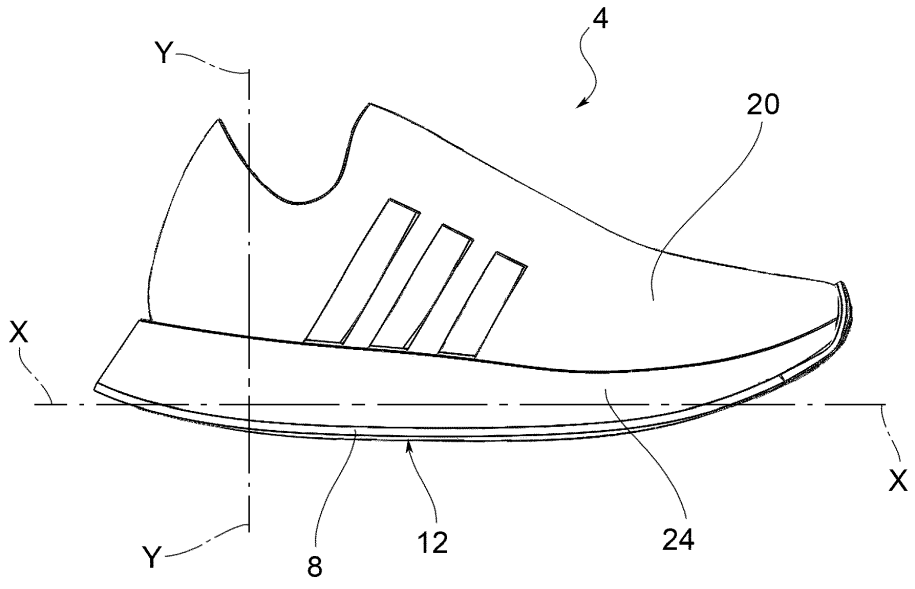


FIG.1

EP 4 101 333 A1

## Description

### FIELD OF APPLICATION

**[0001]** This invention relates to footwear provided with a sole of variable rigidity.

### PRIOR ART

**[0002]** In the field of footwear, it is known to provide soles with devices that are adapted to modify the rigidity of the sole and therefore of the footwear in its entirety.

**[0003]** This need originates from the fact that the user, over the course of using said footwear, may use the same footwear over paths/terrain that are very different from one another in terms of compactness, roughness, gradient, humidity and the like.

**[0004]** Moreover, the same footwear may be used by users who, although they have the same foot size, may have morphological characteristics and weights that are very different from one another.

**[0005]** For all of these variables, commercial footwear always has to use compromised designs which aim to mediate all of the cited requirements/variables of use.

**[0006]** Footwear which includes inflatable devices or removable inserts that are adapted to modify the footwear and/or the rigidity of the shoe is also known.

**[0007]** However, these devices do not satisfy the requirements of all users, particularly as a result of the variation in flexural/torsional rigidity of the sole, and also have reliability problems.

### DISCLOSURE OF THE INVENTION

**[0008]** There is therefore a need to resolve the disadvantages and limitations mentioned with reference to the prior art.

**[0009]** This need is satisfied by footwear according to claim 1.

### DESCRIPTION OF THE DRAWINGS

**[0010]** Further features and advantages of this invention will become more apparent from the following detailed description of preferred, non-limiting embodiments thereof, in which:

Fig. 1 is a side view of footwear according to a possible embodiment of this invention;

Fig. 2 is a side view, in partial cross section, of the footwear in Fig. 1;

Fig. 3 shows a particular detail from the sectional view in Fig. 2;

Fig. 4 is a perspective view, in separate parts, of footwear according to an embodiment of this invention;

Fig. 5 is a perspective view, in separate parts, of footwear according to an embodiment of this invention;

Fig. 6 is a side view, in an assembled configuration, of footwear according to a further embodiment of this invention;

Fig. 7 is a perspective view, in separate parts, of the footwear in Fig. 6.

**[0011]** Elements or parts of elements common to the embodiments described hereinafter will be indicated with the same reference signs.

### DETAILED DESCRIPTION

**[0012]** With reference to the aforementioned figures, footwear of variable rigidity is denoted as a whole by reference sign 4.

**[0013]** It should firstly be noted that, for the purposes of this invention, the term 'footwear' is to be understood in generic and non-restrictive terms; this invention therefore relates to any type of footwear, and not necessarily to sports footwear.

**[0014]** The footwear 4 comprises a sole 8 having a tread 12, which is intended to contact the ground, and an upper face 16 opposite the tread 12.

**[0015]** According to one possible embodiment of this invention, the sole 8, on the side of the upper face 16, has a plurality of plugs or ribs 18.

**[0016]** Said plugs or ribs 18 preferably occupy an area of the upper face 16 of the sole 8 which is at least 5 mm from a perimeter profile P of said sole 8.

**[0017]** According to one possible embodiment, said plugs or ribs 18 have a height between 1 and 5 mm and/or a width between 1 and 15 mm.

**[0018]** According to one embodiment, the plugs or ribs 18 have a distance or pitch of 1 to 10 mm.

**[0019]** The plugs or ribs are preferably integral with the sole 8 and extend along transverse directions T which are perpendicular to a prevailing longitudinal axis X-X of the sole 8. It is also possible for the plugs or ribs 18 to extend along oblique directions S which form an angle of between 20 and 60 degrees with the prevailing longitudinal axis.

**[0020]** According to a further possible embodiment of this invention, the footwear 4 comprises an insole 52 with which said plugs and ribs 18 are associated, preferably on a lower face facing said upper face 16 of the sole 8.

**[0021]** The footwear 4 also comprises an upper 20, in a known manner, and a midsole 24 which is sandwiched between the upper 20 and the sole 8.

**[0022]** According to one embodiment, the midsole 24 is an element made of EVA foam or another material which is adapted to absorb shock.

**[0023]** The midsole 24, on the side of its lower face 28, opposite the upper 20, preferably comprises a recess or seat 32.

**[0024]** It is also possible for the midsole 24 to comprise said recess or seat 32 on its upper side 30, facing the upper 20.

**[0025]** The footwear 4 also comprises a stiffening strut 36; according to one possible embodiment, said stiffening strut 36 is interposed between the lower face 28 of the midsole 24, opposite the upper 20, and said upper face 16 of the sole 8, inside a watertight vacuum chamber 40 delimited between the midsole 24 and the sole 8.

**[0026]** According to a further embodiment, the stiffening strut 36 is interposed between the insole 52 and the upper side 30 of the midsole 24.

**[0027]** In this embodiment, a bag 56 is used which delimits the vacuum chamber 40 and hermetically contains the insole 52 and the stiffening strut 36; said bag 56 is suitably housed within the recess or seat 32.

**[0028]** Said recess or seat 32 preferably defines the vacuum chamber 40.

**[0029]** The footwear 4 is provided with a pump 44 which is configured to create a variable depression inside said vacuum chamber 40.

**[0030]** If the bag 56 is provided, said bag is fluidically connected to said pump 44.

**[0031]** Said pump 44 may be an electric or manual pump. According to an embodiment, said pump 44 is housed in the midsole 24; it is also possible for the pump 44 to be external to the midsole 24 instead.

**[0032]** Said stiffening strut 36 is preferably integral with the lower face 28 of the midsole 24.

**[0033]** For example, the stiffening strut 36 is glued to the lower face 28 of the midsole 24.

**[0034]** According to one possible embodiment, the stiffening strut 36 is made of steel or a composite of resin and high-performance fibers, such as glass fibers, carbon fibers, Kevlar fibers and the like or other plastics materials.

**[0035]** The stiffening strut 36 preferably has a thickness of between 0.1 mm and 5 mm.

**[0036]** As shown, the midsole 24, on the side of its lower face 28, comprises a recess or seat 32; said recess or seat 32 preferably has a height not less than the sum of the thickness of the stiffening strut 36 and the height of the plugs or ribs 18 of the sole 8, said thicknesses and height being measured with respect to a vertical axis Y-Y which is perpendicular to a plane in which the tread 12 lies, i.e. to the ground.

**[0037]** The recess or seat 32 is preferably shaped so as to entirely accommodate the stiffening strut 36, having a counter-shaped recess profile substantially the same as a perimeter profile Q of the stiffening strut 36.

**[0038]** As stated, the vacuum chamber 40 is connected to a pump 44, so as to be able to vary the pressure in the vacuum chamber 40 and thus the rigidity of the sole 8 and of the footwear 4.

**[0039]** For this purpose, the pump 44 is provided with an air suction tube 48 positioned between the midsole 24 and the stiffening strut 36, and the stiffening strut 36 is microperforated to allow air flow from the vacuum chamber 40 positioned between the stiffening strut 36 and the sole 8.

**[0040]** According to a further possible embodiment, said pump 44 is provided with an air suction tube 48 which is positioned directly inside the vacuum chamber 40 and passes through the stiffening strut 36, wherein the sole 4, on the side of the upper face 16, has a plurality of plugs or ribs 18 shaped and spaced so as to allow the passage of an air flow inside the vacuum chamber 40.

**[0041]** The functioning of the footwear according to this invention will now be described.

**[0042]** In particular, as shown, the stiffening strut 36 is positioned between the sole 8 below and the midsole 24 above, inside the vacuum chamber 40.

**[0043]** Depending on the degree of vacuum generated by the pump 44, the compression and therefore the adhesion of the sole 8 and the midsole 24 to the stiffening strut 36 varies greatly.

**[0044]** As this compression increases, the footwear 4 as a whole becomes rigid, since the stiffening strut 36 which forms the most rigid element of the footwear 4 becomes more integral, and vice versa.

**[0045]** Moreover, varying the compression modifies the cushioning (i.e. the compression damping).

**[0046]** Moreover, by increasing the compression between the stiffening strut 36 and the sole 8, the plugs or ribs 18 are compressed further, which improves the adhesion of the sole 8 to the stiffening strut 36 and therefore the overall rigidity of the sole 8 and of the footwear 4 in its entirety.

**[0047]** The plugs or ribs are used to increase the friction and therefore the adhesion between the sole 8 and the stiffening strut 36.

**[0048]** As may be appreciated from what has been described, the solutions described above make it possible to overcome the disadvantages of the prior art.

**[0049]** In particular, the footwear according to this invention makes it possible to effectively modify, as desired, the flexural and torsional rigidity of the sole and of the footwear in its entirety.

**[0050]** The system is effective and reliable over time.

**[0051]** By applying the vacuum, it is possible to increase or reduce the interpenetration and therefore the mutual squashing between the sole, the strut and the midsole.

**[0052]** The form-fit and frictional coupling between the indentations of the sole and the strut in fact make it possible to substantially vary the connection between the sole and the strut.

**[0053]** In so doing, the more the sole and the midsole are secured to the strut, the more the flexural and torsional rigidity of the sole and therefore of the footwear increases.

**[0054]** Moreover, by increasing the vacuum and therefore the compacting of the sole and the midsole on the strut, the damping or cushioning effect of the sole is reduced, and vice versa.

**[0055]** A person skilled in the art, in order to satisfy contingent and specific needs, may make numerous modifications and variations to the footwear solutions described above.

**[0056]** The scope of protection of the invention is defined by the following claims.

## Claims

**1.** Footwear (4) of variable rigidity, comprising:

- a sole (8) having a tread (12) and an upper face (16) opposite the tread (12),
- an upper (20),
- a midsole (24), sandwiched between the upper (20) and the sole (8),
- a stiffening strut (36), placed inside a watertight vacuum chamber (40) delimited by the midsole (24),
- said stiffening strut (36) being joined, inside said vacuum chamber (40), to an upper face (16) of the sole (8) or to an insole (52) interposed between the upper (20) and said stiffening strut (36),
- the footwear (4) being provided with a pump (44) configured to create a variable depression inside said vacuum chamber (40) so as to vary the compression and adhesion between the stiffening strut (36) and the sole (8) or the insole (52).

**2.** The footwear (4) of variable rigidity according to claim 1, wherein said stiffening strut (36) is interposed between a lower face (28) of the midsole (24), opposite the upper (20), and said upper face (16) of the sole (8), inside said watertight vacuum chamber (40) delimited between the midsole (24) and the sole (8).

**3.** The footwear (4) of variable rigidity according to claim 1, wherein said stiffening strut (36) is interposed between the insole (52) and an upper side (30) of the midsole (24), inside said watertight vacuum chamber (40) delimited between the midsole (24) and the insole (52).

**4.** The footwear (4) of variable rigidity according to claim 1, 2 or 3, wherein said vacuum chamber (40) is delimited by a watertight bag (56) and fluidically connected to said pump (44).

**5.** The footwear (4) of variable rigidity according to any of the claims from 1 to 4, wherein the sole (8), on the side of its upper face (16) and/or the insole (52) at a lower side thereof (54), has a plurality of plugs or ribs (18) .

**6.** The footwear (4) of variable rigidity according to claim 5, wherein said plugs or ribs (18) occupy an area of the upper side (16) of the sole (8) and/or an area of the lower side (54) of the insole (52) which is at least 5 mm from a perimeter profile (P) of said sole (8) and/or insole (52) respectively.

**7.** The footwear (4) of variable rigidity according to claim 5 or 6 wherein said plugs or ribs (18) have a height between 1 and 5 mm and/or a width between 1 and 15 mm.

**8.** The footwear (4) of variable rigidity according to claim 5, 6 or 7, wherein said plugs or ribs (18) have a distance or pitch of 1 to 10 mm.

**9.** The footwear (4) of variable rigidity according to any of the claims from 5 to 8, wherein the plugs or ribs (18) are integral with the sole (8) and/or the insole (52) and extend along transverse directions (T), perpendicular to a prevailing longitudinal axis (X-X) of the sole (8).

**10.** The footwear (4) of variable rigidity according to any of the claims from 3 to 9, wherein the sole (8) and/or the insole (52) comprise plugs or ribs (18) extending along oblique directions (S), which form with a prevailing longitudinal axis (X-X) of the sole (8) and/or the insole (52) an angle between 20 and 60 degrees.

**11.** The footwear (4) of variable rigidity according to any of the claims from 1 to 10, wherein the stiffening strut (36) is made of steel or a composite of resin and high-performance fibres, such as glass fibres, carbon, Kevlar and the like.

**12.** The footwear (4) of variable rigidity according to any of the claims from 1 to 11, wherein said stiffening strut (36) has a total thickness of between 0.1 mm and 5 mm.

**13.** The footwear (4) of variable rigidity according to any of the claims from 1 to 12, wherein the midsole (24), on the side of its lower face (28), comprises a recess or seat (32) having a height not less than the sum of the thickness of the stiffening strut (36) and the height of the plugs or ribs (18) of the sole (8), said thicknesses and height being measured with respect to a vertical axis (Y-Y), perpendicular to a tread lying plane (12).

**14.** The footwear (4) of variable rigidity according to claim 13, wherein said recess or seat (32) is shaped so as to entirely accommodate the stiffening strut (36), having a counter-shaped recess profile substantially the same as a perimeter profile (Q) of the stiffening strut (36) .

**15.** The footwear (4) of variable rigidity according to any of the claims from 1 to 14, wherein said pump (44) is provided with an air suction tube (48) positioned between said midsole (24) and said stiffening strut

(36), and wherein said stiffening strut (36) is micro-perforated to allow air flow from the vacuum chamber (40).

**16.** The footwear (4) of variable rigidity according to any of the claims from 1 to 15, wherein said pump (44) is provided with an air suction tube (48) positioned directly inside the vacuum chamber (40), passing through the stiffening strut (36), and wherein the sole (8), on the side of the upper face (16), has a plurality of plugs or ribs (18) shaped and spaced so as to allow the passage of an air flow inside the vacuum chamber (40).

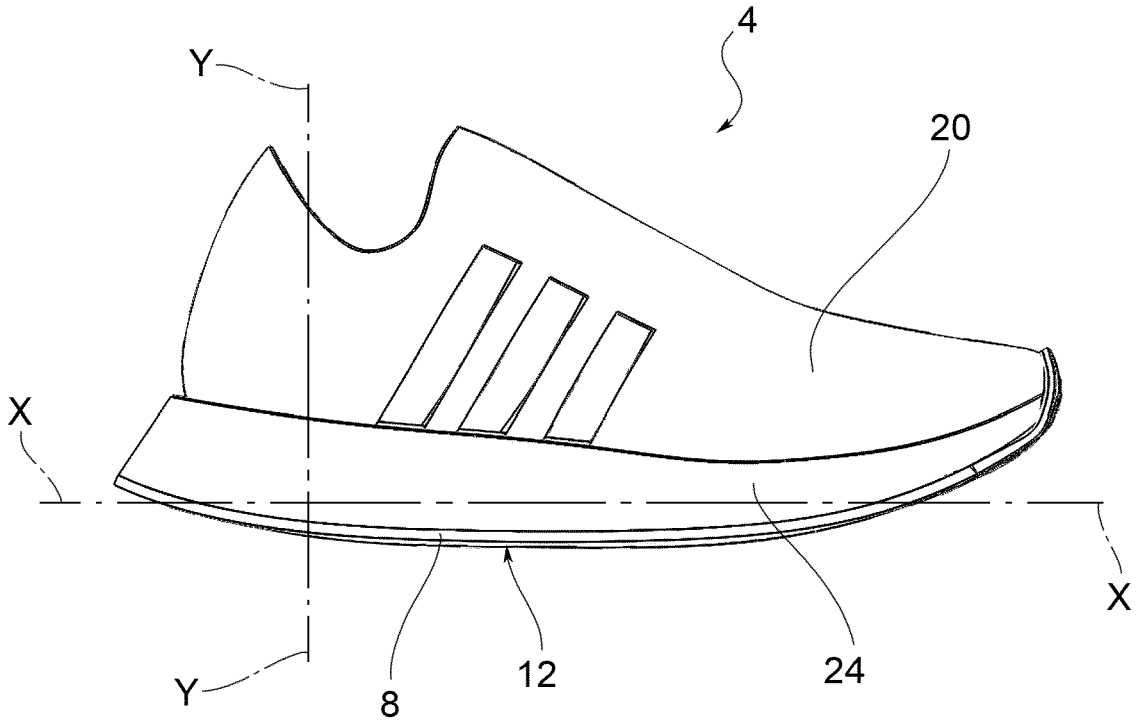


FIG.1

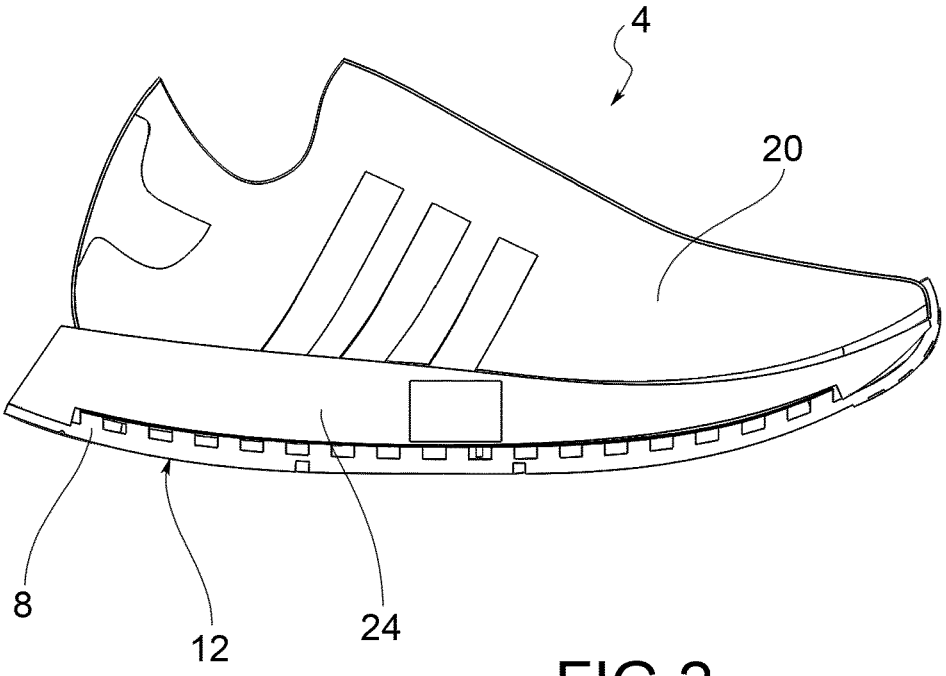


FIG.2

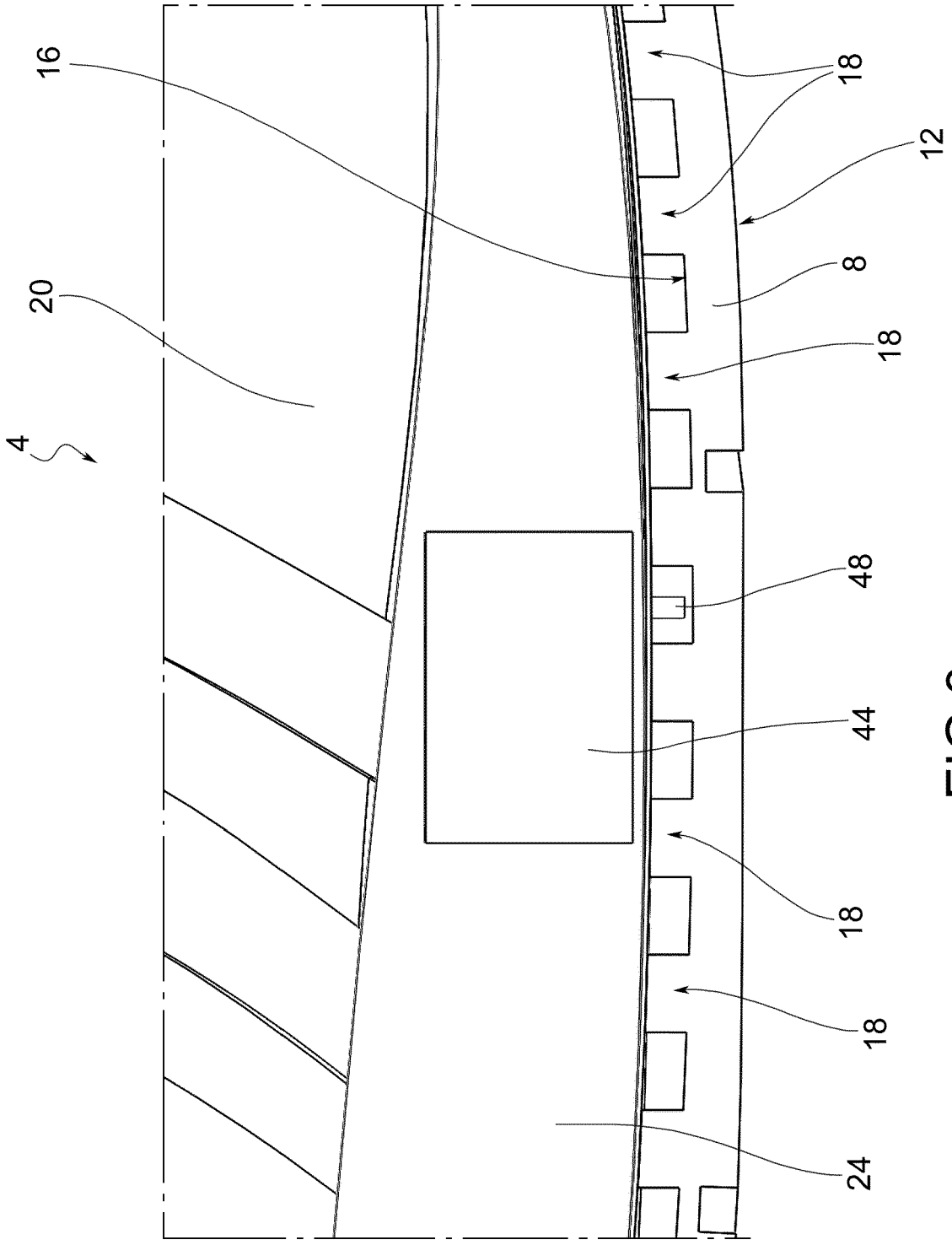


FIG.3

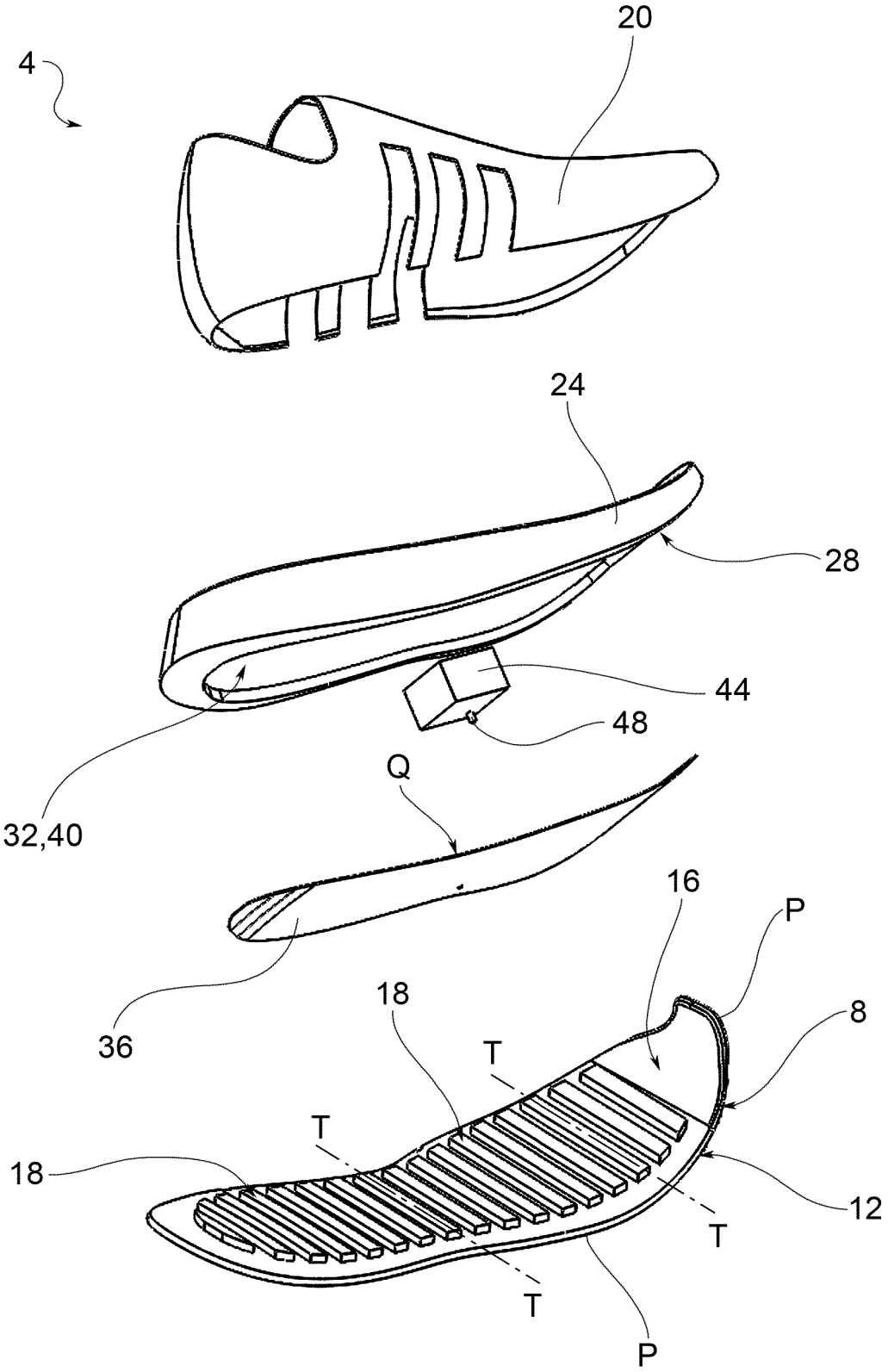


FIG.4

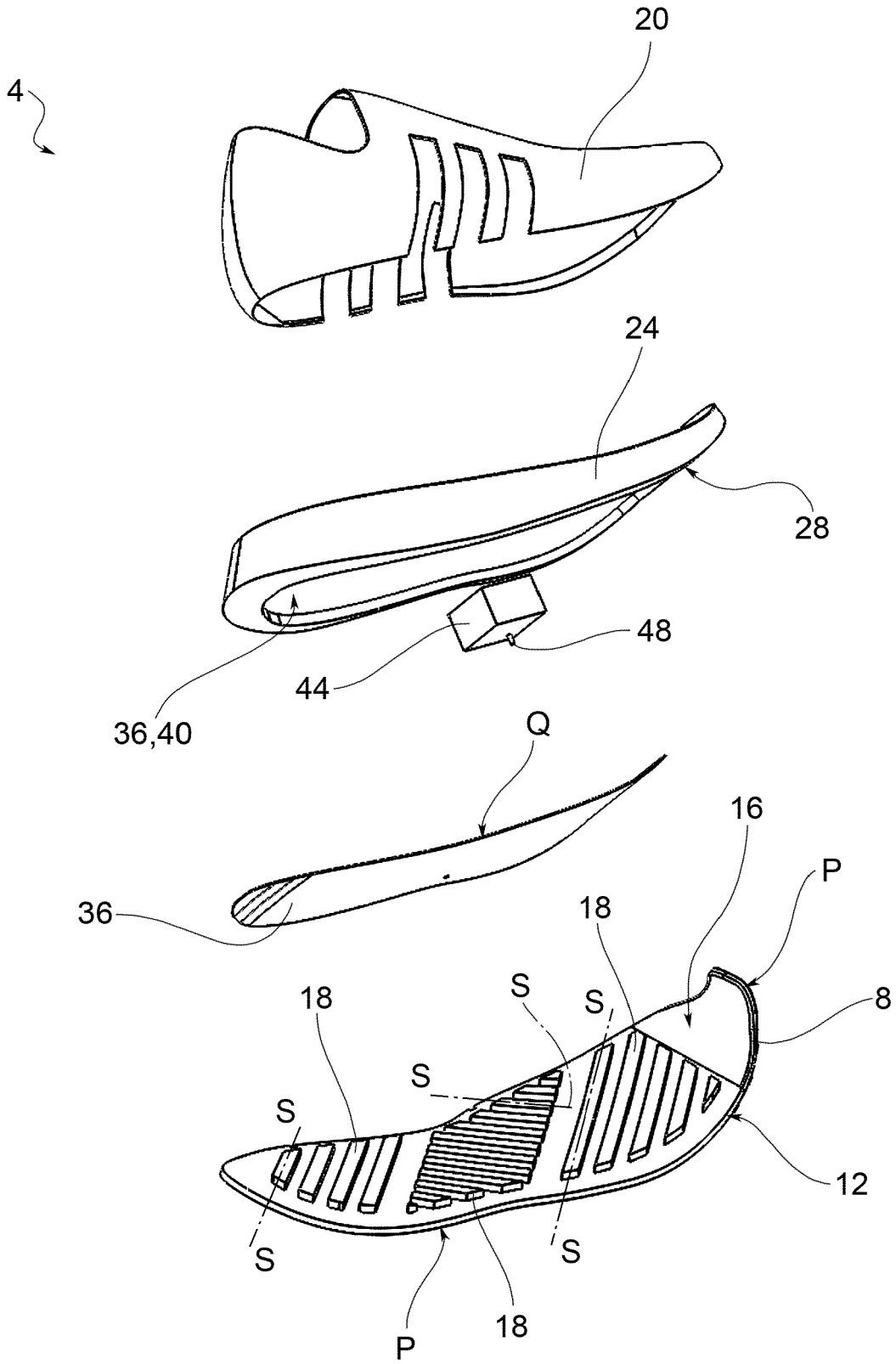


FIG.5

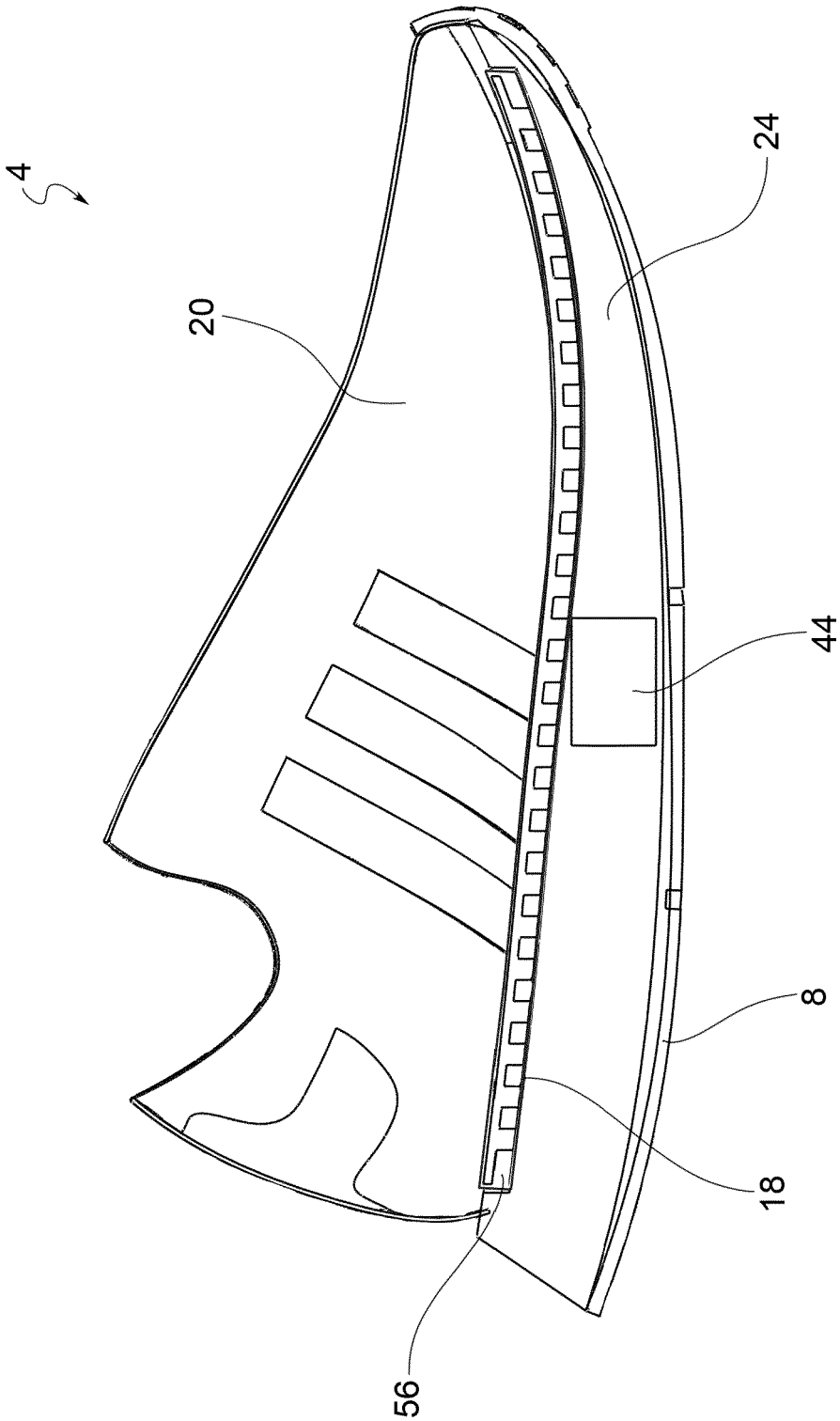


FIG.6

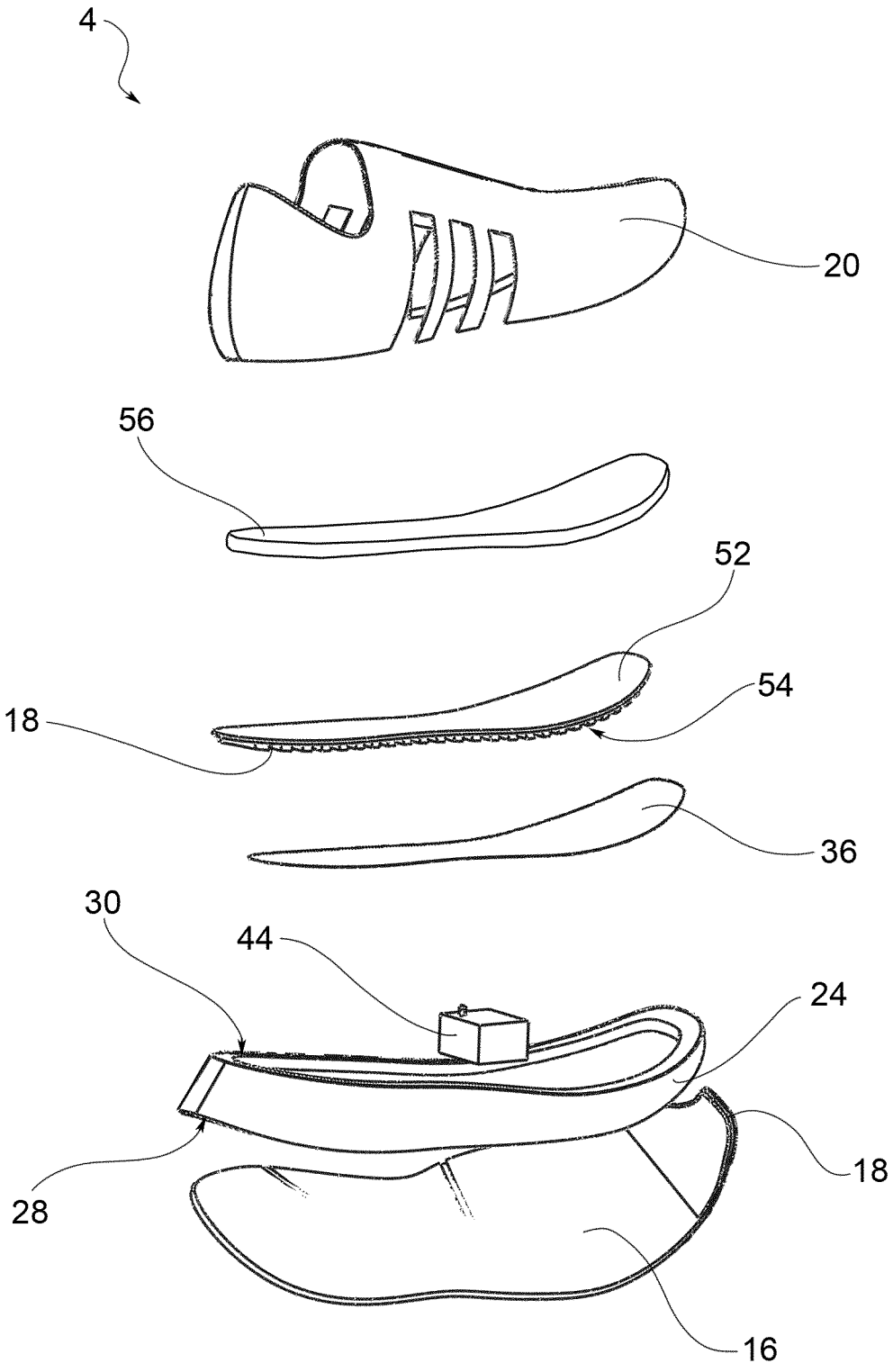


FIG.7

Europäisches Patentamt
European Patent Office
Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 22 17 8461

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| A | US 5 392 534 A (GRIM TRACY E [US])<br>28 February 1995 (1995-02-28)<br>* figures * | 1-16 | INV.<br>A43B13/02<br>A43B13/12<br>A43B13/18 |
| A | KR 200 352 306 Y1 (AVENCUS CO., LTD)<br>4 June 2004 (2004-06-04)<br>* figures * | 1-16 | A43B13/20 |

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 | 18 August 2022 | Gkionaki, Angeliki |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 17 8461

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-08-2022

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 5392534 A | 28-02-1995 | NONE | |
| KR 200352306 Y1 | 04-06-2004 | NONE | |



For more details about this annex : see Official Journal of the European Patent Office, No. 12/82