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(54) **SOLE FOR A SHOE WITH ONE PART TO SUPPORT THE HEEL**

(57) A footwear sole, comprising a structural element 10 providing at least one part R1 suitable to support the heel, wherein said part suitable to support the heel has an opening 2 sized and shaped so that said structural element 10, in correspondence with its part suitable to support the heel, has a U-shape and comprises two opposite arms 1A and 1B linked by an arched arm 1C, substantially forming a U in plan view,
- wherein the inner walls 1A' 1B' 1C' of the above arms of the U at least partially delimit said opening 2,
- wherein said opening 2 is opened in correspondence with the sole face adapted to come into contact with the ground,
- wherein the opening 2 is closed in correspondence with the upper face 10A of the structural element 10 by a bridge element 5, so as to define a cavity 20,

- wherein said bridge element is shaped and sized so that it is substantially arranged under the heel,
- said sole also comprising an exhaust element 4 of the air which may remain trapped into said cavity 20 when the part of the sole comprising said opening 2 is pressed against the ground P, at least partially closing said cavity on the lower side as well,
- wherein said exhaust element 4 shows a substantially rigid body providing at least one through hole 4A suitable to link the cavity 20 with the outside of the sole and so as to exhaust the air present in said cavity in correspondence with at least one section 1C of the outer side wall 1B of the element 10,
- the structural element 10 having a seat 15 suitable to house the body of the exhaust element 4.

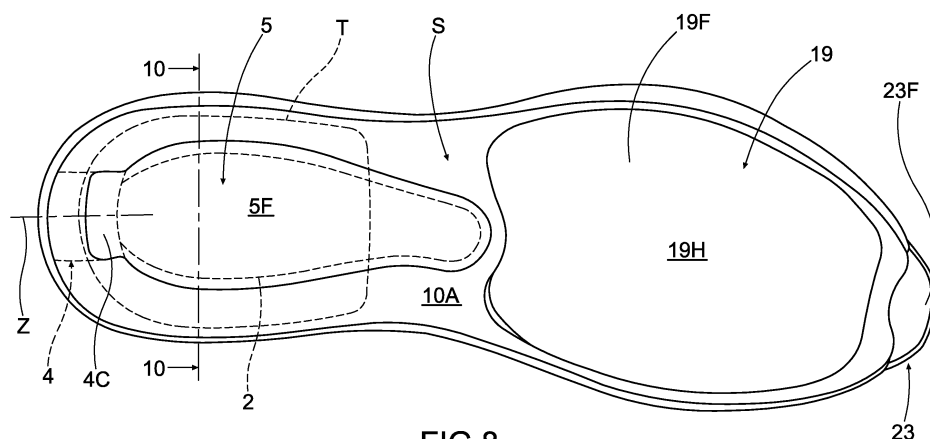


FIG.8

Description

[0001] It is an object of the present invention to provide a footwear sole according to the precharacterising part of the main claim.

[0002] Footwear, particularly sports footwear, soles have long been known showing several technical problems: they are generally not simple and rapid to be produced, because they consist of plentiful components to be assembled to one another, furthermore known soles are comparatively heavy and they are not always sufficiently flexible.

[0003] A further problem related in particular to soles having, a cavity opened on the shoe bottom in the part where the heel rests, such as for example the soles described in US5806210 and US6233846, consists in that, in particular use conditions, this part of the heel, when heavily loaded, is comparatively rigid and does not provide a reliable and stable shock absorption. This is accounted for by the fact that, when the sole is pressed against the ground, air may remain trapped inside the cavity provided in the sole part where the heel rests.

[0004] Similar shock-absorbing problems are to be found in the known soles with reference to the sole area which is suitable to house the phalanges and/or the plantar pad. In known soles, the flexibility and the shock-absorbing skills of the sole are not always sufficient in these areas.

[0005] The object of the present invention is to implement a sole which overcomes the above-mentioned drawbacks, particularly which is suitable to improve the comfort of those who use the sole at least in correspondence with the sole part adapted to support the heel.

[0006] A further object is to implement a sole with a reduced weight.

[0007] A further object is to provide a sole which is simple and rapid to be produced and which consists of a limited number of components.

[0008] These and other objects which will appear blatant to those skilled in the art are achieved by a sole according to the characterising part of the appended claims.

[0009] For an improved understanding of the present invention, drawings are herewith enclosed by way of example and not of limitation, wherein:

fig. 1 shows a perspective schematic top view of a first component of the sole according to the invention;

fig. 2 shows a perspective schematic bottom view of the component of fig. 1,

fig. 3 shows a perspective schematic bottom view of a second component of the sole according to the invention;

fig. 4 shows a perspective schematic bottom view of a third component of the sole according to the invention;

fig. 5 and fig. 6 show a schematic bottom view of a

fourth and of a fifth component of the sole according to the invention;

fig. 7 shows a perspective schematic bottom view of a sole according to the invention, with all the relevant components assembled to one another,

fig. 8 shows a schematic top view thereof,

fig. 9 shows a schematic side view thereof,

fig. 9A shows a schematic rear view thereof,

fig. 10 shows a schematic sectional view according to the line D-D of fig. 8, showing a portion of the foot acting on the sole,

figs. 11-17 show perspective bottom views of seven variations of the form of embodiment shown in figures 1-9.

[0010] In the present context, such spatial terms as "vertical", "horizontal", "above", "below", "upper", "lower", "inner", "outer", "bottom", "top" are used to help describe the invention and with reference to the orientation of the forms of embodiment shown in the drawings. The terms "central", "side", "longitudinal", "crosswise" are used in the usual manner known to those skilled in the art.

[0011] With reference to figures 1-9, they show a first form of embodiment of a sole according to the invention comprising a structural element 10 which develops so as to support the whole foot and which acts as a support for all sole components. This structural element 10 has a plurality of openings 2 (fig. 1), 20 A, 31 A-E, and seats 15, 1N, 1P, 1Q (fig. 2) and 1R (fig. 2) for assembling and/or housing: a bridge element 5 (fig. 3) and an air exhaust element 4 (fig. 3) (suitable to be assembled in the seats 1N and 15, respectively), a shock-absorbing element 19 (fig. 4), suitable to be housed in the seat 1P (fig. 1) with the pads 19A-E fitted into the holes 31 A-E of the structural element 10, and two elements 13 (fig. 6) and 23 (fig. 5) adapted to act as outer sole and suitable to be assembled in seats 1Q and 1R (fig. 2) of the structural element 10, respectively.

[0012] Figures 7 - 9 show the sole with all the above-listed elements.

[0013] The structural element 10 can be divided into a rear region R1 (fig. 2) suitable to support the heel, a central region R2 for the plantar arch and a front region R3 for the forefoot. Hereinafter the features of the rear R1 and central R2 regions will be described first and the features of the front region R3 will be described afterwards.

[0014] The structural element 10, in correspondence with its regions R1 and R2 adapted to support the heel and the plantar arch, has an elongated annular-shaped through opening 2, sized so that said first element 10 in correspondence with its rear part supporting the heel has a U-shape and comprises (in a bottom view) two opposite arms 1 A and 1B (fig. 2 and fig. 7) connected by an arched arm 1C forming a U or a horseshoe shape. The inner walls 1A' 1B' 1C' (fig. 7) of the above arms of the U shape delimit this annular-shaped opening 2 along with a bottom wall 6A.

[0015] These arms 1A 1B 1C converge in a central part 6 of the first element 10 which includes the inner side wall 6A delimiting the opening 2 on the side. This opening 2 has advantageously an annular shape closed on the side. For example, the opening 2 has an elongated drop-shape with a larger part 2A (fig. 2) in the heel and a smaller part 2B in correspondence with the most central part 6 of the element 10 and suitable to support the foot plantar arch. For example, the width L2 of this smaller part 2B of the cavity 2 ranges between 10% and 70% of the maximum width L1 of the larger part 2 A.

[0016] The opening 2 is advantageously opened in correspondence with the sole face which is suitable to come into contact with the ground and in correspondence with said face it has a mouth 2C having the same size as the opening itself.

[0017] The opening 2 extends over at least 50% of the sole part adapted to support the heel (said area is marked by a dashed line identified by reference T in fig. (8), preferably over at least 60% of said area T and more preferably over at least 70% of said area T.

[0018] The opening 2 is closed in correspondence with the upper face 10 A (fig. 7) of the element 10 by a bridge element 5 (fig. 3) comprising a substantially flat wall 5 A featuring: an outer peripheral section 5B suitable to be housed flush in a hollow seat 1 N provided in the upper face 1M (fig. 1) of the first element 10 of the sole and a central stiffening section 5C (suitable to stiffen the bridge element crosswise) having a higher thickness (for example a thickness exceeding the thickness of the outer peripheral section 5B by 10% to 80%) and having such a shape as to partially enter the opening 2 flush. The bridge element 5, through its peripheral section 5B, is rigidly connected, for example by gluing (or in another way known to those skilled in the art), to the hollow seat 1N of the element 10 so that these two elements form a single body.

[0019] The bridge element is shaped and sized so that it is substantially arranged under the heel. According to the invention, the bridge element 5 is made of a harder material than the material of the element 10 it is connected to.

[0020] For example, the hardness of the bridge element 5 is from 10% to 200% higher than the hardness of the element 10, preferably from 30% to 100% higher and even more preferably from 50% to 80% higher.

[0021] Relative to the material of the element 10, when the bridge element 5 is assembled to the relevant seat 1N provided in the element 10, the bridge element can be considered at least crosswise as a rigid or semirigid element (crosswise referring to the direction of the X axis of fig. 3).

[0022] The bridge element 5 is for example made of TPU and/or a similar material. By way of example, the hardness of the material of the bridge element 5 and/or of the exhaust element 4 (described in detail hereinafter) ranges between 65C and 100C, more preferably between 75C and 90C and even more preferably is about

85C.

[0023] The element 10 is made of a more supple and flexible material than the bridge element 5, for example high-density EVA and/or a similar material. By way of example, the hardness of the structural element 10 ranges between 40C and 70C, more preferably between 50C and 70C and even more preferably is about 60C.

[0024] On account of the crosswise rigid or semirigid bridge element 5, when the force F1 (fig. 10) exerted by the heel acts thereupon, it does not bend or it bends only to a limited extent, so that it can convey this force F1 evenly along the perimeter of the hollow seat 1N of the element 10. Ultimately, the bridge element has the function to concentrate the force F1 exerted by the heel in a well-defined portion of the sole, having a U-shape (more limited than in traditional soles, wherein the part supporting the heel is full and without the through opening 2), removing or limiting the components of this force acting horizontally (as shown schematically in fig.10).

[0025] On account of the bridge element, in the heel the sole has improved shock-absorbing features and a higher stability.

[0026] On account of the high density of the material forming the element 10, it can elastically absorb the high thrust concentrated by the bridge 5.

[0027] As regards the rigid or semi rigid behaviour of the bridge element, it must be considered with reference to its transverse axis, namely the X axis represented in fig 3.

[0028] The elongated, drop-like shape of the opening 2 and of the bridge element 5 closing it has the advantage that the flexibility of the sole gradually increases as one moves away from the heel and gets closer to the plantar arch.

[0029] The sole according to the invention also comprises an exhaust element 4 for the air which may remain trapped in the cavity 20 (fig. 10) formed by the through opening 2 and by the bottom wall 5 when the part of the sole comprising this opening 2 is pressed against the ground P (fig. 10), actually closing, at least partially, this cavity on the lower side as well.

[0030] Preferably the above cavity 20 is shaped so as to form a substantially closed cavity when the part of the sole suitable to support the heel is presses against the ground, the exhaust element 4 allowing the air contained in said cavity to flow out.

[0031] It has been experimentally ascertained that the air remaining trapped in the cavity 20 may adversely affect the shock-absorbing features of the sole in correspondence with the heel and that the presence of an exhaust element according to the invention solves this problem, improving such shock-absorbing features.

[0032] The exhaust element 4 has a substantially rigid body providing at least one and preferably two through holes 4A suitable to connect the cavity 20 with the sole outside and so as to exhaust the air contained in said cavity in correspondence with at least one section 1C (fig. 9A) of the outer side 1B of the element 10.

[0033] The exhaust element 4 preferably provides an outer arched wall 4C (fig. 9 A) and an inner arc-shaped wall 4B (fig. 3) suitable to be coupled flush with a section of the outer rear arc-shaped side wall 1C (fig. 9A) of the element 10 of the sole and with an arc-shaped section of the inner arc-shaped wall 1C' (fig. 2) delimiting the through opening 2 on the side, respectively.

[0034] The exhaust element 4 also shows: an upper face 4D, substantially flat and preferably also coplanar with the upper face 5F (fig. 8) of the bridge element 5, and a lower face 4E, also preferably flat and parallel to the upper face 4D.

[0035] As shown in figure 1, the element 10 has a seat 15 suitable to house the body of the exhaust element 4 flush (fig. 7-9), the latter being rigidly connected in this seat, for example, by gluing or by another conventional method known to those skilled in the art. The seat 15 for the exhaust element is advantageously provided in the most extremal part of the element 10, namely in the arched arm 1C of the U-shaped part and is symmetrical to an Y longitudinal axis Y of the sole (fig. 8).

[0036] On account of this particular position of the exhaust element 4, the sole is well-balanced and at any rate adapted to absorb the stresses it is submitted to in correspondence with the heel.

[0037] The exhaust element is a substantially rigid element, namely is an element which, if submitted to the usual forces exerted by the heel on the sole, does not significantly deform, so that the passageways 4 A for the air are always open when the sole is submitted to the usual stresses. This outcome could not be achieved if the air exhaust passageways were provided directly in the U-shaped arms 1 A-C, because these would be compressed under the action of the force exerted on the sole and would hence close said passageways. Advantageously the exhaust element 4 and the bridge element 5 are implemented in a single piece, as shown in fig. 3 with the rear ending part 5D (fig. 3) of the bridge element 5 assembled to the front part 4M of the element 4. Advantageously the upper faces 4C and 5F of the two elements 4 and 5 are coplanar (fig. 8) to each other, so as to form a single flat surface for the heel to rest on.

[0038] The connection between the two elements 4 and 5 further stiffens crosswise the bridge element 5, at least in its rear part which is closest to the element 4.

[0039] The U-shaped arms 1A-C of the element 10, in correspondence with the face adapted to come into contact with the ground, have a hollow seat 1Q (fig. 2) suitable to house an outer sole 13, also with a U-shape, suitable to increase the friction of the sole with the ground and ultimately to improve the grip of the sole to the ground.

[0040] The material this outer sole is made of is a material of a conventional kind for this part of a sole, for example it is a rubber, this kind of material has a comparatively high specific weight which affects the overall weight of the sole itself. In order to limit the overall weight of the sole, according to the invention, the extension of

said outer U-shaped sole 13 is limited to only a portion P1 (fig. 2) of the U-shaped arms provided in correspondence with the heel. Advantageously, a portion 31A 31B 31 C (fig. 2) of the lower face of the arms 1A, 1B, 1C which is closest to the opening 2, of the U-shaped sole remains visible, namely is not covered by the outer sole 13 and a portion 31A' e 31B' (fig. 2) which is closest to the part of the sole supporting the plantar arch of the opposite arms 1 A and 1B of the U shape is not at all covered by the outer sole 13. According to the invention the outer sole only covers an area from 30% to 70% of the face of the U-shaped arms 1A-B facing the ground.

[0041] Advantageously, in order to improve the grip, the outer sole 13 is configured with raised and recessed elements.

[0042] Advantageously, the outer sole 13 has side portions 13 A-B (fig. 9 and 9A) partly extending also along the rear side walls 1C and 1B of the sole.

[0043] The outer sole 13 housed in a hollow seat 1Q provided in the U-shaped arms of the element 10 and therefore is arranged at the same height as or only slightly protruding (for example 1 or 2 mm) relative to the face of said U-shaped arts facing the ground.

[0044] The outer sole is made of a material which is customary to a person skilled in the art for implementing said outer soles, such as a wear-resistant polymer or elastomer, natural or synthetic rubber, TPU, nylon or other polymer blends including TPU and/or nylon or other materials adapted to ensure the necessary functionalities.

[0045] Preferably the hardness of the material composing the outer sole ranges between 50C and 90 C, more preferably between 60C and 80C and even more preferably is about 70C (measured with an LX manual durometer, scale: Shore C).

[0046] According to a form of embodiment, the element 10 in correspondence with the plantar arch has a plurality (for example 3) crosswise through slots 16 (fig. 2) entirely crossing the arms 1A and 1B of the U-shape of the element 10 of the sole, in correspondence with its lower face. These slots are suitable to improve the sole flexibility. These slots 16 are not essential.

[0047] In the forefoot region R3 (fig. 2), the structural element 10 has five through openings 31A-E suitable to allow the five pads 19A-E of the shock-absorbing element 19 to be introduced into the openings themselves. The pads 19A-E have their outermost face slightly convex and slightly protruding (for example protruding by 0.1 mm to 2 mm) from the face which remains visible of the element 10 having the openings 31A-E.

[0048] The shape, the size and the position of the pads 19 A-E are substantially similar to those of the four digital pads (also called digital pulps) and to the metacarpal pad which are present in large felids such as cheetahs.

[0049] The pads 19 A-E play the same function as the corresponding pads present in felids, namely to absorb shocks in both the metatarsal portion of the foot and the phalanges.

[0050] The larger opening 31A and relevant pad 19 A are provided in the sole area adapted to support the front metatarsal portion of the foot sole, namely the so-called foot plantar pad.

[0051] The larger opening 31A and relevant pad 19 A have a polygonal shape, such as for example a pentagonal shape with arched sides, and they have two converging front sides 22 A and 22B forming a K1 angle between 80 and 140°, more preferably between 90° and 130°, and two rear sides 22C 22 D forming an angle K2 between 90° and 20° and more preferably between 70° and 30°, as well as a rear extremal arched side with its concavity turned towards the rear part of the sole.

[0052] The four smaller openings 31B-E and relevant pads 19B-E are provided in the sole area adapted to support the phalanges.

[0053] More particularly, the four openings 31B-E and relevant pads 19B-E all have an annular shape.

[0054] The two larger annular openings and pads 31C-D 19D-C are provided in correspondence with the front end portion of the sole, one on the right and one on the left of an axis of symmetry V (fig. 2) of this front portion of the sole, have a substantially elliptical shape in plan view, the major axes E1 and E2 (fig. 2) of these pads 19C and 19D or openings 31 C and 31 D being slanted relative to the above axis V (so as to form, for example, angles between 45° and 5°).

[0055] The two smaller annular openings and pads 31B, E 19B, E are provided in correspondence with an intermediate part of the front portion of the sole, one on the right and one on the left of an axis of symmetry V (fig. 2) of this front portion of the sole, and they are arranged between the two larger annular pads 31C-D and the metatarsal pad 31A, they have a substantially triangular (as represented) or elliptical shape in plan view, the major axes E3 and E3 (fig. 2) of these pads 19B and 19E or openings 31B and 31 E being slanted relative to the above axis V (so as to form, for example, angles between 45° and 5°).

[0056] As shown in figure 4, the pads 19A-E start from a substantially flat body 19F which, along with the pads, forms the shock-absorbing element 19. This flat body 19F is suitable to be housed flush and to be rigidly connected to (for example by gluing or by other customary methods known to those skilled in the art) in the seat 1P (fig. 1) of the structural element 10. This seat 1P and the flat part 19F of the shock-absorbing element are shaped so that each of the pads 19A-E is entirely encircled by a flat portion of the flat part 19F so that the pads are steadily connected to the upper face 1K (fig. 1) of the front portion of the structural element 10.

[0057] Advantageously the flat part 19F of the shock-absorbing element 19 and the relevant seat 1P are sized and shaped so that the upper face 19H (fig. 8) remaining visible of the shock-absorbing element 19 is substantially flush with and forms a single surface with the adjacent surfaces 10 A (fig. 8) of the structural element 10 and 5F of the bridge element 5. It should be highlighted that the

flat part 19F of the shock-absorbing element is advantageously shaped and sized so as to substantially extend over the whole forefoot area of the sole (as visible in fig. 8). In this way, in the forefoot region the sole has a shock-absorbing layer formed by the thickness of the flat part 19F of the shock absorbing element. For example, said flat part has a thickness between 0.1 mm and 10 mm, more preferably between 0.1 mm and 5 mm, and even more preferably between 0.1 mm and 2 mm.

[0058] As visible in figure 4, the pads start from the inner face 19G of the flat part with side walls 19A'. They are substantially perpendicular to said face 19G and sized so that the upper face remaining visible of the pads slightly protrudes (for example protrudes by 0.1 mm to 2 mm) from the openings 31A-E of the support element 10 and also from the outer sole 23 encircling said pads.

[0059] According to the invention, the material forming the shock-absorbing element is less dense and more supple and absorbing than the material forming the structural element 10.

[0060] According to the invention, the density of the material of the structural element 10 may be higher than the density of the material of the shock-absorbing element by at least about 5%, or 10%, or 15%, or 20%, or 25%, or 30%, or 35%, or 40%, or 45 %, or 50%, or 100%, or 150%, or 200% or more.

[0061] For example, the density of the material of the structural element 10 is a high density and ranges between 1 pound per cubic foot and 20 pounds per cubic foot, preferably between 2 pounds per cubic foot and 12 pounds per cubic foot, or even more preferably between 10 and 13 pounds per cubic foot.

[0062] In general, the higher density of the material of the structural element allows implementing a more rigid and structurally more stable element than a material with a lower density of the shock-absorbing element.

[0063] Advantageously also the hardness of the material of the structural element 10 is higher than the hardness of the material of the shock-absorbing element, preferably by 5% to 100% higher, more preferably by 10% to 50% higher and even more preferably by 15% to 30% higher.

[0064] For example, the hardness of the material of the structural element 10 ranges between 40C and 70C, more preferably ranges between 50C and 70C and even more preferably is about 60C (measured with an LX manual durometer, scale: Shore C).

[0065] For example, the hardness of the material of the shock absorbing element 19 ranges between 40C and 60C and preferably is about 50C (measured with an LX manual durometer, scale: Shore C).

[0066] Advantageously, the element 10 is made of EVA or high-density polyurethane and/or a similar material.

[0067] In correspondence with the front region R3 (fig. 2) of the face facing the ground of the structural element 10, a front outer sole 23 is available (fig. 5). Said front outer sole 23 has the same thickness and is made of the

same material as the rear outer sole 13 described above.

[0068] Preferably, the outer sole 23 has a V-shape and is suitable to be associated only to the most extremal and lateral part of the front region of the shoe sole and not also to the part of the plantar pad.

[0069] The outer sole has four through openings 23 A-D having the same size and position as the openings 31B-E (fig. 2) of the structural element 10; the outer sole 23 hence completely encircles all the pads 19 B-E (as shown in fig. 7). These pads slightly protrude (by 0,1 mm e 2 mm) relative to the outer surface of the sole 23.

[0070] The outer sole has substantially a V- or a U-shape, the two arms 23E and 23 F of the V being configured so as to comprise each one of the smaller openings 23 A and 23D and the base 23G of V which includes the other two openings 23B and 23C.

[0071] As usual, the sole provides an extension 23F suitable to develop upwards so as to form an end bent towards the upper part of the sole on the front tip of the sole.

[0072] Advantageously, in order to improve the flexibility of the extremal forefoot part, the outer sole 23 has a central through slot 23 H (fig. 5) provided between the two openings 23 B and 23 C and further weakened sections 23M provided between the openings 23C and 23D and between the openings 23B and 23A upstream of the openings 23 C and 23B.

[0073] As is the case with the rear outer sole 13, the front outer sole 23 as well has a very limited extension so as to minimise the sole weight.

[0074] In actual fact, the whole region of the sole suitable to support the plantar arch, an extended area of the heel and the whole area of the plantar pad are without an outer sole. The outer sole with its parts 13 and 23 covers as a whole only an area between 30% and 70% of the overall area of the sole facing the ground, more preferably only an area between 40% and 60% and even more preferably an area of about 50%.

[0075] It should be highlighted that the presence of the wide opening 2 has the advantage, among others, to avoid a wide area of outer sole, thus affecting positively both the overall weight of the sole and the amount of material required to implement the sole itself.

[0076] The outer sole 23 is adapted to be introduced and connected into the hollow seat 1R (fig. 2) provided in the face remaining visible of the structural element 10, per example the outer sole 23 is glued (or assembled by another customary method known to those skilled in the art) to said seat.

[0077] The sole according to the invention is particularly simple to be implemented, since it comprises only five components which can be easily manufactured and rapidly assembled: the structural element 10, the component which groups in a single body both the bridge element 5 and the air exhaust element 4, the shock-absorbing element 19 which groups in a single body the five pads 19A-E, and the rear 13 and front 23 outer soles.

[0078] As is usual in soles of the kind described so far,

the sole also has customary side 25 A, 25 C (fig. 1) and rear 25B walls of a conventional shape for those skilled in the art, laterally starting from the upper face S (fig. 8) of the structural element 10 and suitable to be assembled with said upper face of the sole to the shoe uppers (not represented).

[0079] According to the invention, the sole might also be implemented as follows:

- 10 - the forefoot part might be of a conventional type, with only the rear part comprising the features illustrated so far;
- or the sole might be implemented with a rear part of a conventional type and with only the forefoot part
- 15 - comprising the features illustrated so far,
- or the sole might provide two distinct parts, one suitable to support the heel and one suitable to support the forefoot (separated and distinguished from each other by a portion of the shoe uppers bottom to which
- 20 said two parts are assembled), and these two parts might be shaped both with the heel part and with the forefoot part having the features described above or only with the heel part having said features or only with the forefoot part having said features.

[0080] Figure 11 shows a first variation of the invention; the elements of this variation in common with the form of embodiment illustrated above will not be further described and will be marked by the same reference numbers used to describe the form of embodiment shown in figures 1-9, increased by 100. The sole according to the variation of fig. 11 has a structural element 110, formed by one or more layers of plastic materials of the same type or of different type, which in correspondence with at least the heel area has an opening 102 closed by a wall 105' (or by a bridge element 105 of the same type described above) and comprising an exhaust element 104 for the air which may remain trapped in the cavity defined by the walls delimiting the opening 102 and by the closing wall 105'. The forefoot part R3 of the sole is of a conventional type and is therefore not described in detail. Fig. 12 illustrates a second variation of the invention, showing a sole wherein the part Z1 for the heel and the part Z3 for the forefoot are distinct and separate parts and wherein the sole is without a central area suitable to support the plantar arch. This type of sole is customary for those skilled in the art and the two parts Z1 and Z3 are assembled in a conventional manner (for example by gluing) to the bottom F of the shoe uppers T; a section C of the bottom F of the shoe uppers being provided between the heel part Z1 and the forefoot part Z3 of the sole. According to the form of embodiment of fig. 12, the part Z1 of the sole provided in correspondence with the heel has a structural element 210, formed by one or more layers of plastic materials of the same type or of different type, which in correspondence with at least the heel area has an opening 202 closed by a wall 205' (or by a bridge element 205 of the same type described above) and com-

prising an exhaust element 204 for the air which may remain trapped in the cavity defined by the walls delimiting the opening 202 and by the closing wall 205'. The forefoot part Z3 of the sole is of a conventional type and is therefore not described in detail.

[0081] As is customary for those skilled in the art, the two parts Z1 and Z3 of the sole may be connected with each other by a bridge element J (dashed in fig. 12), preferably with a limited thickness, such as a plastic foil, adapted to stiffen the plantar arch; said bridge element J may be, for example, an extension of the bridge element 205 closing the opening 202.

[0082] This sole shows an improved longitudinal flexibility.

[0083] The form of embodiment of fig. 13 shows a variation compared to the form of embodiment of fig. 12, wherein the opening 302 provides, in addition to the air exhaust element 304 on the rear part 301C of the sole, also a further front opening W to allow the air to be exhausted also on the front side (as shown by the arrow S1). The need for the rear air exhaust element 304 in this variation is accounted for by the circumstance that the front opening W may not be sufficient to exhaust the air present in the opening 302, for example because said opening is integrally or partially closed on account of the compression of the sole and/or because it is obstructed by the material built-up therein. The exhaust element 304 ensures a more reliable and safer outflow of the air from the opening 2.

[0084] The form of embodiment of figure 14 shows a further variation of the invention; the elements of this variation in common with the form of embodiment shown in figures 1-9 will not be further described and will be marked by the same reference numbers used to describe the form of embodiment shown in figures 1-9, increased by 400. The sole according to the variation of fig. 14 has a structural element 410 formed by one or more layers of plastic materials of the same type or of different type, which in correspondence with the forefoot area R3 has five through openings from which five pads 419 A-E protrude, and an outer sole 423, also having five openings in correspondence with the pads 419 A-E. This forefoot part is identical to the one described with reference to figures 1-9. The heel part R1 and the plantar arch part R2 of the sole are of a conventional type and will therefore not be described in detail.

[0085] This sole shows a forefoot part with improved shock-absorbing performance.

[0086] Fig. 15 illustrates a further variation of the invention, showing a sole wherein the part Z1' for the heel and the part Z3' for the forefoot are distinct and separate parts and wherein the sole is without a central area suitable to support the plantar arch. This type of sole is customary for those skilled in the art and the two parts Z1' and Z3' are connected in a conventional manner (for example by gluing) to the bottom F of the shoe uppers T. A section C of the bottom F of the shoe uppers is provided between the heel part Z1' and the forefoot part Z3' of the

sole. According to the form of embodiment of fig. 15, the part Z3' of the sole provided in correspondence with the forefoot has five through openings from which five pads 519 A-E protrude, and an outer sole 523, also having five openings in correspondence with the pads 519 A-E. This forefoot part is identical to the one described with reference to figures 1-9. The heel part Z1' of the sole is of a conventional type and will therefore not be described in detail.

[0087] This sole shows an improved longitudinal flexibility.

[0088] As is customary for those skilled in the art, the two parts Z1' and Z3' of the sole may be connected with each other by a bridge element J (dashed in fig. 15), adapted to stiffen the plantar arch.

[0089] Fig. 16 illustrates a further variation of the invention, showing a sole wherein the part Z1" for the heel and the part Z3" for the forefoot are distinct and separate parts and wherein the sole is without a central area suitable to support the plantar arch. This type of sole is customary for those skilled in the art and the two parts Z1" and Z3" are connected in a conventional manner (for example by gluing) to the bottom of the shoe uppers (not represented). A section (not represented) of the bottom of the shoe uppers is provided between the heel part Z1" and the forefoot part Z3" of the sole. According to the form of embodiment of fig. 16, the part Z3" of the sole provided in correspondence with the forefoot has five through openings from which five pads 619 A-E protrude, and an outer sole 623, also having five openings in correspondence with the pads 619 A-E. This forefoot part is identical to the one described with reference to figures 1-9. The heel part Z1" has a structural element 610, formed by one or more layers of plastic materials of the same type or of different type, which in correspondence with at least the heel area has an opening 602 closed by a bridge element 605 of the same type described above (or by a wall) and comprising an exhaust element 604 for the air which may remain trapped in the cavity defined by the walls delimiting the opening 602 and by the bridge element 605. The ends of the two opposite arms 601A and 601B are connected by a part 606 whose inner wall 606 A delimits the opening 602.

[0090] This sole shows an improved longitudinal flexibility.

[0091] As is customary for those skilled in the art, the two parts Z1" and Z3" of the sole may be connected with each other by a bridge element J (dashed in fig. 16), adapted to stiffen the plantar arch and advantageously forming a single piece with the bridge element 605. Figure 17 shows a further variation which is substantially identical to that of fig. 16, where however the forefoot part is divided into two distinct parts K2 and K3, each assembled to the bottom of the shoe uppers to which the sole is applied. The sole accordingly consists of three distinct parts: one for the phalanges K3, one for the plantar pad K2 and one for the heel K1. According to this variation, the shock-absorbing element comprising the pads 719

A-E is obviously divided into two parts: one for the pad 719A and one showing the four pads 719B-E, the same also applying to the support element, which is divided into three parts.

[0092] This sole shows an improved longitudinal flexibility.

[0093] As for the previous forms of embodiment, the bridge element 705 might provide an extension J to connect the parts K1 and K2 to each other.

[0094] Lastly, it should be pointed out once again that the forms of embodiment illustrated so far are provided by way of example and that plentiful further variations are possible, all falling within the same inventive notion. For example, the extension of the opening 2 (fig. 1-9) might be different. Said opening 2 might for example be shorter, so as to extend only in correspondence with the heel (as shown in fig. 17) and not also integrally or partially under the plantar arch. Likewise, the bridge element might have a different shape compared to the one illustrated so far, said bridge element might for example be a wall forming a single piece with the side walls 1A', 1B', 1C', 6A defining the opening 2.

Claims

1. A footwear sole, comprising a structural element 10 providing at least one part R1 suitable to support the heel, wherein said part suitable to support the heel has an opening 2 sized and shaped so that said structural element 10, in correspondence with its part suitable to support the heel and with its face adapted to come into contact with the ground P, has a U-shape or a closed ring shape and comprises two opposite arms 1A, 1B linked by an arched arm 1C,

- wherein the inner walls 1A' 1B' 1C' of the above arms of the U or of the closed ring at least partially delimit said opening 2,
- wherein said opening 2 is opened in correspondence with the sole face adapted to come into contact with the ground,
- wherein the opening 2 is closed in correspondence with the upper face 10A of the structural element 10 by a bridge element 5, so as to define a cavity 20 through said inner walls 1A', 1B', 1C',
- wherein said bridge element 5 is shaped and sized so that it is substantially arranged under the heel,

characterised in that it comprises:

- an exhaust element 4 of the air which may remain trapped into said cavity 20 when the part of the sole comprising said opening 2 is pressed against the ground P, at least partially closing said cavity 20 on the lower side as well,
- wherein said exhaust element 4 shows a sub-

stantially rigid body providing at least one through hole 4A suitable to link the cavity 20 with the outside of the sole and so as to exhaust the air present in said cavity in correspondence with at least one section 1C of the outer side walls 1B of the element 10,

- the structural element 10 having a seat 15 suitable to house the body of the exhaust element 4.

2. A sole according to claim 1, characterise in that the exhaust element 4 and the bridge element 5 consist of a single piece, so as to form a single body and so that said exhaust element helps to further stiffen the bridge element 5 crosswise.
3. A sole according to one of the preceding claims, **characterised in that** the exhaust element 4 and the bridge element 5 consist of a single piece, so as to form a single body, and that a rear end part 5D of the bridge element 5 extends from a front part 4M of the element 4, so that said front part 4M of the element 4 helps to stiffen said bridge element 5 crosswise at least in its said rear end part 5D and/or that the upper faces 4C, 5F of the two exhaust 4 and bridge 5 elements are coplanar to each other so as to form a single flat surface for the heel to rest on.
4. A sole according to one of the preceding claims, **characterised in that** the ends of the walls 1A', 1B' of the opposite arms 1A and 1B of the U or of the closed ring are connected to each other by an end wall 6A opposite the arched wall 1C' of the arm 1C which links said two arms 1A and 1B of the U or the closed ring,
 - wherein said end wall 6A helps to delimit the opening 2,
 - wherein said wall 6A preferably consists of a central part 6 of the structural element 10,
 - wherein said opening 2 has preferably a closed annular shape in a bottom view,
 - wherein the cavity 20 provided at least under the heel is delimited by said walls 1A', 1B', 1C', 6A and by the bridge element 5.
5. A sole according to one of the preceding claims, **characterised in that** the opening 2 is a through opening.
6. A sole according to one of the preceding claims, **characterised in that** the seat 15 suitable to house the body of the exhaust element 4 is provided in the most extremal rear part of the structural element 10, in the arched arm 1C of the U or of the closed ring.
7. A sole according to one of the preceding claims, **characterised in that** the bridge element 5 and/or the exhaust element 4 are made of a harder material

than the structural element 10 to which they are constrained, preferably the hardness of the material of the bridge element 5 and/or the exhaust element 4 is by 10% to 200% higher than the hardness of the material of the element 10, more preferably by 30% to 100% higher and even more preferably by 50% to 80% higher.

8. A sole according to one of the preceding claims, **characterised in that** the bridge element 5 and/or the exhaust element 4 are made of a material having a hardness ranging from 65C to 100C, more preferably from 75C to 90C and even more preferably amounting to about 85C; and that preferably the hardness of the material of the structural element 10 ranges from 40C to 70C, more preferably from 50C to 70C and even more preferably amounts to about 60C.
9. A sole according to one of the preceding claims, **characterised in that** the bridge element is substantially rigid, at least crosswise.
10. A sole according to one of the preceding claims, **characterised in that** the structural element 10 has such a shape and size as to support the whole foot, all the sole components being constrained to said structural element 10.

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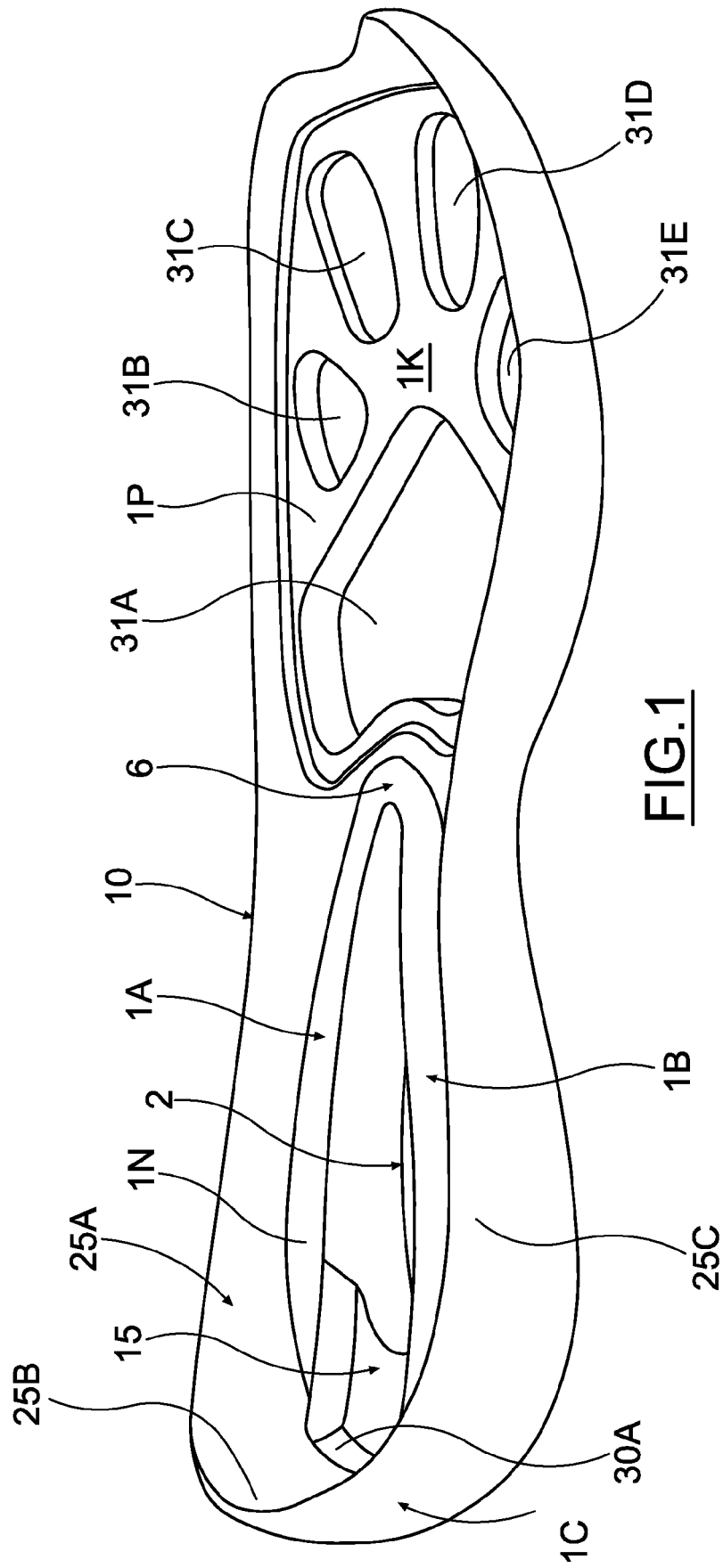


FIG. 1

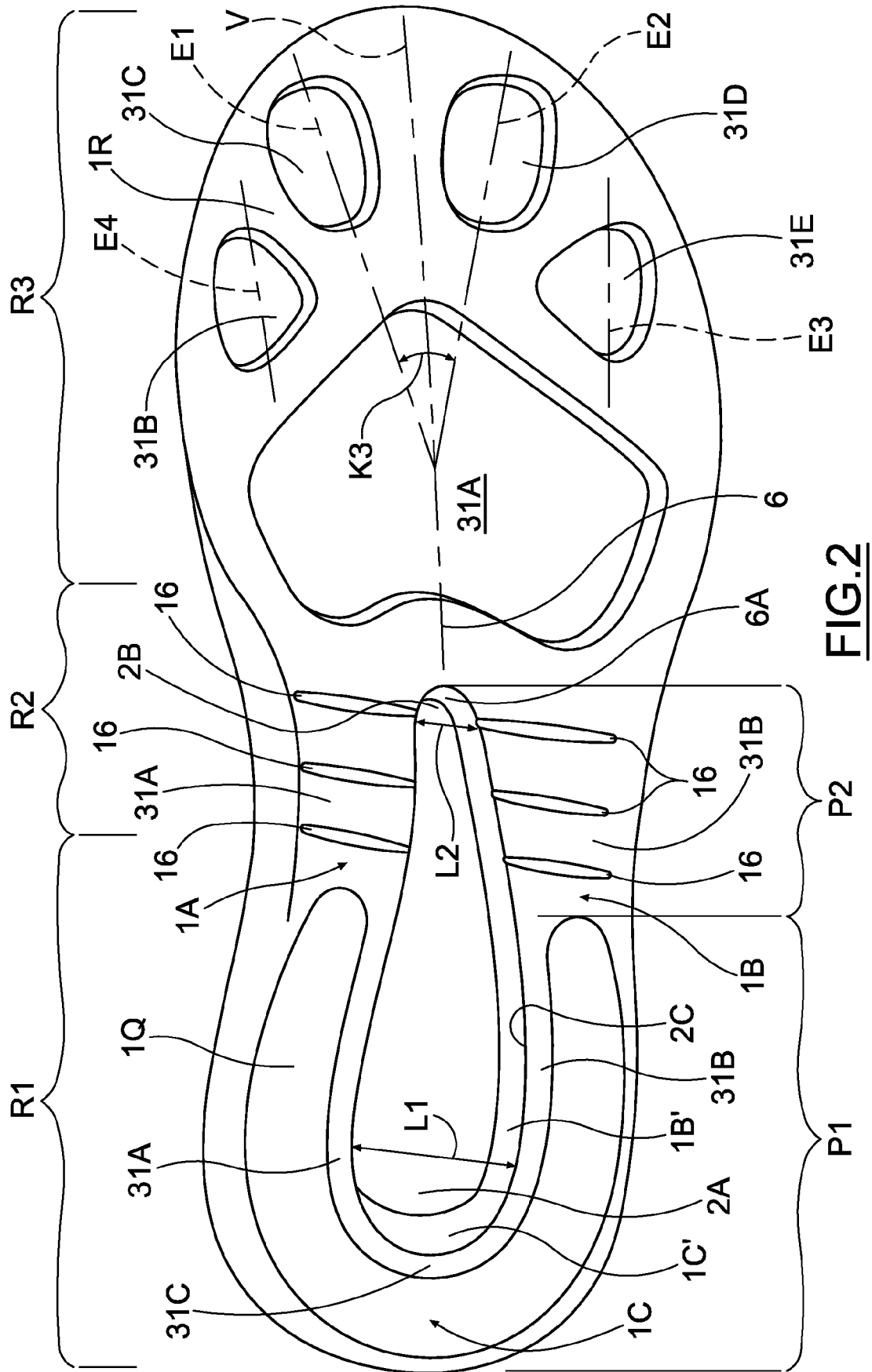


FIG. 2

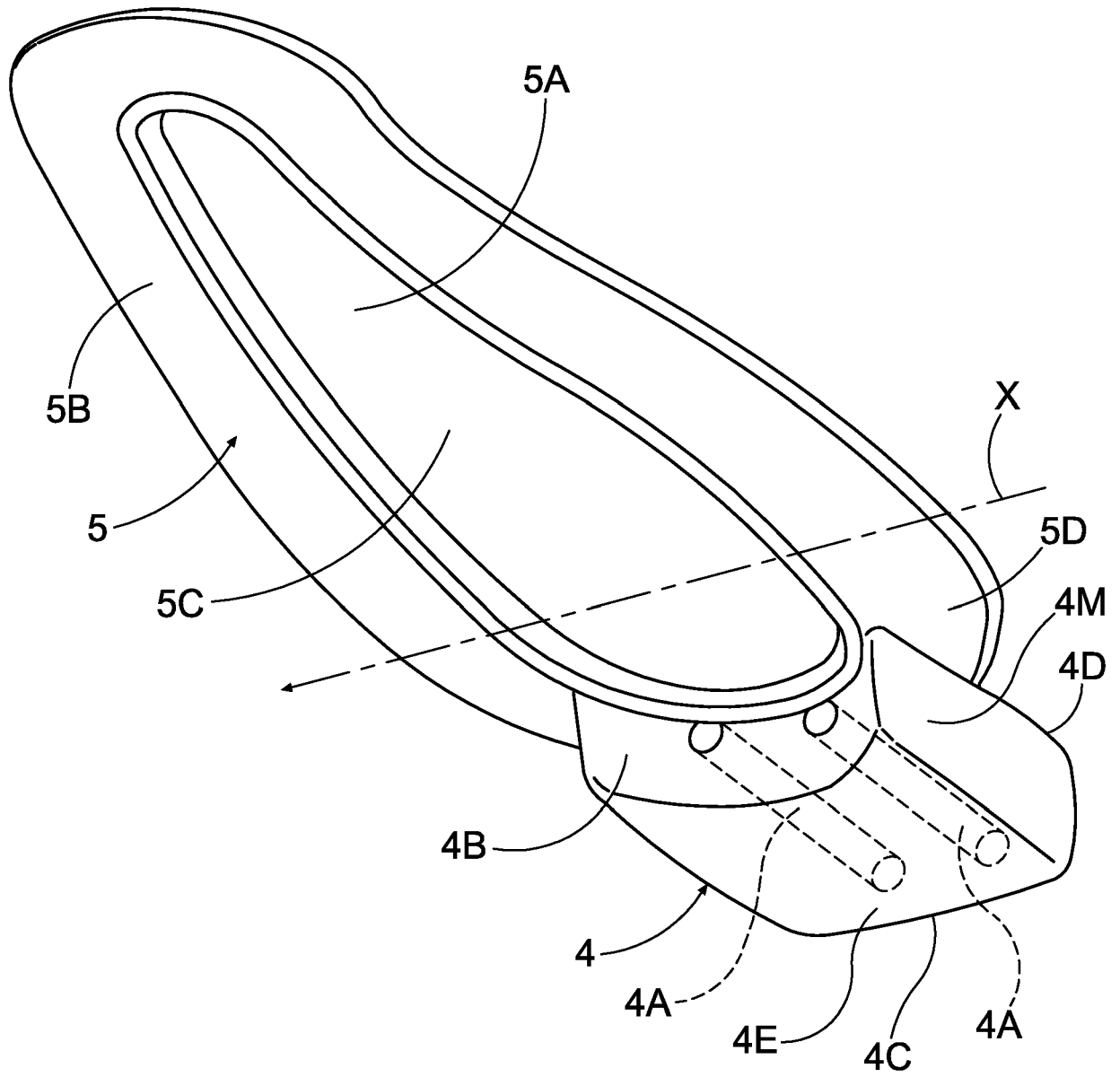


FIG.3

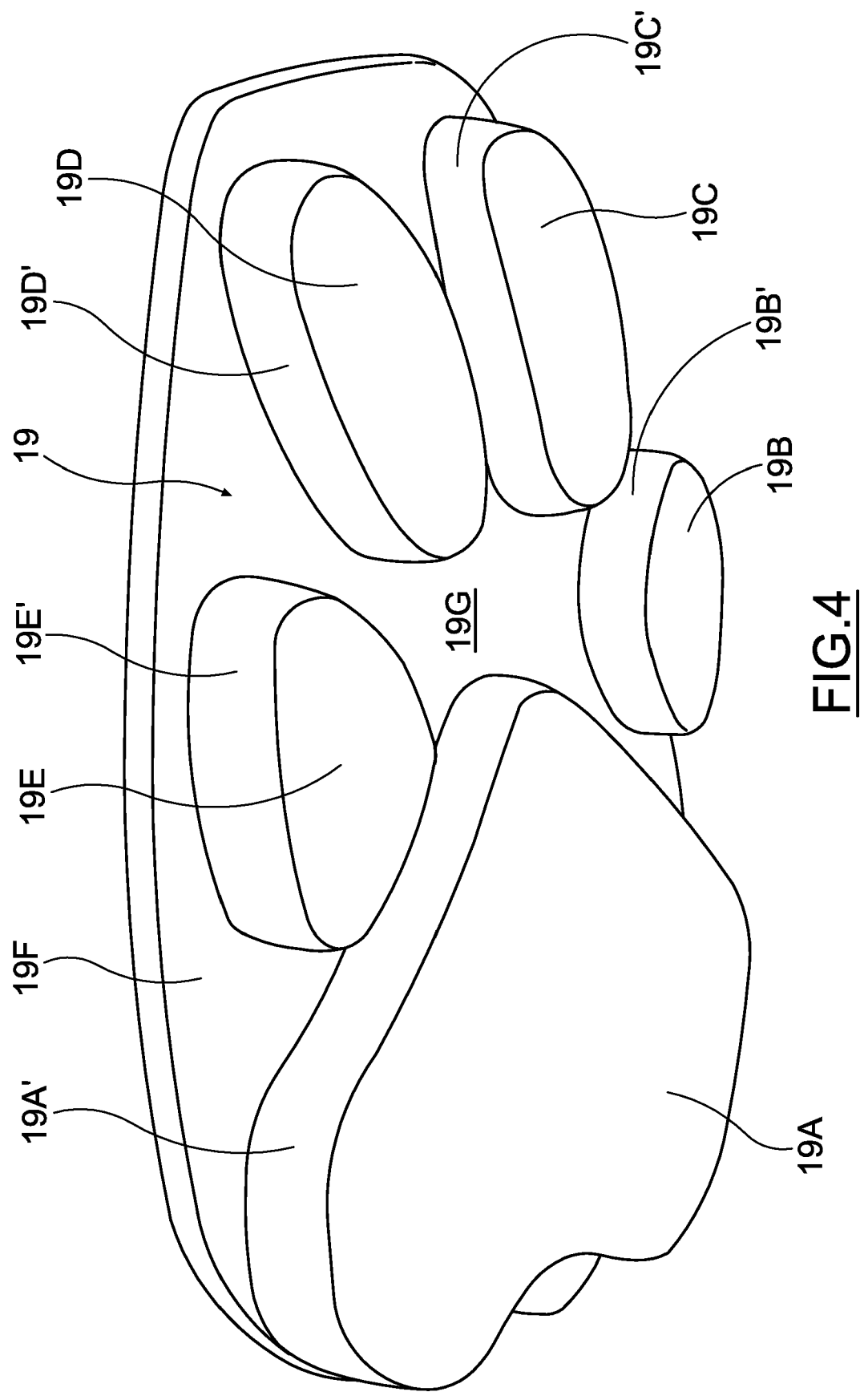


FIG. 4

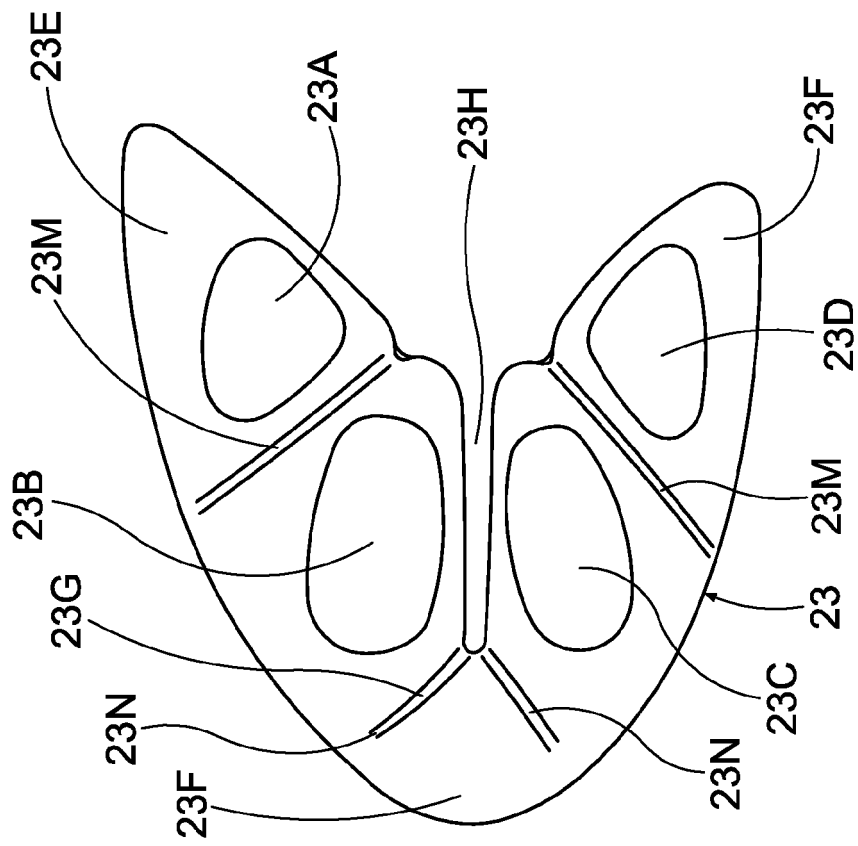


FIG. 5

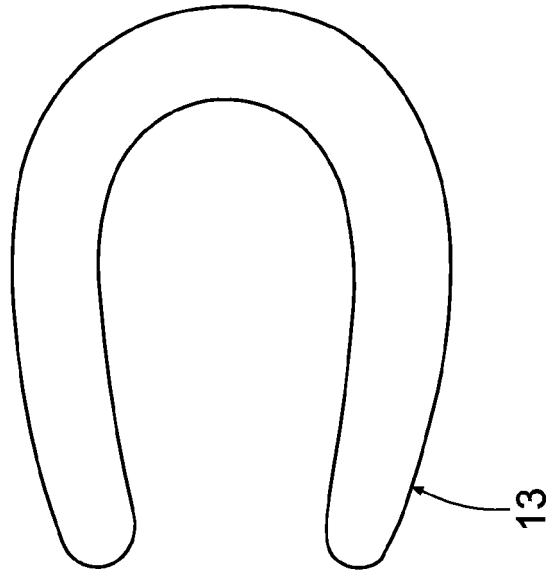


FIG. 6

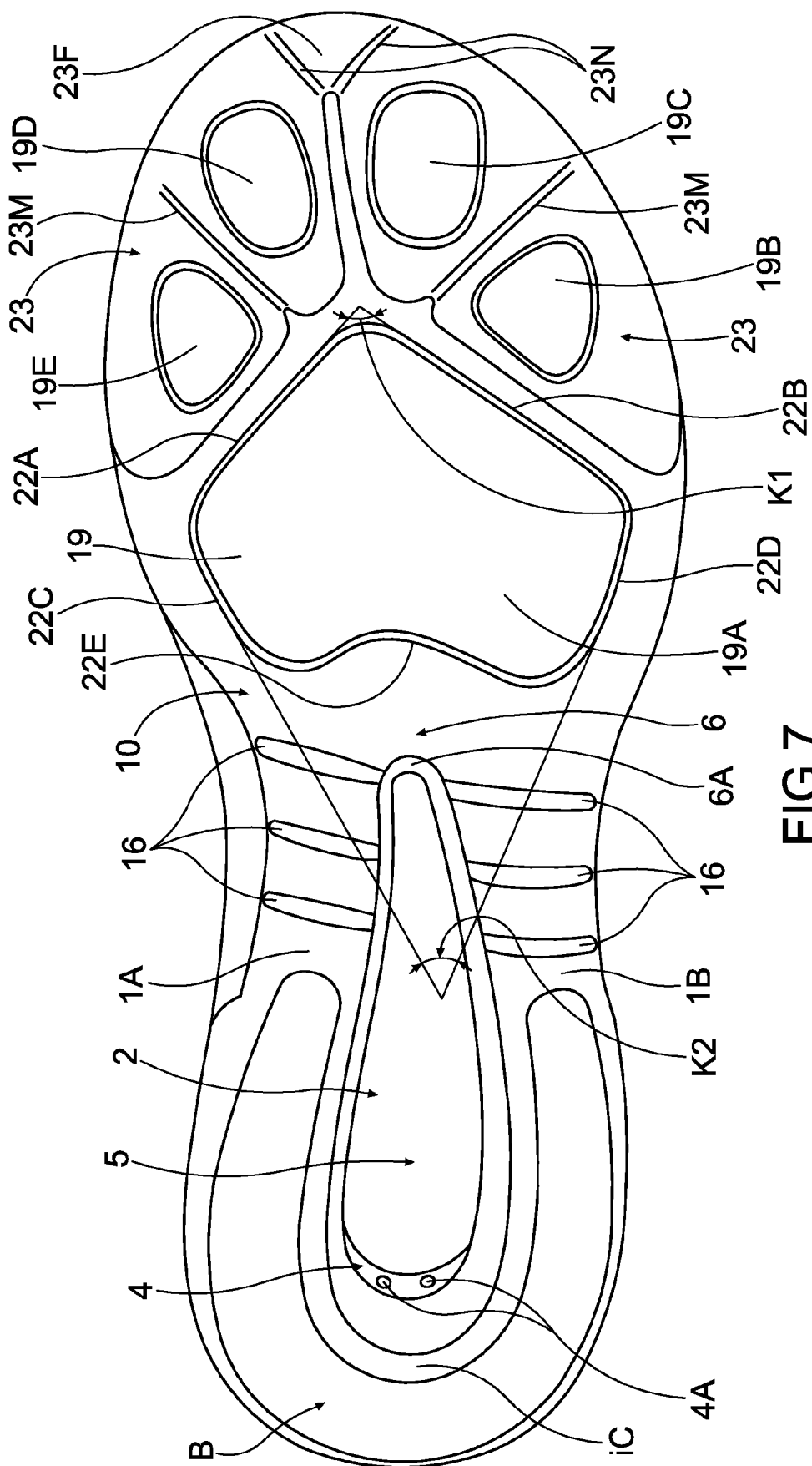


FIG. 7

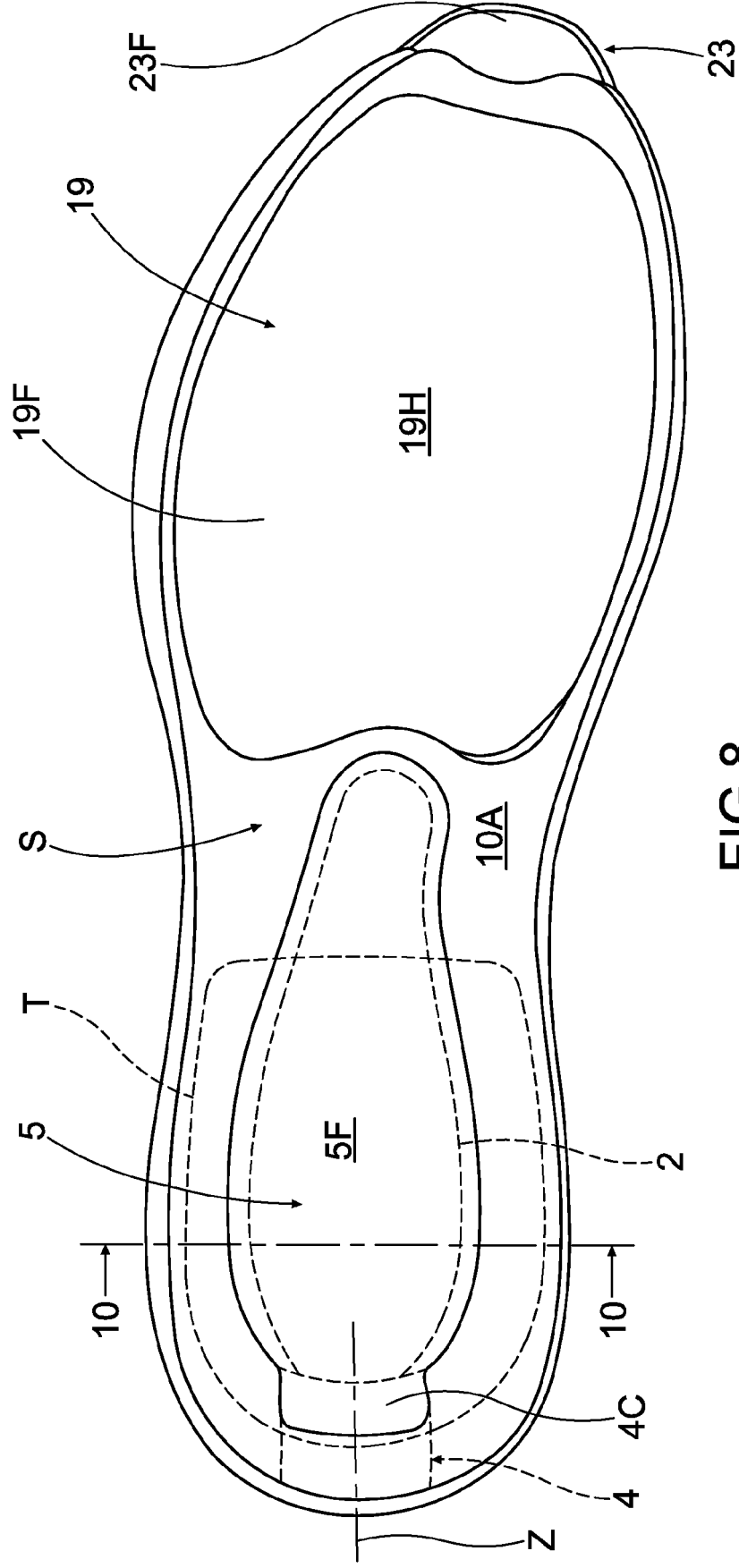


FIG. 8

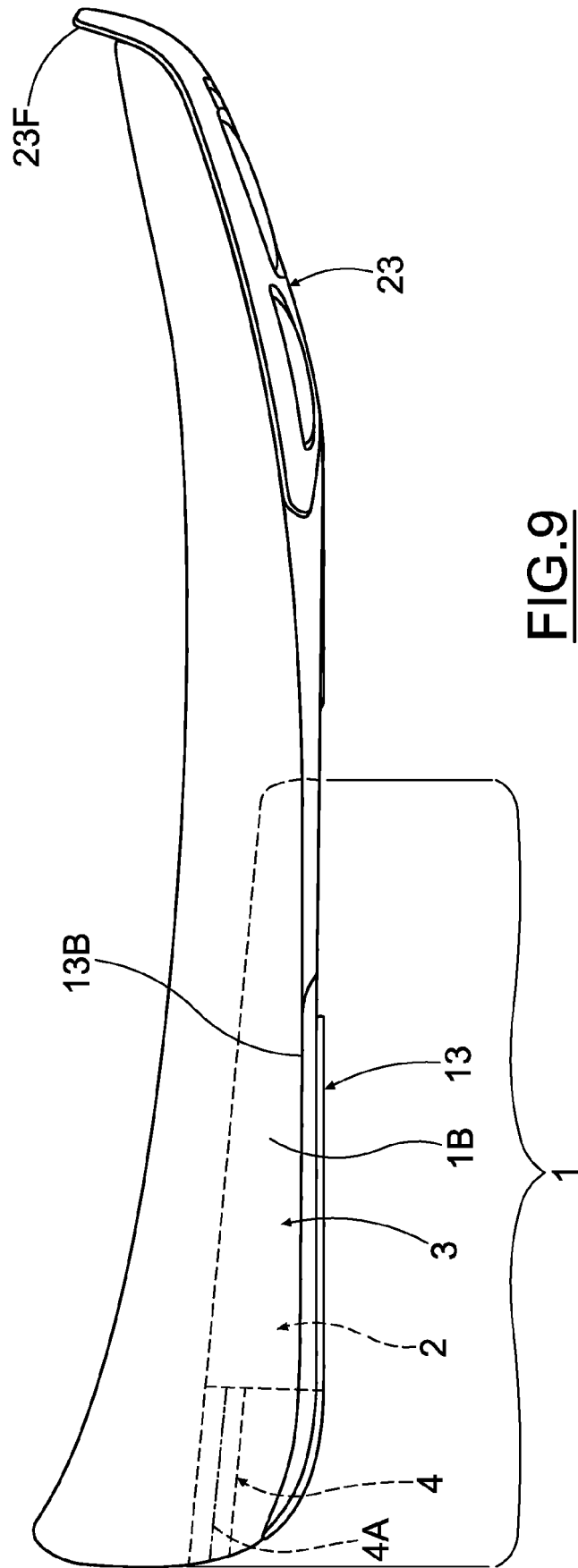


FIG. 9

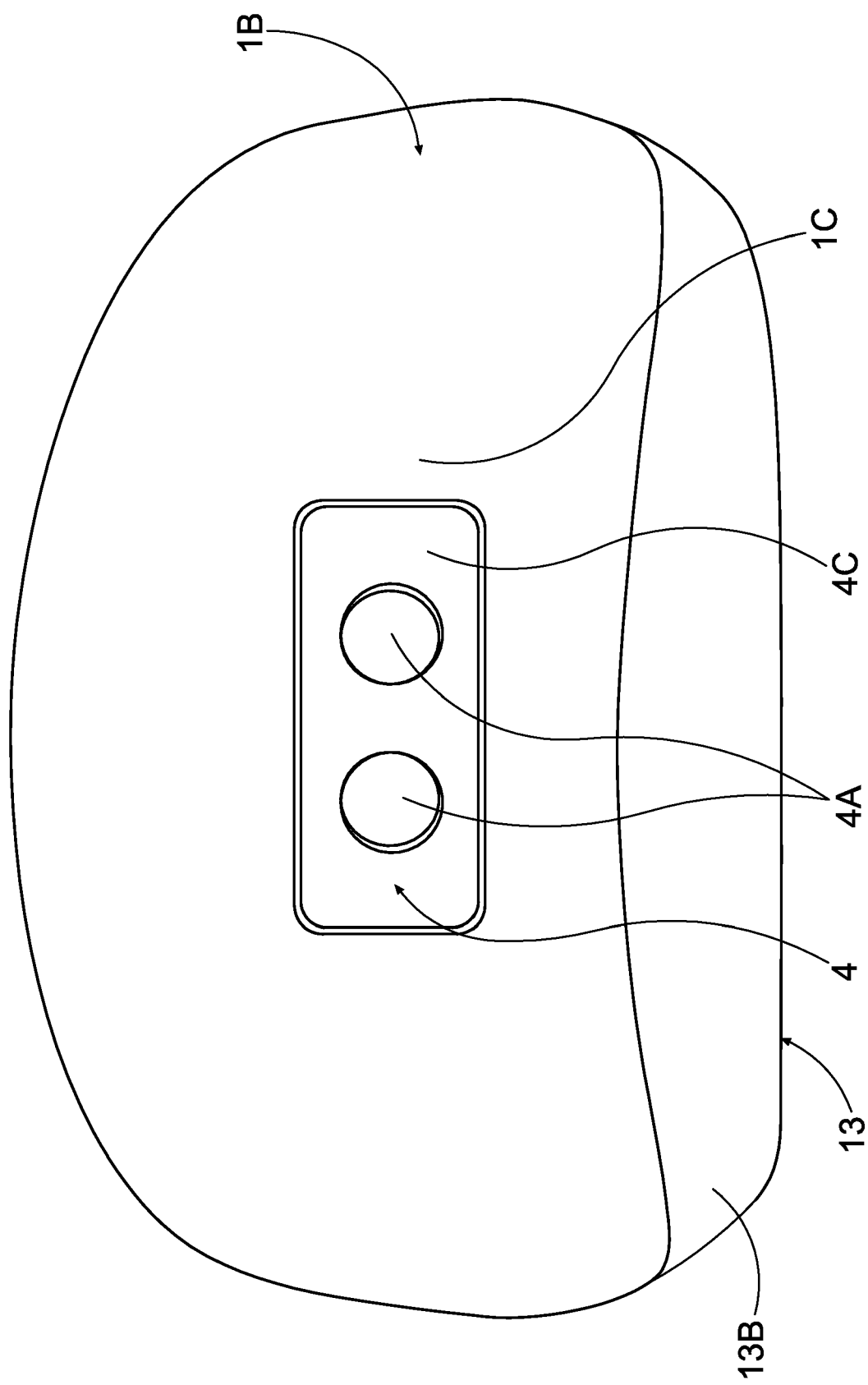


FIG. 9A

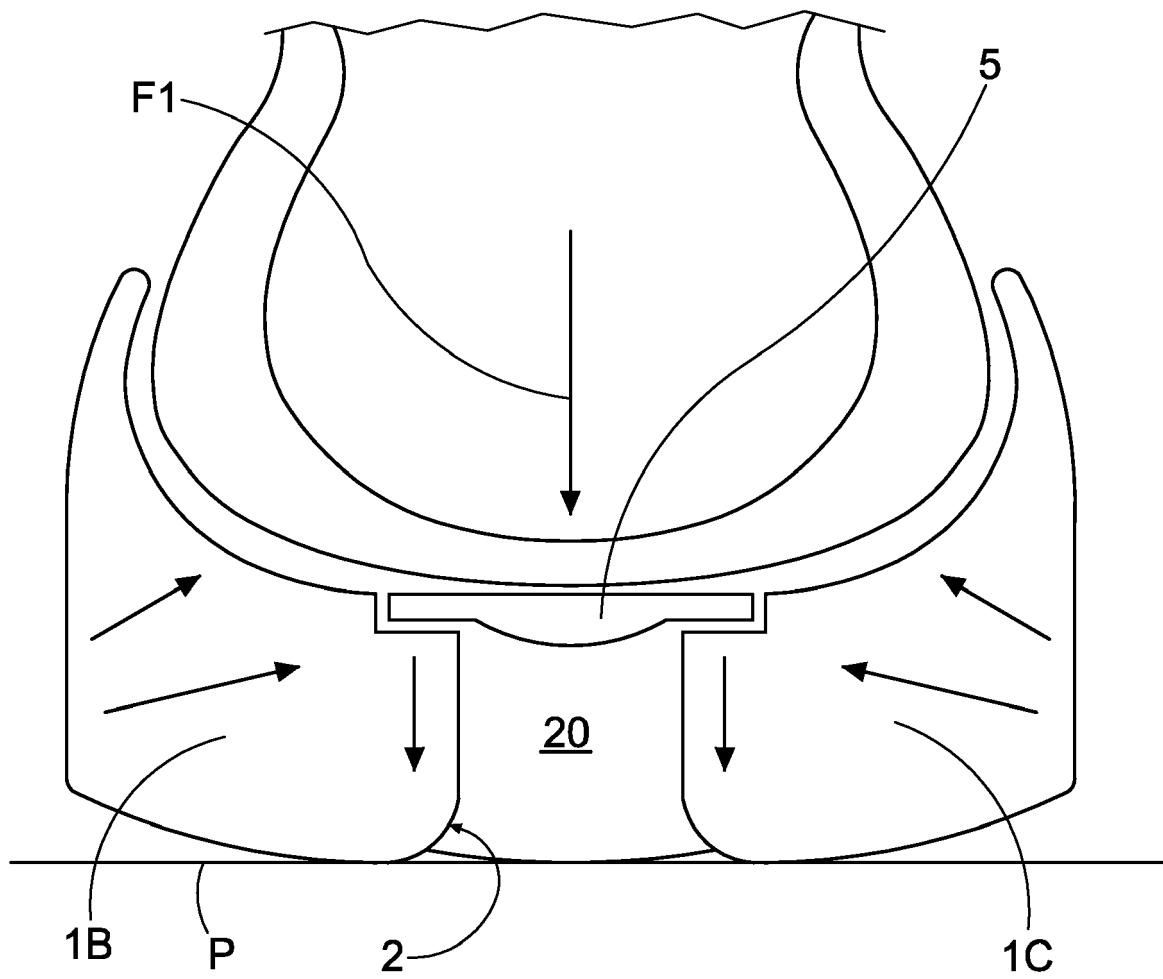
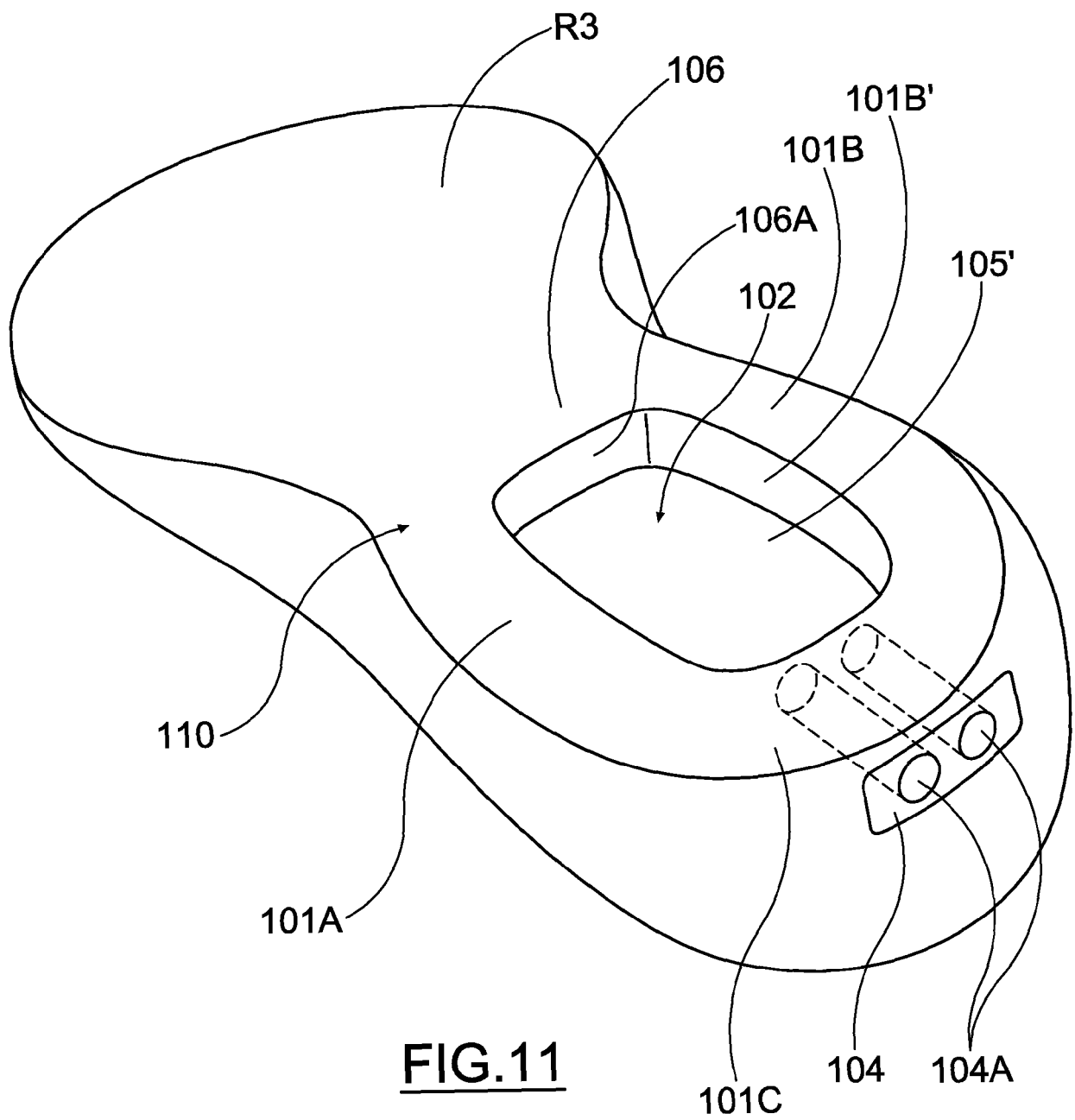


FIG.10



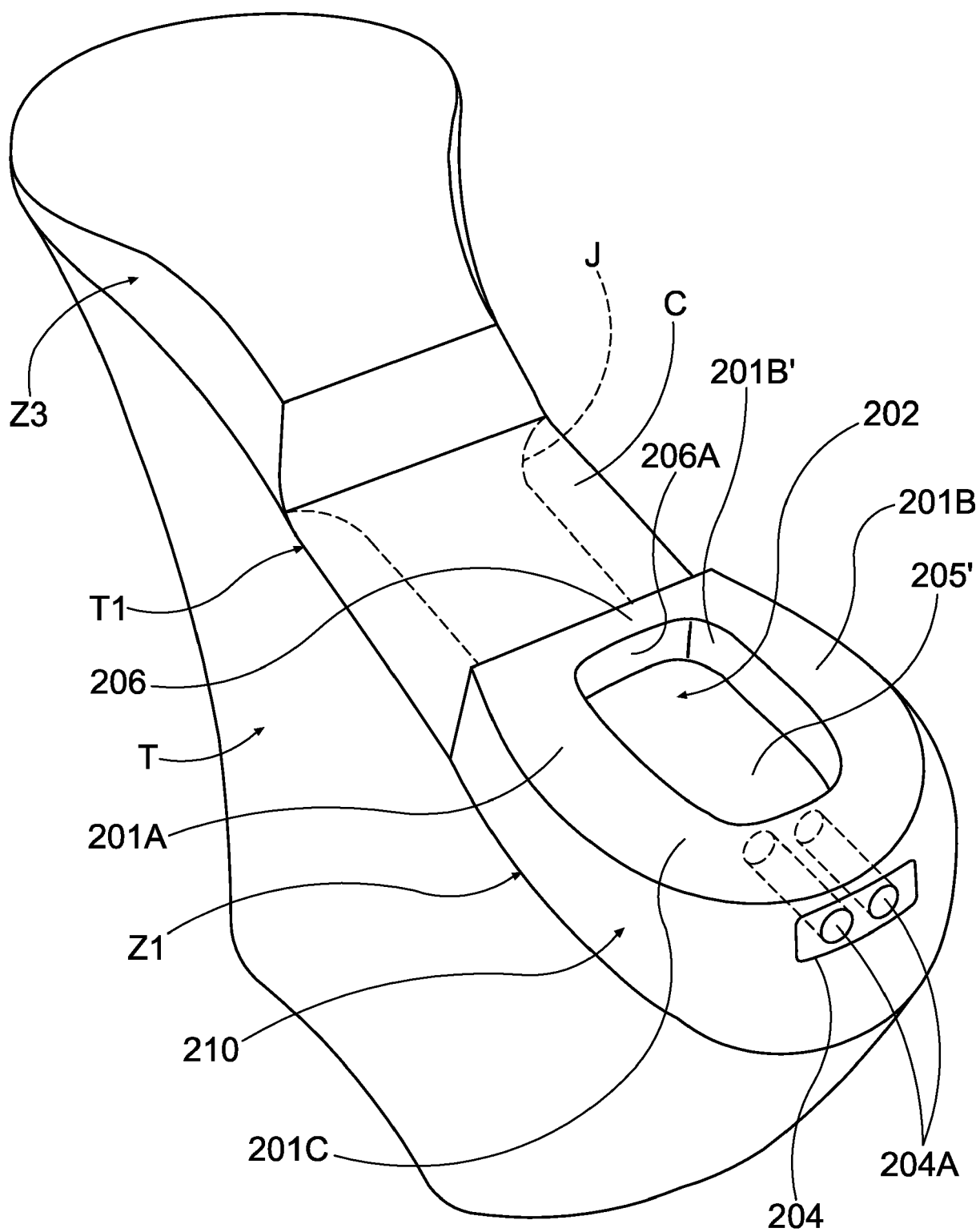


FIG.12

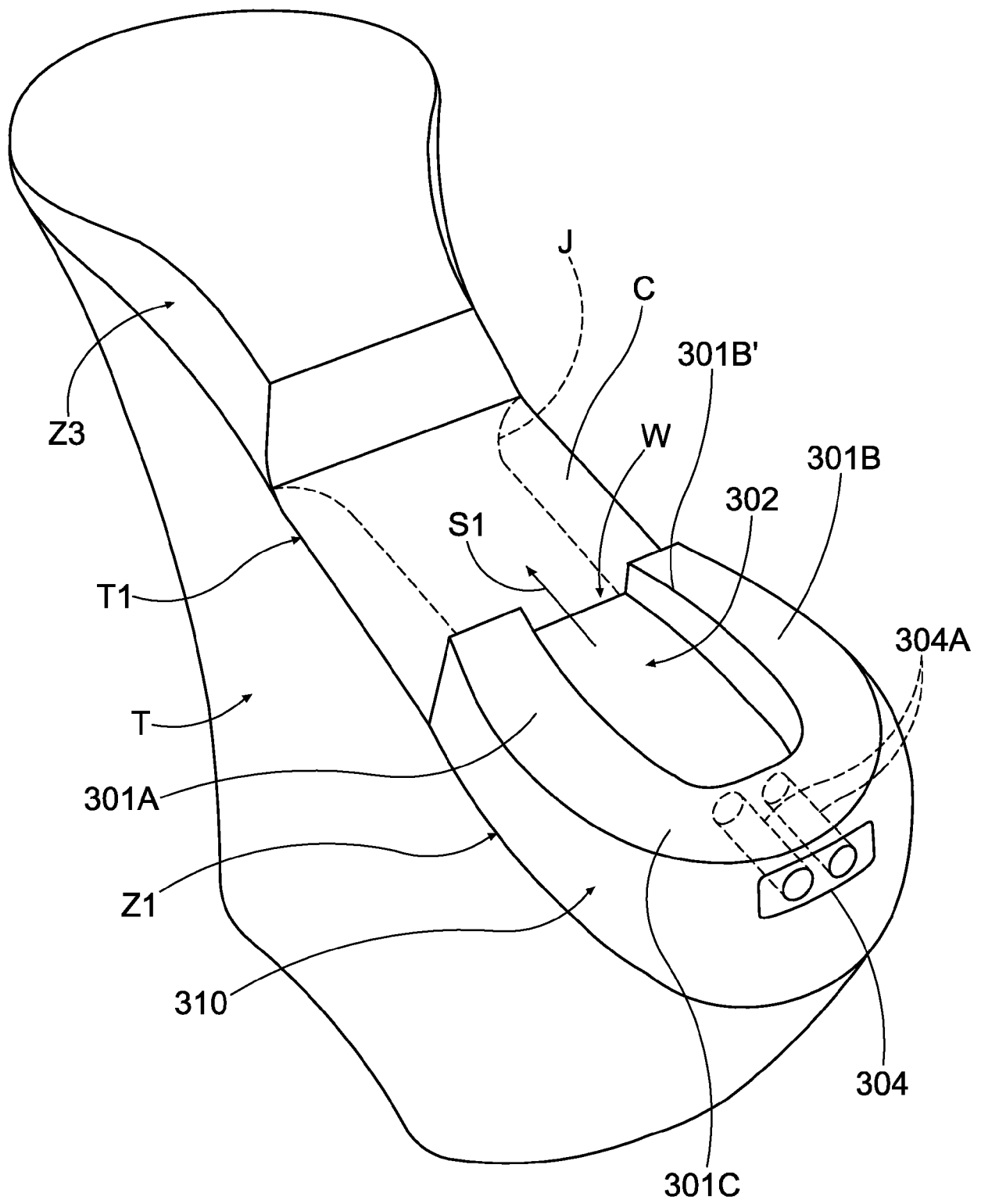


FIG.13

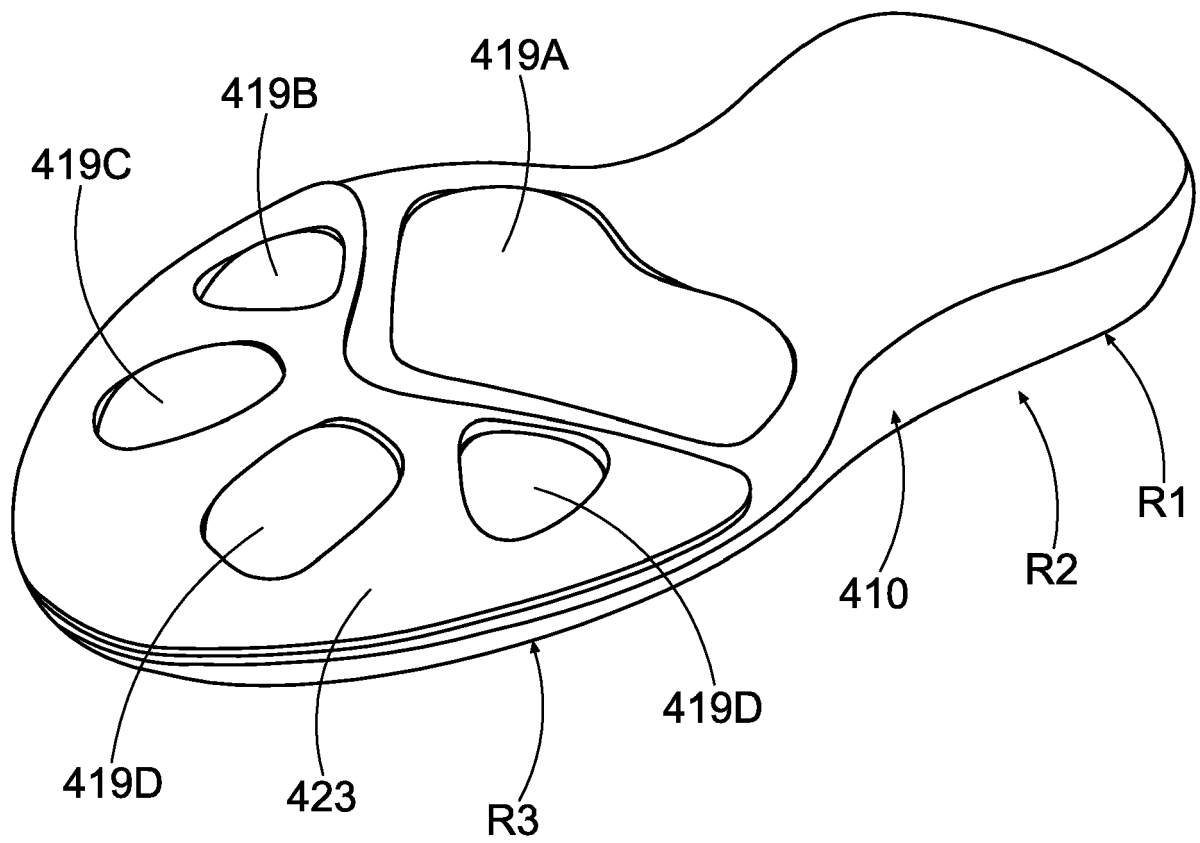


FIG.14

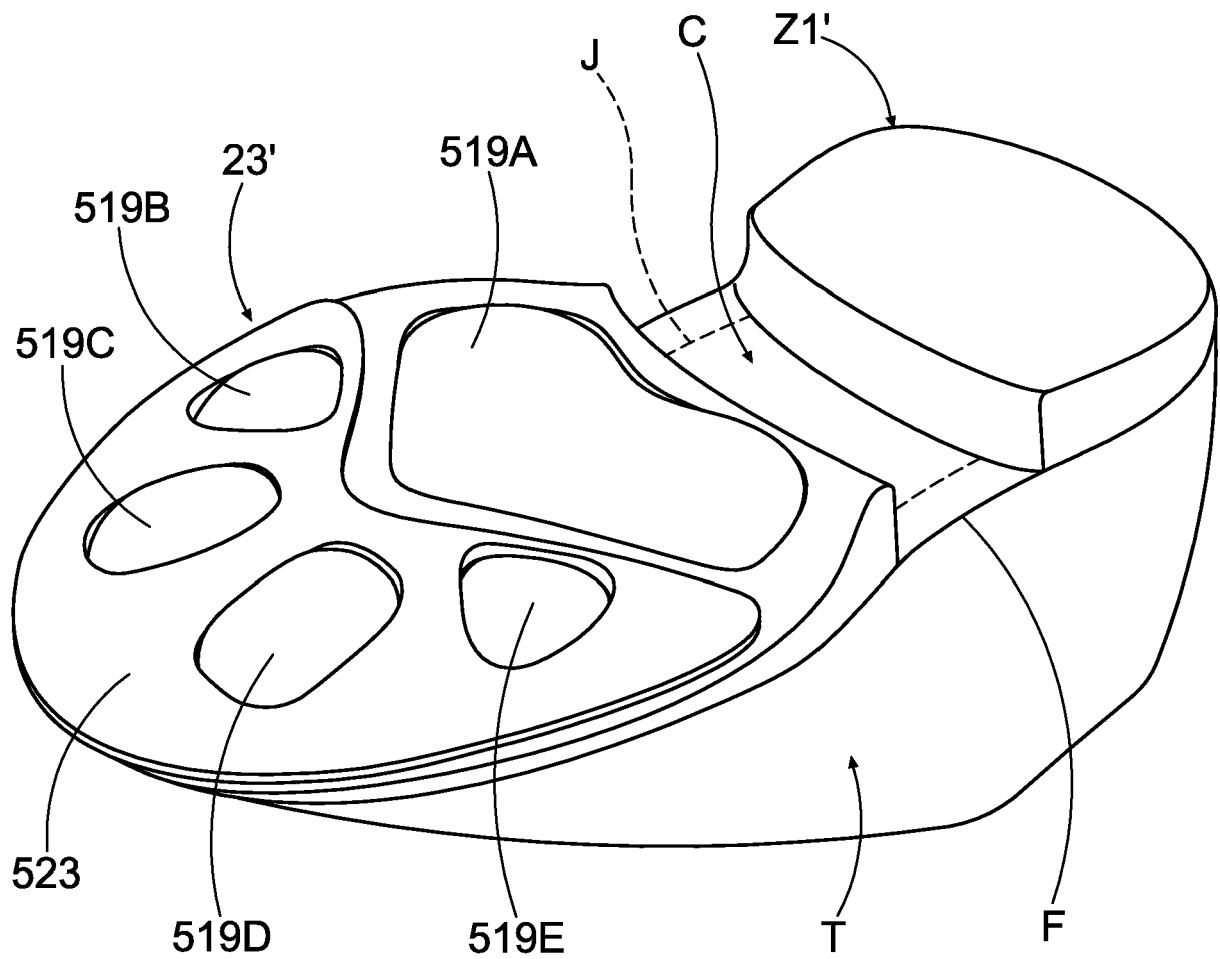


FIG.15

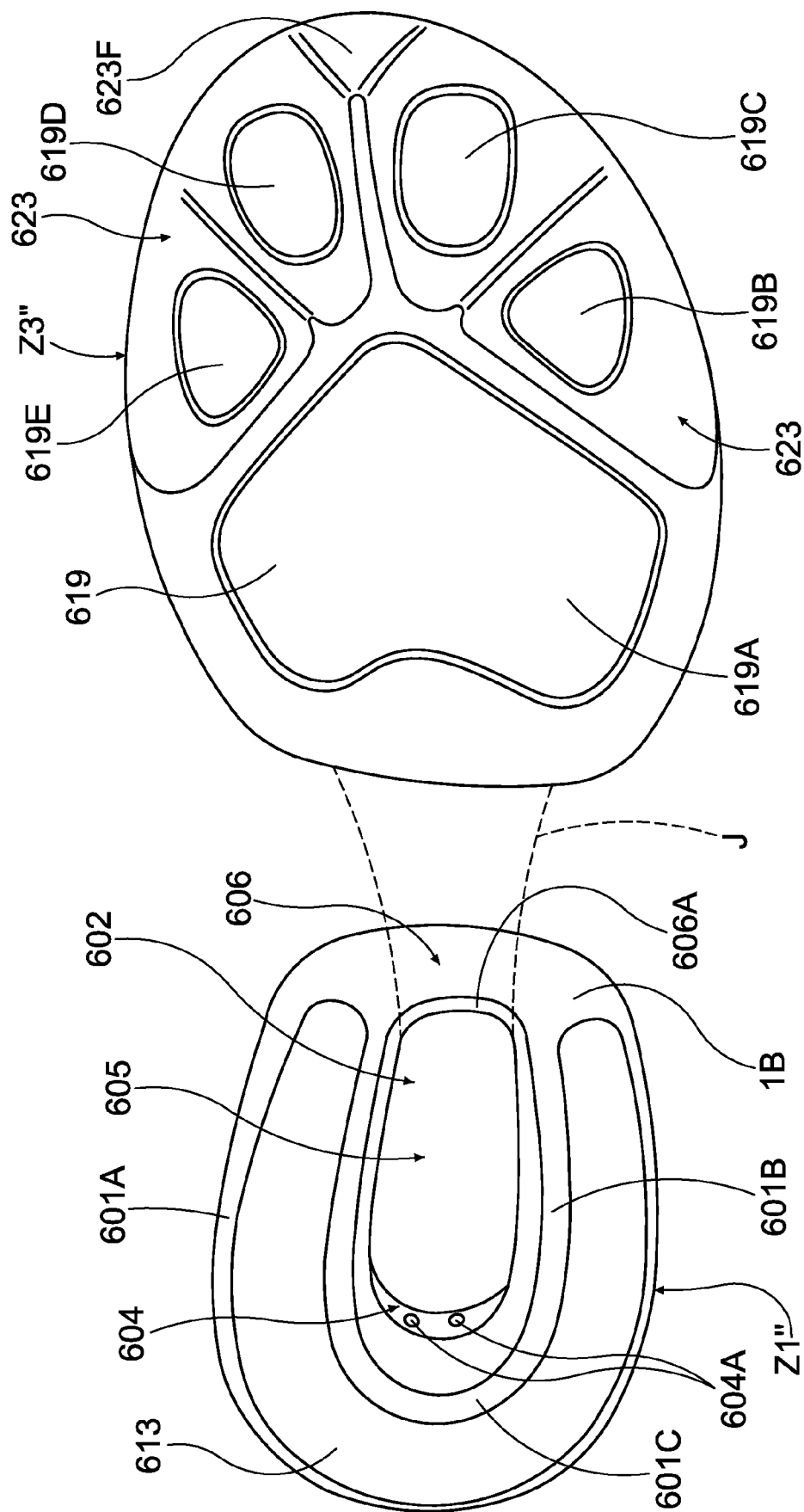


FIG. 16

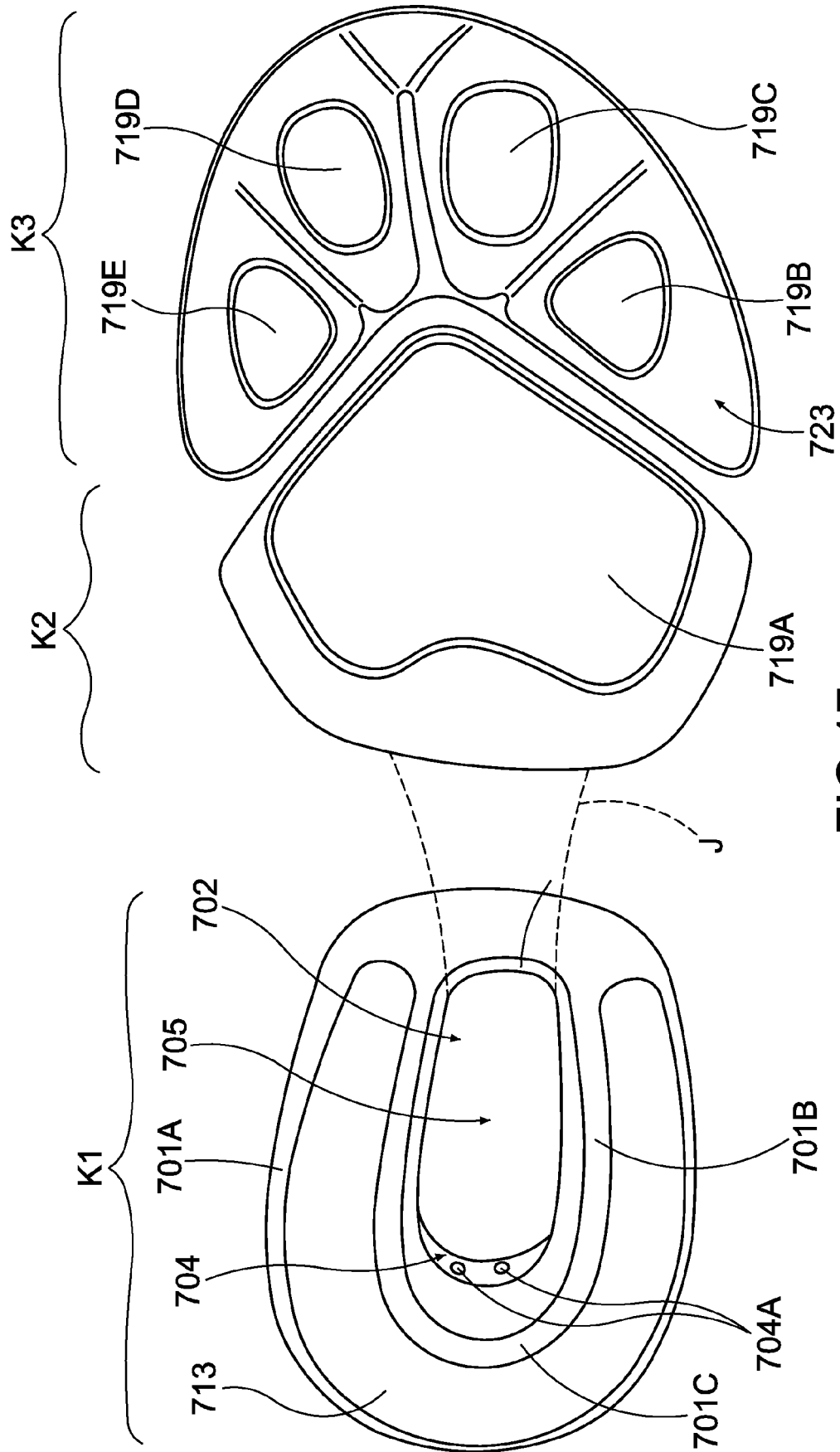


FIG. 17



EUROPEAN SEARCH REPORT

 Application Number
 EP 17 17 3024

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			TECHNICAL FIELDS SEARCHED (IPC)
			A43B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 October 2017	Examiner Ciubotariu, Adrian
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			

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