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

(11) Publication number : **0 619 084 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **94102637.9**

(51) Int. Cl.[5] : **A43B 13/18**

(22) Date of filing : **22.02.94**

(30) Priority : **23.02.93 US 21222**

(43) Date of publication of application :
12.10.94 Bulletin 94/41

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(71) Applicant : **WILSON SPORTING GOODS COMPANY**
8700 West Bryn Mawr
Chicago, Illinois 60631 (US)

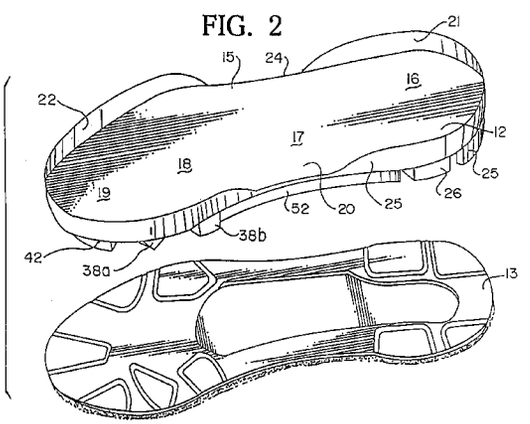
(72) Inventor : **Driscoll, Dennis R.**
226 Butternut Lane
Streamwood, IL 60107 (US)

(74) Representative : **Hiebsch, Gerhard F., Dipl.-Ing. et al**
Postfach 464
D-78204 Singen (DE)

(54) Athletic shoe sole assembly with flexible arches.

(57) An athletic shoe (10) is provided with a sole assembly which includes a plurality of arch portions (25,26) below the principal weight-bearing areas of the foot, namely, the heel (16), metatarsals (18), and toes (19). Each arch portion (25,26) includes at least a pair of base portions (29,30,32,33) and a downwardly facing concave arch surface (31,34) which extends between the base portions (29,30,32,33). A generally flat outer sole (13) extends beneath the base portions (29,30,32,33) and is attached thereto.

FIG. 2



EP 0 619 084 A1

Background and Summary

This invention relates to athletic shoes, and, more particularly, to a sole assembly for athletic shoes which includes flexible arch portions.

The design of athletic shoes requires consideration of a number of complex biomechanical principles regarding proper foot support and weight bearing structure. Such shoes are required to function properly even while the user is engaged in strenuous athletic activity which severely stresses the shoes. The shoes should not only provide proper foot support, but it is advantageous if the shoes also absorb shocks and provide for energy return to the user. The shoes should achieve the foregoing objectives while remaining flexible and lightweight. It is not easy to satisfy all of these somewhat competing factors in a single shoe design.

The invention provides a sole assembly for an athletic shoe which absorbs shocks and returns energy to the foot while remaining flexible and lightweight. The sole includes a midsole which is provided with flexing arches in the weight bearing areas of the foot, namely, the heel, metatarsals, and toes. An outer sole is attached to the arches, and the bottom surface of the outer sole is provided with a skid-resistant tread. Sole material is substantially eliminated between the arches to reduce weight. The arches provide a spring-like function when force is applied by the foot which absorbs shocks and returns energy to the foot when the applied force decreases. If desired, a wedge-shaped cut or some other form of relief can be provided in the bottom surface of the crest of each arch to create a hinge effect which will facilitate flexing of the arch without movement of the legs of the arch.

Description of the Drawing

The invention will be explained in conjunction with illustrative embodiments shown in the accompanying drawing, in which --

Fig. 1 is an exploded perspective view of a court shoe for the right foot which is formed in accordance with the invention;

Fig. 2 is an exploded view of the sole assembly of Fig. 1;

Fig. 3 is a perspective view of the bottom of a midsole for the left foot;

Fig. 4 is a top plan view of an outer sole for the left foot;

Fig. 5 is a bottom plan view of the outer sole of Fig. 4;

Fig. 6 is a side elevational view of the outer sole of Fig. 5;

Fig. 7 is a perspective view of the top of a midsole for a flat shoe for the right foot;

Fig. 8 is a top plan view of an outer sole for the right foot;

Fig. 9 is a perspective view of a midsole for a flat shoe for the right foot;

Fig. 10 is a top plan view of an outer sole for a flat shoe for the right foot;

Fig. 11 is a bottom plan view of the outer sole of Fig. 10;

Fig. 12 is a side elevational view of the outer sole of Fig. 11;

Fig. 13 is an exploded view of another embodiment of shoe for the right foot;

Fig. 14 is an exploded perspective view of the sole assembly of Fig. 13;

Fig. 15 is a bottom perspective view of a sole assembly for the left foot;

Fig, 16 is a top plan view of the sole assembly of Fig. 15;

Fig. 17 is a bottom plan view of the sole assembly of Fig. 15;

Fig. 18 is a bottom perspective view of the inner sole of the sole assembly of Fig. 15;

Fig. 19 is a bottom perspective view of the midsole of the sole assembly of Fig. 15; and

Fig. 20 is a bottom perspective view of the outer sole of the sole assembly of Fig. 15.

Description of Specific Embodiments

Referring first to Figs. 1 and 2, an athletic shoe 10 includes an upper 11, a midsole 12, and an outer sole 13. When the shoe is assembled, the outer sole is attached to the midsole, and the midsole is attached to the upper. If desired, an insole can be inserted in the shoe.

The midsole includes an elongated body 15 which extends below the foot and which includes a heel portion 16, an instep portion 17, a metatarsal portion 18, and a toe portion 19. The body includes a top surface 20 which, in the embodiment illustrated, has raised or contoured edge portions 21 and 22, a generally flat bottom surface 23 (Fig. 3), and right and left edge portions 24 and 25.

Referring to Fig. 3, a pair of arch members 25 and 26 extend downwardly from the heel portion of the body 15. The arch member 25 is located at the rear of the heel and includes a curved rear surface 27. The arch member 26 is spaced longitudinally forwardly of the arch 25 by a slot 28. The arch 25 includes a pair of base portions 29 and 30 which have generally flat bottom surfaces and an upwardly curved concave arch surface 31 which extends laterally between the base portions. The arch 26 similarly includes a pair of base portions 32 and 33 and a concave arch surface 34.

An arch member 36 extends downwardly from the metatarsal portion of the body 15. The metatarsal arch includes a base portion 37 adjacent the left edge of the sole and a base portion 38 adjacent the right

edge of the sole. In the particular embodiment illustrated, the arch 36 is provided with a laterally extending notch 39 which divides the base portion 38 into forward and rearward portions 38a and 38b. However, the notch 39 can be omitted if desired. The midsole illustrated in Fig. 2 is for the left foot, and the two base portions 38a and 38b are located in the portion of the midsole which supports the ball of the foot. A concave arch surface 40 extends laterally between the base portions 37 and 38 and is also intersected by the notch 39.

An arch member 42 extends downwardly from the toe portion of the body 15. The toe arch 42 includes right and left base portions 43 and 44 adjacent the right and left edges of the body and an intermediate base portion 45. A concave arch surface 46 extends between the base portions 43 and 45, and a concave arch surface 47 extends between the base portions 45 and 44. The toe arch 43 and the metatarsal arch 36 are separated by a slot 48.

The two concave arch surfaces 46 and 47 provide two arches in the toe area. If desired, the toe area can be provided with only one arch depending upon the sport category of the particular shoe for which the midsole unit is designed.

Right and left longitudinally extending ribs 51 and 52 are attached to the body 15 between the heel arch 26 and the metatarsal arch 36. In the embodiment illustrated the forward ends of the ribs merge with the metatarsal arch 36 and the rear ends terminate in laterally outwardly extending portions 53 and 54. A pair of laterally extending ribs 55 and 56 extend between the longitudinal ribs. Each of the lateral ribs includes an arched bottom surface 57.

The midsole can be molded integrally, or can be formed from separate parts which are suitably secured, as by adhesive. The material of the midsole is compressible and resilient, and suitable materials include ethylene vinyl acetate (EVA), compression molded rubber (CMR), and polyurethane (PU). Some flexible yet relatively rigid composite material such as Kevlar, graphite, or Hytrel could be laminated to the inner or lower surfaces of the arches to increase support and performance. Such composite material could also be used to enhance the mid foot structure.

In one specific embodiment of the midsole the thickness of the body portion 15 was about 3/16 inch, the vertical dimension of the heel arches 35 and 26 was about 15/16 inch, the vertical dimension of the metatarsal arch 36 was about 5/8 inch, and the vertical dimension of the toe arch 42 was about 1/2 inch. The thickness of the arch members at the top of the arch was about 1/4 inch. The body portion therefore was inclined upwardly from the toe portion to the heel portion when the midsole was supported by the base portions of the arches. The bottom edges of the longitudinal ribs 51 and 52 slope gradually upwardly from the bottom surface of the metatarsal arch 36 to the bottom surface of the heel arch 26 to support the edges of the instep portion of the midsole. The foregoing dimensions may vary according to the sport shown for the drawing for which the shoe is designed.

The outer sole 13 is substantially flat and relatively thin (see Fig. 6). However, the outer sole could have a side wall structure which could interface with the feet of the arches. The outer sole includes a bottom surface 59 which is provided with a skid-resistant tread (Fig. 5) and a substantially flat top surface 60. The particular tread illustrated in Fig. 5 is designed for use on a court shoe such as a basketball shoe. The weight of the outer sole is reduced by a central opening 61. The central opening could be filled with transparent rubber or other material which would allow the arch system to be visible.

The top surface 60 of the outer sole is provided with a plurality of elevated ridges or side wall portions which surround the base portions of the arches on the midsole for positioning the outer sole relative to the midsole. Generally L-shaped ridges 62 and 63 at the rear end of the heel are shaped and sized to extend along the inside and front surfaces of the base portions 29 and 30 of the heel arch 25. U-shaped ridges 64 and 65 extend along the rear, inside, and front surfaces of the base portions 32 and 33 of the front heel arch 26.

Ridge 66 is shaped to extend around the base portian 17 of the metatarsal arch 36. Ridges 67 and 68 are shaped to extend around the base portions 38a and 38b, respectively, of the metatarsal arch. Ridges 67, 70, and 71 at the toe end are shaped to extend around the base portions 43-45, respectively, of the toe arch 42.

The ridges form a frame within which the feet of the arches can rest. In the embodiment illustrated the feet rest within the perimeter of the ridges. Alternatively, the foot could be provided with notches or grooves and could rest on the ridges with a tongue and groove or dove tail effect. In some cases, indentations instead of ridges could be formed in the outer sole into which portions of the feet of the arches would extend.

The outer sole is molded from material which provides the desirable properties of wear resistance and skid resistance. Suitable materials are conventional outsole rubber compounds or polyurethane. Any footwear soling compound which offers the desired properties of durability, traction, and flexion would be appropriate. The outer sole is permanently attached to the midsole by adhesives, fusion, or the like.

Figures 7 and 8 illustrate a midsole and an outer sole for a running shoe for a right foot, and Figures 9-12 illustrate a midsole and an outer sole for a running shoe for the left foot. The midsole 75 is substantially the same as the midsole 12 except that the top surface 76 is substantially flat and does not include the raised edge portions. Referring to Figure 9, the mid-

sole 75 similarly includes a body portion 77, a pair of heel arches 78 and 79, a metatarsal arch 80, and a toe arch 81 which correspond to the arch members previously described. Longitudinal right and left ribs 82 and 83 extend between the metatarsal arch 80 and the heel arch 79.

The outer sole 84 for the flat shoe is substantially the same as the outer sole 13 except that the bottom surface 85 thereof (Fig. 11) is provided with a tread which is suitable for flat shoes. The upper surface 86 of the inner sole 84 is provided with raised ridges as illustrated in Figure 4 which are designed to surround the base portions of the arches on the midsole 75.

The arch members in the heel, metatarsal, and toe portions of the midsole are located under the primary weight-bearing areas of the sole. The mid portions of the arches have less material than the ends or base portions, and the midportions flex as downward force is applied during running, jumping, etc. The flexing of the compressible, and resilient material of the arches absorbs shock and cushions the foot. The resilient material of the arches also acts as a spring and returns energy upwardly against the foot as the force exerted by the root decreases.

Since the weight of the user is supported by the arch members, the material of the midsole can be substantially eliminated in the areas between the arches. The relatively thin body portion provides sufficient support for the foot in the areas between the arches. The midsole is therefore extremely lightweight yet still provides excellent support. The voided areas between the arch members also improve ventilation through the midsole.

A modified embodiment of a shoe is illustrated in Figs. 13-20. An athletic shoe 90 includes an upper 91 and a sole assembly 92. The sole assembly includes a midsole 93, an outer sole 94, and a liner 95 which is sandwiched between the midsole and the outer sole.

Figs. 13 and 14 illustrate a sole assembly 92 for a right shoe, and Figs. 15-20 illustrate a similar sole assembly for a left shoe.

Referring to Fig. 18, the midsole 93 includes a heel portion 96, an instep portion 97, a metatarsal portion 98, and a toe portion 99. A pair of arch members 100 and 101 extend downwardly from the heel portion. The arch member 100 includes an upwardly curved arch surface 102, and the arch member 101 includes an upwardly curved arch surface 103 which is corrugated or ribbed. The corrugations act as an accordion pleat and allows the material to flex and move.

Three arch members 105, 106, and 107 extend downwardly from the toe portion of the midsole. A surface 108 extends between the arch members 105 and 106 and is curved at the juncture with the arch members. A surface 109 extends between the arch member 106 and 107 and is curved adjacent the arch members.

A rib 111 extends along the right side of the midsole between the instep portion and the metatarsal portion. A notch 112 is formed in the rib in the metatarsal area. A shorter rib 113 extends along the left side of the midsole. The ribs 111 and 113 are joined by cross ribs 114 and 115. Recessed areas 116, 117, and 118 are provided between the ribs 111, 113, 114, and 115. The longer ribs 111 and 112 provide greater stability, and the notch 112 facilitates flexing.

The bottom surfaces of the arches 100, 101 and 105-107 and the ribs 111 and 113-115 lie in substantially the same plane and are supported by correspondingly shaped portions of the liner 95. Referring to Figs. 14 and 19, the liner includes a bottom 120 and a side wall 121 which extends upwardly around the sides and heel of the midsole 93. The bottom conforms to the bottom surface of the midsole and includes heel arch portions 122 and 123 which are shaped to abut the heel arch members 100 and 101 and arch surfaces 102 and 103 of the midsole; toe arch portions 124, 125, and 126 which are shaped to abut the toe arch members 105-107 and surfaces 108-109 of the midsole, and rib portions 127, 128, 129, and 130 which are shaped to abut the ribs 111, 113-115 and recess 116-118. Openings 131, 132, 133, and 134 are extended through the bottom of the midsole. The heel arch portion 123 includes a corrugated arch 135. The liner is stiffer than the relatively soft midsole and provides stability and rigidity to the midsole.

The outer sole 94 includes a bottom surface 138 and an upwardly extending side wall 139. The bottom surface of the midsole is provided with a skid-resistant tread (Fig. 20). The bottom of the midsole has a shape corresponding to the bottom of the liner 95. The outer sole includes a pair of pocket portions 140 and 141 which receive and support the base portions of the heel arch 122, a pair of pocket portions 142 and 143 which receive and support the base portions of the heel arch 123, pocket portions 144, 145, and 146 which receive and support the toe arch portions 124-126, and pocket portions 147 and 148 which receive and support the rib portions 127, and 128.

The bottom of the outer sole is provided with a central opening 149 which exposes the cross ribs 129 and 130 of the liner (Figs. 15 and 17) and the portions of the midsole which are exposed by the openings 131-134 in the liner.

The sole assembly 92 functions in the same way as the sole assemblies illustrated in Figs. 1-12. The arch member of the midsole and the liner in the heel and toe areas and the ribs 111 and 113-115 of the midsole and 127-130 of the liner in the metatarsal and instep areas are located in the primary weight-bearing areas of the sole. The mid-portions of the arches and the areas between the ribs can flex downwardly as

forces are applied during running, jumping, etc. The flexing of the compressible and resilient material absorbs shocks and cushions the foot and returns energy upwardly against the foot as the downward force decreases.

The forward portions of the ribs 111 and 113 or the midsole 93 correspond to the metatarsal arches 37 and 38 of the midsole of Fig. 2. The upwardly extending recessed portion 118 of the midsole 93 corresponds to the arch surface 40 of Fig. 2 and can flex downwardly under loads applied to the sole assembly.

The material of the midsole 93 and the outer sole 94 can be the same as previously described. The material of the liner 95 can be polyurethane, nylon, or other plastics. The liner is advantageously injection molded.

While in the foregoing specification a detailed description of a specific embodiments of the invention was set forth for the purpose of illustration, it will be understood that many of the details herein given may be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

Claims

1. A sole assembly for a shoe comprising an elongated body adapted to be positioned below a foot and having a heel portion, an arch portion, a metatarsal portion, and a toe portion, a top surface extending from the heel portion to the toe portion, and a pair of side edge portions which extend between the heel portion and the toe portion, an arch member on the body which extends below the side edges thereof and which includes a pair of laterally spaced base portions and an upwardly spaced arch surface which extends laterally between the base portions, and an outer sole attached to the base portions.

2. A sole assembly for a shoe comprising:

an elongated body adapted to be positioned below a foot and having a heel portion, an arch portion, a metatarsal portion, and a toe portion, a top surface extending from the heel portion to the toe portion, and a pair of side edge portions which extend between the heel portion and the toe portion,

a heel arch on the heel portion of the body which extends between the side edges,

a metatarsal arch on the metatarsal portion of the body which extends between the side edges,

a toe arch on the toe portion of the body which extends between the side edges,

each of said arch members having a pair of base portions and an upwardly spaced arch surface which extends between the base portions.

3. The sole assembly of claim 2 including an outer sole having top and bottom surfaces, the top surface of the outer sole being attached to said arches and the bottom surface of the outer sole having a skid-resistant tread.

4. The sole assembly of claim 3 including a pair of longitudinally extending ribs which extend between the heel arch and the metatarsal arch adjacent the side edges of the body.

5. The sole assembly of claim 2 including a pair of longitudinally extending ribs which extend between the heel arch and the metatarsal arch adjacent the side edges of the body.

6. The sole assembly of claim 2 in which the heel arch includes first and second longitudinally spaced arch portions.

7. The sole assembly of claim 2 in which the toe arch includes a pair of laterally spaced downwardly facing concave arch surfaces.

8. The sole assembly of claim 2 in which the toe arch includes a side base portion adjacent each of said side edge portions of the body, an intermediate base portion positioned between the side base portions, a first downwardly facing concave arch surface between one of the side base portions and the intermediate base portions, and a second downwardly facing concave arch surface between the other of the side base portions and the intermediate base portion.

9. The sole assembly of claim 2 in which the metatarsal arch includes a pair of longitudinally spaced base portions adjacent one of the side edge portions of the body and generally below the portion of the body which is adapted to support the ball of a foot and a third base portion adjacent the other side edge portion of the body.

10. The sole assembly of claim 2 in which the heel arch includes first and second longitudinally spaced pairs of laterally spaced base portion, each of the base portions being adjacent one of the side edge portions of the body, a first downwardly facing concave arch surface extending between the first pair of base portions, and a second downwardly facing concave arch surface extending between the second pair of the base portions.

11. A sole assembly for a shoe comprising:

an elongated body adapted to be positioned below a foot and having a heel portion, an arch portion, a metatarsal portion, and a toe portion, a top surface extending from the heel portion to the toe portion, and a pair of side edge portions which extend between the heel portion and the toe portion,

a heel arch portion on the heel portion of the body having a pair of base portions adjacent the side edge portions of the body and an upwardly spaced arch surface which extends between the base portions,

a metatarsal arch portion having a pair of longitudinally spaced base portions adjacent one of the side edge portions of the body and generally below the portion of the body which is adapted to support the ball of a foot and a third base portion adjacent the other side edge portion of the body and an upwardly spaced arch surface extending between the base portions,

a toe arch portion on the toe portion of the body having a pair of side base portions adjacent the side edge portions of the body and an intermediate base portion positioned between the base portions, a first upwardly spaced arch surface between one of the side base portions and the intermediate base portion, and a second upwardly spaced arch surface between the other side base portion and the intermediate base portion, and

an outer sole having top and bottom surfaces, the top surface of the outer sole being attached to said base portions. the bottom surface of the outer sole having a skid-resistant tread.

12. The sole assembly of claim 11 including a pair of longitudinally extending ribs which extend between the heel arch and the metatarsal arch adjacent the side edges of the body.

13. The sole assembly of claim 12 including a laterally extending rib which extends laterally between the longitudinally extending ribs.

14. The sole assembly of claim 11 in which said outer sole includes a plurality of ridge portions which extend upwardly from the top surface of the outer sole and which extend around said base portions.

15. The sole assembly of claim 11 including a second heel arch portion on the heel portion of the body which is longitudinally spaced from the first-mentioned heel arch portion, the second heel arch portion having a pair of base portions adjacent the side edge portions of the body and an upwardly spaced arch surface extending between the base portions.

FIG. 1

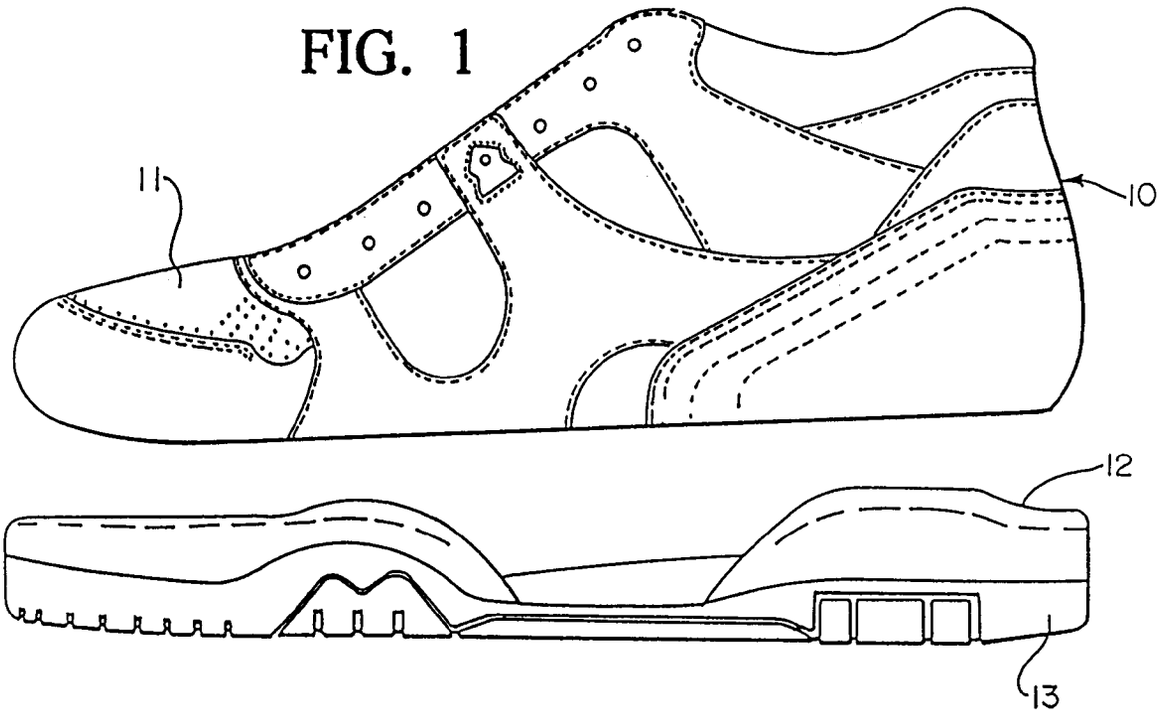


FIG. 2

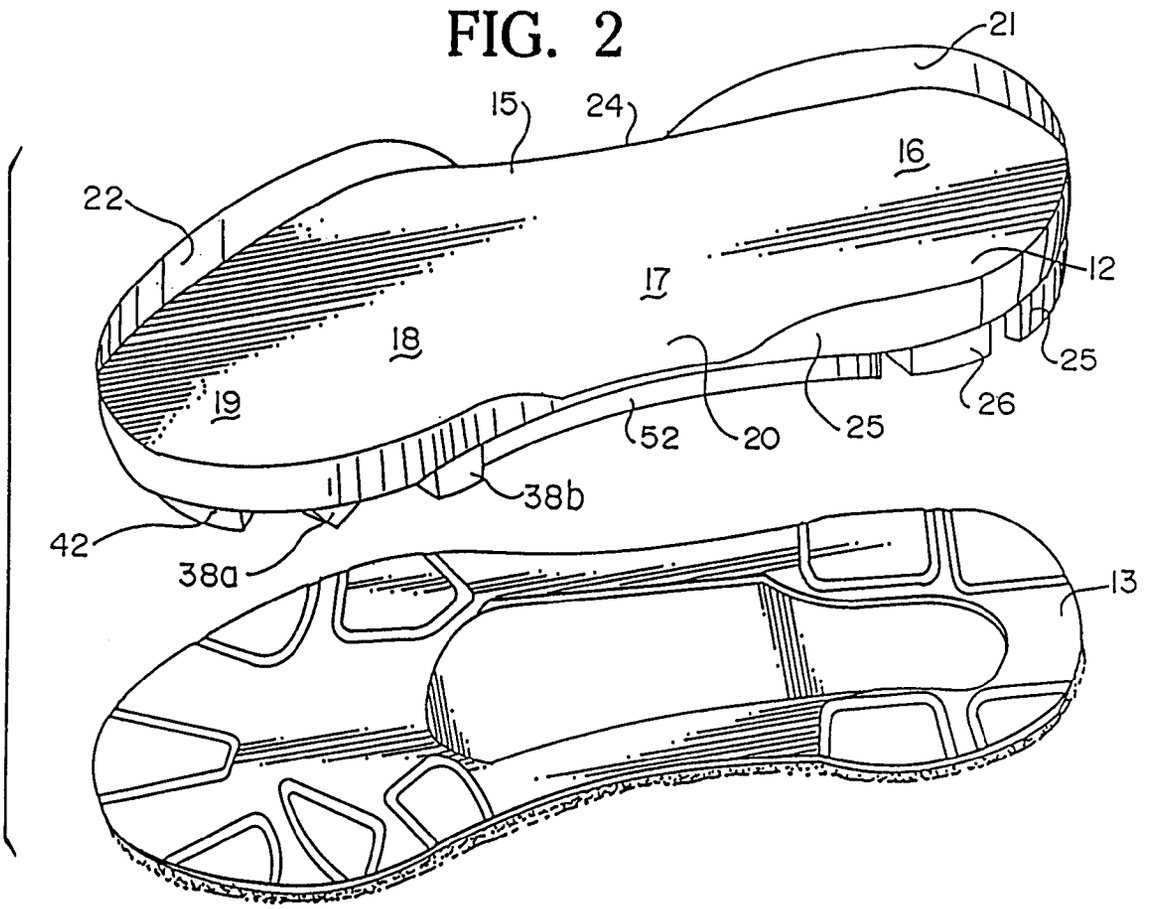


FIG. 3

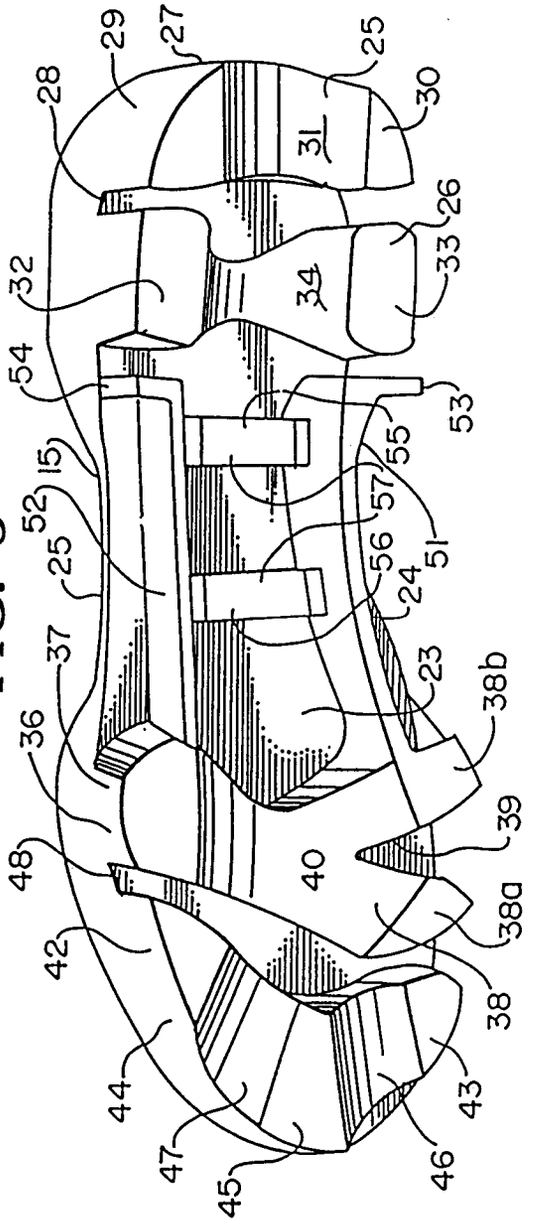

29
27
28
25
30
31
26
32
33
34
54
53
15
55
52
57
25
56
51
24
37
23
38b
36
39
48
40
38a
42
38
44
43
47
46
45

FIG. 4

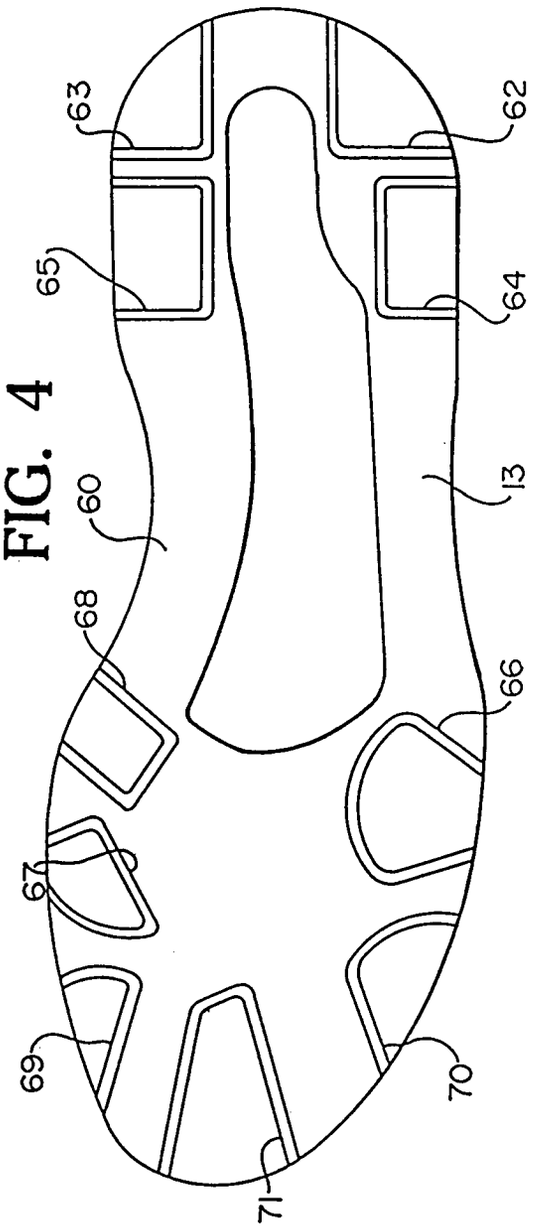

63
62
65
64
60
13
68
66
67
69
70
71

FIG. 5

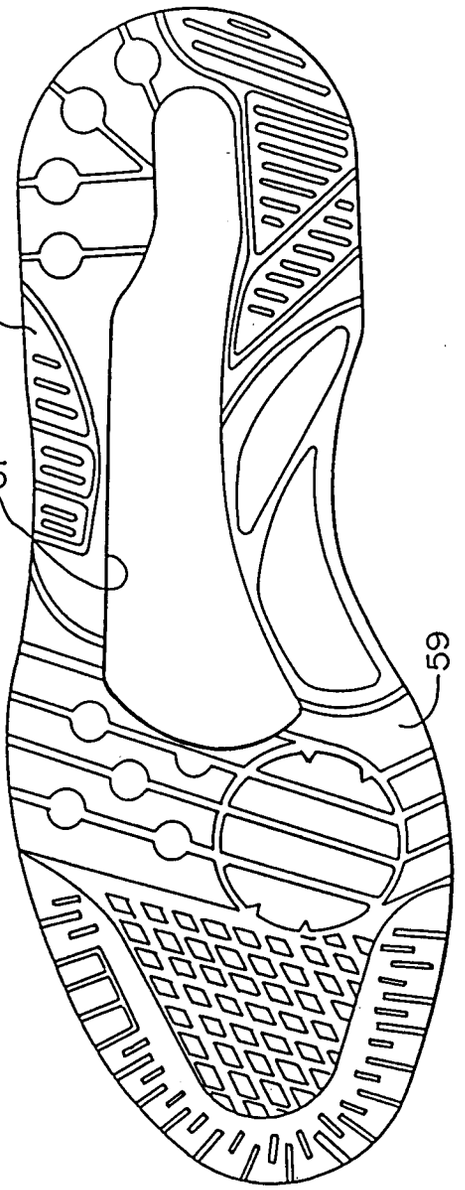
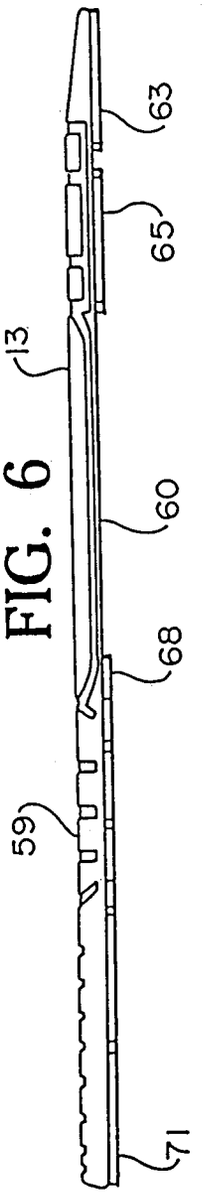


FIG. 6



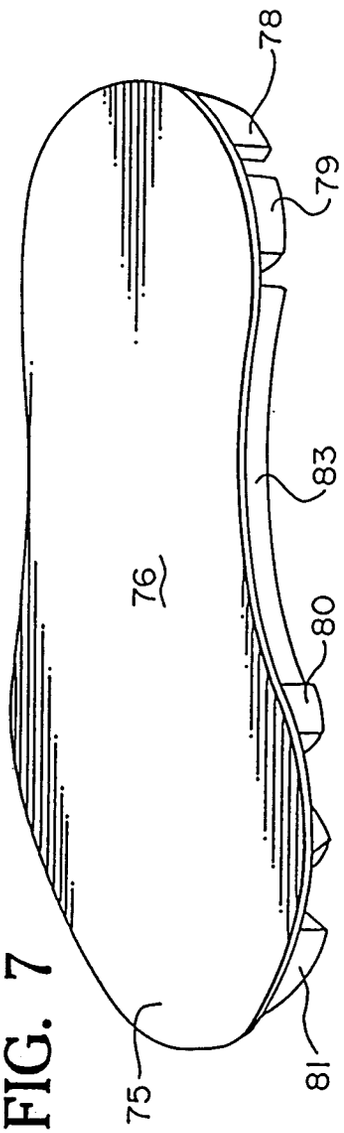


FIG. 7

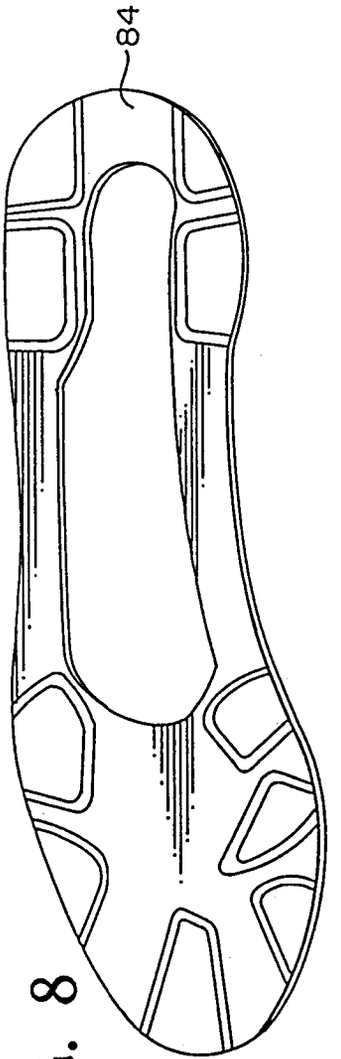


FIG. 8

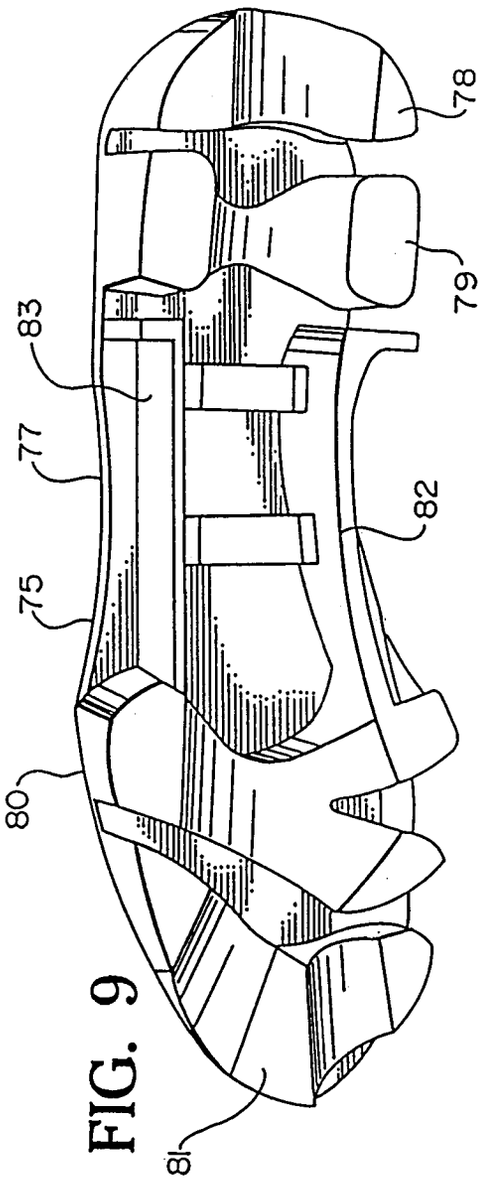


FIG. 9

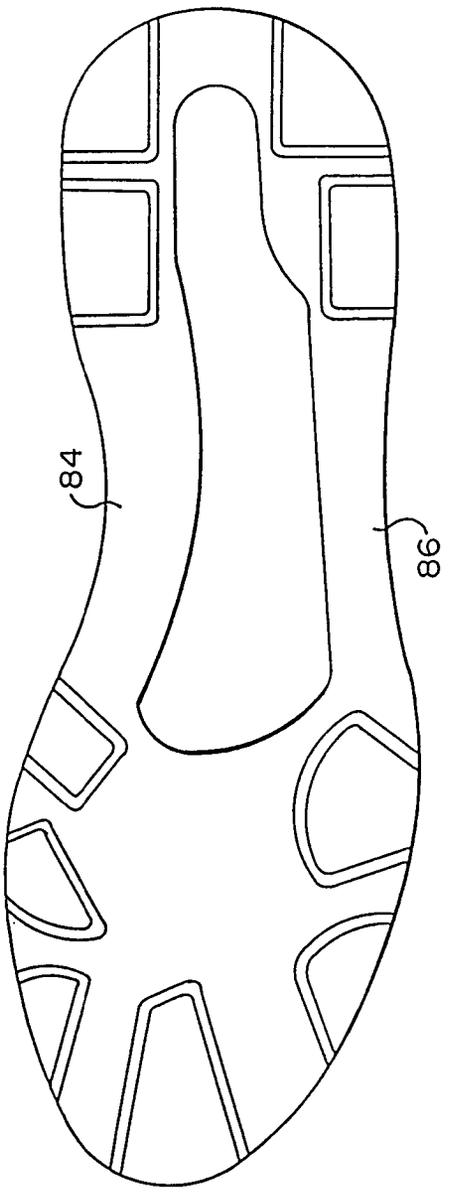


FIG. 10

FIG. 11

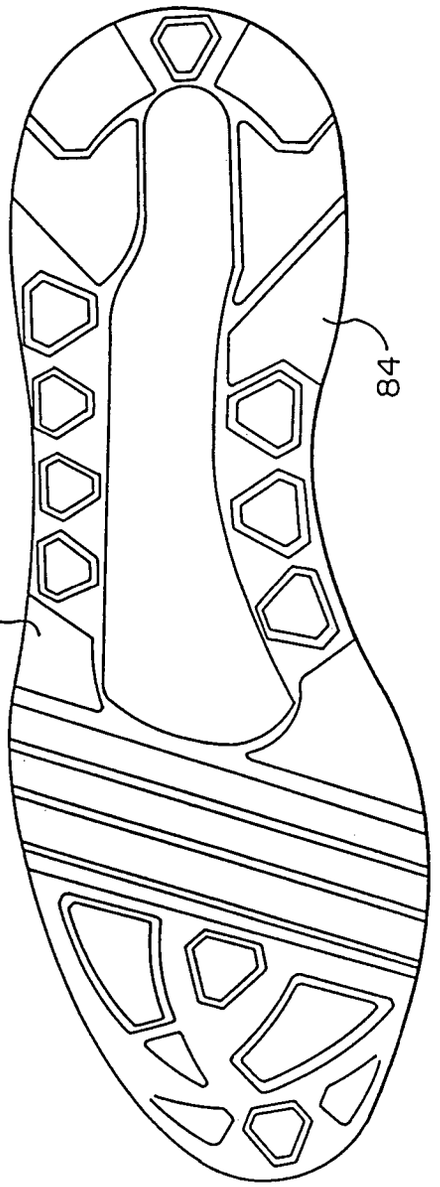


FIG. 12

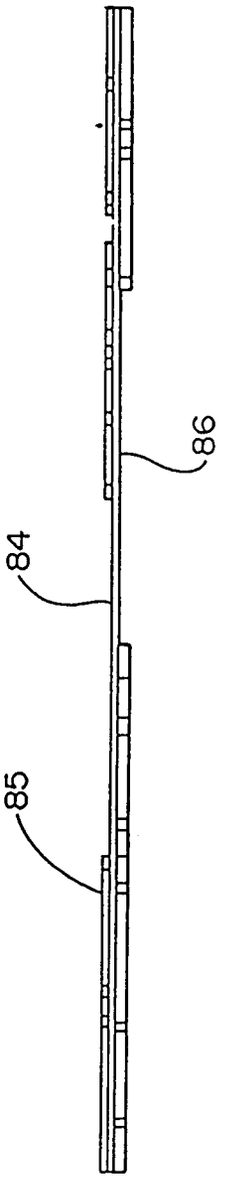


FIG. 13

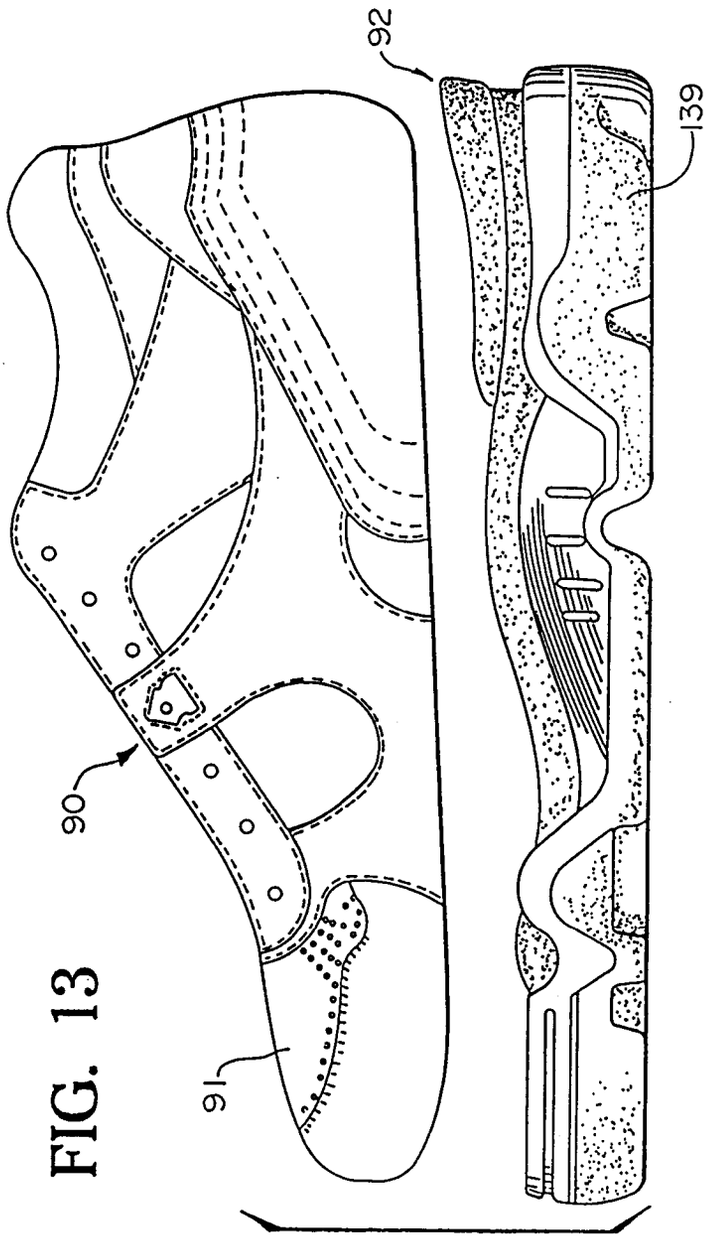


FIG. 14

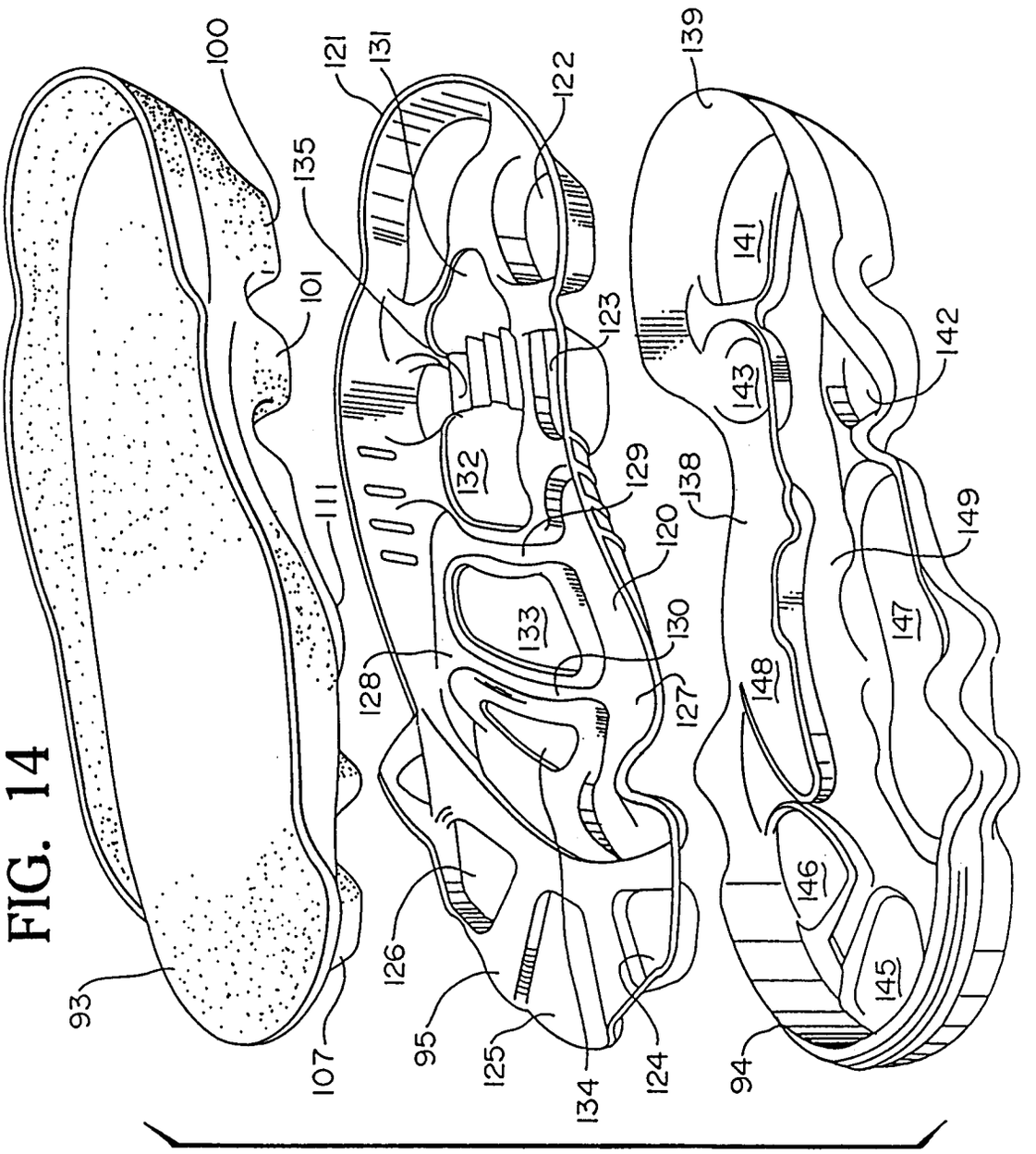

93
100
101
107
111
121
131
122
123
132
129
138
120
130
133
128
127
126
95
125
134
124
135
139
141
142
143
149
147
148
146
145
94

FIG. 15

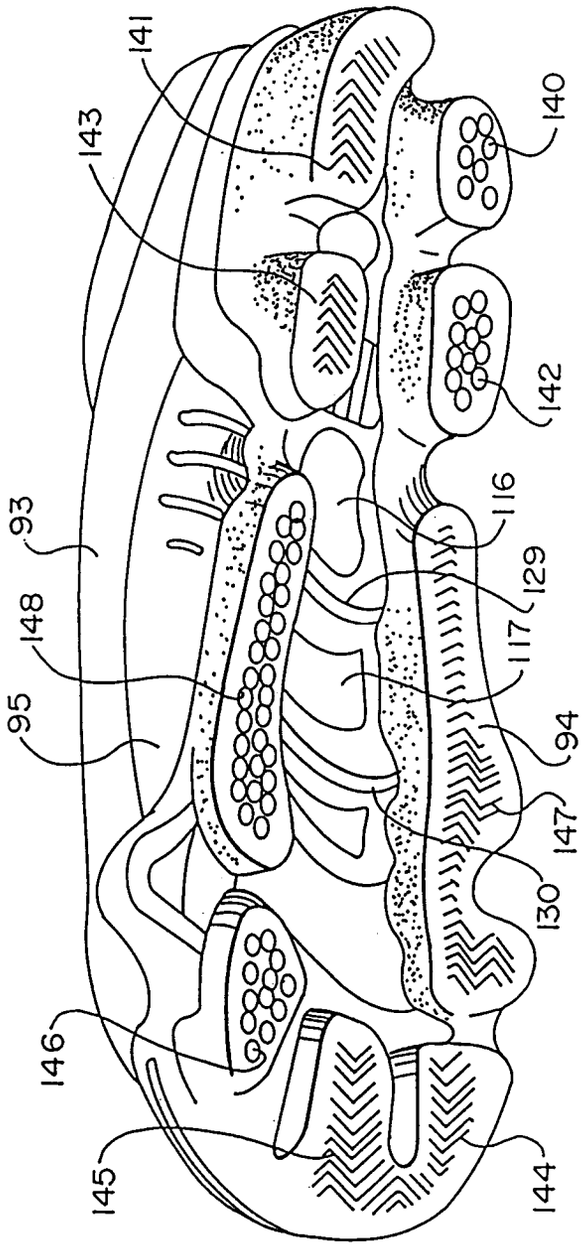


FIG. 16

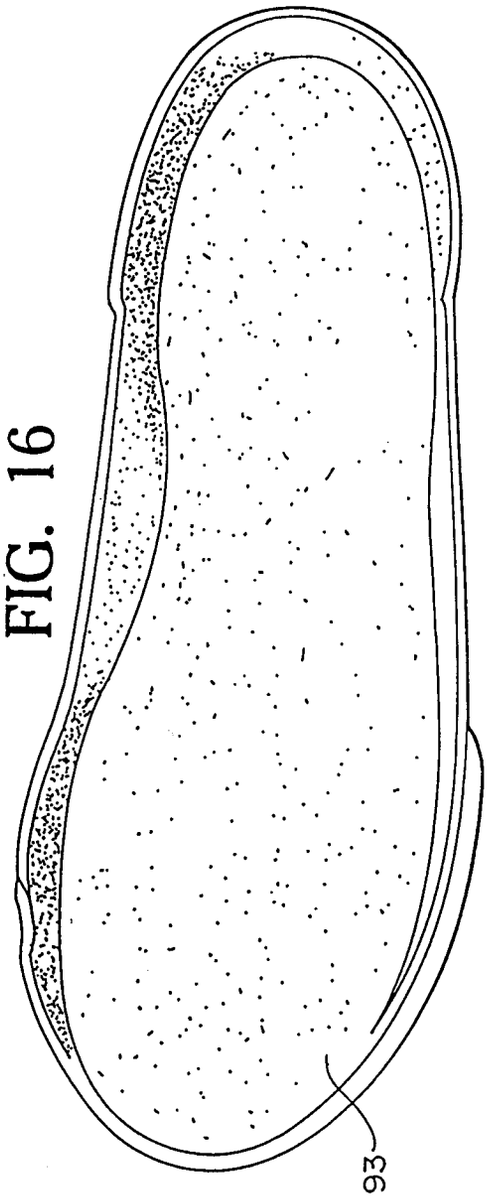


FIG. 17

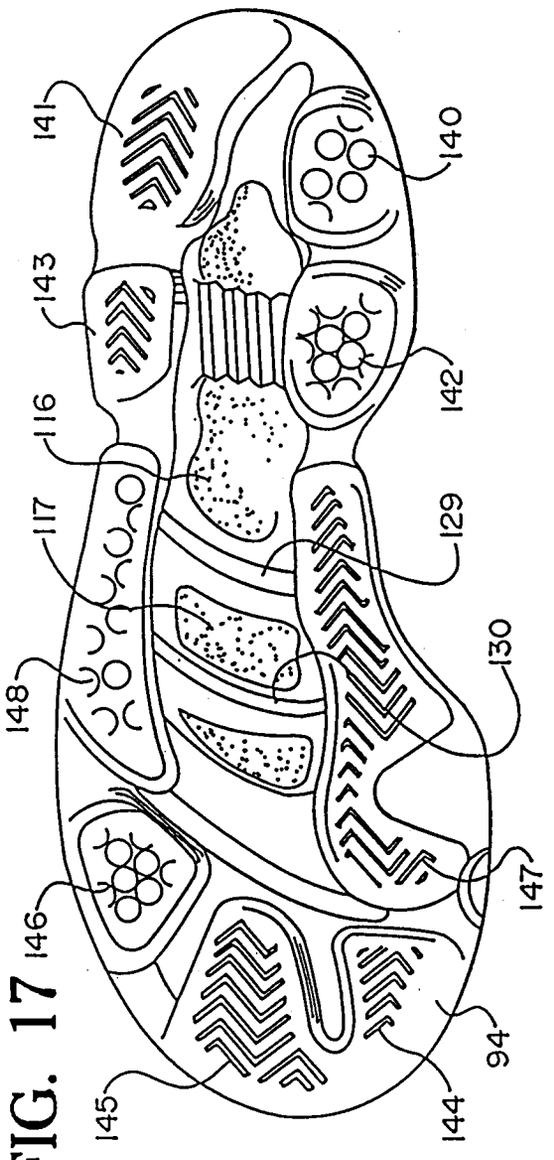

141
140
143
142
116
129
117
130
148
146
147
145
144
94

FIG. 18

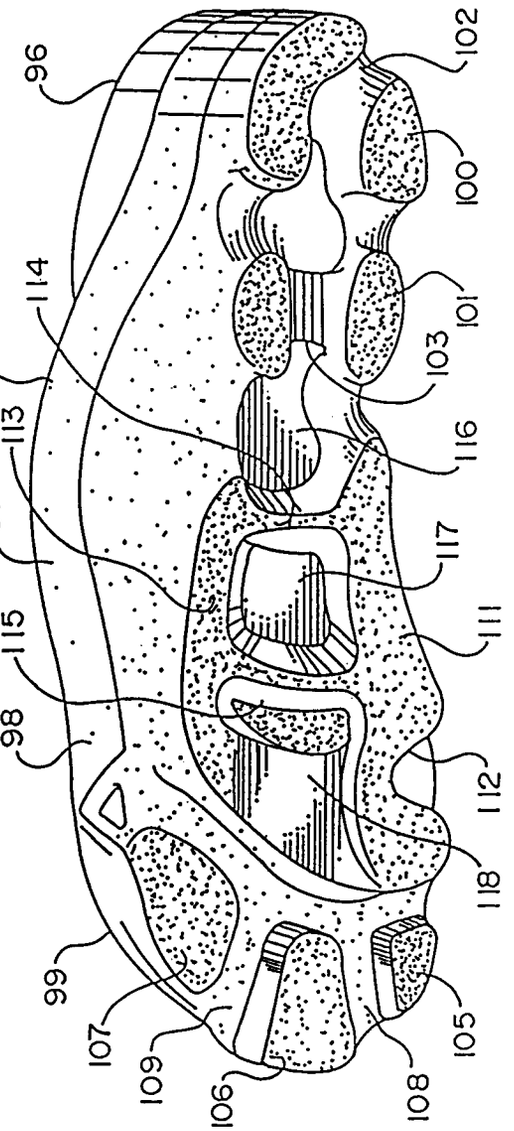

96
102
100
114
101
93
103
113
116
97
117
111
115
98
112
118
99
107
105
109
106
108

FIG. 19

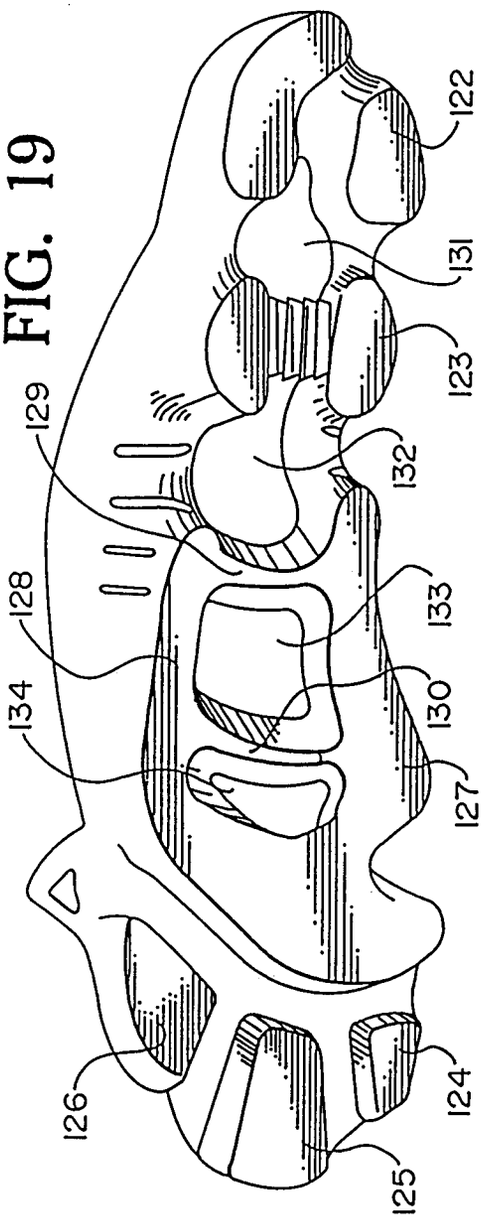
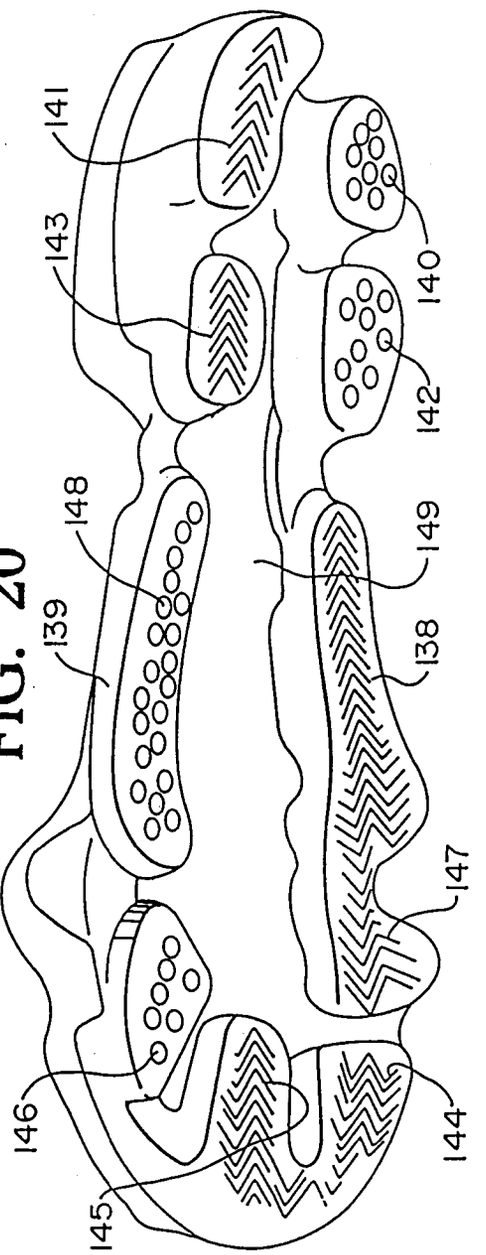

122
131
123
129
132
128
133
134
130
127
126
124
125

FIG. 20


141
143
140
142
148
149
139
138
147
146
144
145

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 10 2637

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	WO-A-92 08383 (ADIDAS) * the whole document * ---	1-3,6,7,11	A43B13/18
A	FR-A-2 611 122 (AUTRY INDUSTRIES) * the whole document * -----	1,2,11	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A43B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 July 1994	Declerck, J

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)