US007918041B2

(12) **United States Patent**
Cho

(10) **Patent No.: US 7,918,041 B2**
(45) **Date of Patent: Apr. 5, 2011**

(54) **FOOTWEAR COOLING SYSTEM**

(75) Inventor: **Jang Rae Cho**, Busan (KR)

(73) Assignee: **NIKE, Inc.**, Beaverton, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 846 days.

(21) Appl. No.: **11/849,512**

(22) Filed: **Sep. 4, 2007**

(65) **Prior Publication Data**

US 2009/0056172 A1 Mar. 5, 2009

(51) **Int. Cl.**
A43B 7/06 (2006.01)
A43B 13/18 (2006.01)

(52) **U.S. Cl.** ..... **36/3 B**; 36/28

(58) **Field of Classification Search** ..... 36/3 B, 36/28, 29, 3 R, 30 R

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

30,391	A	10/1860	Dexter
41,879	A	3/1864	Webb
60,987	A	1/1867	Ayer
363,377	A	5/1887	Faye, Jr.
379,579	A	3/1888	Jensen
387,335	A	8/1888	Barker
418,966	A	1/1890	Welander
452,655	A	5/1891	Valiant
485,180	A	11/1892	Eastman
556,825	A	3/1896	King
570,814	A	11/1896	Owen
578,794	A	3/1897	Warner
592,822	A	11/1897	Parker
660,552	A	10/1900	Sharood
746,862	A	12/1903	Matson
853,336	A	5/1907	Ball
896,488	A	8/1908	Valiant
940,856	A	11/1909	Critz, Jr.
1,029,110	A	6/1912	Drobinski
1,106,986	A	8/1914	Stucki
1,138,557	A	5/1915	Gustaveson
1,535,207	A	4/1925	Dorff
1,540,430	A	6/1925	Sims
1,616,254	A	2/1927	De Suarez
1,696,457	A	12/1928	Shanahan
1,797,309	A	3/1931	Wojciechowski
1,828,320	A	10/1931	Daniels
1,932,557	A	10/1933	Meucci
1,981,300	A	11/1934	Berg
1,994,681	A	3/1935	Blumenfeld
2,098,412	A	11/1937	Bovay
2,153,304	A	4/1939	Gruber
2,200,849	A	5/1940	Margolin
2,334,719	A	11/1943	Margolin
2,344,762	A	3/1944	Wylie
2,347,207	A	4/1944	Margolin

(Continued)

FOREIGN PATENT DOCUMENTS

CH	198691	7/1938

(Continued)

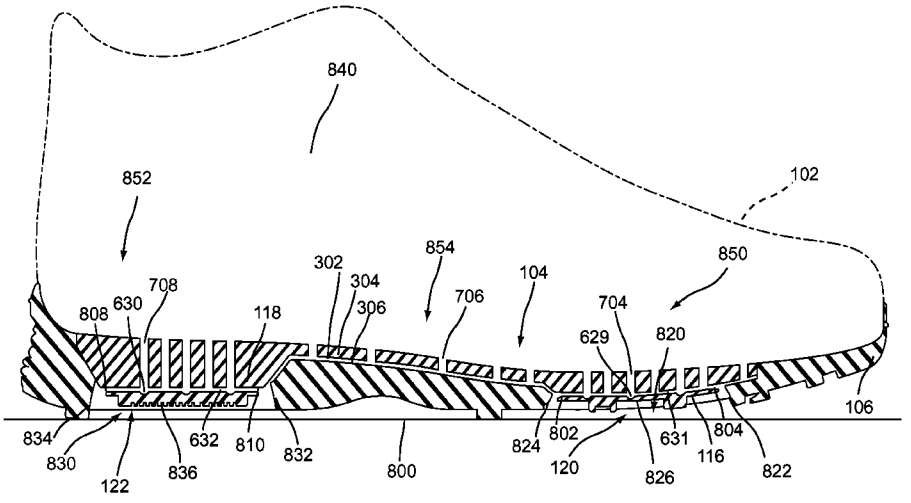
Primary Examiner — Ted Kavanaugh

(74) *Attorney, Agent, or Firm* — Plumsea Law Group, LLC

(57) **ABSTRACT**

An article of footwear including a cooling system is disclosed. The article of footwear includes a sole system. The sole system includes a first compression chamber and a second compression chamber, each configured to compress during motion. The compression of the first compression chamber and the second compression chamber creates a pressure imbalance that facilitates the exchange of air throughout the article of footwear by means of apertures disposed along the upper sole portion, and channels configured to transfer air to the apertures.

11 Claims, 9 Drawing Sheets



U.S. PATENT DOCUMENTS

2,356,490	A		8/1944	Crotty
2,432,533	A		12/1947	Margolin
2,434,024	A		1/1948	Vlasak
2,437,065	A		3/1948	Austin
2,457,944	A		1/1949	Vlastos
2,558,973	A		7/1951	Meaker
2,614,339	A		10/1952	Herceg
2,720,041	A		10/1955	Kajtar
2,722,063	A		11/1955	Drefvelin
2,725,645	A		12/1955	Scala
2,751,692	A		6/1956	Cortina
2,884,716	A		5/1959	Shelare et al.
3,086,301	A		4/1963	Pastor
3,256,621	A		6/1966	Linton
3,383,782	A		5/1968	McGinnity
3,426,455	A		2/1969	Drago
3,555,709	A		1/1971	Raffaelli, Sr.
3,574,958	A		4/1971	Martuch et al.
3,863,272	A		2/1975	Guille
4,000,566	A		1/1977	Famolare, Jr.
4,005,531	A		2/1977	Weintraub et al.
4,063,371	A		12/1977	Batra
4,078,321	A		3/1978	Famolare, Jr.
4,112,599	A		9/1978	Krippelz
4,134,955	A		1/1979	Hanrahan, Jr. et al.
4,151,660	A		5/1979	Yoshimi et al.
4,215,492	A		8/1980	Sandmeier
4,222,183	A		9/1980	Haddox
4,290,211	A		9/1981	Csengeri
4,297,796	A		11/1981	Stirtz et al.
4,408,401	A		10/1983	Seidel et al.
4,438,573	A		3/1984	McBarron
4,485,568	A		12/1984	Landi et al.
4,507,880	A		4/1985	Ohashi
4,571,853	A		2/1986	Medrano
4,619,055	A		10/1986	Davidson
4,635,385	A		1/1987	Ogden
4,654,982	A		4/1987	Lee
4,679,335	A		7/1987	Berlese
4,693,021	A		9/1987	Mazzarolo
4,739,765	A		4/1988	Sydor et al.
4,754,559	A		7/1988	Cohen
4,776,110	A		10/1988	Shiang
4,813,160	A		3/1989	Kuznetz
4,831,749	A		5/1989	Tsai
4,835,883	A		6/1989	Tetrault et al.
4,837,948	A		6/1989	Cho
4,864,738	A		9/1989	Horovitz
4,893,418	A		1/1990	Ogden
4,894,932	A		1/1990	Harada et al.
4,896,440	A		1/1990	Salaverria
4,897,936	A	*	2/1990	Fuerst ..... 36/30 A
4,899,465	A		2/1990	Bleimhofer et al.
4,899,467	A		2/1990	Mackey
4,910,887	A		3/1990	Turner et al.
4,912,858	A		4/1990	Mochizuki
4,939,851	A		7/1990	Miller
4,979,317	A		12/1990	Fukuoka
4,993,173	A		2/1991	Gardiner
5,035,068	A		7/1991	Biasi
5,044,096	A		9/1991	Polegato
5,171,033	A		12/1992	Olson et al.
5,235,761	A		8/1993	Chang
5,295,312	A		3/1994	Blumberg et al.
5,317,819	A		6/1994	Ellis, III
5,319,866	A		6/1994	Foley et al.
5,341,581	A		8/1994	Huang
5,342,070	A		8/1994	Miller et al.
5,357,689	A		10/1994	Awai
5,367,788	A		11/1994	Chen
5,367,791	A	*	11/1994	Gross et al. 36/31
5,390,430	A		2/1995	Fitchmun et al.
5,465,508	A		11/1995	Bourdeau
5,499,459	A		3/1996	Tomaro
5,505,011	A		4/1996	Bleimhofer
5,551,172	A		9/1996	Yu
5,584,130	A		12/1996	Perron
5,588,226	A		12/1996	Schenkel
5,598,644	A		2/1997	Polegato
5,607,745	A		3/1997	Ogden
5,611,152	A		3/1997	Richard et al.
5,619,809	A	*	4/1997	Sessa ..... 36/3 R
5,655,314	A		8/1997	Petracci
5,664,343	A		9/1997	Byrne
5,685,091	A		11/1997	Yalamanchili
5,697,171	A		12/1997	Phillips
5,699,627	A		12/1997	Castro
5,714,229	A		2/1998	Ogden
5,738,937	A		4/1998	Baychar
5,775,005	A	*	7/1998	McClelland 36/31
5,797,610	A		8/1998	Grande et al.
5,815,949	A	*	10/1998	Sessa ..... 36/3 B
5,826,349	A		10/1998	Goss
5,845,418	A		12/1998	Chi
5,852,884	A		12/1998	Miotto
5,946,824	A		9/1999	Tighe et al.
5,955,172	A		9/1999	Hurten
5,979,076	A		11/1999	Li
5,983,524	A		11/1999	Polegato
5,983,525	A		11/1999	Brown
5,992,052	A		11/1999	Moretti
5,996,250	A		12/1999	Reed et al.
6,006,447	A		12/1999	Neal et al.
6,012,236	A		1/2000	Pozzobon
6,032,388	A		3/2000	Fram
6,041,518	A		3/2000	Polycarpe
6,041,519	A		3/2000	Cheng
6,085,444	A		7/2000	Cho
6,196,556	B1		3/2001	Bonaventure et al.
6,305,100	B1		10/2001	Komarnycky
6,330,757	B1	*	12/2001	Russell 36/28
6,416,610	B1		7/2002	Matis et al.
6,446,360	B1		9/2002	Sheets et al.
6,562,271	B2		5/2003	Hiraoka et al.
6,594,918	B2		7/2003	Hatfield et al.
6,681,500	B2		1/2004	Moretti
6,817,112	B2		11/2004	Berger et al.
6,948,260	B2		9/2005	Lin et al.
6,976,319	B2		12/2005	Pfander
2002/0011009	A1		1/2002	Pan
2002/0012784	A1		1/2002	Norton et al.
2002/0078593	A1		6/2002	Pavelescu et al.
2002/0166262	A1		11/2002	Hernandez
2003/0136024	A1		7/2003	Su
2005/0126036	A1	*	6/2005	Wu ..... 36/3 B
2005/0172513	A1		8/2005	Lechhart et al.
2009/0193690	A1	*	8/2009	Moretti ..... 36/3 B

FOREIGN PATENT DOCUMENTS

DE	20808	4/1882
DE	203734	4/1908
DE	3225451	7/1982
DE	121957	10/1990
DE	9208875.9	10/1992
DE	4128704	3/1993
DE	19937334	10/2001
EP	0350611	1/1990
EP	0857433	8/1998
EP	0927524	7/1999
EP	0956789	11/1999
EP	0960579	12/1999
FR	1142786	9/1957
GB	395221	7/1933
GB	2183140	6/1987
GB	2315010	1/1998
IT	352511	9/1937
JP	9248203	9/1997
JP	2001029110	2/2001
WO	WO 9406317	3/1994
WO	WO 9728711	8/1997
WO	WO 9851177	11/1998
WO	WO 9966812	12/1999

* cited by examiner

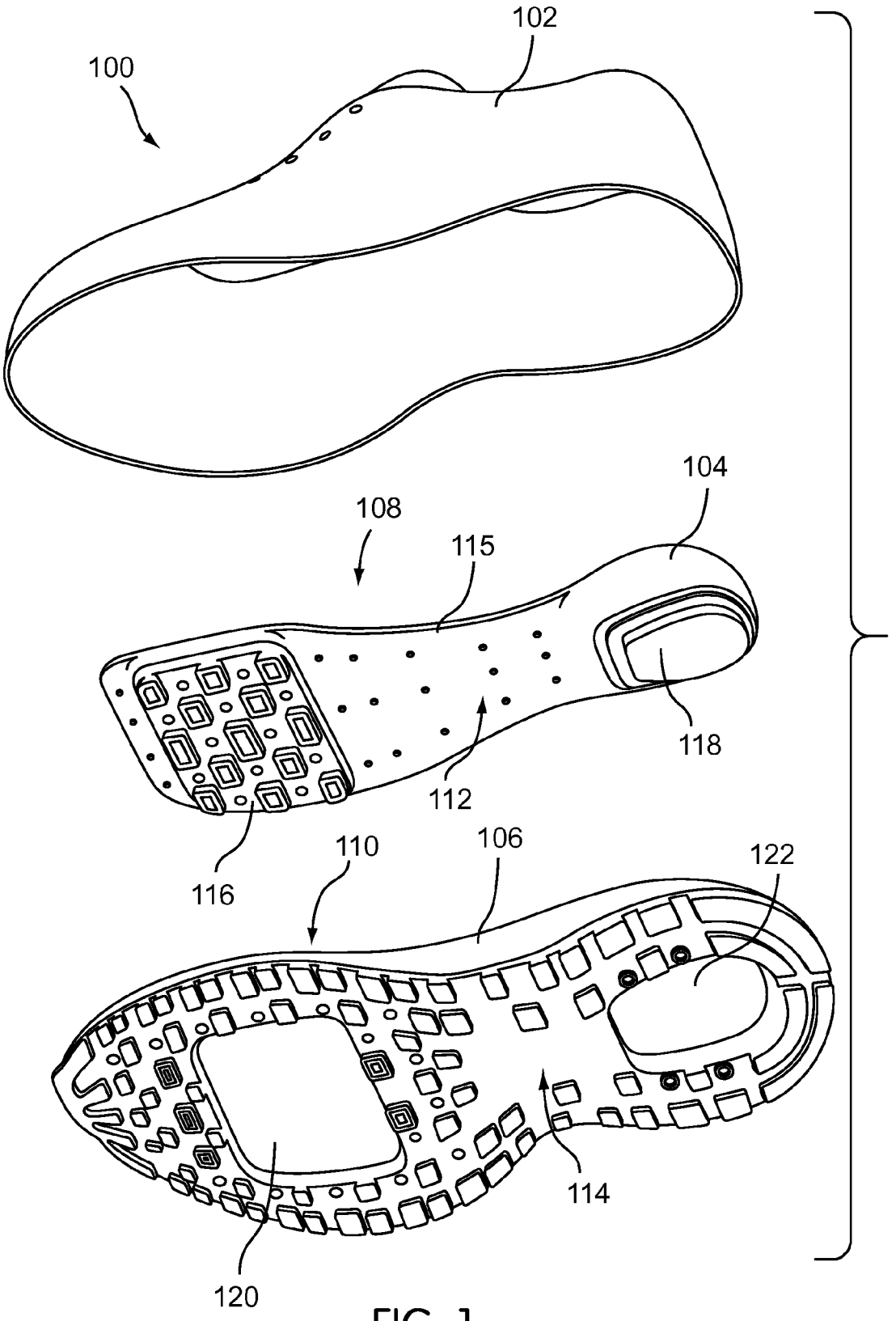


FIG. 1

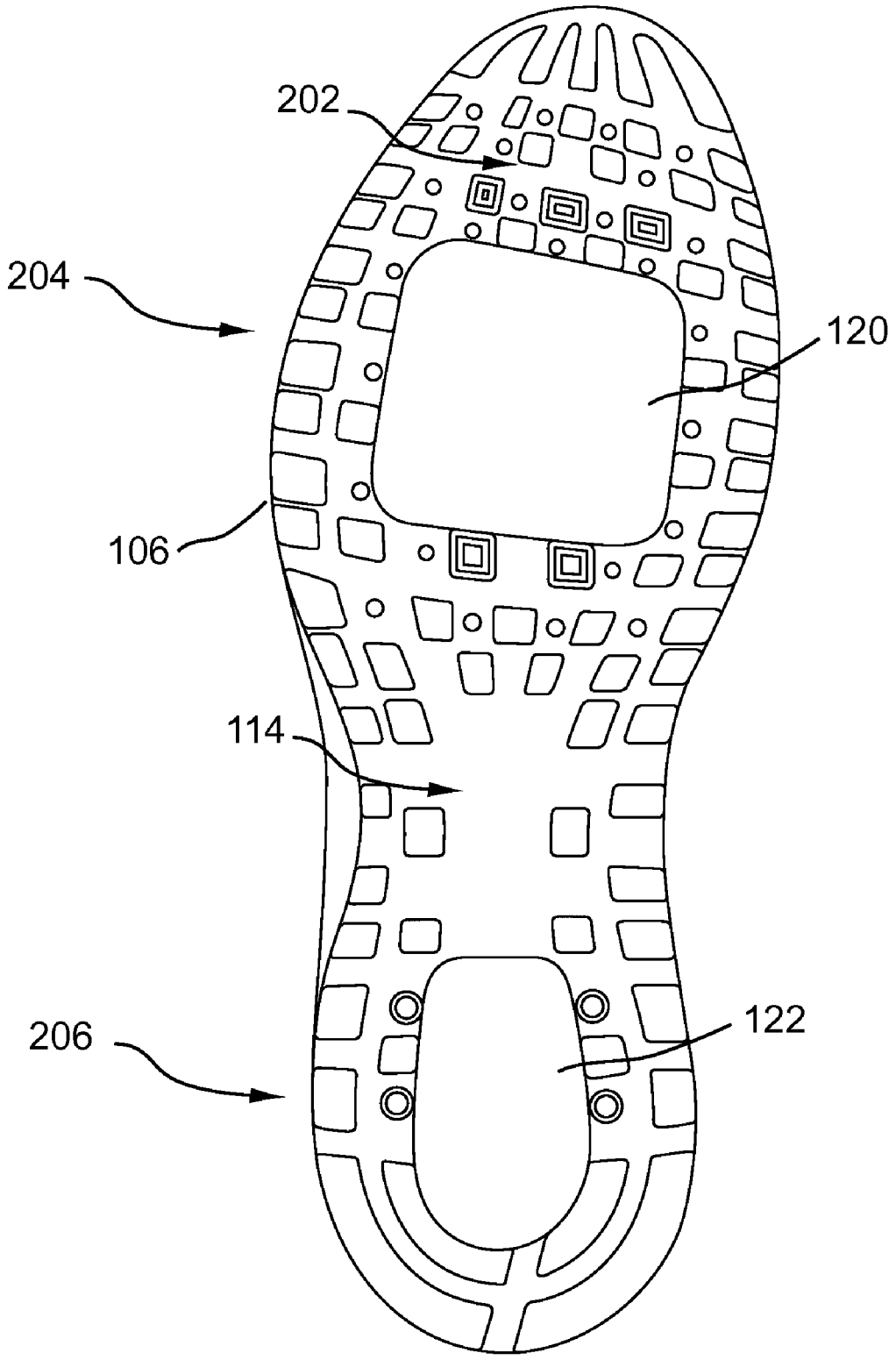


FIG. 2

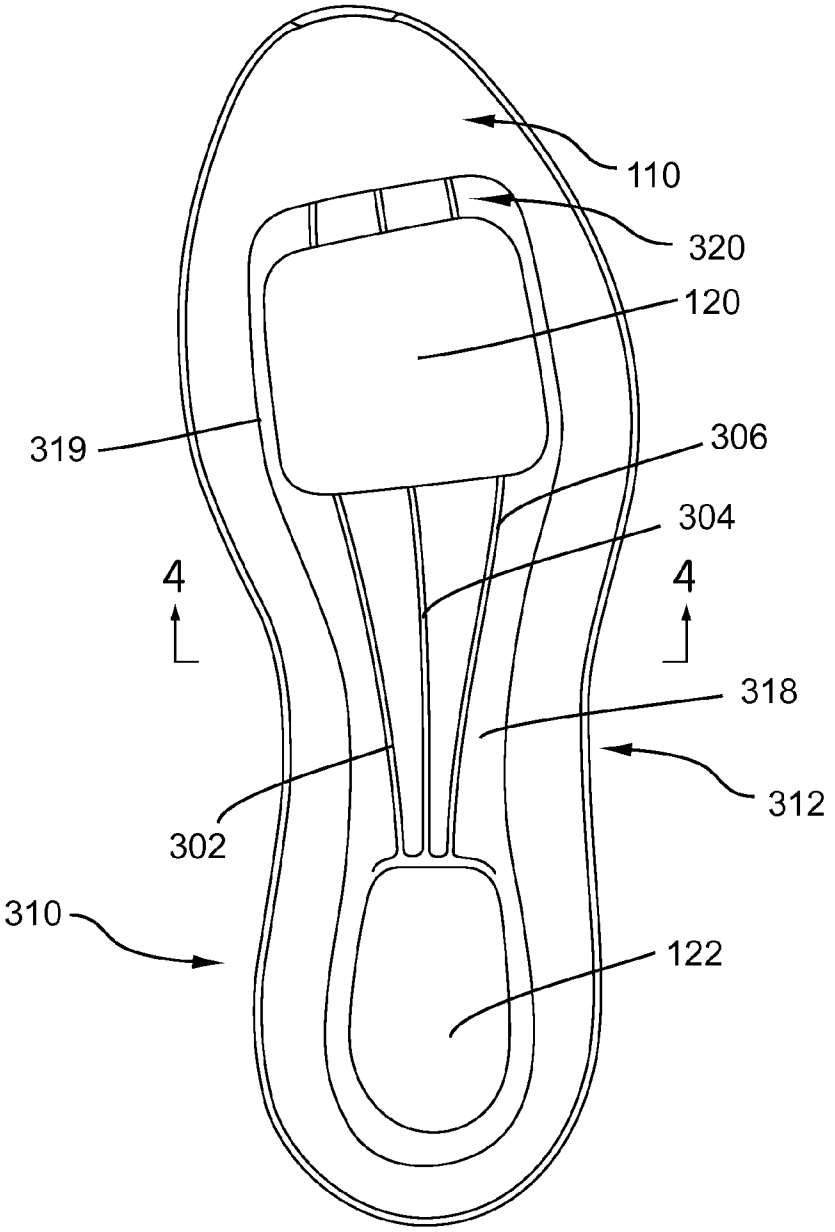

110
320
120
319
306
304
4
4
318
312
302
310
122

FIG. 3

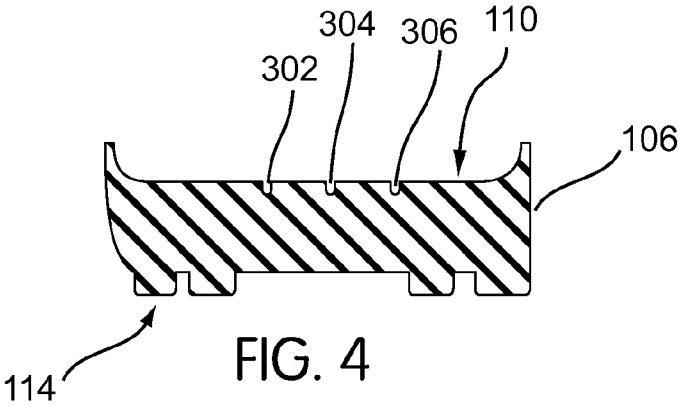

304
306
110
302
106
114

FIG. 4

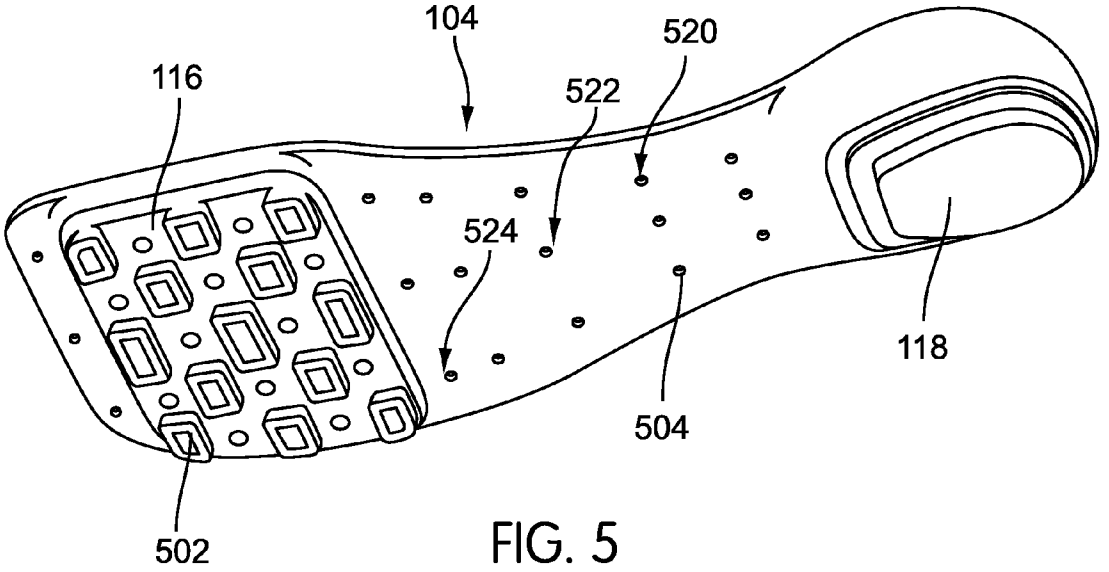

104
520
116
522
524
118
504
502

FIG. 5

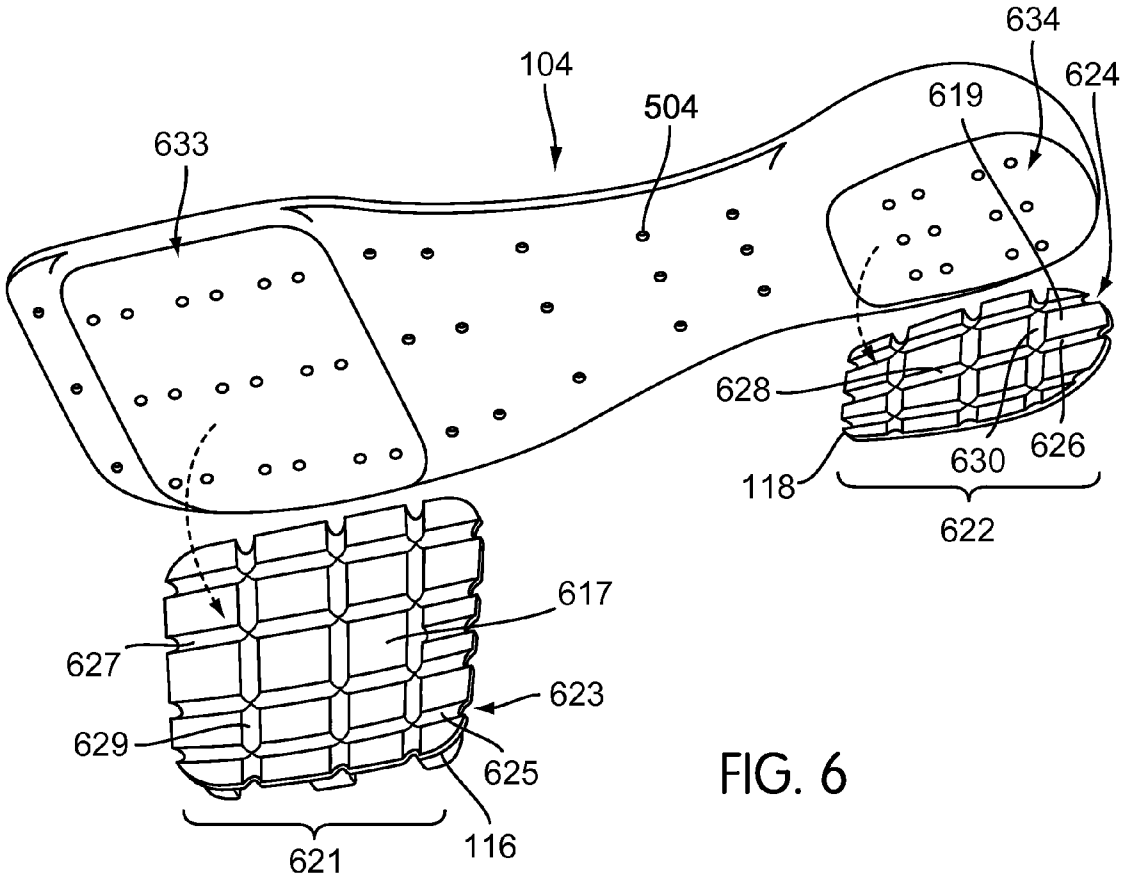

634
104
624
619
504
633
628
630
626
118
622
617
627
623
629
625
621
116

FIG. 6

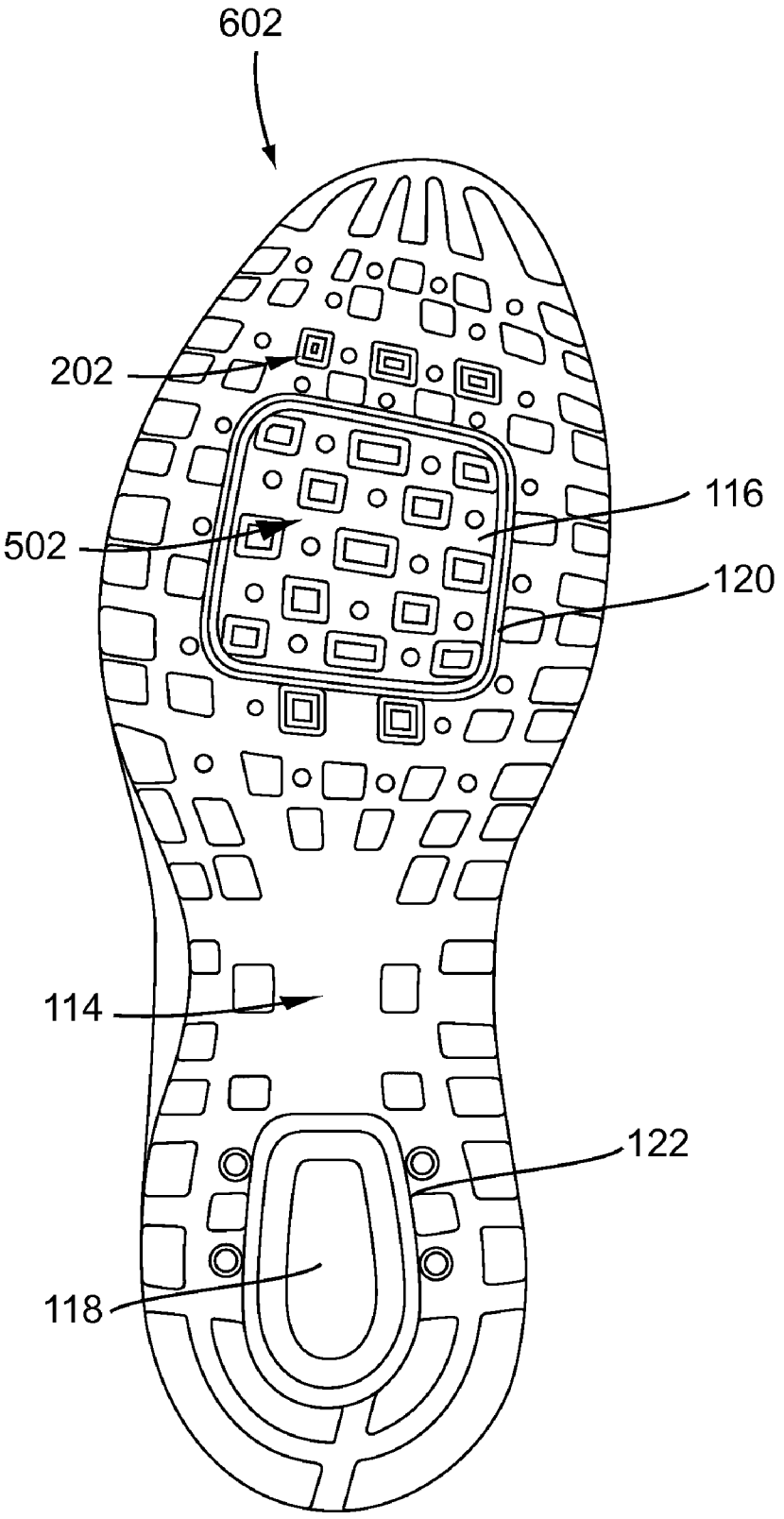


FIG. 7

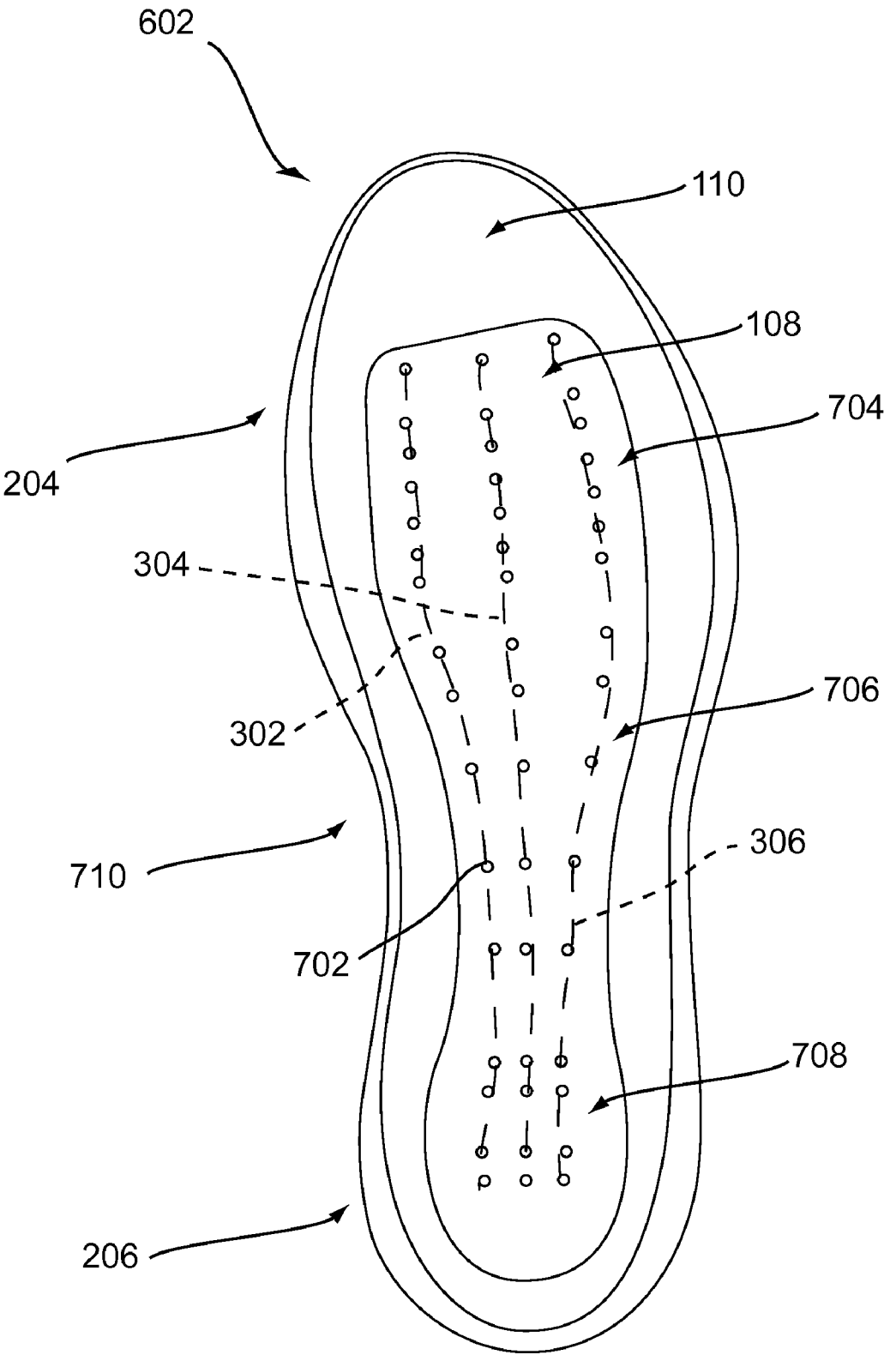


FIG. 8

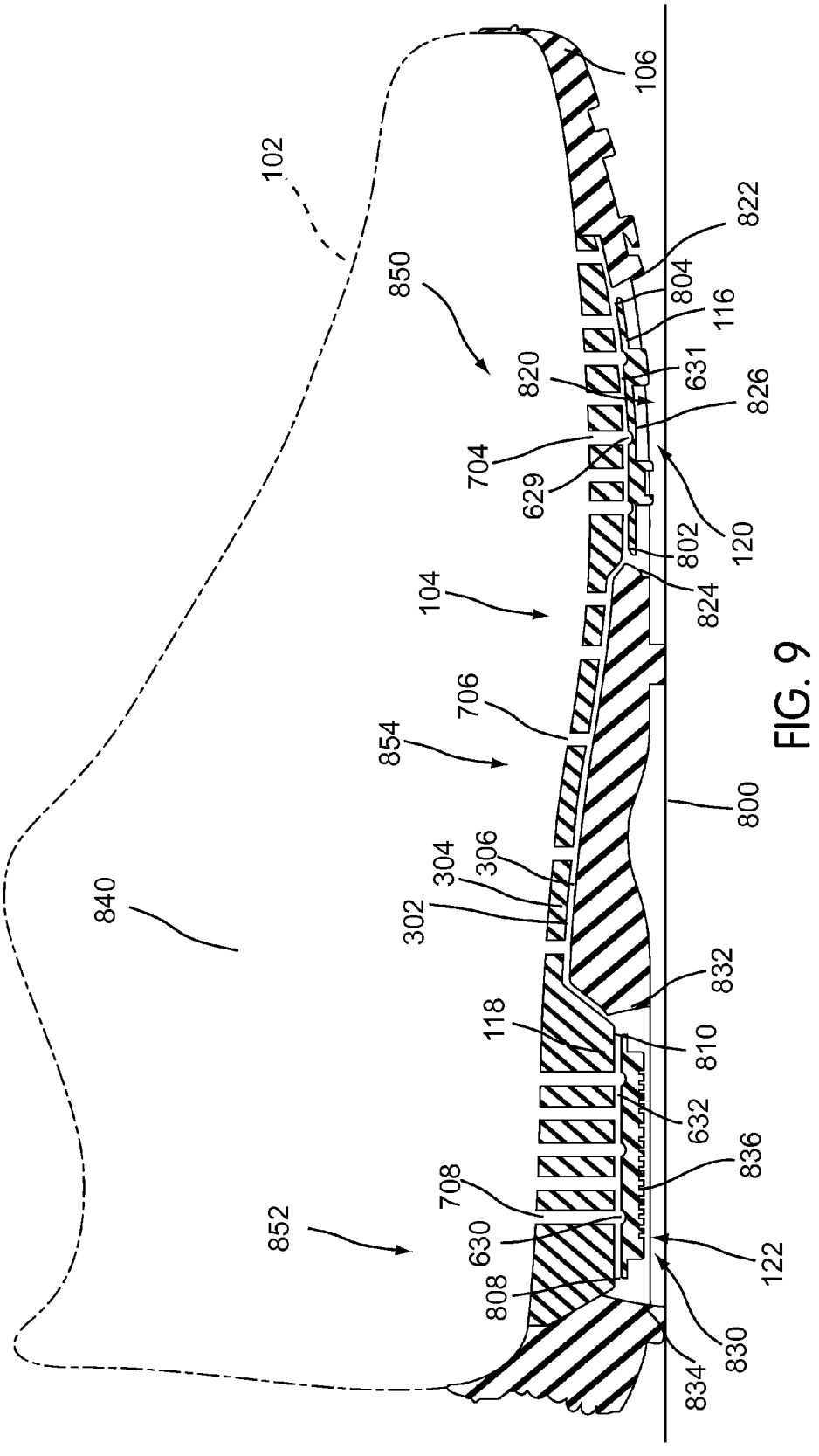

102
106
822
850
804
116
820
631
826
704
629
802
120
824
104
706
854
800
840
304
306
302
832
118
810
632
836
708
852
630
122
808
830
834

FIG. 9

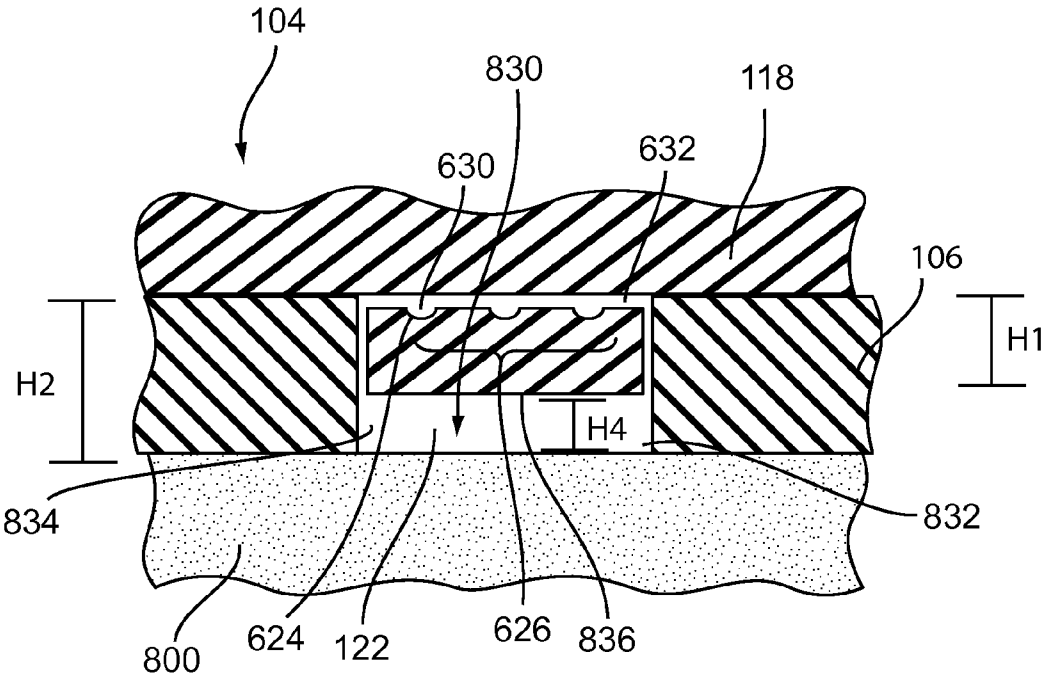

104
830
118
630
632
106
H2
H1
H4
834
832
800
624
122
626
836

FIG. 10

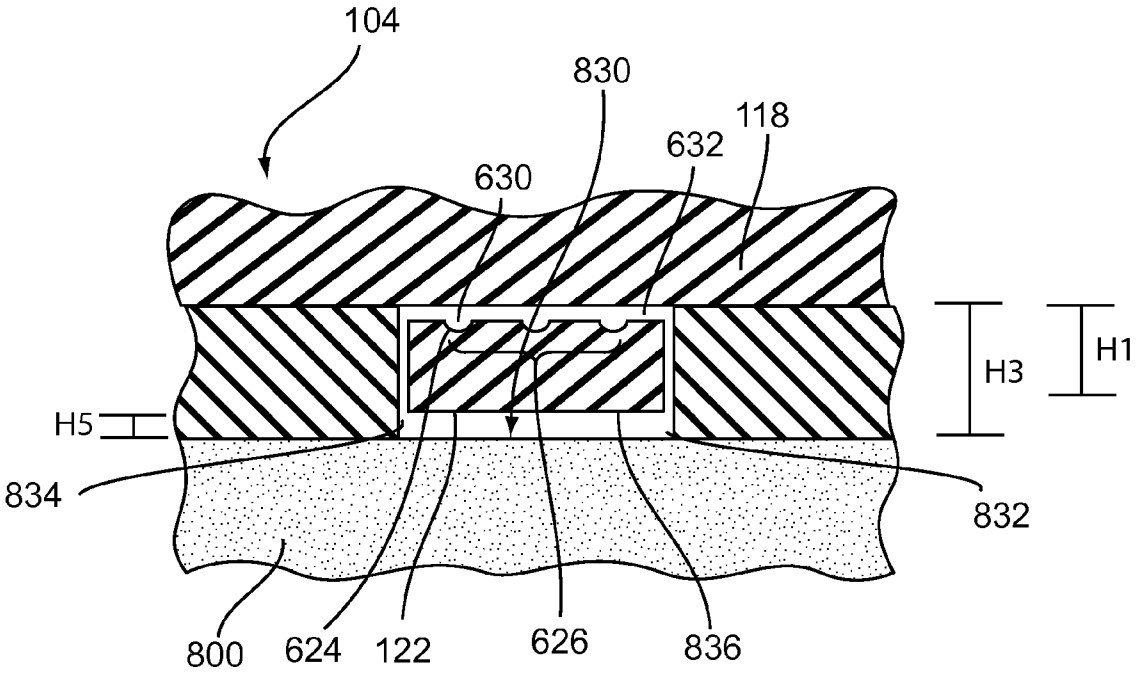

104
830
118
632
630
H3
H1
H5
834
832
800
624
122
626
836

FIG. 11

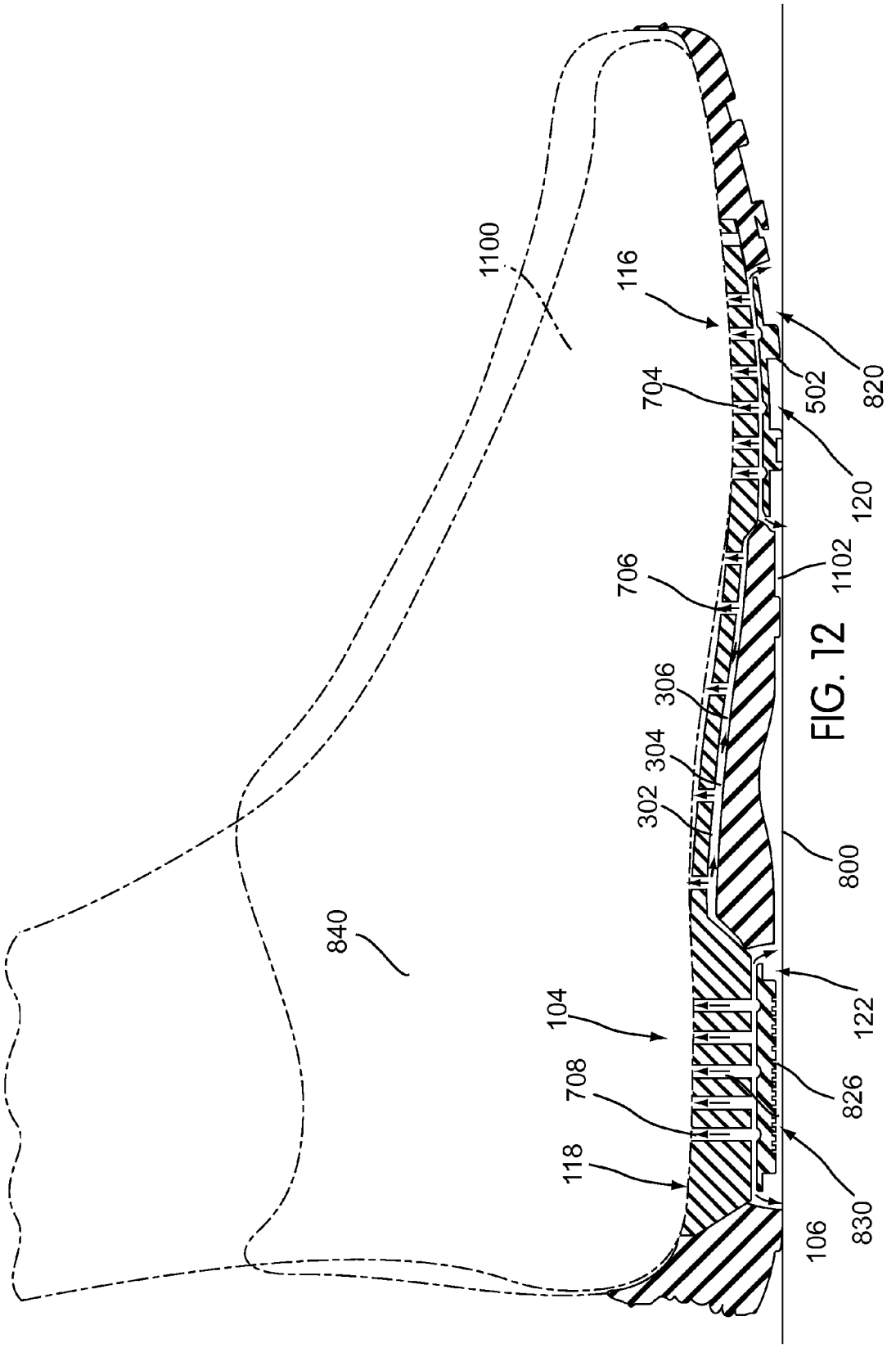

1100
116
704
502
820
120
706
1102
306
304
302
800
840
104
122
708
826
118
830
106

FIG. 12

FOOTWEAR COOLING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to footwear, and in particular a cooling system for an article of footwear.

2. Description of Related Art

Articles of footwear with ventilation systems have been proposed. In general, cooling or ventilation systems included in articles of footwear may be divided into two categories: those passively allowing air exchange and those including a mechanism for actively facilitating air exchange.

The following references teach passive systems. Moretti (U.S. Pat. No. 5,992,052) discloses a shoe with a vapor permeable insole that also includes a waterproof membrane. Polegato (U.S. Pat. No. 5,983,524) discloses a similar vapor-permeable shoe that is also water proof. Lechhart et al. (U.S. patent number 2005/0172513) disclose a breathable sole structure for footwear. The footwear sole structure includes an insole, an outsole, and a functional membrane system.

Berger et al. (U.S. Pat. No. 6,817,112) teaches an article of footwear that includes openings for ventilation and vapor exchange. The sole of Berger's design includes at least three layers. Each of the layers has one or more openings, so that ventilation and air exchange may occur within the article of footwear. The partial overlapping of these holes provides a substantially larger number of openings without reducing the mechanical stability of the shoe. Although these references teach the concept of allowing air to be transferred through the insole or a membrane in the article of footwear, there is no mechanism for facilitating the flow of air.

Articles of footwear including provisions for actively facilitating air exchange have been disclosed. Pfander (U.S. Pat. No. 6,976,319) discloses an article of footwear that includes a midsole having a front portion with a plurality of spaced holes that are vertically aligned to allow airflow through the midsole. In particular, the plurality of spaced holes are aligned with a set of moguls in the outsole for the purpose of providing air flow through the midsole when the moguls are deformed by the weight and walking action of the wearer. Generally, however, the holes in the midsole are positioned only in the forefoot region. Furthermore, the air is not channeled directly to the holes, but rather the holes are in contact with a large space, and the moguls deform within that large space. This design lacks an efficient means of circulating the air directly throughout the entirety of the midsole.

Huang (U.S. Pat. No. 5,341,581) discloses a compression cooling system of a shoe midsole comprising mainly a main body, an air sac and an air duct. During typical use, the air duct of the Huang device, which is disposed along the heel, is compressed and circulates air through the air duct. Air is transported through the air duct to an air slot and four air holes, disposed along the forefoot of the midsole. This design requires an air admitting one-way valve and an air discharging one-way valve. In addition, the air holes in the midsole are not distributed throughout the midsole, but only in the forefoot portion. The design of Huang requires a large number of components in order to achieve ventilation of the foot through the midsole and outsole and does not include holes for ventilation throughout the entirety of the midsole.

There is a need in the art for an article of footwear incorporating a simple design, eliminating the need for multiple layers and valves, and a design that simultaneously incorporates multiple holes disposed along the midsole to provide ventilation to the entire length of the article of footwear.

SUMMARY OF THE INVENTION

A footwear cooling system is disclosed. In one aspect, the invention provides an article of footwear comprising: an upper; an upper sole portion including an upper sole portion body and a projecting portion extending from a first side of the upper sole portion body; the upper sole portion including at least one aperture; a lower sole portion including a hole, configured to receive the upper sole portion; a compression chamber defined by a lower surface of the projecting portion and at least one side wall of the hole disposed in the outsole; the compression chamber having a first volume; and where the compression chamber has a second volume after being compressed and wherein the change in volume forces air through the at least one aperture.

In another aspect, the upper sole portion includes a first projecting portion and a second projecting portion.

In another aspect, the first projecting portion corresponds to a forefoot region of the upper sole portion.

In another aspect, the second projecting portion corresponds to a heel region of the upper sole portion.

In another aspect, the outsole includes at least one channel.

In another aspect, the channel corresponds to the aperture.

In another aspect, the invention provides an article of footwear, comprising: an upper; an upper sole portion including at least one projecting portion on a first side; a lower sole portion including a hole configured to receive the projecting portion; and

where a first side of the projecting portion includes at least one tread element.

In another aspect, a first surface of the projecting portion is composed of a similar material as the outsole.

In another aspect, the outsole includes at least one tread element disposed along a second side.

In another aspect, the tread element disposed along the projecting portion is composed of the same material as the tread element disposed along the outsole.

In another aspect, the first side of the projecting portion includes multiple tread elements.

In another aspect, the tread element disposed along a first side of the projecting portion increases traction between the article of footwear and a surface.

In another aspect, the upper sole portion includes a second projecting portion, including a second tread element disposed along a first side of the second projecting portion.

In another aspect, the invention provides an article of footwear, comprising: an upper and an upper sole portion; a hole disposed on a lower sole portion configured to receive a portion of the upper sole portion; the outsole including an outer surface on a first side; and where the first portion of the upper sole portion approaches the outer surface of the outsole when a predetermined force is applied to the upper sole portion.

In another aspect, the first portion of the upper sole portion is co-planar with the outer surface of the outsole.

In another aspect, the first portion of the upper sole portion corresponds to a projecting portion of the upper sole portion.

In another aspect, the predetermined force is applied by means of a wearer stepping down with an article of footwear.

In another aspect, the first portion of the upper sole portion recedes from the outer surface of the outsole once a predetermined force has been applied and then released.

In another aspect, the upper sole portion includes a second portion, and the outsole includes a second hole configured to receive the second portion of the upper sole portion.

In another aspect, the second portion of the upper sole portion approaches the outer surface of the outsole when a predetermined force is applied.

Other systems, methods, features and advantages of the invention will be, or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the following claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

FIG. **1** is an isometric exploded view of a preferred embodiment of an article of footwear;

FIG. **2** is a plan view of a preferred embodiment of the bottom of an outsole;

FIG. **3** is a plan view of a preferred embodiment of the top of an outsole;

FIG. **4** is a cross sectional view of a preferred embodiment of an outsole;

FIG. **5** is an isometric view of a preferred embodiment of an upper sole portion;

FIG. **6** is an isometric view of a preferred embodiment of an upper sole portion;

FIG. **7** is a plan view of a preferred embodiment of the bottom of a sole system;

FIG. **8** is a plan view of a preferred embodiment of the top of a sole system;

FIG. **9** is a side view of a preferred embodiment of a sole system before compression;

FIG. **10** is a schematic view of a preferred embodiment of a compression chamber before a force has been applied to the upper sole portion;

FIG. **11** is a schematic view of a preferred embodiment of a compression chamber after a force has been applied to the upper sole portion; and

FIG. **12** is a side view of a preferred embodiment of a sole system during compression.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An article of footwear with a cooling system is disclosed. The cooling system comprises an outsole, including channels, and an upper sole portion including apertures. FIG. **1** is an exploded isometric view of a preferred embodiment of an article of footwear **100**. Article of footwear **100** preferably includes upper **102**. Upper **102** may be constructed of any material. Although upper **102** is shown generically in this embodiment, in general upper **102** may comprise any shape and/or design. In a preferred embodiment, article of footwear **100** further includes upper sole portion **104**. A first side **108** of upper sole portion **104** is preferably disposed proximate to a wearer's foot once the wearer's foot has been inserted. Upper sole portion **104** preferably includes upper sole portion body **115**. Upper sole portion **104** also preferably includes a first projecting portion **116** and a second projecting portion **118**. First projecting portion **116** and second projecting portion **118** preferably project outward with respect to a second side **112** of upper sole portion body **115**. In some embodiments, upper sole portion **104** may include more than two projecting portions. In other embodiments, upper sole portion **104** may include only one projecting portion.

In a preferred embodiment, article of footwear **100** also includes lower sole portion **106**. A first side **110** of lower sole portion **106** is preferably configured to contact second side **112** of upper sole portion body **115**. A second side **114** of lower sole portion **106** is preferably configured to contact the ground. In a preferred embodiment, lower sole portion **106** includes a first hole **120** and a second hole **122**. First hole **120** and second hole **122** may be different sizes. In a preferred embodiment, first hole **120** is slightly larger than second hole **122**. In some embodiments, lower sole portion **106** may include more than two holes. In other embodiments, lower sole portion **106** may include only one hole.

In a preferred embodiment, first hole **120** and second hole **122** are configured to receive first projecting portion **116** and second projecting portion **118**, respectively. That is, once upper sole portion **104** and lower sole portion **106** are assembled, first projecting portion **116** sits within first hole **120** and second projecting portion **118** sits within second hole **122**. In a preferred embodiment, the depth of first hole **120** is preferably greater than the height of first projecting portion **116**. Likewise, the depth of second hole **122** is preferably greater than the height of second projecting portion **118**. With this arrangement second side **114** of lower sole portion **106** may be in contact with the ground. However, neither first projecting portion **116** nor second projecting portion **118** will initially contact the ground. Instead, a small gap will be left between each projecting portion and the ground.

It is common for outsoles to include provisions for providing traction between an article of footwear and a surface. In a preferred embodiment, lower sole portion **106** may include tread elements. The tread elements may be composed of a similar material to second side **114** of lower sole portion **106**, or may be composed of a different material. In some embodiments, tread elements may be composed of rubber. FIG. **2** is a plan view of a preferred embodiment of second side **114** of lower sole portion **106**. In this embodiment, lower sole portion **106** includes tread elements **202**. Second side **114** of lower sole portion **106** preferably includes first hole **120** and second hole **122**. In some embodiments, first hole **120** is disposed along a forefoot region **204** of lower sole portion **106**. Likewise, second hole **122** may be disposed along a heel region **206** of lower sole portion **106**. In a preferred embodiment, first hole **120** and second hole **122** extend through to first side **110** (see FIG. **3**) of lower sole portion **106**.

FIG. **3** is a plan view of a preferred embodiment of first side **110** of lower sole portion **106**. As disclosed above, first hole **120** and second hole **122** preferably extend through lower sole portion **106** to first side **110**. First hole **120** and second hole **122** can be observed in FIG. **3**. In some embodiments, lower sole portion **106** includes recessed region **318**, disposed proximate to first hole **120** and second hole **122**, and bounded by periphery **319**. Recessed region **318** is preferably a portion of lower sole portion **106** that is configured to receive upper sole portion **104** in a manner that allows first side **108** of upper sole portion **104** to be flush with first side **110** of lower sole portion **106** after upper sole portion **106** is mounted.

In a preferred embodiment, lower sole portion **106** may include one or more channels that facilitate the transport of air to various portions of the upper sole portion. In the exemplary embodiment, lower sole portion **106** includes first channel **302**, second channel **304**, and third channel **306**. First channel

302 may be disposed closest to a medial side 310 of lower sole portion 106. Second channel 304 may be disposed along the center of lower sole portion 106. Third channel 306 may be disposed closest to a lateral side 312 of lower sole portion 106.

In some embodiments, first channel 302, second channel 304 and third channel 306 are all narrow grooves formed into first side 110 of lower sole portion 106. In some embodiments, first channel 302, second channel 304, and third channel 306 may be tubes or ducts that are fitted to lower sole portion 106. Generally, any conduit or medium that permits this transfer of air can be used as a channel. In a preferred embodiment, first channel 302, second channel 304, and third channel 306 each extend between second hole 122 and first hole 120. Additionally, each channel preferably extends through forward portion 320 of recession region 318.

In general, lower sole portion 106 may include any number of channels. These channels are preferably configured to allow air to flow through them. As air initially enters article of footwear 100 through first hole 120 and second hole 122, first channel 302, second channel 304 and third channel 306 distribute the air across the entire length of article of footwear 100. In a preferred embodiment, each channel is configured to be open prior to the insertion of upper sole portion 104 into lower sole portion 106. Once upper sole portion 104 and lower sole portion 106 have been assembled, first channel 302, second channel 304, and third channel 306 are closed along their open side by upper sole portion 104. With this configuration, air is transported through the channels and air is delivered to predetermined locations that correspond to various apertures along upper sole portion 104.

FIG. 4 is a cross-sectional view of a preferred embodiment of lower sole portion 106. Second side 114 of lower sole portion 106 is preferably configured to contact a surface. First side 110 of lower sole portion 106, which includes first channel 302, second channel 304, and third channel 306, is preferably configured to contact the upper sole portion. The shape of each channel is seen to be semi-circular in this embodiment. In other embodiments, the shape of the channels may vary. Additionally, the depth of each channel may be varied. In a preferred embodiment, the depth of each channel is substantially less than the thickness of lower sole portion 106.

Referring to FIG. 5, a preferred embodiment of upper sole portion 104 includes apertures 504. Preferably, apertures 504 facilitate the transfer of air between the lower sole portion and the inside of an article of footwear. In some embodiments, apertures 504 may be disposed into three groups. In the exemplary embodiment, a first group 520, a second group 522, and a third group 524 of apertures are disposed lengthwise along upper sole portion 104. Preferably, first group 520, second group 522, and third group 524 are associated with the first channel, the second channel, and the third channel of the lower sole portion 106, respectively.

As previously disclosed, upper sole portion 104 preferably includes first projecting portion 116 and second projecting portion 118. First projecting portion 116 preferably includes provisions for applying traction to the ground. In a preferred embodiment, first projecting portion 116 may include tread elements 502. Tread elements 502 may be composed of a similar material to first projecting portion 116 or they may be composed of a different material than first projecting portion 116. In some embodiments, second projecting portion 118 may also include tread elements.

In some embodiments, first projecting portion 116 and second projecting portion 118 may include provisions for receiving and distributing air across upper sole portion 104. Referring to FIG. 6, first upper surface 617 and second upper surface 619 of projecting portions 116 and 118, respectively, may include air distribution systems.

In the exemplary embodiment, first projecting portion 116 may include first air distribution system 621 disposed on first upper surface 617. Preferably, first air distribution system 621 includes first air inlet portions 623 and intersecting channels 625. Intersecting channels 625 may include first set of air distribution channels 627 that are oriented longitudinally and second set of air distribution channels 629 that are distributed laterally. Intersecting channels 625 may be disposed just under first aperture set 633 of apertures 504.

In this preferred embodiment, first air inlet portions 623 are semi-circular and are configured to place outside air in fluid communication with intersecting channels 625 as well as first air distribution cavity 631 disposed between first projecting portion 116 and upper sole portion 104 (see FIG. 9). Preferably, first set of air distribution channels 627 are configured to coincide with channels 302, 304 and 306 of upper sole portion 104 (see FIG. 3). With this preferred arrangement, air may be evenly distributed under upper sole portion 104 and under apertures 504.

In a preferred embodiment, second projecting portion 118 may include second air distribution system 622 disposed on second upper surface 619. This arrangement is preferably similar to the arrangement of first air distribution system 621 on first upper surface 617 of first projecting portion 116. Preferably, second air distribution system 622 includes second air inlet portions 624 and intersecting channels 626. Intersecting channels 626 may include third set of air distribution channels 628 that are oriented longitudinally and fourth set of air distribution channels 630 that are distributed laterally. Intersecting channels 626 may be disposed just under second aperture set 634 of apertures 504.

In this preferred embodiment, second air inlet portions 624 are semi-circular and are configured to place outside air in fluid communication with intersecting channels 626 as well as second air distribution cavity 632 disposed between second projecting portion 118 and upper sole portion 104 (see FIG. 9). Preferably, second set of air distribution channels 628 are also configured to coincide with channels 302, 304 and 306 of upper sole portion 104 (see FIG. 3). With this preferred arrangement, air may be evenly distributed under upper sole portion 104 and under apertures 504.

In this specification and throughout the claims, a combination of the lower sole portion with the upper sole portion is referred to as a sole system. FIG. 7 is a plan view of a preferred embodiment of sole system 602, from below. Sole system 602 includes tread elements 202 of lower sole portion 106 and tread elements 502 of upper sole portion 104. Here, first projecting portion 116 may be seen through first hole 120. Likewise, second projecting portion 118 may be seen through second hole 122.

FIG. 8 is top plan view of a preferred embodiment of sole system 602, from above. In this embodiment, first side 108 of upper sole portion 104 is seen to be coincident with first side 110 of lower sole portion 106. In some embodiments, first side 108 of upper sole portion 104 may be slightly raised or lowered with respect to first side 110 of lower sole portion 106. Upper sole portion 104 may include apertures 702, disposed along first side 108 of upper sole portion 104. In a preferred embodiment, apertures 702 are aligned just above channels in lower sole portion 106. That is, the apertures 702 are configured to be disposed in lines that coincide with first channel 302, second channel 304, and third channel 306 of lower sole portion 106. The positions of these channels are indicated in FIG. 8 by dotted lines.

In addition to being disposed along lines, apertures **702** may be divided into aperture regions. First aperture region **704** is preferably disposed along forefoot region **204** of lower sole portion **106**. Second aperture region **706** is preferably disposed along middle region **710** of lower sole portion **106**. Third aperture region **706** is preferably disposed along heel region **206** of lower sole portion **106**. Each aperture region may function to exchange air at a different portion of the article of footwear.

As previously discussed, a system for facilitating air exchange between outside air and the air enclosed within the upper of an article of footwear is provided. This system preferably includes a set of compression chambers that are formed in the sole system. FIG. **9** is a side cross-sectional view of a preferred embodiment of an article of footwear in contact with surface **800**. In FIG. **9**, upper **102** is shown in phantom.

In a preferred embodiment, first projecting portion **116** and second projecting portion **118** of upper sole portion **104** are preferably set within first hole **120** and second hole **122** of lower sole portion **106**. First lower surface **826** of first projecting portion **116** preferably defines a top portion of first compression chamber **820**. Along the sides, first compression chamber **820** is preferably bounded by a first wall **822** and a second wall **824** of first hole **120**. A third and fourth wall of first hole **120**, not shown here, also bound first compression chamber **820**.

In a similar manner to first compression chamber **820**, the top of second compression chamber **830** is defined by second lower surface **836** of second projecting portion **118**. The walls of second compression chamber **830** are defined by first wall **832** and second wall **834** of second hole **122**. A third and fourth wall of first hole **122**, not shown here, also bound second compression chamber **830**.

In some embodiments, a compression chamber may not include four walls. In general, a compression chamber may be formed from a lower surface of a projecting portion and any number of walls of a hole disposed in an outsole. For example, a triangularly shaped compression chamber may include only three walls.

In a preferred embodiment, a bottom side of each compression chamber **820** and **830** is defined by surface **800**. In other words, surface **800** serves as the bottom side of compression chambers **820** and **830**. Furthermore, first compression chamber **820** and second compression chamber **830** each include an initial volume. Referring to FIG. **9**, first compression chamber **820** is preferably in fluid communication with enclosure **840** of upper **102** by way of a system of apertures and a system of channels. In particular, first compression chamber **820** is preferably in fluid communication with forefoot region **850** of enclosure **840** via first aperture region **704**.

Likewise, second compression chamber **830** is preferably in fluid communication with heel region **852** of enclosure **840** via third aperture region **708**. In addition, first compression chamber **820** and second compression chamber **830** are both in fluid communication with middle region **854** of enclosure **840** via second aperture region **706**. In particular, second aperture region **706** is in fluid communication with first compression chamber **820** and second compression chamber **830** via first channel **302**, second channel **304** and third channel **306**.

In some embodiments, first projecting portion **116** includes first inlet **802** and second inlet **804**. Preferably, first inlet **802** and second inlet **804** allow air to be exchanged between first aperture region **704** and first compression chamber **820**. Likewise, second projecting portion **118** preferably includes third inlet **808** and fourth inlet **810**. Third inlet **808** and fourth inlet **810** preferably allow air to be exchanged between third aperture region **708** and second compression chamber **830**.

The reduction of the volume of air in second compression chamber **830** as a result of a force applied to the upper sole portion **104** is best understood by referring to FIGS. **10** and **11**. FIG. **10** is a schematic diagram of a preferred embodiment of second compression chamber **830** prior to compression. Recall that second compression chamber **830** is defined by the walls of second hole **122**. First wall **832** and second wall **834** can be seen in FIGS. **10** and **11**. Third wall and fourth wall of second hole **122** are not shown in this cross sectional view. Second compression chamber **830** further includes lower surface **836** of second projecting portion **118** of upper sole portion **104**. In this embodiment, second compression chamber **830** has a first initial volume.

Referring to FIG. **10**, H**1** is the height of second projecting portion **118**. The initial height of lower sole portion **106**, H**2**, can also be seen in FIG. **10**. Before compression, the distance between second lower surface **836** of second projecting portion **118** and surface **800** is H**4**. As a force is applied to upper sole portion **104**, preferably by a wearer's foot, second projecting portion **118** will move further into second hole **122**. This is illustrated in the following figure.

FIG. **11** is a schematic diagram of a preferred embodiment of second compression chamber **830** during compression. Compression causes lower surface **836** to be lowered and approach surface **800**. As the width of second compression chamber **830** stays relatively constant during the compression step, the volume of second compression chamber **830** is reduced from a first volume to a second volume. This can be observed by comparing FIG. **10** and FIG. **11**. Here, the height of second projecting portion **118**, H**1**, is the same. However, the height of lower sole portion **106**, H**3** has been reduced from its original value, H**2**. The weight of the wearer of article of footwear **100** bearing down on lower sole portion **106** can cause this compression. The compression of lower sole portion **106** causes the distance H**5** between second lower surface **836** and surface **800** to be reduced when compared with initial distance H**4**, the distance prior to compression.

With this preferred arrangement, the motion of second lower surface **836** can assist in moving air to and from various parts of article of footwear **100**. In particular, air enters at intake air passages **624** and moves through air distribution channels **626**, including fourth set of air distribution channels **630**. Preferably, air also moves through second air distribution cavity **632**.

FIGS. **10** and **11** are intended to be schematic representations of the basic motions of first compression chamber **820** and second compression chamber **830**. The apertures disposed along the upper sole portion in previous figures are not shown here to improve clarity. In a preferred embodiment, first projecting portion **116** and second projecting portion **118** will both include a system of apertures as shown in FIGS. **9** and **12**. Furthermore, while FIGS. **10** and **11** are shown with respect to second compression chamber **830**, the operation of first compression chamber **820** would be substantially similar. That is, the volume of air initially confined within first compression chamber **820** would be reduced as first lower surface **826** approaches surface **800**.

This reduction in volume, of both compression chambers **820** and **830**, creates a pressure imbalance that facilitates the exchange of air between the inside of the upper and the outside air. In particular, this change in volume forces air through the apertures and channels disposed along upper sole portion **104**. FIG. **12** is a side cross sectional view of a preferred embodiment of article of footwear **100**, once a wearer's foot **1100** has been inserted and is applying force to upper sole

portion **104**. In this embodiment, first projecting portion **116** and second projecting portion **118** have been inserted further into first hole **120** and second hole **122**, reducing the volume of air in first compression chamber **820** and second compression chamber **830**.

The arrows in FIG. **12** represent the exchange of air between first compression chamber **820**, second compression chamber **830**, and enclosed region **840** of upper **102**. In addition, as upper sole portion **104** depresses, lower surface **826** of first projecting portion **116** eventually contacts surface **800**. During this compression step, air is preferably moved through first aperture region **704**, second aperture region **706**, and third aperture region **708**. Additionally, air is also preferably moved through first channel **302**, second channel **304**, and third channel **306**.

Because first projecting portion **116** includes tread elements **502**, first projecting portion **116** provides traction between the article of footwear and surface **800**. In some embodiments, first projecting portion **116** need not contact surface **800**. Instead, first projecting portion **116** may approach outer surface **1102** of lower sole portion **106** but fail to contact surface **800**. In situations where first projecting portion **116** contact surface **800**, lower surface **826** of first projecting portion **116** may be flush with outer surface **1102** of lower sole portion **106**.

Additionally, as the force is removed from upper sole portion **104**, the volume of air in first compression chamber **820** and second compression chamber **830** increases. This increase in the volumes of air creates another pressure difference that causes air to flow in the reverse direction. With each step the wearer of the article of footwear is imposing a force, and then releasing the force, creating an alternating exchange of air between first compression chamber **820**, second compression chamber **830** and enclosed region **840** of article of footwear **100**. Since wearer's foot **1100** is preferably disposed within enclosed region **840**, the air proximate to wearer's foot **1100** is constantly being circulated and cooled.

While various embodiments of the invention have been described, the description is intended to be exemplary, rather than limiting and it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible that are within the scope of the invention. Accordingly, the invention is not to be restricted except in light of the attached claims and their equivalents. Also, various modifications and changes may be made within the scope of the attached claims.

What is claim is:

1. An article of footwear, comprising:

an upper;

an upper sole portion including an upper sole portion body and a projecting portion extending from a first side of the upper sole portion body;

the upper sole portion including at least one aperture;

a lower sole portion including a first side configured to contact the upper sole portion body and a second side configured to contact a ground surface;

the lower sole portion including a hole, the hole configured to extend through the lower sole portion from the first side to the second side and is further configured to receive the projecting portion of the upper sole portion;

a compression chamber defined by a lower surface of the projecting portion and at least one wall of the hole extending through the lower sole portion;

the compression chamber having a first volume;

wherein the compression chamber has a second volume after being compressed and wherein the change in volume forces air through the at least one aperture;

wherein the lower sole portion includes at least one channel; and

wherein the channel corresponds to the aperture.

2. The article of footwear according to claim **1**, wherein the upper sole portion includes a first projecting portion and a second projecting portion.

3. The article of footwear according to claim **2**, wherein the first projecting portion corresponds to a forefoot region of the upper sole portion.

4. The article of footwear according to claim **2**, wherein the second projecting portion corresponds to a heel region of the upper sole portion.

5. The article of footwear according to claim **1**,

wherein the projecting portion is configured to move within the hole between a first distance from the second side of the lower sole portion when the lower sole portion is uncompressed and a second distance from the second side of the lower sole portion when the lower sole portion is compressed, the second distance being smaller than the first distance; and

wherein a first side of the projecting portion includes at least one tread element.

6. The article of footwear according to claim **5**, wherein a first surface of the projecting portion is composed of a similar material as the second side of the lower sole portion.

7. The article of footwear according to claim **5**, wherein the lower sole portion includes at least one tread element disposed along the second side.

8. The article of footwear according to claim **7**, wherein the tread element disposed along the projecting portion is composed of the same material as the tread element disposed along the second side of the lower sole portion.

9. The article of footwear according to claim **5**, wherein the first side of the projecting portion includes multiple tread elements.

10. The article of footwear according to claim **5**, wherein the tread element disposed along the first side of the projecting portion increases traction between the article of footwear and a surface.

11. The article of footwear according to claim **5**, wherein the upper sole portion includes a second projecting portion, including a second tread element disposed along a first side of the second projecting portion.

* * * * *