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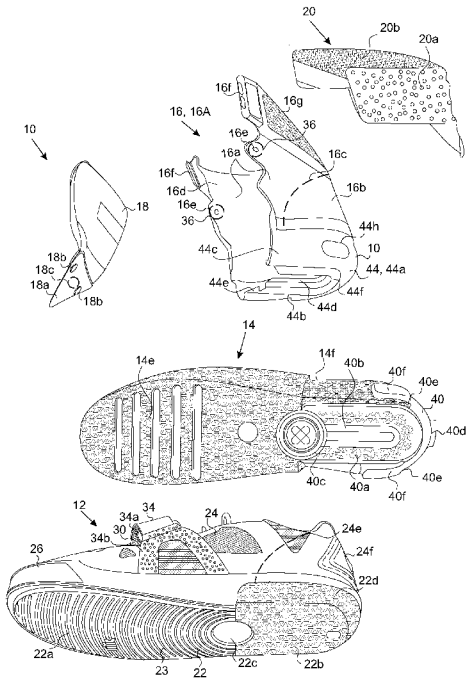


FIG. 1

(57) Abstract: A modular shoe having interchangeable: outer shoe shell, footbed and internal heel collar. The outer shoe shell provisions a full upper secured to an outsole. The footbed provides the primary cushioning for the wearer's foot, and the internal heel collar is releasably secured to the footbed, the footbed and the internal heel collar presenting a sub-assembly that is mountable within the outer shoe shell. The modular system can include additional components such as tongue extensions and various decoratives.

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MODULAR SHOE SYSTEM

Field

[001] The invention relates to a modular shoe system.

Background

[002] Although there are quite a variety of shoe designs commercially available, it is typical for each design to be massed produced in order to spread the cost of development and manufacture over multiple units so that a pair of shoes can be relatively affordable to the average consumer. However, some consumers also crave individuality. To be truly individual one would need to design and manufacture a unique pair of shoes, which would be an expensive undertaking. A modular shoe system which enables a consumer to interchange various parts could overcome that challenge and allow a consumer to express his or her own individuality at a reasonable price point.

Summary

[003] In one aspect, a modular shoe is provided which includes an outer shoe shell, an interchangeable footbed, and an interchangeable internal heel collar. The footbed and the internal heel collar each include connectors for releasably securing the footbed and the internal heel collar to one another and forming a partial assembly that is mountable within the unitary outer shoe shell.

[004] The outer shoe shell can include an outsole and an upper, the outsole incorporating a tread, and the upper encompassing anterior, posterior, medial and lateral aspects of a wearer's foot when the shoe is worn.

[005] The footbed preferably provides the primary cushioning for the wearer's foot.

[006] A cinching mechanism can also be provided for securing the shoe on the wearer's foot.

[007] The upper can include a first heel counter and the internal heel collar can include a second heel counter opposed to the first heel counter.

[008] The footbed and the internal heel collar can be connected together by a tongue and groove joint. More particularly, the internal heel collar can include a semi-rigid or rigid socket; a rear portion of the footbed can includes at least a semi-rigid or rigid plate; and one of the socket and the plate can include an elongate tongue while the other of the plate and the socket can include a mating elongate groove, such that, when the tongue is inserted into the groove, the footbed seats into the socket. A reinforcement rib can surround the groove.

[009] The footbed and the internal heel collar can also or alternatively be connected by a snap-fit joint.

[0010] The interchangeable internal heel collar can include a high-top style where the internal heel collar features prominently over a posterior topline of the upper and a low-top style where the internal heel collar does not feature prominently over the posterior topline of the upper.

[0011] The medial and lateral portions of the upper and medial and lateral portions of the internal heel collar can each include one or more magnets for registering the respective upper portions and internal heel collar portions.

[0012] The cinching mechanism can include shoelace eyelets, and the medial and lateral upper magnets can be disposed about medial and lateral posterior-most eyelets.

[0013] The upper can include a tongue, and an interchangeable tongue extension connectable to the tongue.

[0014] An interchangeable U-shaped decorative can be attached to the internal heel collar. An interchangeable decorative band can be connected to the U-shaped decorative, the band

having magnets therein for holding the band in a looped configuration about the wearer's leg when the shoe is worn.

[0015] The foregoing modular shoe enables a consumer to interchange various components and/or decoratives, allowing the consumer of the modular shoe to express his or her own creativity and/or individuality at a reasonable price point.

Brief Description of Drawings

[0016] The foregoing and other aspects of the invention will be better appreciated with reference to the accompanying drawings, wherein:

[0017] Fig. 1 is an exploded view of a modular shoe system, which employs a first set of interchangeable components according to a first embodiment;

[0018] Fig. 2 is a side view of a sub-assembly of the modular shoe system shown in Fig. 1, the sub-assembly providing a footbed and interior heel collar;

[0019] Fig. 3 is a bottom perspective view of the sub-assembly shown in Fig. 2;

[0020] Fig. 4 is a top frontal perspective view of a footbed shown in Fig. 1, in isolation;

[0021] Fig. 5 is a top frontal perspective view of the sub-assembly shown in Fig. 2;

[0022] Fig. 6 is a top frontal perspective view of an outer shoe shell shown in Fig. 1, in isolation;

[0023] Fig. 7 is a side perspective view of the outer shoe shell shown in Fig. 1, in isolation;

[0024] Fig. 8 is an opposing side perspective view of the outer shoe shell shown in Fig. 7;

[0025] Fig. 9 is a perspective view of the modular shoe shown in Fig. 1, in assembly;

[0026] Fig. 10 is a rear perspective view of the modular shoe shown in Fig. 1, in assembly;

[0027] Fig. 11 is a side perspective view of the modular shoe shown in Fig. 1, in assembly, with additional decorative accoutrements;

[0028] Fig. 12 is an exploded view of the modular shoe system, which employs a second set of interchangeable components according to a second embodiment that may be interchanged with similar components of the first embodiment;

[0029] Fig. 13 is a partial exploded, partial assembly view of the modular shoe shown in Fig. 12; and

[0030] Fig. 14 is an assembly view of modular shoe shown in Fig. 12.

Detailed Description

[0031] Figs. 1-11 show a modular shoe system 10 (which may be abbreviated herein as 'modular shoe' or simply 'shoe') according to a first embodiment which utilizes a plurality of interchangeable components to provide an athletic or athletic-style shoe 10. Instantiations of these components may have different colours, textures, decorative features, and manufacturing details. Figs. 12- __ show the modular shoe 10 according to a second embodiment, which can use the same or similar components as the first embodiment. Instantiations of these components may also have different colours, textures, decorative features, and manufacturing details.

[0032] Generally speaking, the modular shoe 10 includes an interchangeable outer shoe shell 12, an interchangeable footbed 14, an interchangeable internal heel collar 16, an optional interchangeable tongue extension 18, and one or more optional interchangeable decoratives 20.

[0033] The outer shoe shell 12 provisions an outsole 22, an upper 24, an optional foxing 26, an optional tongue 28 (seen best in Fig. 6), and a cinching mechanism 30.

[0034] As shown in the first and second embodiments, the outsole 22 can – and preferably does – include a tread 23. The outsole 22 can be manufactured by adhering two major components: a front outsole piece 22a and a rear outsole piece 22b, each of which can have a different tread pattern. The rear outsole piece 22b can include a flex portion 22c positioned substantially underneath the foot arch, as provided by a non-treaded thin wall section of the outsole 22. The rear outsole piece 22b can also include a sidewall 22d which adjoins the foxing 26. The rear outsole piece 22b can be transparent, translucent or opaque. The outsole pieces 22a, 22b can be formed from rubber via molding operations or any other desired material.

[0035] As shown in the first and second embodiments, the upper 24 encompasses a wearer's toes, at least a portion of the foot instep and at least a portion of the hindfoot such that the upper 24 encompasses anterior, posterior, medial and lateral aspect of the wearer's foot when the shoe 10 is worn. As seen best in Fig. 6 of the first embodiment, the upper 24 can be provisioned from a variety of elongate pieces, including an external-environment oriented outer lining 24j and a comfort oriented inner lining 24k. The upper 24 provides a toe box portion 24a, a vamp portion 24b, and medial and lateral quarters 24c joined along seam 24d. It will be understood that the upper 24 can alternatively be formed from a variety of other pieces that are stitched or otherwise joined together, as will be seen in Figs. 12 - 14 of the second embodiment. A heel counter, shown by stippled line 24e in Figs. 1, 7 & 8, can be incorporated between the outer and inner linings so 24j, 24k as to define a generally U-shaped external heel collar 24f, which provides the upper 24 with rigidity in the posterior region as well as keeping shoe opening 24g unobstructed. The heel counter 24e may be omitted if desired.

[0036] The upper 24 can be sewn, adhered or otherwise secured to the outsole 22. The foxing 26 can adjoin the upper 24 and the outsole 22. As shown in the first and second embodiments the foxing 26 can encircle the outer shoe shell 12 so as to cover from view the

seam between the upper 24 and the outsole 22. The foxing 26 may be shortened in length or omitted altogether.

[0037] The tongue 28 can be sewn or otherwise secured to the upper 24 and can include one or more connector portions for attaching the optional interchangeable tongue extension 18 to the tongue 28/upper 24. As shown in the first and second embodiments these connector portions can include snapfit members 28a (seen best in Fig. 6) and a magnet 28b (shown in stippled lines) sewn or otherwise embedded between an external-environment oriented outer lining and a comfort oriented inner lining which forms the tongue 28. Any other suitable connector can be used to attach the optional interchangeable tongue extension 18 to the tongue 28/upper 24 such as a hook and loop fastener, laces, or a buckle.

[0038] As shown in the first and second embodiments, the tongue 28 can be relatively long and substantially co-extensive with the length of an eyestay 32a. In alternative embodiments, the length of the tongue 28 may be shortened considerably so that the connection with the tongue extension 18 occurs around the position of anterior-most eyelets 32b".

[0039] The cinching mechanism 30 can include at least one of a lacing 32 and a strapping 34, seen best in Fig. 6. As seen in the first and second embodiments the lacing 32 can include an eyestay 32a secured to the upper 24, having eyelets 32b for accepting shoelaces 32c. As seen best in Figs. 6 - 8 of the first embodiment, the strapping 34 can include a D-ring 34a connected to the outer shoe shell 12, for example via a flexible tab 34b fixed to one side of the upper 24. The strapping 34 can include hook and loop type fastening strips 34c, 34d for cinching the strap 34 when slotted through the D-ring 34a to close on itself. In alternative embodiments the lacing 32 and strapping 34 may be omitted and the cinching mechanism provided by a resilient un-bifurcated tongue 28 so as to provide a 'slip-on' shoe.

[0040] While the flexible tab 34b holding D-ring 34a is shown fixed to one side of the upper 24, in alternative embodiments the tab 34b can be releasably secured to the upper 24, for example, by way of hook and loop fasteners, snap fits, a buckle or hooks. This will enable the wearer to quickly swap tabs 34b and change the style or colour of the shoe on a whim. The strapping 34 can likewise be releasably secured to the upper 24, for example, by way of hook and loop fasteners, snap fits, a buckle or hooks, enabling the wearer to quickly swap strappings 34, which may stylistically matched with swapped tabs 34, to change the style or colour of the shoe on a whim. The interchangeable tab 34b and strapping 34 can thus be considered as a form of decorative.

[0041] Although the outer shoe shell 12 appears to be a complete shoe, it should be noted that the outsole 22, consisting essentially of the tread 23, and the external heel collar 24f are relatively thin and unforgiving, not anatomically configured to directly receive the foot. Due to inadequate sole and heel comfort/support the outer shoe shell 12 would be unlikely worn for any extended period of time, particularly not for its intended function as an athletic or casual shoe. The interchangeable footbed 14 and the internal heel collar 16 provide the additional components that make the shoe 10 practical.

[0042] The footbed 14 provides the core cushioning for the foot. The footbed 14 can have an anatomically configured superior face 14a (seen best in Fig. 4) for receiving the typical foot, including a posterior concave hollow 14b for the inferior portions of the heel, a middle convex formation 14c for the arch, and an anterior concave depression 14d for the ball of the foot. As shown in the illustrated embodiments the footbed 14 does not have a covering insole or lining but such a covering may be provided in the alternative. As seen best in Figs. 1 and 3, the inferior face 14e of the footbed 14 can be substantially flat to mate with a substantially flat inner surface of the outsole 22, which allows the footbed 14 to slide relatively unhindered into the outer shoe shell 12 over the inner surface of the outsole 22. The footbed 14 can be formed from a resilient material such as ethylene vinyl acetate (EVA)

or polyurethane (PU) and can be relatively thick. having a typical thickness from about ½ inch to about 2 inches, especially as compared to the outsole 22, which can have a typical thickness ranging from about ¼ to about ½ inch. Being interchangeable, various footbeds 14 can have different thickness or densities, e.g., soft or hard, to accommodate personal preferences and/or different intended activities, e.g., walking or playing sports. The modular shoe 10 also enables a worn or compressed footbed 14, which typically wears much faster than the outsole 22, to be readily replaced without having to replace the entire shoe.

[0043] The footbed 14 includes a connector 40, described in greater detail below, for connecting the footbed 14 to the internal heel collar 16.

[0044] As seen in the first and second embodiment, and with particular reference to Figs. 1-3 and 5, the internal heel collar 16 can have sidewalls 16a and a posterior wall 16b for collectively cradling the wearer's heel. The internal heel collar 16 can be formed from inner and outer fabric layers with a relatively stiff counter, shown by stippled line 16c, sewn or otherwise secured therebetween. The shoe 10 thus provides opposed, mutually reinforcing heel counters 24e, 16c in the upper and in the internal heel collar, respectively, for resisting rearward forces. The internal heel collar 16 may also include padding in its anterior aspect to increase the wearer's comfort.

[0045] The internal heel collar 16 can be provisioned in different, interchangeable, styles. For example, Figs. 1-3, 5 9 and 10 of the first embodiment show the internal heel collar 16 in a high-top style 16A and Figs. 11 - 13 of the second embodiment show the internal heel collar 16 in a low-top style 16B. The modular shoe 10 thus enables the wearer to rapidly and conveniently switch between high-top and low-top styles at his or her convenience without having to purchase an additional shoe.

[0046] As seen best in Fig. 9, the high-top style internal heel collar 16A features prominently above the topline 24h of the upper 24 and can include a band of thicker padding 16d

positioned to envelope the posterior, medial and lateral aspects of the foot above the wearer's ankle when the shoe 10 is worn. The high-top style internal heel collar 16A can include medial and lateral eyelets 16e (see Figs. 1 and 6) that can be juxtaposed with the topmost medial and lateral eyelets 32b' on the upper 24 for cinching the high-top style internal heel collar 16A with the shoe laces 32c. If desired, magnets 36 can be secured about the high-top style internal heel collar eyelets 16e and the upper topmost eyelets 32b' in order to releasably align one another. The high-top style internal heel collar 16A can also include additional eyelets 16f disposed at the terminations of the padding band 16d for additional cinching of the high-top style internal heel collar 16A with shoe laced 32c. The high-top style internal heel collar 16A can also include a hook and loop fastener strip 16g (seen best in Fig. 1) for releasably attaching decoratives as discussed in greater detail below.

[0047] As seen best in Fig. 13, the low-cut style internal heel collar 16B features much less prominently above the topline 24h of the upper 24 and can include the medial and lateral eyelets 16e that can be juxtaposed with the topmost medial and lateral eyelets 32b' on the upper 24 for cinching the low-top style internal heel collar 16B with the shoe laces 32c.

[0048] Regardless of style, the internal heel collar 16 can include a connector 44 (seen best in Figs. 1-3) for connecting the internal heel collar 16 to the footbed 14. As shown in the illustrated embodiments the connector 44 can include a semi-rigid U-shaped socket 44a into which the rear portion of the footbed 14 can be releasably seated. More particularly, the U-shaped socket 44a can feature a bottom wall 44b and a continuous U-shaped side wall 44c. The bottom wall 44b can feature an elongate groove 44d with a semi-circular entrance aperture 44e and can also include a U-shaped stiffening rib 44f surrounding the elongate groove 44d. The sidewall 44c can feature a plurality of spaced apart apertures such as medial and lateral apertures 44g and posterior aperture 44h. The rear portion of the footbed can have a U-shaped rebate 14f for receiving the socket 44a. The footbed connector 40 can include a substantially rigid plate 40a (seen best in Fig. 1) secured to the inferior face 14e of

the footbed cushioning material. The plate 40a can incorporate a substantially rigid elongate tongue 40b terminating in at least a substantially rigid semi-circular wall 40c disposed generally underneath the arch convex formation 14c. The plate 40a can also include a locating lug 40d and snap fingers comprising medial and lateral cantilever beams 40e with terminating hook lugs 40f, which lugs 40d, 40f are disposed about the footbed sidewall.

[0049] As will be seen best from Figures 2, 3 and 5, the footbed tongue 40b is insertable into the internal heel collar groove 44d. In the process the footbed locating lug 40d seats into internal heel collar posterior aperture 44h and the footbed hook lugs 40f deflect until they are inserted into internal heel collar medial and lateral apertures 40g, whereupon the cantilever beams 40e return to their original shape to releasably lock the footbed 14 with the internal heel collar 16. In this manner the footbed and inner heel collar connectors 40,44 provide a tongue and groove joint as well as snap-fit joint. Once the footbed 14 and interior heel collar 16 are connected to one another the sub-assembly (see, for example, Fig. 2) can then be inserted as a unit into the outer shoe shell 12 whereupon the upper 24 can be cinched tight. The elongate tongue and grove joint in particular ensures that the footbed 14 and internal heel collar 16 are robustly connected to one another and do not disengage in use as the wearer's foot flexes while walking or running.

[0050] In alternative embodiments, the male and female aspects of the tongue and groove joint can be reversed with the tongue being located on the internal heel counter and the groove disposed on the foootbed plate. Likewise, in alternative embodiments the male and female aspects of the snap fit joint can be reversed with the apertures being located on the footbed and the snap fingers being located on the internal heel collar socket.

[0051] The internal heel collar socket 44a can be colored in which case the color can be visible through the rear outsole piece 22b if the latter is transparent or translucent.

[0052] As seen best in Fig. 1, the tongue extension 18 can include a tab 18a with snapfit members 18b that mate with the tongue snap fit members 28a. A magnet, shown by stippled line 18c, can be provisioned in the tongue extension 18 to couple with the magnet 28b in the tongue 28, easing the task of connecting the tongue and tongue extension snapfit members 18b, 28a. The tongue extension 18 may be padded, if desired.

[0053] The decorative 20 can include a generally U-shaped decorative 20a having a hook and loop fastener strip 20b for attaching the decorative 20a to the hook and loop fastener strip 16g of the high-top style inner heel collar 16A. If desired, the decorative 20 can include buckle receptacles 20c on terminating ends thereof. As seen in Fig. 11, a decorative band 46 having buckle clips 46a can be connected to the receptacles 20c of the decorative 20a. The decorative band 46 can include magnets (shown by stippled lines 46b) thereon so that the band 46 can be held in a looped configuration around the wearer's leg.

[0054] From the foregoing it should be appreciated that modular shoe described herein enables a consumer to interchange various components and decoratives to thereby achieve different looks and styles without having to buy a new pair of shoes, allowing the consumer to express his or her own creativity and individuality at a reasonable price point.

[0055] It should be appreciated that the invention is not limited to what has been particularly shown and described herein. For example, while the foregoing has described and shown the modular shoe in an athletic style, it will be understood that the modular shoe can embody other styles, such as casual, dress, or any other desired style. Likewise, the invention can include combinations or sub-combinations of the various features described herein as well as modifications, variations and permutations hereto which will occur to persons skilled in the art without departing from the fair meaning of the accompanying claims.

FEATURE LIST

10 modular shoe system

12 outer shoe shell

14 footbed

14a superior face

14b heel hollow

14c arch formation

14d depression

14e inferior face

14f rebate

16 internal heel collar

16A high top style internal heel collar

16B low top style internal heel collar

16a sidewall

16b posterior wall

16c counter

16d padding band

16e eyelet

16f eyelet

16g hook and loop fastener strip

18 tongue extension

20 decorative

20a U-shaped decorative

20b hook and loop fastener strip

20c buckle receptacle

22 outsole

22a front outsole piece

22b rear outsole piece

22c flex portion

22d sidewall

23 tread

24 upper

24a toe box portion

24b vamp portion

24c quarter

24d seam

24e counter

24f external heel collar

24g opening

24h topline

24j outer lining

24k inner lining

26 foxing

28 tongue

28a snapfit member

28b magnet

30 cinching mechanism

32 lacing

32a eyestay

32b eyelets

32c shoelace

34 strapping

34a D-ring

34b tab

34c,d hook and loop fastener strips

36 magnets

40 connector

40a plate

40b tongue

40c wall

40d locating lug

40e beam

40f hook lug

44 connector

44a socket

44b bottom wall

44c side wall

44d groove

44e entrance aperture

44f stiffening rib

44g aperture

44h aperture

46 decorative band

46a clip

46b magnet

Claims

1. A modular shoe, comprising:

an outer shoe shell comprising an outsole and an upper, wherein the outsole incorporates a tread, and wherein the upper encompasses anterior, posterior, medial and lateral aspects of a wearer's foot when the shoe is worn;

an interchangeable footbed which provides the primary cushioning for the wearer's foot;

an interchangeable internal heel collar,

wherein the footbed and the internal heel collar include connectors for releasably securing the footbed and the internal heel collar to one another, the footbed and the internal heel collar being mountable within the unitary outer shoe shell; and

a cinching mechanism for securing the shoe on the wearer's foot.

2. A modular shoe according to claim 1, wherein the upper includes a first heel counter and wherein the internal heel collar includes a second heel counter opposed to the first heel counter.

3. A modular shoe according to claim 1, wherein the footbed and the internal heel collar are connected together by a tongue and groove joint.

4. A modular shoe according to claim 3, wherein:

the internal heel collar includes a semi-rigid or rigid socket;

a rear portion of the footbed includes at least a semi-rigid or rigid plate;

one of the socket and the plate include an elongate tongue and the other of the plate and the socket include a mating elongate groove, wherein, when the tongue is inserted into the groove, the footbed seats into the socket.

5. A modular shoe according to claim 4, including a reinforcement rib surrounding the groove.

6. A modular shoe according to claim 3, wherein the footbed and the internal heel collar are connected by a snap-fit joint.

7. A modular shoe according to claim 1, wherein the footbed and the internal heel collar are connected by a snap-fit joint.

8. A modular shoe according to claim 1, wherein the interchangeable internal heel collar includes a high-top style where the internal heel collar features prominently over a posterior topline of the upper and a low-top style where the internal heel collar does not feature prominently over the posterior topline of the upper.

9. A modular shoe according to claim 1, wherein medial and lateral limp portions of the upper and medial and lateral limp portions of the internal heel collar each includes one or more magnets for registering respective limp portions.

10. A modular shoe according to claim 9, wherein the cinching mechanism including shoelace eyelets, and wherein the medial and lateral upper magnets are disposed about medial and lateral posterior-most eyelets.

11. A modular shoe according to claim 1, wherein the upper includes a tongue, and further including an interchangeable tongue extension connectable to the tongue.

12. A modular shoe according to claim 1, including an interchangeable U-shaped decorative attachable to the internal heel collar.

13. A modular shoe according to claim 13, including an interchangeable decorative band connectable to the U-shaped decorative, the band having magnets therein for holding the band in a looped configuration about the wearer's leg when the shoe is worn.

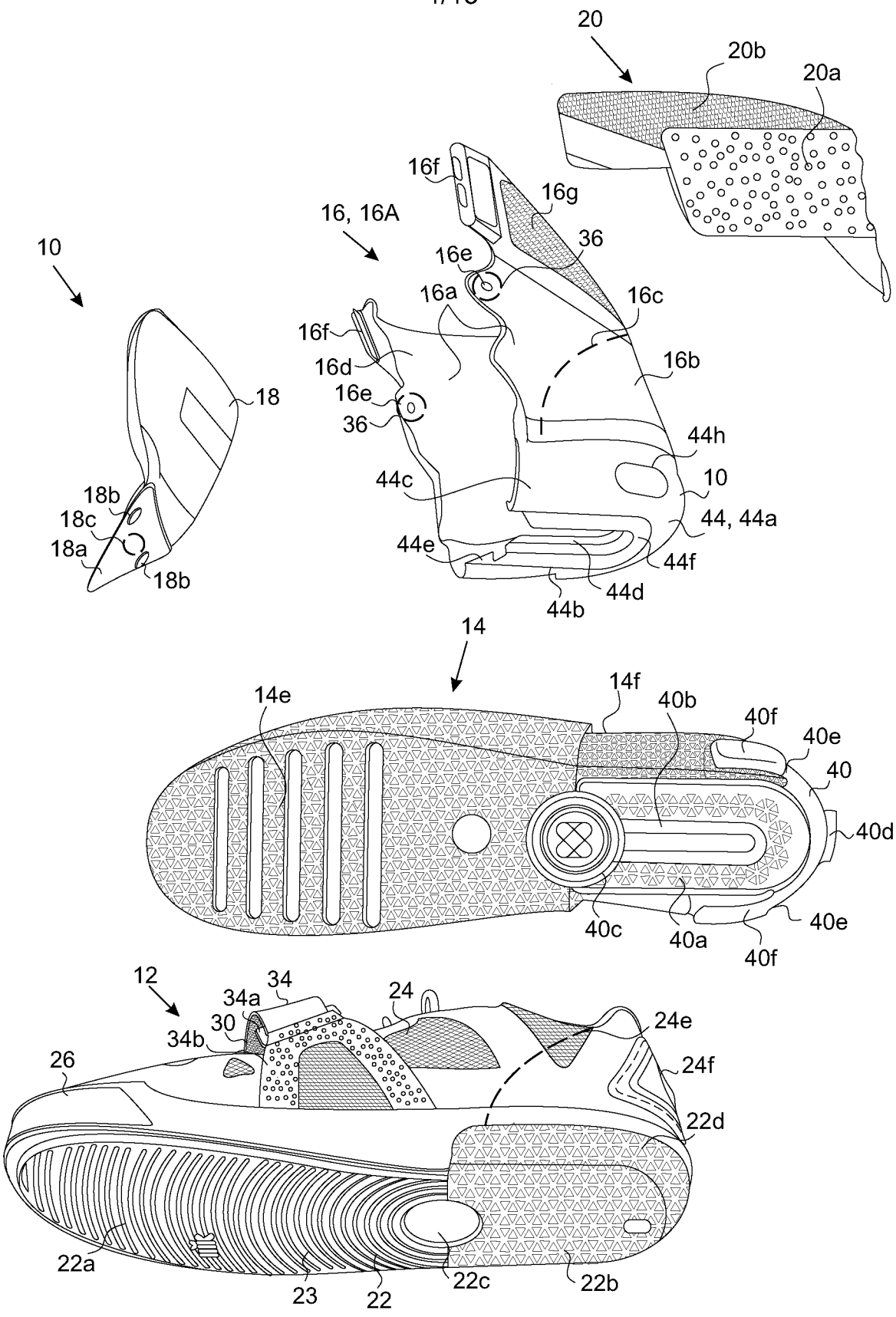

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FIG. 1

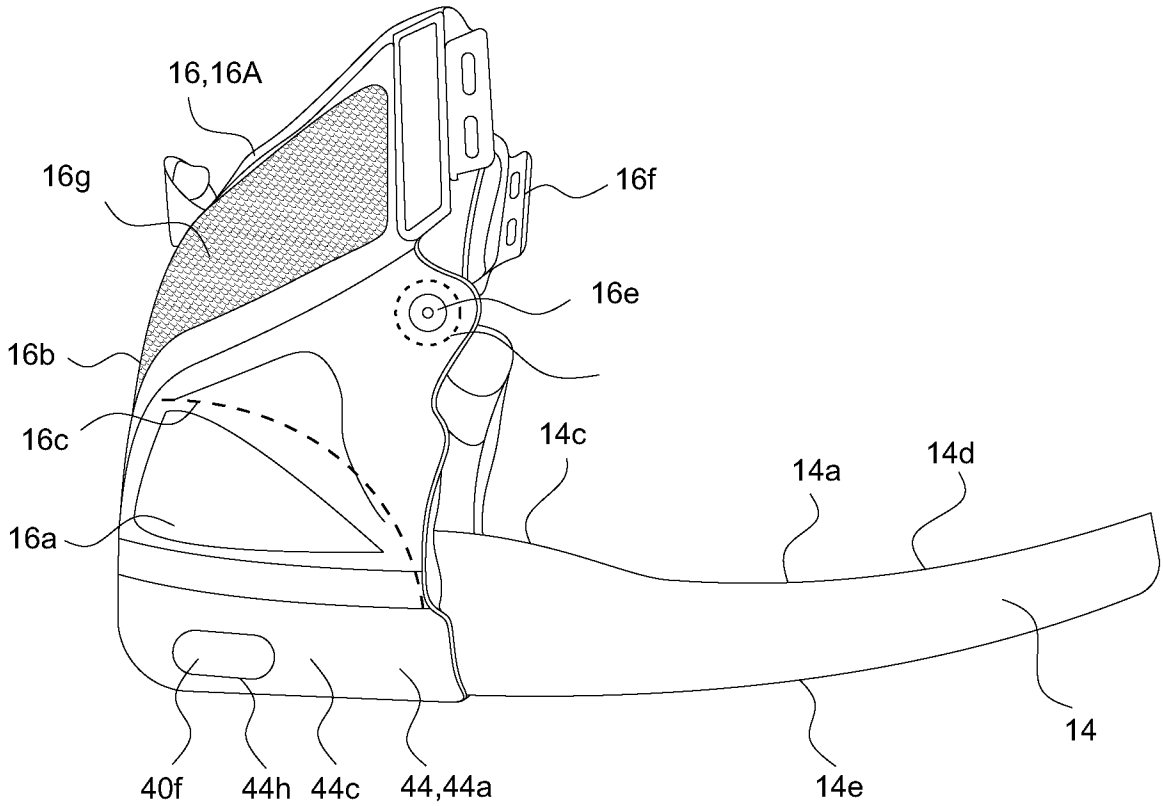

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16g
16f
16e
16b
16c
14c
14a
14d
16a
14
40f
44h
44c
44,44a
14e

FIG. 2

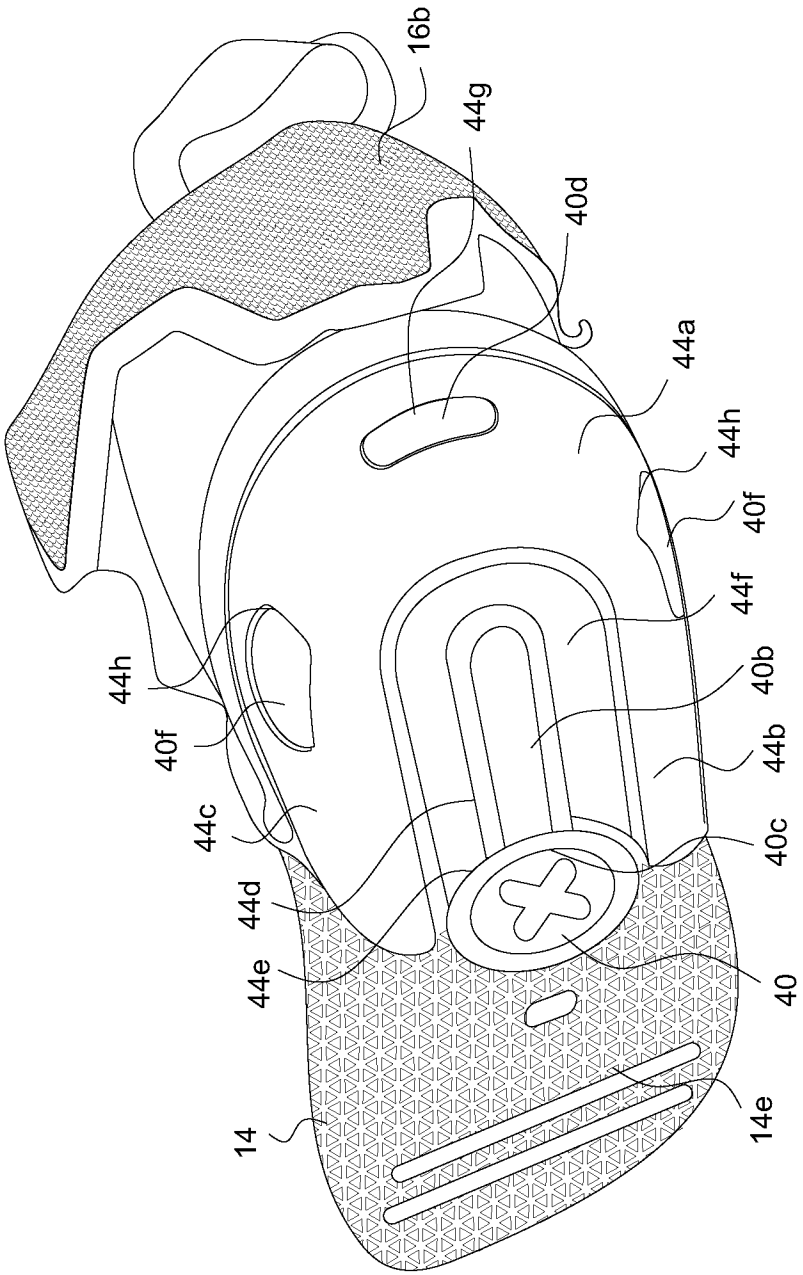

16b
44g
40d
44a
44h
40f
44f
40b
44b
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40
14e
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40f
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FIG. 3

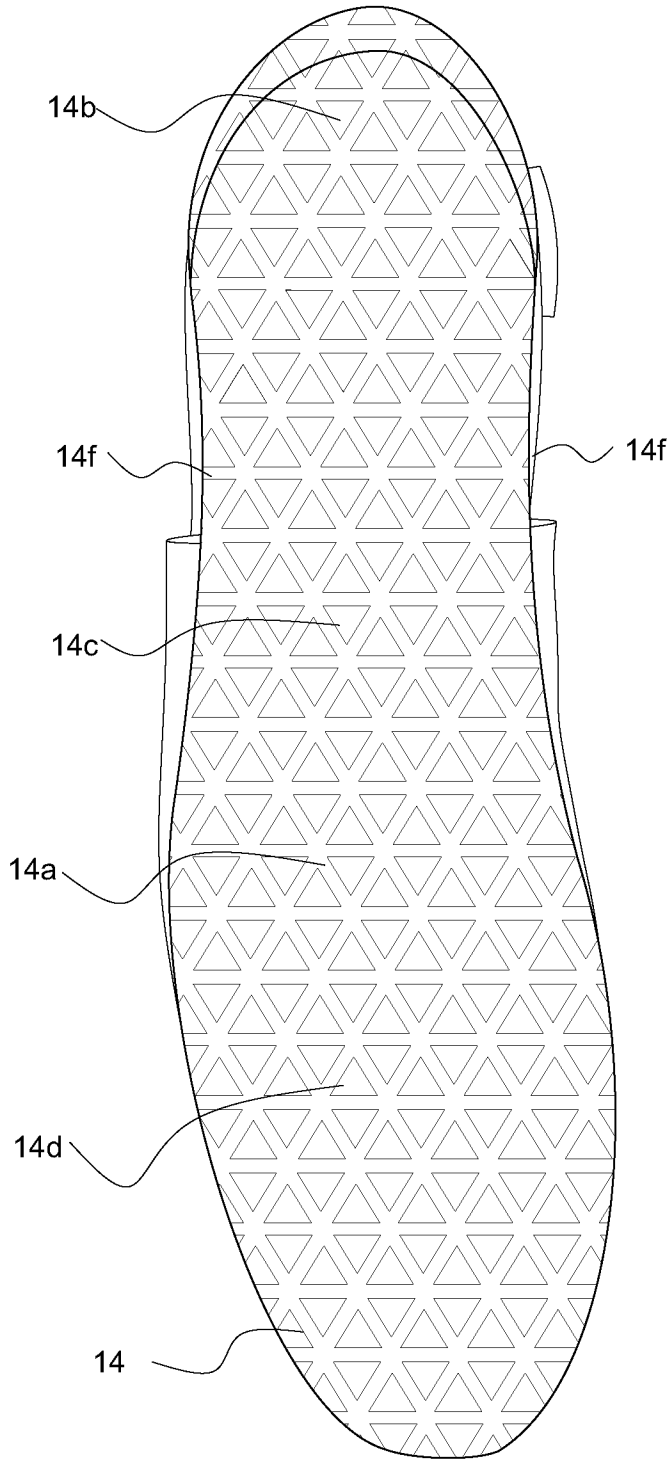


FIG. 4

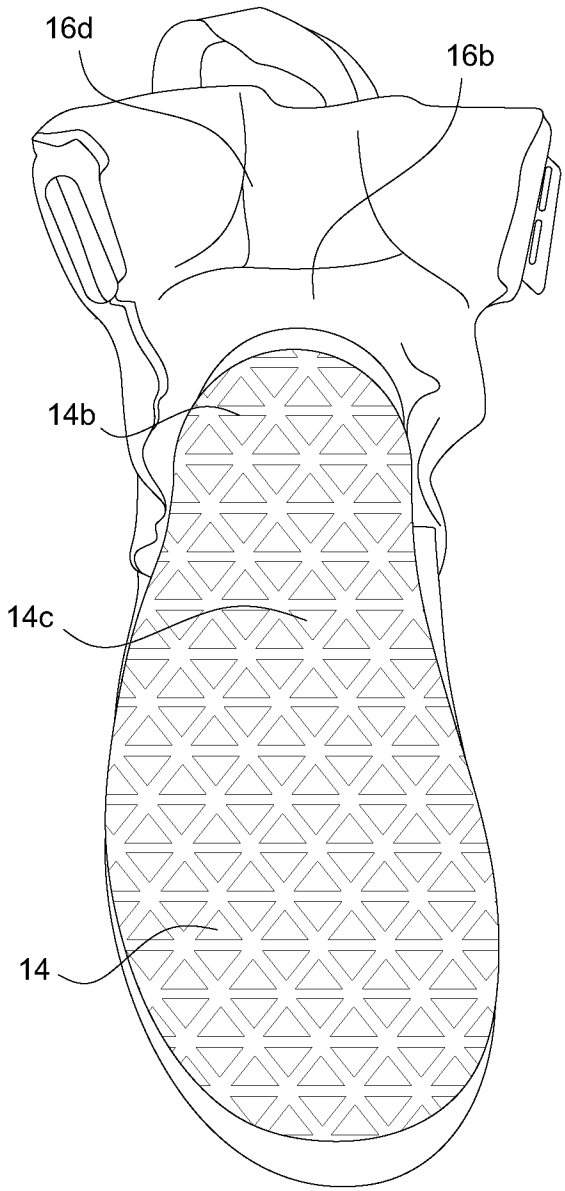


FIG. 5

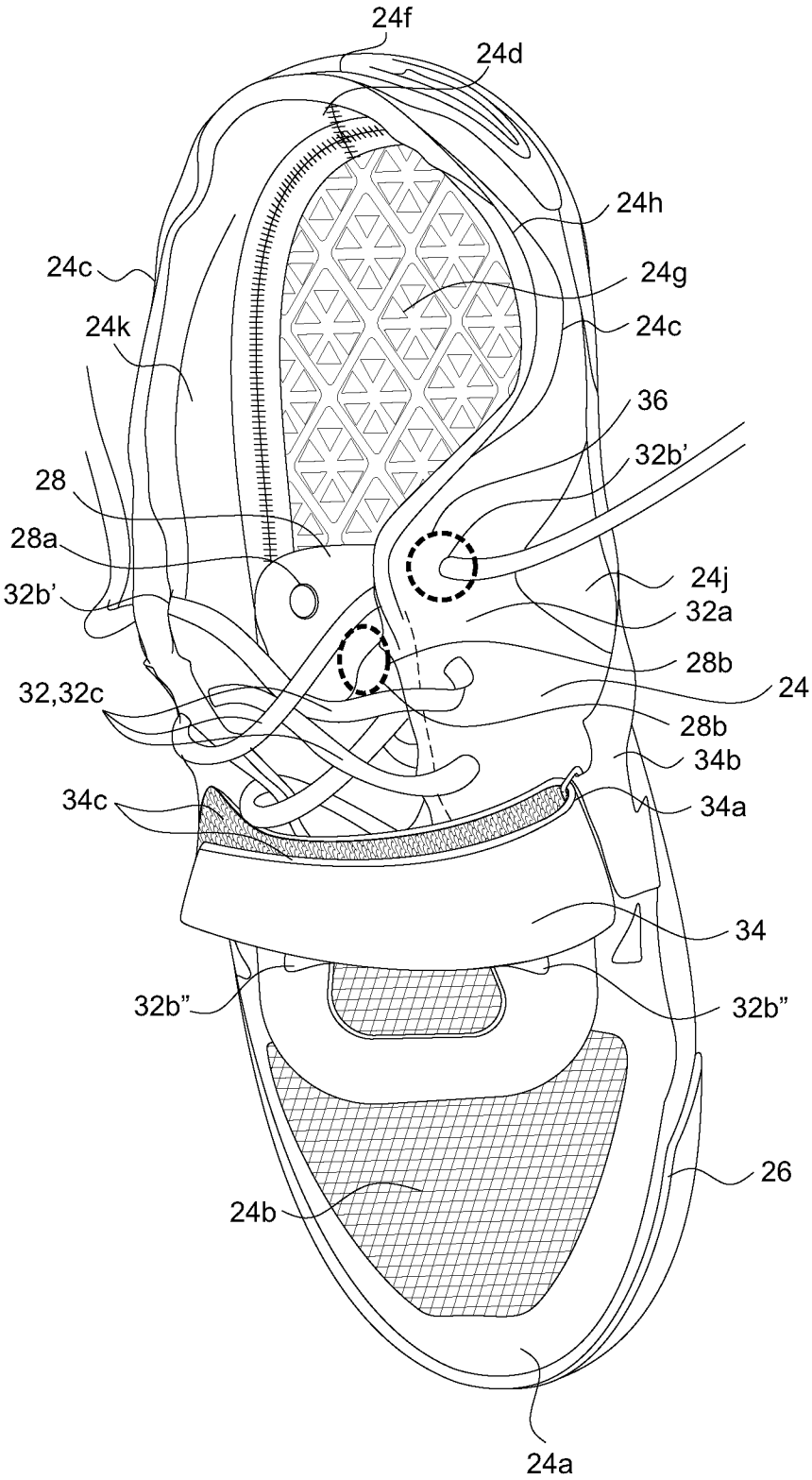

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24d
24h
24c
24g
24k
24c
36
32b'
28
28a
32b'
24j
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24
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34b
34c
34a
34
32b"
32b"
26
24b
24a

FIG. 6

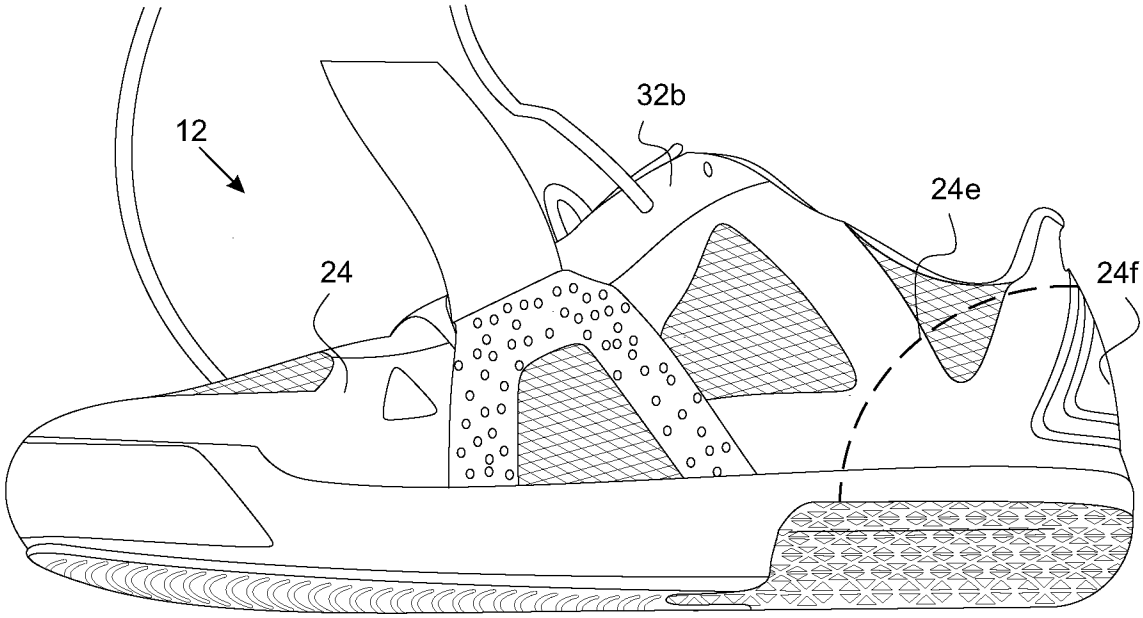


FIG. 7

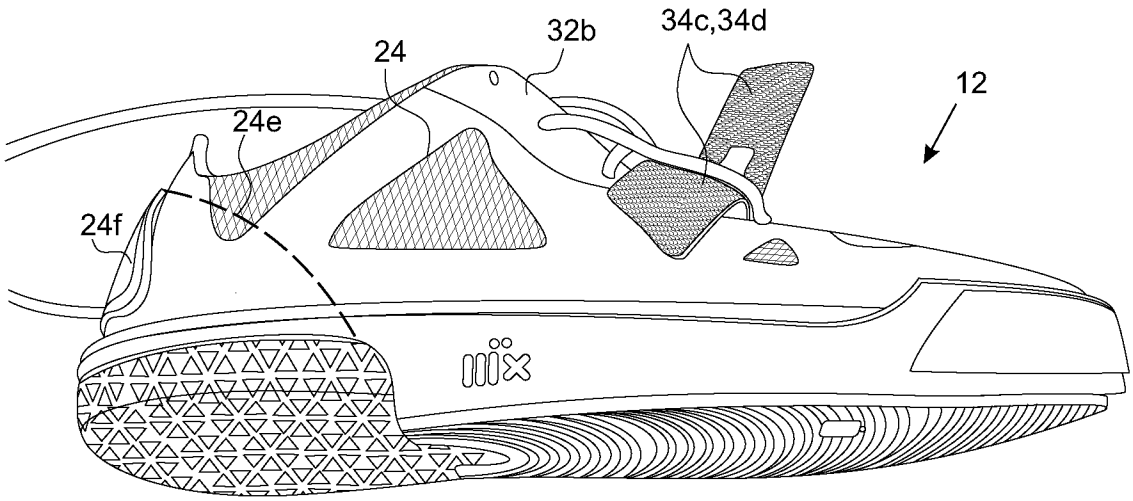


FIG. 8

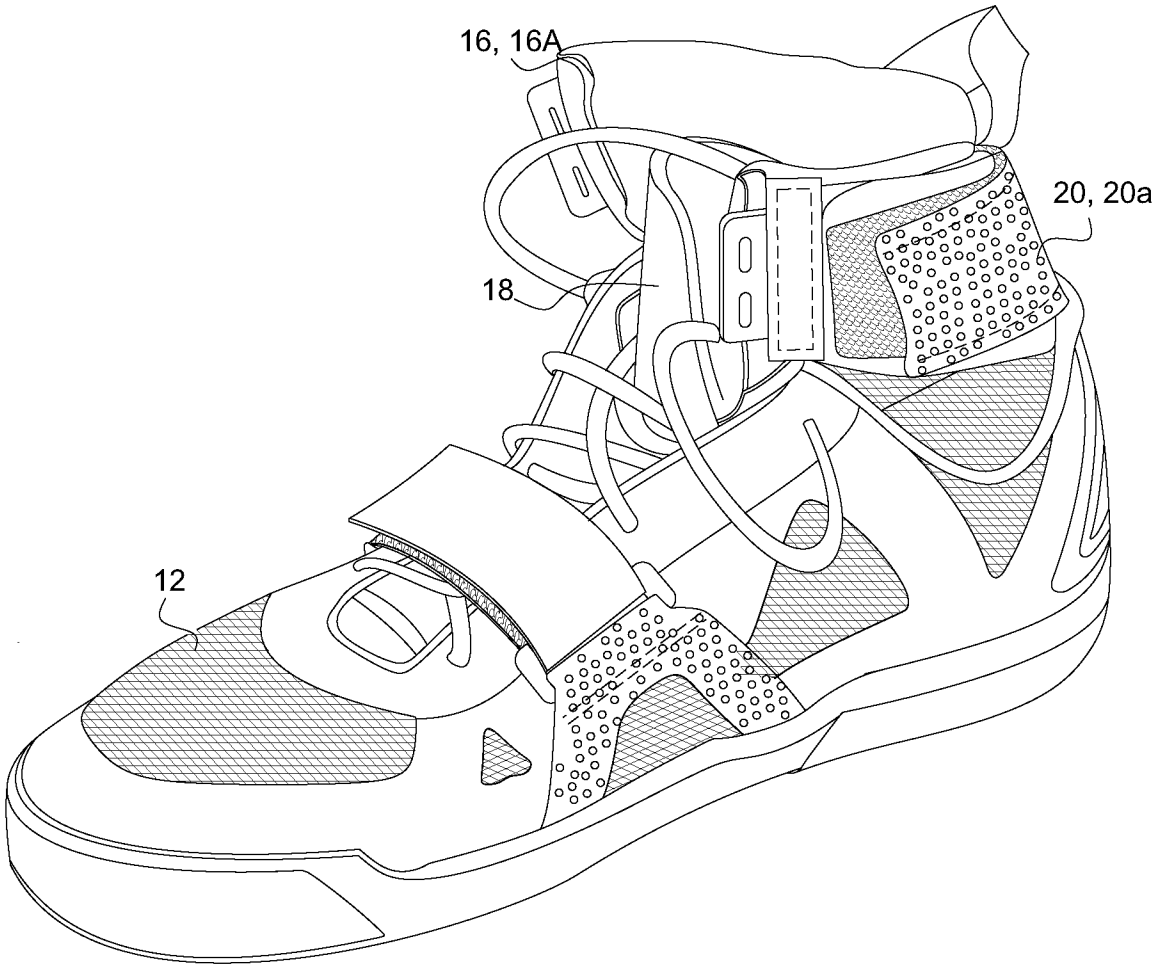


FIG. 9

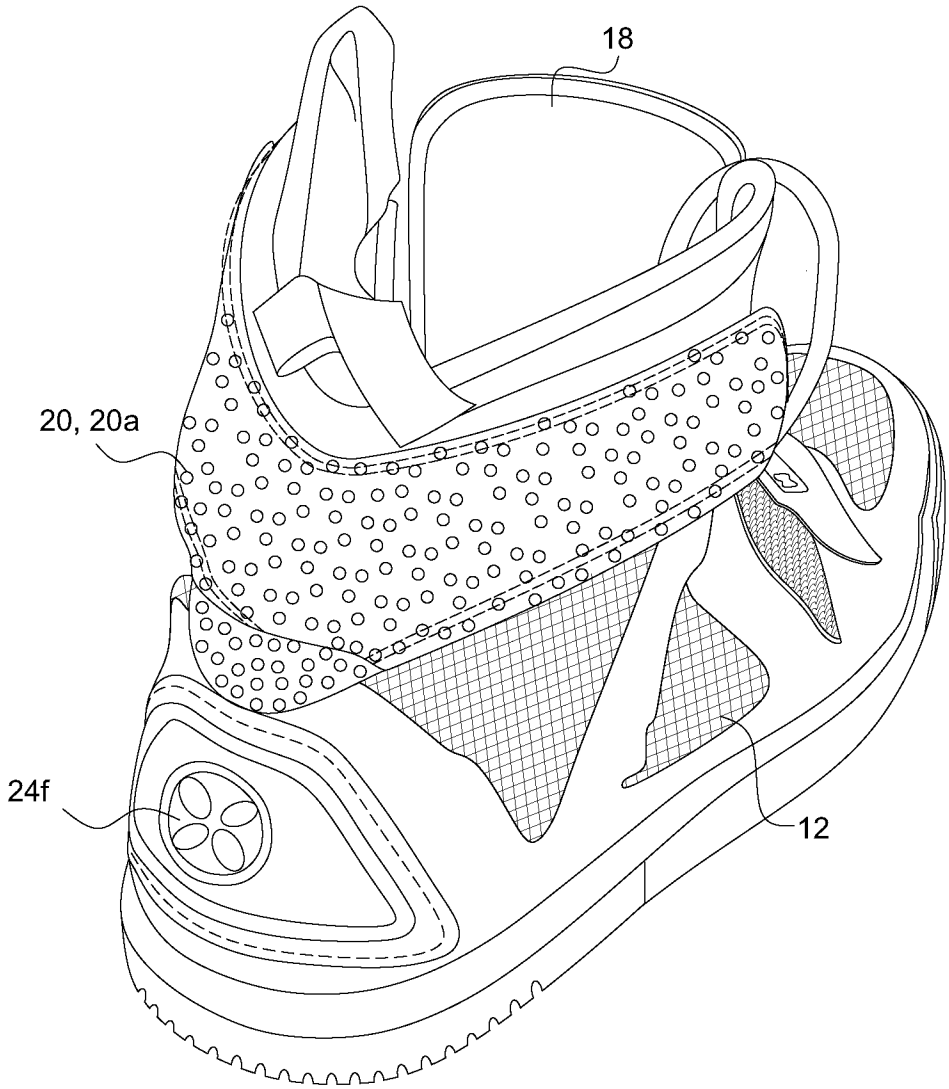


FIG. 10

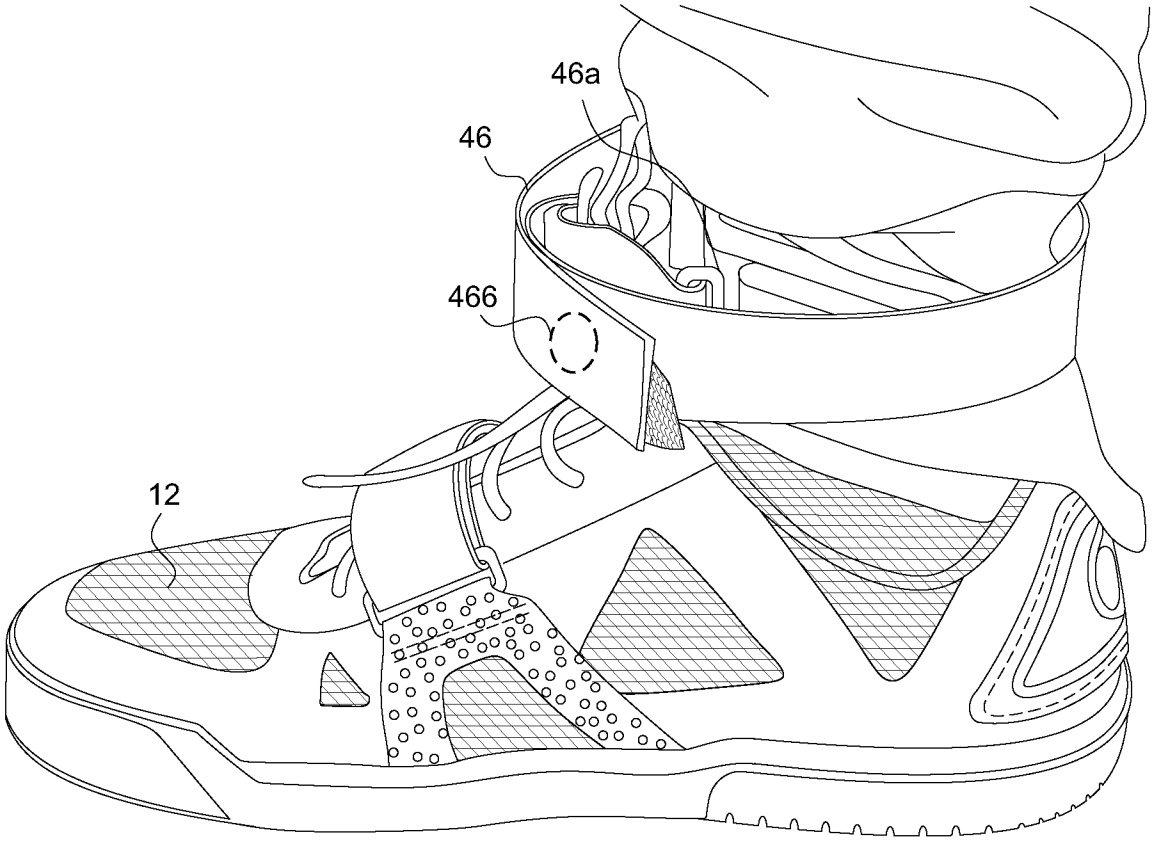


FIG. 11

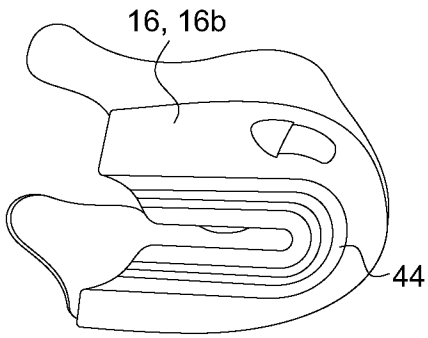


FIG. 12C

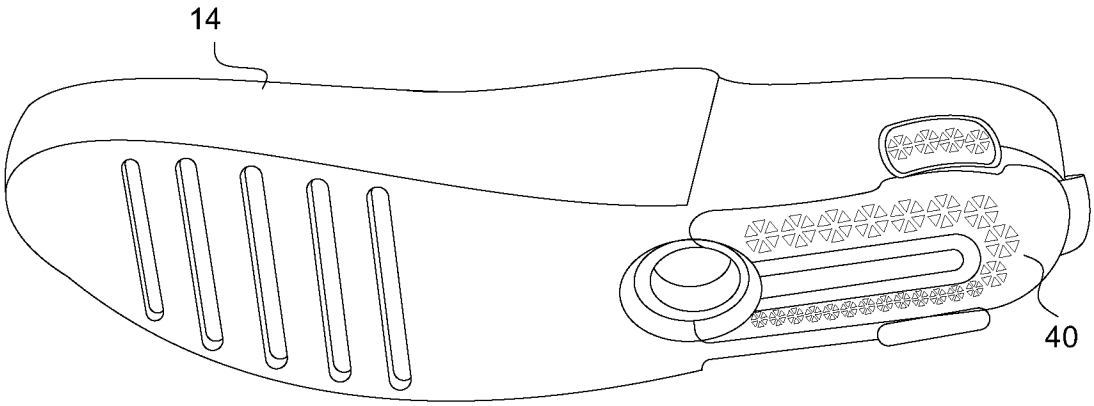


FIG. 12B

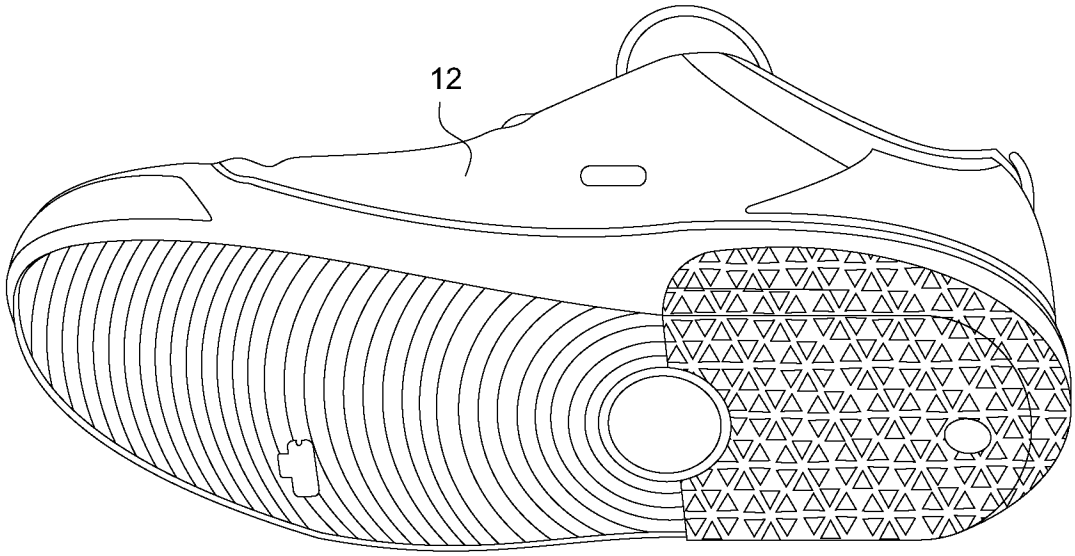


FIG. 12A

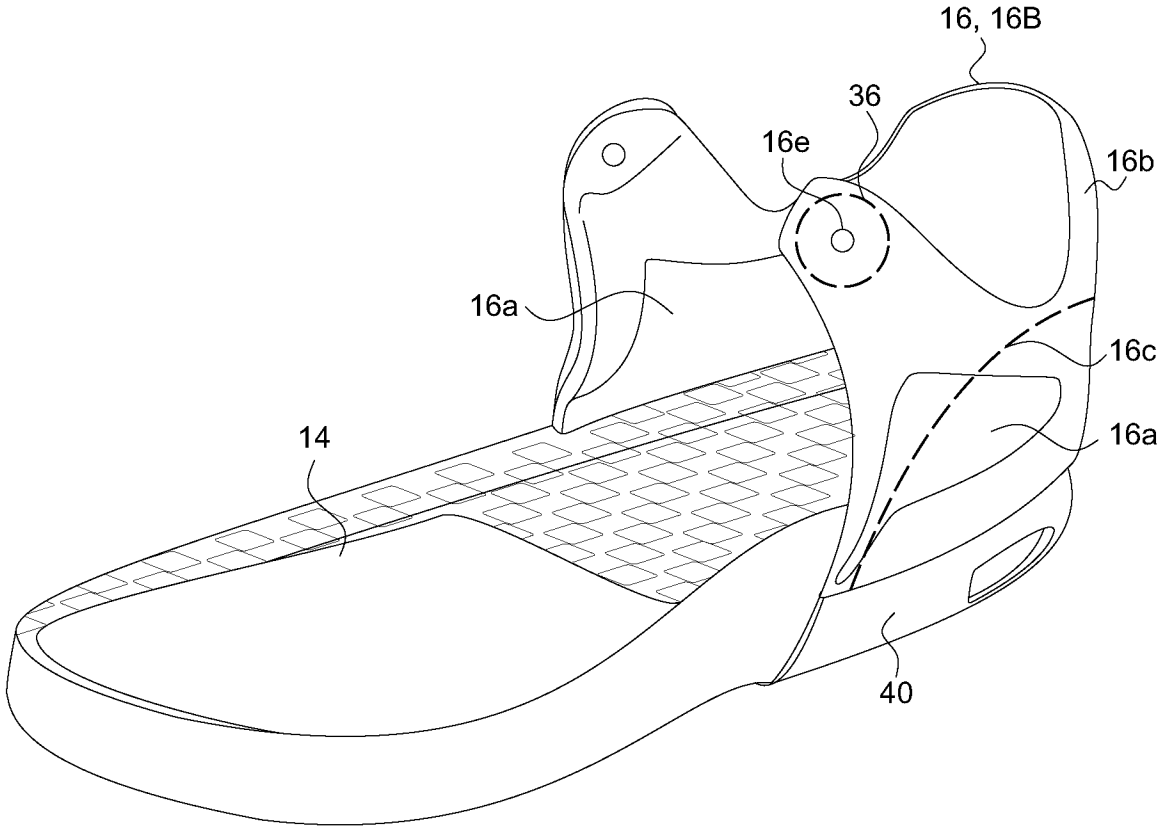


FIG. 13A

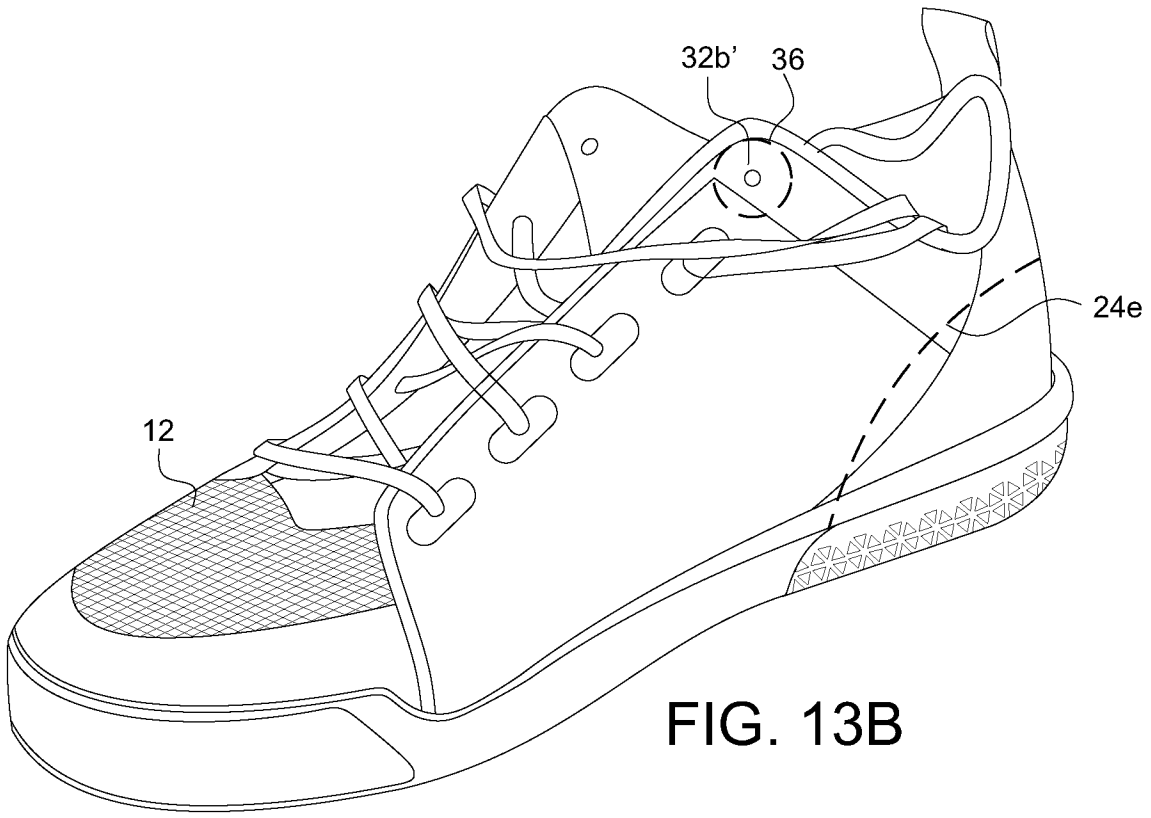


FIG. 13B

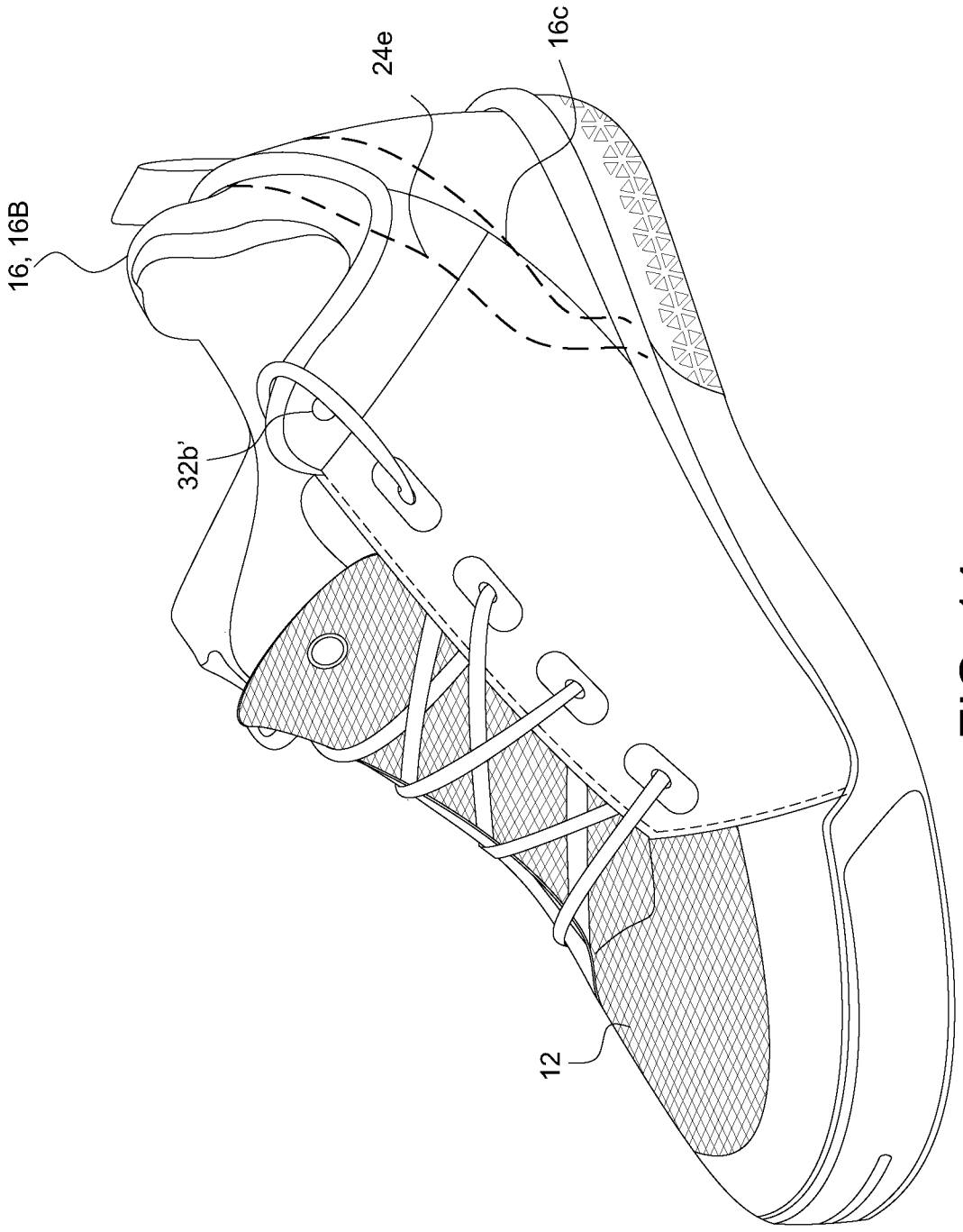


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2018/051179

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***A43B 3/24*** (2006.01) , ***A43B 13/36*** (2006.01) , ***A43B 3/00*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: ***A43B*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel-Orbit (Fampat), Google with key words, such as: footwear, shoe, boot, interchangeable, removable, footbed and changeable

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 102010022185 A1 (BOETSCH, M.) 24 November 2011 (24-11-2011) *whole document*	1-13
A	DE 202005016117 U1 (CARL SEMLER SCHUHFABRIK) 23 February 2006 (23-02-2006) *whole document*	1-13

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search 24 January 2019 (24-01-2019)	Date of mailing of the international search report 24 January 2019 (24-01-2019)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Pengfei Zhang (819) 639-7928

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2018/051179

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
DE 102010022185 A1	24 November 2011 (24-11-2011)	NONE	
DE 202005016117 U1	23 February 2006 (23-02-2006)	NONE	