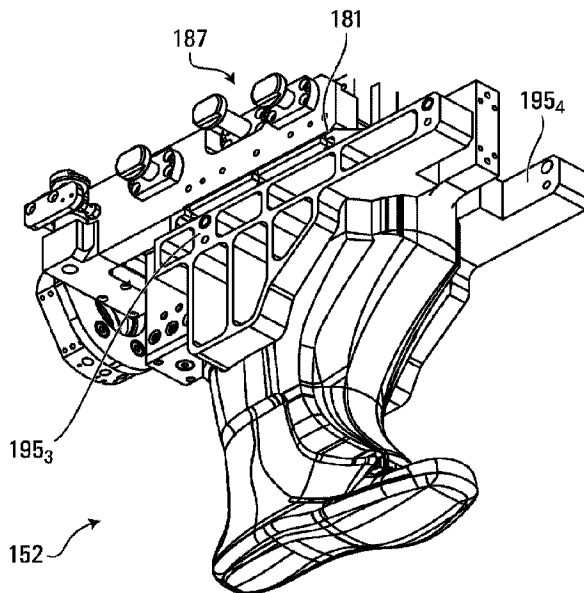




(86) Date de dépôt PCT/PCT Filing Date: 2018/05/25
 (87) Date publication PCT/PCT Publication Date: 2019/11/28
 (45) Date de délivrance/Issue Date: 2023/09/12
 (85) Entrée phase nationale/National Entry: 2020/11/25
 (86) N° demande PCT/PCT Application No.: CA 2018/050617
 (87) N° publication PCT/PCT Publication No.: 2019/222828

(51) Cl.Int./Int.Cl. *B29D 35/10* (2010.01),
A43B 5/16 (2006.01), *A43D 3/00* (2006.01),
A63C 1/42 (2006.01)
 (72) Inventeurs/Inventors:
 LABONTE, IVAN, CA;
 PAYEUR, CONRAD, CA;
 DESCHENES, CANDIDE, CA;
 LAMBERT, SEBASTIEN, CA
 (73) Propriétaire/Owner:
 BAUER HOCKEY, LTD., CA
 (74) Agent: SMART & BIGGAR LP

(54) Titre : PATIN OU AUTRES CHAUSSURES
 (54) Title: SKATE OR OTHER FOOTWEAR



(57) **Abrégé/Abstract:**

A skate (e.g., an ice skate) for a skater (e.g., a hockey player). The skate comprises a skate boot for receiving a foot of the skater and a skating device (e.g., a blade and a blade holder) disposed beneath the skate boot to engage a skating surface (e.g., ice). At least part of the skate boot and optionally at least part of one or more other components (e.g., the skating device) may be constructed from one or more materials (e.g., foams) molded by flowing in molding equipment during a molding process (e.g., injection molding or casting). This may allow the skate (or other footwear) to have useful performance characteristics (e.g., reduced weight, proper fit and comfort, etc.) while being more cost-effectively manufactured. Other articles of footwear are also provided.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization

International Bureau

(43) International Publication Date
28 November 2019 (28.11.2019)(10) International Publication Number
WO 2019/222828 A1

(51) International Patent Classification:

B29D 35/10 (2010.01) A43D 3/00 (2006.01)
A43B 5/16 (2006.01) A63C 1/42 (2006.01)

(21) International Application Number:

PCT/CA2018/050617

(22) International Filing Date:

25 May 2018 (25.05.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:

US PCT/CA2017/050155 (CIP)
Filed on 09 February 2017 (09.02.2017)

(71) Applicant: BAUER HOCKEY, LTD. [CA/CA]; 60 Rue Jean-Paul-Cayer, Blainville, Québec J7C 0N9 (CA).

(72) Inventors: LABONTÉ, Ivan; 6717, Av. Christophe-Colomb, #403, Montreal, Québec H2S 2H3 (CA). PAYEUR, Conrad; 996, rue Guindon, Prévost, Québec J0R 1T0 (CA). DÉSCHÈNES, Candide; 112, Jean-François Régis, St-Jérôme, Québec J7Y 4R7 (CA). LAMBERT, Sébastien; 1766, rue de Saint-Émilien, Saint-Jérôme, Québec J5L 2S8 (CA).

(74) Agent: SMART & BIGGAR; Suite 330, 1000 De La Gauchetière St. W., Montreal, Québec H3B 4W5 (CA).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: SKATE OR OTHER FOOTWEAR

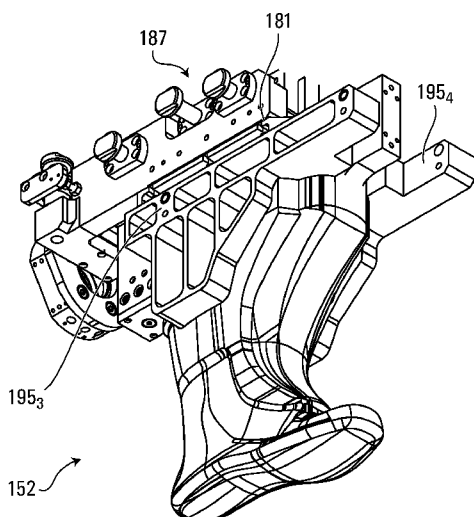


FIG. 94

(57) Abstract: A skate (e.g., an ice skate) for a skater (e.g., a hockey player). The skate comprises a skate boot for receiving a foot of the skater and a skating device (e.g., a blade and a blade holder) disposed beneath the skate boot to engage a skating surface (e.g., ice). At least part of the skate boot and optionally at least part of one or more other components (e.g., the skating device) may be constructed from one or more materials (e.g., foams) molded by flowing in molding equipment during a molding process (e.g., injection molding or casting). This may allow the skate (or other footwear) to have useful performance characteristics (e.g., reduced weight, proper fit and comfort, etc.) while being more cost-effectively manufactured. Other articles of footwear are also provided.

WO 2019/222828 A1 

Published:

- *with international search report (Art. 21(3))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

SKATE OR OTHER FOOTWEAR

FIELD

- 5 The invention generally relates to footwear, including skates (e.g., ice skates) such as for playing hockey and/or for other activities.

BACKGROUND

- 10 Skates are used by skaters in various sports such as ice hockey, roller hockey, etc. A skate comprises a skate boot that typically comprises a number of components that are assembled together to form the skate boot. This can include a shell, a toe cap, a tongue, a tendon guard, etc.
- 15 For example, an approach to manufacturing a shell of a skate boot of conventional skates consists of thermoforming different layers of synthetic material and then assembling these layers to form the shell. However, such conventional skates may sometimes be overly heavy, uncomfortable, lacking in protection in certain areas, and/or a bad fit on a skater's foot. Moreover, such conventional skates can be
20 expensive to manufacture.

Similar considerations may arise for other types of footwear (e.g., ski boots, motorcycle boots, work boots, etc.).

For these and/or other reasons, there is a need for improvements directed to skates and other footwear.

5

SUMMARY

In accordance with various aspects of the invention, there is provided a skate (e.g., an ice skate) for a skater. The skate comprises a skate boot for receiving a foot of the skater and a skating device (e.g., a blade and a blade holder) disposed beneath
10 the skate boot to engage a skating surface. At least part of the skate boot and optionally at least part of one or more other components (e.g., the skating device) of the skate is constructed from one or more materials (e.g., foams) molded by flowing in molding equipment during a molding process (e.g., injection molding or casting). This may allow the skate to have useful performance characteristics (e.g., reduced
15 weight, proper fit and comfort, etc.) while being more cost-effectively manufactured. Other articles of footwear are also provided.

In accordance with an aspect of the invention, there is provided a skate boot for a skate, the skate comprising a skating device disposed beneath the skate boot to
20 engage a skating surface, the skate boot defining a cavity to receive a foot of a user, the skate boot comprising a body that comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, wherein: the medial side portion, the lateral side
25 portion, the heel portion, and the ankle portion of the body are molded together and integral with one another; and the body comprises a plurality of layers comprising a plurality of materials that are different and molded by flowing.

In accordance with another aspect of the invention, there is provided a method of
30 making a skate boot for a skate, the skate comprising a skating device disposed beneath the skate boot to engage a skating surface, the skate boot defining a cavity

to receive a foot of a user, the method comprising: providing a molding apparatus; and molding a body of the skate boot using the molding apparatus, the body comprising a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, wherein: the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body are molded together and integral with one another; and the molding comprises causing flow of a plurality of materials that are different in the molding apparatus to form a plurality of layers of the body.

10

In accordance with another aspect of the invention, there is provided an article of footwear for receiving a foot of a user, the article of footwear comprising a body that comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, wherein: the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body are molded together and integral with one another; and the body comprises a plurality of layers comprising a plurality of materials that are different and molded by flowing.

20

In accordance with another aspect of the invention, there is provided a skate boot for a skate, the skate comprising a skating device disposed beneath the skate boot to engage a skating surface, the skate boot defining a cavity to receive a foot of a user, the skate boot comprising a body that comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, wherein: the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body are molded together and integral with one another; and the body comprises a plurality of injection-molded layers comprising a plurality of materials that are different.

30

In accordance with another aspect of the invention, there is provided a method of making a skate boot for a skate, the skate comprising a skating device disposed beneath the skate boot to engage a skating surface, the skate boot defining a cavity to receive a foot of a user, the method comprising: providing an injection molding apparatus; and injection molding a body of the skate boot using the injection molding apparatus, the body comprising a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, wherein: the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body are molded together and integral with one another; and the body comprises a plurality of injection-molded layers comprising a plurality of materials that are different.

In accordance with another aspect of the invention, there is provided a skate boot for a skate, the skate comprising a skating device disposed beneath the skate boot to engage a skating surface, the skate boot defining a cavity to receive a foot of a user, the skate boot comprising: a body comprising a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user; a tendon guard projecting upwardly from the body; and a slash guard comprising a cut-resistant material, extending above the body, and movable relative to the tendon guard.

In accordance with another aspect of the invention, there is provided a last for molding a body of a skate boot of a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user. The last is configured to mold the body of the skate boot such that the body of the skate boot comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user. The last is reconfigurable to facilitate demolding of the

body of the skate boot from the last such that the last is changeable between a molding configuration to mold the body of the skate boot on the last and a demolding configuration to demold the body of the skate boot from the last. The last comprises a plurality of last members movable relative to one another to change between its
5 molding configuration and its demolding configuration. Respective ones of the last members are movable relative to one another while remaining connected to one another as the last changes between its molding configuration and its demolding configuration.

10 In accordance with another aspect of the invention, there is provided a method of making a skate boot for a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user. The method comprises: providing a last changeable between a molding configuration and a demolding configuration; molding a body of
15 the skate boot on the last in the molding configuration such that the body of the skate boot comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user; changing the last from the molding configuration to the demolding configuration to facilitate
20 removal of the body of the skate boot from the last; and demolding the body of the skate boot from the last in the demolding configuration. The last comprises a plurality of last members movable relative to one another. The changing comprises moving respective ones of the last members relative to one another while maintaining a connection between respective ones of the last members.

25

In accordance with another aspect of the invention, there is provided a last for molding a body of an article of footwear to receive a foot of a user. The last is configured to mold the body of the article of footwear such that the body of the footwear comprises a medial side portion to face a medial side of the user's foot, a
30 lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user. The last

is reconfigurable to facilitate demolding of the body of the article of footwear from the last such that the last is changeable between a molding configuration to mold the body of the article of footwear on the last and a demolding configuration to demold the body of the article of footwear from the last. The last comprises a plurality of last
5 members movable relative to one another to change between its molding configuration and its demolding configuration. Respective ones of the last members are movable relative to one another while remaining connected to one another as the last changes between its molding configuration and its demolding configuration.

10 In accordance with another aspect of the invention, there is provided a method of making an article of footwear to receive a user's foot. The method comprises: providing a last changeable between a molding configuration and a demolding configuration; molding a body of the article of footwear on the last in the molding configuration such that the body of the article of footwear comprises a medial side
15 portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user; changing the last from the molding configuration to the demolding configuration to facilitate removal of the body of the article of footwear from the last; and demolding the body of the article of footwear
20 from the last in the demolding configuration. The last comprises a plurality of last members movable relative to one another. The changing comprises moving respective ones of the last members relative to one another while maintaining a connection between the respective ones of the last members.

25 In accordance with another aspect of the invention, there is provided a flexible female mold member for molding a body of a skate boot of a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user. The flexible female mold member is configured to be part of a female mold and disposed adjacent to a
30 last for molding the body of the skate boot. The flexible female mold member comprises an inner surface preformed to define a cavity between the flexible female

mold member and the last to receive polymeric material to mold at least a portion of the body of the skate boot such that the inner surface of the flexible female mold member creates an outer surface of the portion of the body of the skate boot.

- 5 In accordance with another aspect of the invention, there is provided a method of making a skate boot of a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user. The method comprises providing a female mold and a last for molding a body of the skate boot. The female mold comprises a flexible female
- 10 mold member comprising an inner surface preformed to define a cavity between the flexible female mold member and the last. The method comprises causing polymeric material to flow in the cavity to mold at least a portion of the body of the skate boot such that the inner surface of the flexible female mold member creates an outer surface of the portion of the body of the skate boot.

15

In accordance with another aspect of the invention, there is provided a flexible female mold member for molding a body of an article of footwear. The article of footwear is configured to receive a foot of a user. The flexible female mold member is configured to be part of a female mold and disposed adjacent to a last for molding
5 the body of the article of footwear. The flexible female mold member comprises an inner surface preformed to define a cavity between the flexible female mold member and the last to receive polymeric material to mold at least a portion of the body of the article of footwear such that the inner surface of the flexible female mold member creates an outer surface of the portion of the body of the article of footwear.

10

In accordance with another aspect of the invention, there is provided a method of making an article of footwear to receive a foot of a user. The method comprises: providing a female mold and a last for molding a body of the article of footwear. The female mold comprises a flexible female mold member comprising an inner surface
15 preformed to define a cavity between the flexible female mold member and the last. The method comprises causing polymeric material to flow in the cavity to mold at least a portion of the body of the article of footwear such that the inner surface of the flexible female mold member creates an outer surface of the portion of the body of the article of footwear.

20

In accordance with another aspect of the invention, there is provided a method of making a skate boot of a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user. The method comprises: placing a sheet in a mold for
25 molding a body of the skate boot; and causing flow of material in the mold to mold at least a portion of the body of the skate boot. The sheet conforms to the portion of the body of the skate boot.

In accordance with another aspect of the invention, there is provided a skate boot for
30 a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user.

The skate boot comprises a body comprising: a layer of material molded by flowing; and a sheet conforming to and provided during molding of the layer of material.

In accordance with another aspect of the invention, there is provided a method of
5 making an article of footwear to receive a foot of a user. The method comprises: placing a sheet in a mold for molding a body of the article of footwear; and causing flow of material in the mold to mold at least a portion of the body of the article of footwear. The sheet conforms to the portion of the body of the article of footwear.

10 In accordance with another aspect of the invention, there is provided an article of footwear to receive a foot of a user. The article of footwear comprises a body comprising: a layer of material molded by flowing; and a sheet conforming to and provided during molding of the layer of material.

15 In accordance with another aspect of the invention, there is provided a skate boot for a skate. The skate comprises a skating device disposed beneath the skate boot to engage a skating surface. The skate boot is configured to receive a foot of a user. The skate boot comprises a body that comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's
20 foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user. The medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body are molded together and integral with one another by flow of material in a mold. The body is free of parting lines opposite from one another.

25

In accordance with another aspect of the invention, there is provided an article of footwear for receiving a foot of a user. The article of footwear comprises a body that comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the
30 user's foot, and an ankle portion to receive an ankle of the user. The medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body

are molded together and integral with one another by flow of material in a mold. The body is free of parting lines opposite from one another.

These and other aspects of the invention will now become apparent to those of ordinary skill in the art upon review of the following description of embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

10 A detailed description of embodiments of the invention is provided below, by way of example only, with reference to drawings annexed hereto, in which:

Figure 1 is an example of a skate for a skater, in accordance with an embodiment of the invention;

15

Figure 2 is an exploded view of the skate;

Figure 3 is a perspective view of a shell of a skate boot of the skate;

20 Figures 4 to 7 are respective side, front, top and bottom views of the shell of Figure 3;

Figure 8 is a cross-sectional view of the shell taken along line 8-8 of Figure 5;

25 Figures 9 and 10 are cross-sectional views of the shell taken along lines 9-9 and 10-10 of Figure 4;

Figure 11 is a block diagram showing a molding process implementing a molding apparatus to form the shell of the skate boot;

30 Figure 12 is a cross-sectional view of the shell showing a plurality of subshells of the shell, including an internal, an intermediate and an external subshell of the shell;

Figure 13 is an example of a last of the molding apparatus used to form the shell;

Figure 14 is a cross-sectional view of the last and a first female mold used to produce
5 the internal subshell of the shell;

Figure 15 is a cross-sectional view of the last and a second female mold used to produce the intermediate subshell of the shell;

10 Figure 16 is a cross-sectional view of the last and a third female mold used to produce the external subshell of the shell;

Figures 17 and 18 are perspective cross-sectional views of the shell of Figure 3 taken along different points of a length of the shell;

15

Figure 19 is a cross-sectional view of the shell in an embodiment in which the shell comprises a reinforcement and a design element disposed between the intermediate subshell and the external subshell;

20 Figures 20A and 20B are side views of the shell in embodiments in which the reinforcement comprises a rib;

Figures 21A and 21B are side views of the shell in embodiments in which the reinforcement comprises a reinforcing sheet;

25

Figure 21C is a side view of the shell in accordance with an embodiment in which the reinforcement comprises a single fiber;

Figure 22 is a conceptual illustration of constituents of a material flowing into a mold
30 cavity to produce a resulting polymeric material;

Figure 23 is a perspective view of an embodiment in which the shell comprises an overlay;

Figure 24 is a perspective view of a tongue of the skate boot;

5

Figure 25 is a side view of a blade of a skating device of the skate;

Figures 26A to 29 show different examples of embodiments in which the blade is affixed to a blade holder of the skating device of the skate;

10

Figure 30 is a side view of the shell in an embodiment in which a limited part of the blade holder is molded integrally with the shell;

Figures 31 and 32 are cross-sectional views of examples of securing the limited part of the blade holder which is molded integrally with the shell with another part of the blade holder;

15

Figure 33 is a cross-sectional view of the blade holder in an embodiment in which the blade holder comprises a blade-detachment mechanism;

20

Figure 34 is a side view of the blade of the skating device;

Figure 35 is a cross-sectional view of the blade taken along line 35-35 of Figure 34;

Figure 36 is a side view of the skate in an embodiment in which a toe cap, a tongue, a tendon guard, a footbed and a pair of lace members of the skate boot are molded integrally with the shell;

25

Figure 37 is a side of the skate in an embodiment in which the shell of the skate boot is molded alone (i.e., separately from the toe cap, the tongue, the tendon guard, the footbed and the lace members of the skate boot);

30

Figure 38 is a side view of the skate in an embodiment in which any of the toe cap, the tongue, the tendon guard, the footbed and the lace members are molded integrally with the shell of the skate boot;

5

Figure 39 is a cross-sectional view of the shell of the skate boot in an embodiment in which the shell is a unitary shell (i.e., has no subshells);

Figure 40 is a cross-sectional view of the shell of the skate boot in an embodiment in which the shell comprises subshells;

Figures 41A, 41B and 41C are cross-sectional views of the shell in embodiments in which at least one of the subshells comprise an opening in a sole region of the shell;

Figure 42, 43A and 43B are cross-sectional views of the shell in embodiments in which a footbed of the skate boot is formed integrally with the shell of the skate boot;

Figures 44A and 44B are cross-sectional views of the shell in embodiments in which the external subshell of the shell and/or the internal subshell of the shell comprises an opening at the sole region of the shell;

Figure 45 is a cross-sectional view of the shell in an embodiment in which the footbed of the skate boot is formed integrally with the shell and is in contact with the external subshell of the shell;

25

Figure 46 is a cross-sectional view of the shell in an embodiment in which the footbed of the skate boot is an insert that is disposed between given ones of the subshells of the shell;

Figures 47A and 47B are cross-sectional views of the shell in embodiments in which a limited part of the blade holder is molded integrally with the shell;

30

Figure 48 is a cross-sectional of the shell in an embodiment in which the footbed of the skate boot is formed integrally with the shell;

- 5 Figure 49 is a cross-sectional view of the shell in an embodiment in which the shell comprises the internal, intermediate and external subshells and is molded separately from the blade holder;

Figure 50 is a cross-sectional view of the shell in an embodiment in which the shell
10 comprises four subshells;

Figure 51 is a cross-sectional view of the shell in an embodiment in which the blade holder is molded separately from the shell and is affixed to the shell;

- 15 Figure 52 is a cross-sectional view of the shell in an embodiment in which the blade holder is molded integrally with the shell and the intermediate subshell making up the blade holder is exposed;

Figure 53 is a cross-sectional view of the shell in an embodiment in which the blade
20 holder is molded integrally with the shell and a given subshell envelops the blade holder but not the shell;

Figure 54 is an exploded view of the skate in an embodiment in which the shell is molded separately from the blade holder and from other components of the skate boot,
25 notably the toe cap, the tongue, the tendon guard, the footbed and the lace members of the skate boot;

Figure 55 is a perspective view of the blade holder in an embodiment in which the blade holder is formed separately from the shell of the skate boot;

30

Figure 56 is a top view of a cross-section of the shell taken along an ankle portion of

the shell;

Figures 57A and 57B show top cross-sectional views of the ankle portion of the shell in accordance with an embodiment in which the skate boot comprises a reinforcement
5 which comprises an extension;

Figures 58 and 59 show embodiments in which the extension connects a medial ankle side of the ankle portion to a lateral ankle side of the ankle portion in a direction frontwardly of the ankle portion of the shell;

10

Figures 60 and 61 show examples in which the extension comprises a plurality of free ends that are movable relative to one another and converge toward one another;

Figure 62 shows an example of a variant in which the extension is in a rear portion of
15 the ankle portion of the shell;

Figures 63 and 64 show examples in which the reinforcement comprises two extensions, including one in the rear portion of the ankle portion of the shell;

20 Figure 65 is an example of a variant in which the rear portion of the ankle portion comprises an opening;

Figure 66 is a perspective view of the shell of the skate boot in accordance with a variant in which the reinforcement comprises the lace members of the skate boot;

25

Figures 67 and 68 show different examples of the shell in accordance with the variant of Figure 66;

Figure 69 shows an example of the shell in accordance with the variant of Figure 66
30 and in which the skate boot comprises an extension;

Figure 70 is a side view of the skate boot of Figure 63;

Figures 71A and 71B show side and front views of the skate in accordance with another embodiment;

5

Figure 72 shows an example of a test for determining the stiffness of a part of a subshell;

Figure 73 shows an example of an embodiment in which an outermost one of the subshells makes up an outer surface of the shell and an outer surface of the blade holder;

10

Figure 74 shows an example of a variant in which the blade holder has no opening extending from its lateral side to its medial side;

15

Figures 75 to 77 show an example of a variant in which the shell and/or the blade holder comprises one or more inserts over which a subshell is molded;

Figures 78A to 78C show other examples of the variant of Figure 75 in which the inserts form a part of the shell;

20

Figure 79 shows an example of a variant in which one or more of the subshells comprises a filled portion comprising a different material;

25 Figures 80A to 80F show other examples of the variant of Figure 79;

Figures 81 and 82 show an example of a variant in which a sheet is used during molding of the shell;

30 Figure 83 shows an example of a variant in which the skate boot comprises a slash guard;

Figure 84 shows an example of a variant of the slash guard of Figure 83;

Figure 85 shows a top view of a portion of the slash guard of Figure 83;

5

Figures 86A to 86D show examples of a variant in which the shell and/or blade holder and/or other components made integrally with the shell are molded as separate pieces which are then assembled together;

10 Figure 87 shows an example of a variant in which the blade holder comprises an insert for receiving the blade;

Figure 88 shows an example of a variant in which the blade holder comprises a void;

15 Figure 89 shows an example of a variant in which the shell and/or the blade holder and/or other components made integrally with the shell comprises an opening configured to modify a performance of the skate boot;

Figure 90 shows an example of an embodiment in which a material of a given subshell
20 comprises a polymeric substance and an expansion agent;

Figure 91 shows an example of the expansion agent of Figure 90;

Figures 92 and 93 show examples of the last to form the shell in other embodiments;
25

Figures 94 to 105 show an example of the last to form the shell in another embodiment;

Figures 106 to 110 show an example of the last to form the shell in another
30 embodiment;

Figures 111 to 115 show an example of the last to form the shell in another embodiment;

Figures 116 and 117 show an example of the last to form the shell in another
5 embodiment;

Figures 118 and 119 show an example of the last to form the shell in another embodiment;

10 Figures 120 to 122 show an example of a flexible female mold member in another embodiment;

Figure 123 shows an example of a variant in which the footwear is a ski boot;

15 Figure 124 shows an example of a variant in which the footwear is a work boot; and

Figures 125 and 126 are side and front views of a right foot of the skater with an integument of the foot shown in dotted lines and bones shown in solid lines.

20 In the drawings, embodiments of the invention are illustrated by way of example. It is to be expressly understood that the description and drawings are only for purposes of illustration and as an aid to understanding, and are not intended to be a definition of the limits of the invention.

25 **DETAILED DESCRIPTION OF EMBODIMENTS**

Figure 1 shows an example of footwear 10 for a wearer in accordance with an embodiment of the invention. In this example, the footwear 10 is a skate for a skater to skate on a skating surface 12. In this embodiment, the skate 10 is a hockey skate for
30 the skater who is a hockey player playing hockey. In this example, the skate 10 is an ice skate, a type of hockey played is ice hockey, and the skating surface 12 is ice.

The skate 10 comprises a skate boot 22 for receiving a foot 11 of the player and a skating device 28 disposed beneath the skate boot 22 to engage the skating surface 12. In this embodiment, the skating device 28 comprises a blade 26 for contacting the ice 12 and a blade holder 24 between the skate boot 22 and the blade 26. The skate 10 has a longitudinal direction, a widthwise direction, and a heightwise direction.

In this embodiment, as further discussed below, the skate 10, including at least part of the skate boot 22 and possibly at least part of one or more other components (e.g., the blade holder 24), is constructed from one or more materials (e.g., foams) molded by flowing in molding equipment during a molding process (e.g., injection molding or casting). This may allow the skate 10 to have useful performance characteristics (e.g., reduced weight, proper fit and comfort, etc.) while being more cost-effectively manufactured.

The skate boot 22 defines a cavity 54 for receiving the player's foot 11. With additional reference to Figures 125 and 126, the player's foot 11 includes toes T, a ball B, an arch ARC, a plantar surface PS, a top surface TS, a medial side MS, and a lateral side LS. The top surface TS of the player's foot 11 is continuous with a lower portion of a shin S of the player. In addition, the player has a heel HL, an Achilles tendon AT, and an ankle A having a medial malleolus MM and a lateral malleolus LM that is at a lower position than the medial malleolus MM. The Achilles tendon AT has an upper part UP and a lower part LP projecting outwardly with relation to the upper part UP and merging with the heel HL. A forefoot of the player includes the toes T and the ball B, a hindfoot of the player includes the heel HL, and a midfoot of the player is between the forefoot and the hindfoot.

The skate boot 22 comprises a front portion 56 for receiving the toes T of the player, a rear portion 58 for receiving the heel HL and at least part of the Achilles tendon AT and the ankle A of the player, and an intermediate portion 60 between the front portion 56 and the rear portion 58.

More particularly, in this embodiment, the skate boot 22 comprises a shell 30, a toe cap 32, a tongue 34, a tendon guard 35, a liner 36, a footbed 38, and an insole 40. The skate boot 22 also comprises lace members 44₁, 44₂ and eyelets 46₁-46_E extending
5 through (e.g., punched into) the lace members 44₁, 44₂, the shell 30 and the liner 36 vis-à-vis apertures 48 in order to receive laces for tying on the skate 10. In some embodiments, the skate boot 22 may not comprise any lace members and the eyelets 46₁-46_E may extend directly through the shell 30 and the liner 36 via the apertures 48.

10 The shell 30 is a body of the skate boot 22 that imparts strength and structural integrity to the skate 10 to support the player's foot 11. More particularly, in this embodiment, as shown in Figure 3, the shell 30 comprises a heel portion 62 for receiving the heel HL of the player, an ankle portion 64 for receiving the ankle A of the player, medial and lateral side portions 66, 68 for respectively facing the medial and lateral sides MS, LS
15 of the player's foot 11, and a sole portion 69 for facing the plantar surface PS of the player's foot 11. The shell 30 thus includes a quarter 75 which comprises a medial quarter part 77, a lateral quarter part 79, and a heel counter 81. The medial and lateral side portions 66, 68 include upper edges 70, 72 which, in this embodiment, constitute upper edges of the lace members 44₁, 44₂ (i.e., the lace members 44₁, 44₂ are made
20 integrally with the shell as will be described later). The heel portion 62 may be formed such that it is substantially cup-shaped for following the contour of the heel HL of the player. The ankle portion 64 comprises medial and lateral ankle sides 74, 76. The medial ankle side 74 has a medial depression 78 for receiving the medial malleolus MM of the player and the lateral ankle side 76 has a lateral depression 80 for receiving
25 the lateral malleolus LM of the player. The lateral depression 80 is located slightly lower than the medial depression 78 for conforming to the morphology of the player's foot 11. The ankle portion 64 further comprises a rear portion 82 facing the lower part LP of the Achilles tendon AT of the player.

30 In this embodiment, with additional reference to Figure 11, the shell 30 comprises one or more materials molded into a shape of the shell 30 by flowing in a molding

apparatus 150 during a molding process (e.g., injection molding or casting). More particularly, in this embodiment, the shell 30 comprises a plurality of materials M_1 - M_N that are molded into the shape of the shell 30 by flowing in the molding apparatus 150 during the molding process. The materials M_1 - M_N are different from one another, such as by having different chemistries and/or exhibiting substantially different values of one or more material properties (e.g., density, modulus of elasticity, hardness, etc.). In this example, the materials M_1 - M_N are arranged such that the shell 30 comprises a plurality of layers 85₁-85_L which are made of respective ones of the materials M_1 - M_N . In that sense, in this case, the shell 30 may be referred to as a "multilayer" shell and the layers 85₁-85_L of the shell 30 may be referred to as "subshells". This may allow the skate 10 to have useful performance characteristics (e.g., reduced weight, proper fit and comfort, etc.) while being more cost-effectively manufactured.

The materials M_1 - M_N may be implemented in any suitable way. In this embodiment, each of the materials M_1 - M_N is a polymeric material. For example, in this embodiment, each of the polymeric materials M_1 - M_N is polyurethane (PU). Any other suitable polymer may be used in other embodiments (e.g., polypropylene, ethylene-vinyl acetate (EVA), nylon, polyester, vinyl, polyvinyl chloride, polycarbonate, polyethylene, an ionomer resin (e.g., Surlyn®), styrene-butadiene copolymer (e.g., K-Resin®) etc.), self-reinforced polypropylene composite (e.g., Curv®), or any other thermoplastic or thermosetting polymer).

In this example of implementation, each of the polymeric materials M_1 - M_N is a foam. In this case, each of the polymeric materials M_1 - M_N is a PU foam. This foamed aspect may allow the shell 30 to be relatively light while providing strength. For instance, in some embodiments, a density of each of the polymeric materials M_1 - M_N may be no more than 40 kg/m³, in some cases no more than 30 kg/m³, in some cases no more than 20 kg/m³, in some cases no more than 15 kg/m³, in some cases no more 10 kg/m³ and in some cases even less. One or more of the polymeric materials M_1 - M_N may not be foam in other examples of implementation.

In this embodiment, the materials M_1 - M_N of the subshells 85_1 - 85_L of the shell 30 constitute at least part of the heel portion 62, the ankle portion 64, the medial and lateral side portions 66, 68, and the sole portion 69 of the shell 30. More particularly, in this embodiment, the materials M_1 - M_N constitute at least a majority (i.e., a majority or
 5 an entirety) of the heel portion 62, the ankle portion 64, the medial and lateral side portions 66, 68, and the sole portion 69 of the shell 30. In this example, the materials M_1 - M_N constitute the entirety of the heel portion 62, the ankle portion 64, the medial and lateral side portions 66, 68, and the sole portion 69 of the shell 30.

10 The subshells 85_1 - 85_L constituted by the polymeric materials M_1 - M_N may have different properties for different purposes.

For instance, in some cases, a polymeric material M_x may be stiffer than a polymeric material M_y such that a subshell comprising the polymeric material M_x is stiffer than a
 15 subshell comprising the polymeric material M_y . For example, a ratio of a stiffness of the subshell comprising the polymeric material M_x over a stiffness of the subshell comprising the polymeric material M_y may be at least 1.5, in some cases at least 2, in some cases at least 2.5, in some cases 3, in some cases 4 and in some cases even more.

20

In some cases, a given one of the subshells 85_1 - 85_L may be configured to be harder than another one of the subshells 85_1 - 85_L . For instance, to provide a given subshell with more hardness than another subshell, the hardness of the polymeric materials M_1 - M_N may vary. For example, a hardness of the polymeric material M_x may be greater
 25 than a hardness of the polymeric material M_y . For example, in some cases, a ratio of the hardness of the polymeric material M_x over the hardness of the polymeric material M_y may be at least 1.5, in some cases at least 2, in some cases at least 2.5, in some cases at least 3, in some cases at least 4, in some cases at least 5 and in some cases even more.

30

To observe the stiffness of a subshell 85_x , as shown in Figure 72, a part of the subshell

85_x can be isolated from the remainder of the subshell 85_x (e.g., by cutting, or otherwise removing the part from the subshell 85_x, or by producing the part without the remainder of the subshell 85_x) and a three-point bending test can be performed on the part to subject it to loading tending to bend the part in specified ways (along a defined
5 direction of the part if the part is anisotropic) to observe the rigidity of the part and measure parameters indicative of the rigidity of the part. For instance in some embodiments, the three-point bending test may be based on conditions defined in a standard test (e.g., ISO 178(2010)).

10 For example, to observe the rigidity of the subshell 85_x, the three-point bending test may be performed to subject the subshell 85_x to loading tending to bend the subshell 85_x until a predetermined deflection of the subshell 85_x is reached and measure a bending load at that predetermined deflection of the subshell 85_x. The predetermined deflection of the subshell 85_x may be selected such as to correspond to a
15 predetermined strain of the subshell 85_x at a specified point of the subshell 85_x (e.g., a point of an inner surface of the subshell 85_x). For instance, in some embodiments, the predetermined strain of the subshell 85_x may be between 3% and 5%. The bending load at the predetermined deflection of the subshell 85_x may be used to calculate a bending stress at the specified point of the subshell 85_x. The bending stress at the
20 specified point of the subshell 85_x may be calculated as $\sigma=My/I$, where M is the moment about a neutral axis of the subshell 85_x caused by the bending load, y is the perpendicular distance from the specified point of the subshell 85_x to the neutral axis of the subshell 85_x, and I is the second moment of area about the neutral axis of the subshell 85_x. The rigidity of the subshell 85_x can be taken as the bending stress at the
25 predetermined strain (i.e., at the predetermined deflection) of the subshell 85_x. Alternatively, the rigidity of the subshell 85_x may be taken as the bending load at the predetermined deflection of the subshell 85_x.

A stiffness of the subshells 85₁-85_L may be related to a modulus of elasticity (i.e.,
30 Young's modulus) of the polymeric materials M_1 - M_N associated therewith. For example, to provide a given subshell with more stiffness than another subshell, the

modulus of elasticity of the polymeric materials M_1 - M_N may vary. For instance, in some embodiments, the modulus of elasticity of the polymeric material M_x may be greater than the modulus of elasticity of the polymeric material M_y . For example, in some cases, a ratio of the modulus of elasticity of the polymeric material M_x over the modulus of elasticity of the polymeric material M_y may be at least 1.5, in some cases at least 2, in some cases at least 2.5, in some cases at least 3, in some cases at least 4, in some cases at least 5 and in some cases even more. This ratio may have any other suitable value in other embodiments.

10 In some cases, a given one of the subshells 85_1 - 85_L may be configured to be denser than another one of the subshells 85_1 - 85_L . For instance, to provide a given subshell with more density than another subshell, the density of the polymeric materials M_1 - M_N may vary. For instance, in some embodiments, the polymeric material M_x may have a density that is greater than a density of the polymeric material M_y . For example, in some cases, a ratio of the density of the material M_x over the density of the material M_y may be at least 1.1, in some cases at least 1.5, in some cases at least 2, in some cases at least 2.5, in some cases at least 3 and in some cases even more. a certain value

20 In this embodiment, as shown in Figure 12, the subshells 85_1 - 85_L comprise an internal subshell 85_1 , an intermediate subshell 85_2 and an external subshell 85_3 . The internal subshell 85_1 is "internal" in that it is an innermost one of the subshells 85_1 - 85_L . That is, the internal subshell 85_1 is closest to the player's foot 11 when the player dons the skate 10. In a similar manner, the external subshell 85_3 is "external" in that is an outermost one of the subshells 85_1 - 85_L . That is, the external subshell 85_3 is furthest from the player's foot 11 when the player dons the skate 10. The intermediate subshell 85_2 is disposed between the internal and external subshells 85_1 , 85_3 .

The internal, intermediate and external subshells 85_1 , 85_2 , 85_3 comprise respective polymeric materials M_1 , M_2 , M_3 . In this embodiment, the polymeric materials M_1 , M_2 , M_3 have different material properties that impart different characteristics to the internal,

intermediate and external subshells 85₁, 85₂, 85₃. As a result, in certain cases, a given one of the subshells 85₁, 85₂, 85₃ may be more resistant to impact than another one of the subshells 85₁, 85₂, 85₃, a given one of the subshells 85₁, 85₂, 85₃ may be more resistant to wear than another one of the subshells 85₁, 85₂, 85₃, and/or a given one of
5 the subshells 85₁, 85₂, 85₃ may be denser than another one of the subshells 85₁, 85₂, 85₃.

For instance, a density of each of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may vary. For example, in this embodiment, the densities of the internal,
10 intermediate and external subshells 85₁, 85₂, 85₃ increase inwardly such that the density of the internal subshell 85₁ is greater than the density of the intermediate subshell 85₂ which in turn is greater than the density of the external subshell 85₃. For example, the density of the internal subshell 85₁ may be approximately 30 kg/m³, while the density of the intermediate subshell 85₂ may be approximately 20 kg/m³, and the
15 density of the external subshell 85₃ may be approximately 10 kg/m³. The densities of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may have any other suitable values in other embodiments. In other embodiments, the densities of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may increase outwardly such that the external subshell 85₃ is the densest of the subshells 85₁-85_L. In yet other
20 embodiments, the densities of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may not be arranged in order of ascending or descending density.

Moreover, in this embodiment, a stiffness of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may vary. For example, in this embodiment, the stiffness of the
25 internal subshell 85₁ is greater than the respective stiffness of each of the intermediate subshell 85₂ and the external subshell 85₃.

In addition, in this embodiment, a thickness of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may vary. For example, in this embodiment, the intermediate
30 subshell 85₂ has a thickness that is greater than a respective thickness of each of the internal and external subshells 85₁, 85₃. For example, in some cases, the thickness of

each of the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 may be between 0.1 mm to 25 mm, and in some cases between 0.5 mm to 10 mm. For instance, the thickness of each of the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 may be no more than 30 mm, in some cases no more than 25 mm, in some cases no more than 15 mm, in some cases no more than 10 mm, in some cases no more than 5 mm, in some cases no more than 1 mm, in some cases no more than 0.5 mm, in some cases no more than 0.1 mm and in some cases even less.

In order to provide the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 with their different characteristics, the polymeric materials M_1 , M_2 , M_3 of the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 may comprise different types of polymeric materials. For instance, in this example, the polymeric material M_1 comprises a generally soft and dense foam, the polymeric material M_2 comprises a structural foam that is more rigid than the foam of the polymeric material M_1 and less dense than the polymeric material M_1 , and the polymeric material M_3 is a material other than foam. For example, the polymeric material M_3 of the external subshell 85_3 may consist of a clear polymeric coating.

The subshells 85_1 - 85_L may be configured in various other ways in other embodiments. For instance, in other embodiments, the shell 30 may comprise a different number of subshells or no subshells. For example, in some embodiments, as shown in Figure 39, the shell 30 may be a single shell and therefore does not comprise any subshells. In other embodiments, as shown in Figure 40, the shell 30 may comprise two subshells 85_1 - 85_L .

Moreover, as shown in Figures 41A to 41C, when the shell 30 comprises two subshells, notably interior and exterior subshells 85_{INT} , 85_{EXT} , if the exterior subshell 85_{EXT} has a density that is greater than a density of the interior subshell 85_{INT} , a given one of the subshells 85_{INT} , 85_{EXT} may have an opening, which can be referred to as a gap, along at least part of the sole portion 69 of the shell 30 (e.g., along a majority of the sole portion 69 of the shell 30). For example, as shown in Figure 41A,

in some embodiments, the exterior subshell 85_{EXT} may comprise a gap G at the sole portion 69 of the shell 30 such that the interior and exterior subshells 85_{INT}, 85_{EXT} do not overlie one another at the sole portion 69 of the shell 30 (i.e., the interior subshell 85_{INT} may be the only subshell present at the sole portion 69 of the shell 30). As shown in Figure 41B, in an embodiment in which the exterior subshell 85_{EXT} has a gap at the sole portion 69 of the shell 30, the interior subshell 85_{INT} may project outwardly toward the exterior subshell 85_{EXT} at the sole portion 69 of the shell 30 and fill in the gap of the exterior subshell 85_{EXT} such that a thickness of the interior subshell 85_{INT} is greater at the sole portion 69 of the shell 30. As another example, as shown in Figure 41C, in an embodiment in which the interior subshell 85_{INT} has a gap at the sole portion 69 of the shell 30, the exterior subshell 85_{EXT} may project inwardly toward the interior subshell 85_{INT} at the sole portion 69 of the shell 30 and fill in the gap of the interior subshell 85_{INT} such that a thickness of the exterior subshell 85_{EXT} is greater at the sole portion 69 of the shell 30. As shown in Figure 42, the footbed 38 may be formed integrally with the shell 30 such as to cover at least partially an inner surface of the innermost subshell (in this case, the interior subshell 85_{INT}) and overlie the sole portion 69 of the shell 30. In other cases, the footbed 38 may be inserted separately after the molding process of the shell 30 has been completed.

20

In some embodiments, as shown in Figures 44A and 44B, when the shell 30 comprises three subshells, notably the internal, intermediate and external subshells 85₁, 85₂, 85₃, and the external subshell 85₃ has a density that is greater than a density of the intermediate subshell 85₂, the external subshell 85₃ may comprise a gap 61 at the sole portion 69 of the shell 30 and the intermediate subshell 85₂ may project into the external subshell 85₃ at the sole portion 69 of the shell 30 such as to fill in the gap 61 of the external subshell 85₃. In such embodiments, the intermediate subshell 85₂ may have a greater thickness at the sole portion 69 of the shell 30.

30 In some embodiments, as shown in Figure 50, the subshells 85₁-85_L of the shell 30 may include four subshells 85₁, 85₂, 85₃, 85₄.

In this embodiment, the subshells 85₁-85_L constituted by the polymeric materials M₁-M_N are integral with one another such that they constitute a monolithic one-piece structure. That is, the subshells 85₁-85_L constituted by the polymeric materials M₁-M_N are
5 integrally connected to one another such that the shell 30 is a one-piece shell. In this example of implementation, this is achieved by the subshells 85₁-85_L bonding to one another in the molding apparatus 150 during the molding process by virtue of chemical bonding of the polymeric materials M₁-M_N.

10 The subshells 85₁-85_L constituted by the polymeric materials M₁-M_N are molded into the shape of the shell 30 by flowing into the molding apparatus 150 during the molding process. In this embodiment, the molding process comprises causing the polymeric materials M₁-M_N to flow (i.e., in liquid or other fluid form) in the molding apparatus 150 so as to form the subshells 85₁-85_L and thus the shell 30 within the molding apparatus
15 150 and recovering the shell 30 from the molding apparatus 150 once its molding is completed.

In this embodiment, the molding process of the shell 30 is injection molding and the molding apparatus 150 comprises a male mold 152 (also commonly referred to as a
20 "last") with which all the polymeric materials M₁-M_N are molded into shape, as shown in Figure 13. That is, in this example, the last 152 is a single last with which all of the subshells 85₁-85_L of the shell 30 are formed. The molding apparatus 150 also comprises a plurality of female molds 154₁-154_N, each female mold 154_i being configured to contain the last 152 at different stages of the molding process. In this
25 embodiment, each female mold 154_i comprises first and second portions 155, 157 that are secured together to contain the last 152.

An example of a method for molding the shell 30 comprising the internal, intermediate and external subshells 85₁, 85₂, 85₃ will be described in more detail below with
30 reference to Figures 14 to 16.

With additional reference to Figure 14, in order to mold the internal subshell 85₁, the last 152 is secured within a first female mold 154₁ to form a mold cavity 156 between the last 152 and the first female mold 154₁. The mold cavity 156 has a shape of the desired internal subshell 85₁. The mold cavity 156 is then filled with a desired polymeric material M₁ via a sprue, runner and gate system (not shown) of the first female mold 154₁ and left to cure. Once the polymeric material M₁ has cured for a sufficient amount of time to form the internal subshell 85₁, the first female mold 154₁ is opened (i.e., its first and second portions 155, 157 are separated from one another) and removed from the molding apparatus 150 while the last 152 remains on the molding apparatus 150 with the internal subshell 85₁ still on it.

At this stage, with additional reference to Figure 15, in order to form the intermediate subshell 85₂, a second female mold 154₂ is installed on the molding apparatus 150. The last 152 is secured within the second female mold 154₂ to form a mold cavity 158 between the internal subshell 85₁ (and in some cases at least part of the last 152) and the second female mold 154₂. The mold cavity 158 has a shape of the desired intermediate subshell 85₂. The mold cavity 158 is then filled with a desired polymeric material M₂ via a sprue, runner and gate system (not shown) of the second female mold 154₂ and left to cure. Once the polymeric material M₂ has cured for a sufficient amount of time to form the intermediate subshell 85₂, the second female mold 154₂ is opened (i.e., its first and second portions 155, 157 are separated from one another) and removed from the molding apparatus 150 while the last 152 remains on the molding apparatus 150 with the internal subshell 85₁ and the intermediate subshell 85₂ still on it.

With additional reference to Figure 16, in order to form the external subshell 85₃, a third female mold 154₃ is installed on the molding apparatus 150. The last 152 is secured within the third female mold 154₃ to form a mold cavity 160 between the intermediate subshell 85₂ (and in some cases at least part of the last 152, and in some cases at least part of the internal subshell 85₁) and the third female mold 154₃. The mold cavity 160 has a shape of the desired external subshell 85₃. The mold cavity 160 is then filled

with a desired polymeric material M_3 via a sprue, runner and gate system (not shown) of the third female mold 154_3 and left to cure.

Once the polymeric material M_3 has cured for a sufficient amount of time to form the external subshell 85_3 , the shell 30, including its now formed internal, intermediate and external subshells 85_1 , 85_2 , 85_3 , is demolded from (i.e., removed from) the last 152. This may be achieved in various ways.

For instance, in some embodiments, the polymeric materials M_1 , M_2 , M_3 which constitute the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 may have sufficient elasticity to allow an operator of the molding apparatus 150 to remove the shell 30 from the last 152 by flexing the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 of the shell 30. In some cases, the shell 30 may be removed from the last 152 while at least a given one of the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 has not fully cured such that the shell 30 has some flexibility that it would not have if the at least one given one of the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 had fully cured.

Moreover, in some embodiments, with additional reference to Figures 92 to 119, the last 152 may be reconfigurable to facilitate demolding (i.e., removal) of the shell 30 from the last 152. That is, a configuration (e.g., shape) of the last 152 may be changeable between a "molding" configuration to mold the shell 30 on the last 152 and a "demolding" configuration to demold the shell 30 from the last 152. The demolding configuration of the last 152 differs from the molding configuration of the last 152, notably in that demolding of the shell 30 from the last 152 is easier in the demolding configuration of the last 152 than in the molding configuration of the last 152 (e.g., less effort has to be exerted on the shell 30 to remove the shell 30 from the last 152 in its demolding configuration than in its molding configuration, or removal of the shell 30 from the last 152 in its demolding configuration is readily allowed while removal of the shell 30 from the last 152 in its molding configuration is precluded without damaging the shell 30). For example, the last 152 may contract (i.e., be reduced in size) in its

demolding configuration relative to its molding configuration. Removal of the shell 30 from the last 152, which may be by holding the shell 30 to move it away from the last 152 and/or holding and moving at least part of the last 152 away from the shell 30, is thus facilitated.

5

This may be particularly useful to mold the shell 30 on the last 152 such that the shell 30 has undercuts 51₁-51₆, i.e., recesses (e.g., depressions) or other reentrant portions, which would otherwise complicate demolding of the shell 30. For example, in this embodiment, the undercuts 51₁, 51₂ are the medial and lateral depressions 78, 80 for receiving the medial and lateral malleoli MM, LM of the player, the undercuts 51₃, 51₄ are recesses 83₁, 83₂ defined by curvature of the heel portion 62 in the longitudinal and heightwise directions of the skate 10 and curvature of the heel portion 62 in the widthwise direction of the skate 10 such that the heel portion 62 is substantially cup-shaped, and the undercuts 51₅, 51₆ are recesses 86₁, 86₂ defined by curvature of the medial side portion 66 and curvature of the lateral side portion 68 in the longitudinal and heightwise directions of the skate 10 adjacent to the player's forefoot. The shell 30 may have any other suitable undercut such as the undercuts 51₁-51₆ in other embodiments.

20 Furthermore, this may facilitate demolding of the shell 30 from the last 152 without deforming the shell 30. That is, a shape of the shell 30 once molding is completed can be maintained during and upon demolding. In this example, this may be useful as the shell 30 is rigid (e.g., to avoid stressing the shell 30, etc.).

25 For example, in some embodiments, a volume occupied by the last 152 may be reduced from its molding configuration to its demolding configuration such that the volume occupied by the last 152 in its demolding configuration is smaller than the volume occupied by the last 152 in its molding configuration.

30 In some embodiments, as shown in Figure 92, the last 152 comprises a cavity 163 to receive a fluid 167 to vary the volume occupied by the last 152, by expanding and

contracting the last 152. For instance, in some cases, the last 152 may be an inflatable last that can be expanded and retracted by controlling a fluid pressure within the last 152. For instance, the inflatable last 152 may be filled with the fluid 167 which is air (or any other fluid) to expand the inflatable last 152 to a “molding” size at which the molding process is carried out, and then emptied of air to contract the inflatable last 152 to a “demolding” size that is less than the molding size and at which the demolding of the shell 30 from the last 152 can be carried out. The fluid 167 may be a liquid (e.g., water, oil, etc.) or any other suitable fluid in other cases.

10 As a variant, in some embodiments, as shown in Figure 93, the cavity 163 of the last 152 may contain particles 169₁-169_P, such as beads, granules, sand, or other grit, that are configured to vary a rigidity of the last 152 in response to flow of the fluid 167 relative to (i.e., into or out of) the cavity 163 of the last 152. For instance, the particles 169₁-169_P may rigidify (i.e., increase the rigidity of the last 152) when the fluid 167
15 flows out of the cavity 167 (e.g., by vacuum).

As another example, in some embodiments, as shown in Figures 94 to 105, the last 152 may comprise a plurality of last members 175₁-175_M that are movable relative to one another to change between its molding configuration and its demolding
20 configuration. The last members 175₁-175_M may be viewed as last “modules” so that the last 152 is a “modular” last. Each of the last members 175₁-175_M is shaped such that the last members 175₁-175_M collectively form the shape of the last 152 to mold the shell 30 in its molding configuration.

25 In this embodiment, respective ones of the last members 175₁-175_M are movable relative to one another while remaining connected to one another as the last 152 changes between its molding configuration and its demolding configuration. The last 152 comprises a control system 187 to control movement of the last members 175₁-175_M relative to one another. The control system 187 comprises a linkage 181 that
30 includes links 183₁-183_C linking adjacent ones of the last members 175₁-175_M so that they are movable relative to one another and an actuating mechanism 191 that

includes a plurality of actuators 193₁-193₄ operable to move the last members 175₁-175_M relative to one another between the molding configuration of the last 152 and the demolding configuration of the last 152.

5 Adjacent ones of the last members 175₁-175_M may be translatable and/or rotatable relative to one to change the last 152 between its molding configuration and its demolding configuration. That is, adjacent ones of the last members 175₁-175_M may move relative to one by translation, rotation, or a combination of translation and rotation to change the last 152 between its molding configuration and its demolding
10 configuration. For example, in this embodiment, the linkage 181 comprises translation guides 195₁-195₄ for translating adjacent ones of the last members 175₁-175_M relative to one another and a pivot 197 for pivoting adjacent ones of the last members 175₁-175_M relative to one another.

15 In this embodiment, the last member 175₁ is a front central last member to form part of a front region of the shell 30 including a central part of the toe cap 32 integrally formed with the shell 30 and a front central part of the sole portion 69; the last member 175₃ is a rear central last member to form part of a rear central region of the shell 30 including a central part of the heel portion 62, a central part of the ankle portion 64, and a rear
20 central part of the sole portion 69; the last member 175₂ is an intermediate central last member disposed between the front central last member 175₁ and the rear central last member 175₃ to form an intermediate central part of the sole portion 69; and the last members 175₄, 175₄ are medial and lateral last members to form medial and lateral parts of the heel portion 62, medial and lateral parts of the ankle portion 64, medial and
25 lateral parts of the sole portion 69, medial and lateral parts of the toe cap 32 integrally formed with the shell 30, and the medial and lateral side portions 66, 68 of the shell 30.

More particularly, in this embodiment, the last members 175₁-175_M are movable relative to one another to change the last 152 from its molding configuration to its
30 demolding configuration by: (1) translating the intermediate central last member 175₂ upwardly relative to the front central last member 175₁ and the rear central last

member 175₃ via the translation guide 195₁, 195₂; (2) translating the intermediate central last member 175₂ forwardly towards the front central last member 175₁ via the translation guide 195₂ that is slanted relative to the translation guide 195₁ such that the front central last member 175₁ and the rear central last member 175₃ are closer to one another and the rear central last member 175₃ clears the heel portion 62 of the shell 30; (3) translating the rear central last member 175₃ upwardly relative to the front central last member 175₁ via the translation guide 195₂; (4) pivoting the front central last member 175₁, the rear central last member 175₃ and the intermediate central last member 175₂ together about the pivot 197 so that the front central last member 175₁ clears the central part of the toe cap 32 integrally formed with the shell 30; and (5) translating the medial and lateral last members 175₄, 175₄ laterally towards one another to clear the medial and lateral parts of the heel portion 62, the medial and lateral parts of the ankle portion 64, the medial and lateral parts of the sole portion 69, the medial and lateral parts of the toe cap 32 integrally formed with the shell 30, and the medial and lateral side portions 66, 68 of the shell 30, thereby clearing all of the shell 30 that can be removed from the last 152. The shell 30 can thus be molded and easily demolded, even with its undercuts 51₁-51₆, without deforming it during demolding.

In a variant, in some embodiments, as shown in Figures 106 to 110, last members 175₁, 175₂ are movable relative to one another to change the last 152 from its molding configuration to its demolding configuration by: (1) rotating the last member 175₂, which forms the heel portion 62 of the shell 30, relative to the last member 175₁ to clear the heel portion 62 of the shell 30; and then rotating the last member 175₁ and the last member 175₂ together to remove them from the shell 30.

In some embodiments, respective ones of the last members 175₁-175_M of the last 152 may be movable relative to one another by disconnecting and separating them from one another. For example, one or more of the last members 175₁-175_M of the last 152 may be disassembled to facilitate removal of the shell 30 from the last 152. In such embodiments, one or more of the links 183₁-183_C linking adjacent ones of the last

members 175₁-175_M allow these adjacent last members to be connected to one another in the molding configuration of the last 152 and to be disconnected and separated from one another in the demolding configuration of the last 152.

- 5 The last members 175₁-175_M may comprise any suitable material. In this embodiment, the last members 175₁-175_M are rigid. For example, the last members 175₁-175_M may be made of metal, rigid plastic, wood, or any other suitable material.

In a variant, in some embodiments, as shown in Figures 111 to 115, the last 152
10 comprises a base 199 that includes last members 175₁, 175₂ which are movable relative to one another, and a last member 175₃ that is a removable covering 179, i.e., sheath, which covers the base 199 and is removable from the base 199. The sheath 179 may allow different sizes or shapes of the shell 30 to be molded on the 152 by using different sheaths similar to the sheath 179, protect against leakage of the
15 polymeric material M₁ during injection, and/or reduce or eliminate internal parting lines on the shell 30.

In this embodiment, the sheath 179 is flexible to facilitate its placement onto the base 199 of the last 152 and its subsequent removal upon molding, yet sufficiently strong to
20 maintain its desired shape during molding of the shell 30. For instance, in some embodiments, the sheath 179 may comprise an elastomeric material, such as silicone rubber or any other polymeric material with suitable elasticity. For example, in some embodiments, a hardness of the elastomeric material of the sheath 179 may be between 10 Shore A and 99 Shore A or have any other suitable value. This may create
25 a sealing effect to protect against leakage of the polymeric material M₁ during injection. Also, the sheath 179 may have a smooth external surface that may reduce or eliminate internal parting lines on the shell 30.

Thus, in this embodiment, the sheath 179 is placed over the base 199 of the last 152
30 for molding the shell 30. This is facilitated by flexibility of the sheath 179. Then, to demold the shell 30, the last member 175₂ is moved relative to the last member 175₁

and the sheath 179 to clear a front region of the sheath 179. In this example, the last member 175₁ includes a cavity 171 and the last member 175₂ is rotatable into the cavity 171, thus effectively moving into an interior of the last member 175₁. The last member 175₁ and the last member 175₂ which is located in the cavity 171 are then
5 moved upwardly out of the sheath 179. The shell 30 may be removed by deforming the sheath 179 to take the shell 30 away from it. Alternatively, in some cases, the sheath 179 may be left in the shell 30 to be part of the skate boot 22 of the skate 10.

The sheath 179 of the last 152 may be implemented in various other ways in other
10 embodiments.

For example, in some embodiments, the sheath 179 may comprises a reinforcement (e.g., a layer of fabric such as mesh, a thin metallic layer, a plastic film, etc.) within its elastomeric material to reinforce it (e.g., protect against tearing).
15

As another example, in some embodiments, the sheath 179 may be injection molded using a thermoplastic material such as polypropylene, polyethylene (e.g., high-density polyethylene), or any other suitable material (e.g., with low surface adhesion).

20 As another example, in some embodiments, as shown in Figures 116 and 117, a thickness of the sheath 179 may vary to define the undercuts 51₁-51₆ of the shell 30 while facilitating demolding of the shell 30 from the last 152. For example, in this embodiment, the sheath 179 is thicker at locations of the medial and lateral depressions 78, 80 of the shell 30 for receiving the medial and lateral malleoli MM, LM
25 of the player, the recesses 83₁, 83₂ defined by the curvature of the heel portion 62 in the longitudinal and heightwise directions of the skate 10 and the curvature of the heel portion 62 in the widthwise direction of the skate 10, and the recesses 86₁, 86₂ defined by the curvature of the medial side portion 66 and the curvature of the lateral side portion 68 in the longitudinal and heightwise directions of the skate 10 adjacent to the
30 player's forefoot. Also, in this embodiment, the last member 175₁ is shaped (e.g., straight or tapered downwardly) so as to be movable vertically during demolding and

the last member 175₂ can be removed from the shell 30 after moving the last member 175₁ vertically.

As another example, in some embodiments, the sheath 179 may be a film placed (e.g.,
5 wrapped about) the base 199 of the last 152.

As another example, in other embodiments, the sheath 179 may be an impermeable sock pullable onto and off the last 152.

10 The control system 187 to control movement of the last members 175₁-175_M relative to one another may be implemented in any other suitable way in other embodiments.

For example, in some embodiments, as shown in Figure 118 and 119, the control system 187 may be configured to control movement of last members 175₁, 175₂ so
15 that the last 152 is expandable into its molding configuration and contractible into its demolding configuration. In this embodiment, the links 183₁-183_C between the last members 175₁, 175₂ include a central member 186 and arms 189₁-189_A that extend from the central member 186 to respective ones of the last members 175₁, 175₂, such that movement of the central member 186 in a given direction (e.g., downwardly)
20 causes the arms 189₁-189_A to push the members 175₁, 175₂ away from one another to expand the last 152 for molding the shell 30, and movement of the central member 186 in an opposite direction (e.g., upwardly) causes the arms 189₁-189_A to pull the members 175₁, 175₂ towards one another to contract the last 152 for demolding the shell 30.

25

The last members 175₁-175_M may be implemented in any other suitable way in other embodiments. For example, in various embodiments, the last members 175₁-175_M may have any other suitable shape, there may be any other suitable number of last members (e.g., two, three, four, six, seven, etc. last members), respective ones of the
30 last members 175₁-175_M may move in any other way relative to one another, etc. Also, in various embodiments, features of the last members 175₁-175_M of different

embodiments considered herein may be combined together in some examples of implementation.

With additional reference to Figures 120 to 122, in some embodiments, a given one of the female molds 154₁-154₃ may comprise a flexible female mold member 410 comprising an inner surface 414 constituting at least part of an inner surface of the given one of the female molds 154₁-154₃ and preformed to define a given one of the mold cavities 156, 158, 160 between itself and the last 152 in which a given one of the polymeric materials M₁-M₃ is injected to mold a given one of the subshells 85₁-85₃ such that the inner surface 414 creates an outer surface of the given one of the subshells 85₁-85₃. The flexible female mold member 410, which will also be referred to as a “membrane”, is configured to avoid at least one parting line on the shell 30 that would otherwise result because of the portions 155, 157 of the given one of the female molds 154₁-154₃ if the membrane 410 was omitted.

15

For example, in this embodiment, the membrane 410 is part of the female mold 154₁ such that its inner surface 414 is preformed to define the mold cavity 156 between itself and the last 152 in which the polymeric material M₁ is injected to mold the subshell 85₁ such that the inner surface 414 creates the outer surface of the subshell 85₁.

20

The inner surface 414 of the membrane 410 is preformed in that it is formed to define the mold cavity 156 to mold the subshell 85₁ and create the outer surface of the subshell 85₁ before the membrane 410 is placed in the molding apparatus 150. For instance, the membrane 410 may be preformed in a separate mold in a prior operation.

25

The membrane 410 is flexible to flex during movement of the portions 155, 157 of the female mold 154₁ when closing and opening the female mold 154₁ and overlies one or more spaces where the portions 155, 157 of the female mold 154₁ move relative to one another. This allows one or more parting lines to be avoided as the membrane 410 overlies where these one or more parting lines would otherwise be located.

30

In this embodiment, the membrane 410 extends continuously to constitute to at least a majority (i.e., a majority or an entirety) of the inner surface of the female mold 154₁ and to create at least a majority of the outer surface of the subshell 85₁. More particularly, in this embodiment, the membrane 410 comprises medial and lateral side portions 420, 5 422, an ankle portion 424, a heel portion 426, and a sole portion 428 that are integral and continuous with one another as a one-piece structure. In this example, the membrane 410 is flexible and jointless (i.e., without any joint) at the heel portion 426 and a rear of the ankle portion 424, while the medial and lateral side portions 420, 422 and medial and lateral parts of the sole portion 428 are separable and movable relative 10 to one another, to allow the membrane 410 to flex during movement of the portions 155, 157 of the female mold 154₁ when closing and opening the female mold 154₁.

Thus, in this embodiment, the membrane 410 is configured such that the subshell 85₁ may be free of parting lines opposite from one another (i.e., on opposite sides of the 15 subshell 85₁). For instance, in this embodiment, the subshell 85₁ may have a parting line 263, which in this example is in a toe portion of the subshell 85₁, but is free of any parting line opposite to the parting line 263, i.e., at an opposite side of the subshell 85₁, which in this example is a heel portion and a rear of an ankle portion of the subshell 85₁, because of the membrane 410.

20

In this embodiment, the membrane 410 may comprise an elastomeric material, such as silicone rubber, any other rubber, or any other polymeric material with suitable elasticity. For example, in some embodiments, a hardness of the elastomeric material of the membrane 410 may be between 10 Shore A and 99 Shore A or have any other 25 suitable value.

The membrane 410 of the molding apparatus 150 may be implemented in various other ways in other embodiments.

30 For example, in other embodiments, the membrane 410 may be flexible and jointless at other areas while separable and movable elsewhere to allow the membrane 410 to

flex during movement of the portions 155, 157 of the female mold 154_i when closing and opening the female mold 154_i. For instance, in some embodiments, the membrane 410 may be flexible and jointless at the sole portion 428, while medial and lateral parts of the ankle portion 424, medial and lateral parts of the heel portion 426, and the medial and lateral side portions 420, 422 are separable and movable relative to one another, to allow the membrane 410 to flex during movement of the portions 155, 157 of the female mold 154_i when closing and opening the female mold 154_i. In other embodiments, the membrane 410 may be flexible and jointless at a front portion, while medial and lateral parts of the sole portion 428, medial and lateral parts of the ankle portion 424, medial and lateral parts of the heel portion 426 and the medial and lateral side portions 420, 422 are separable and movable relative to one another, to allow the membrane 410 to flex during movement of the portions 155, 157 of the female mold 154_i when closing and opening the female mold 154_i.

As another example, in some embodiments, the membrane 410 may comprises a reinforcement (e.g., a layer of fabric such as mesh, a thin metallic layer, a plastic film, etc.) within its elastomeric material to reinforce it (e.g., protect against tearing).

As another example, in some embodiments, the membrane 410 may be injection molded using a thermoplastic material such as polypropylene, polyethylene (e.g., high-density polyethylene), or any other suitable material (e.g., with low surface adhesion).

As another example, in some embodiments, the membrane 410 may be incorporated into a rigid casting of a material (e.g., polyurethane, epoxy or other polymeric material; aluminum, steel or other metallic material; cement; etc.) stiffer and stronger than that of the membrane.

While the molding process has been described as being performed on a single molding apparatus 150, in some embodiments, the molding process may utilize various molding apparatuses (e.g., molding stations), each apparatus comprising a different female mold 154_i. In such embodiments, the last 152, still mounted with at least one subshell

85_i, can be moved from one molding station to the next without requiring removal of the female molds installed on the various molding apparatuses. In some embodiments, molding stations may be horizontally distributed (e.g., linearly and/or in a carousel or other rotary or otherwise curved arrangement). In other embodiments, molding stations
5 may be vertically distributed such as being stacked vertically over one another, which may be more efficient space-wise.

With additional reference to Figures 19 and 20, in some embodiments, the shell 30 may comprise a reinforcement 115 disposed between certain ones of the subshells
10 85₁-85_L of the shell 30 such as, for example, between the intermediate and external subshells 85₂, 85₃. The reinforcement 115 is produced separately from the shell 30 and is configured to reinforce selected areas of the shell 30 (e.g., the medial and/or lateral side portions 66, 68 of the shell 30) such as, for example, to make it stronger or stiffer (e.g., increase resistance to deflection or impacts). In order to include the
15 reinforcement 115 between the intermediate and external subshells 85₂, 85₃, the reinforcement 115 is affixed to an exterior surface of the intermediate subshell 85₂ after forming the intermediate subshell 85₂ and prior to forming the external subshell 85₃. For instance, the reinforcement 115 may be mechanically affixed (e.g., stapled, stitched, etc.), glued (e.g., via an adhesive), ultrasonically bonded, or affixed in any
20 other suitable way to the exterior surface of the intermediate subshell 85₂.

The reinforcement 115 may be configured in any suitable way. For instance, as shown in Figure 20A, the reinforcement 115 may comprise a plurality of ribs 117₁-117_R (or a single rib 117_i) which project outwardly from the exterior surface of the intermediate
25 subshell 85₂ when the reinforcement 115 is affixed to the intermediate subshell 85₂. Moreover, the ribs 117₁-117_R may extend on the shell 30 and/or on the blade holder 24. As shown in Figure 20B, in some embodiments, the ribs 117₁-117_R may extend from the shell 30 to the blade holder 24. That is, the ribs 117₁-117_R have a vertical extent that spans the blade holder 24 and the shell 30. In other examples, the ribs
30 117₁-117_R may span the blade holder 24, the shell 30 and the lace members 44₁, 44₂. Furthermore, in some cases, the ribs 117₁-117_R may not all be disposed between the

same subshells. For example, in some cases, a first rib 117_i may be disposed between the intermediate and external subshells 85₂, 85₃ while a second rib 117_j is disposed between the internal and intermediate subshells 85₁, 85₂.

5 Alternatively, as shown in Figure 21, the reinforcement 115 may comprise a reinforcing sheet 119 that is similarly affixed to the exterior surface of the intermediate subshell 85₂ (e.g., glued thereto). In this embodiment, the reinforcing sheet 119 comprises a material that is stiffer and/or harder than the polymeric material M₂ of the intermediate subshell 85₂. For instance, the reinforcing sheet 119 may comprise a composite
10 material comprising thermoset material, thermoplastic material, carbon fibers and/or fiberglass fibers. For example, the composite material may be a fiber-matrix composite material that comprises a matrix in which fibers are embedded. The matrix may include any suitable polymeric resin, such as a thermosetting polymeric material (e.g., polyester, vinyl ester, vinyl ether, polyurethane, epoxy, cyanate ester, etc.), a
15 thermoplastic polymeric material (e.g., polyethylene, polypropylene, acrylic resin, polyether ether ketone, polyethylene terephthalate, polyvinyl chloride, polymethyl methacrylate, polycarbonate, acrylonitrile butadiene styrene, nylon, polyimide, polysulfone, polyamide-imide, self-reinforcing polyphenylene, etc.), or a hybrid thermosetting-thermoplastic polymeric material. The fibers may be made of any
20 suitable material such as carbon fibers, polymeric fibers such as aramid fibers, boron fibers, glass fibers, ceramic fibers, etc.

Furthermore, in some embodiments, the reinforcing sheet 119 may comprise a fabric or textile material. For example, the reinforcing sheet 119 may comprise a fabric mesh
25 such as a nylon mesh or any other suitable fabric material. For example, the reinforcing sheet 119 may envelop the subshell 85_x over which it is disposed such as to cover at least a majority (i.e., a majority or an entirety) of an outer surface of that subshell 85_x. Moreover, the reinforcing sheet 119 may also cover at least a majority of an internal surface of a subsequent subshell 85_y overlying the subshell 85_x. Thus, the
30 reinforcing sheet 119 may extend from the lateral side portion 66 to the medial side portion 68 of the shell 30. In other cases, the reinforcing sheet 119 may be disposed at

limited portions of the shell 30 (e.g., only the ankle portion 64 of the shell 30).

In another example, as shown in Figure 21C, the reinforcement 115 may comprise a single fiber 111 rather than a fabric mesh. The single fiber 111 is configured to apply
5 tension forces on the shell 30 and/or other components of the skate boot 22. In particular, the tension of the single fiber 111 is transmitted onto the shell 30 and thus may allow controlling its performance.

In some embodiments, multiple reinforcements 115 may be included between the
10 subshells 85₁-85_L of the shell 30. For instance, a rib 117_i may be disposed at a selected area of the shell 30 while a reinforcing sheet 119 may be disposed at another selected area of the shell 30.

Moreover, in some embodiments, rather than or in addition of the reinforcement 115,
15 the shell 30 may comprise a decoration 121, which can be referred to as a design element, disposed between certain ones of the subshells 85₁-85_L of the shell 30 such as, for instance, between the intermediate and external subshells 85₂, 85₃ as shown in Figure 19. The design element 121 constitutes an aesthetic element that is produced separately from the shell 30 and may be included in the shell 30 in order to affect its
20 aesthetic look. For instance, the design element 121 may comprise a piece of material including a graphical representation of: one or more alphanumeric characters that may form text (e.g., a word, a message, etc.); one or more symbols (e.g., a logo, a sign, an emblem, etc.); one or more shapes or patterns; and/or one or more real or imaginary objects (e.g., a person, an animal, a vehicle, an imaginary or fictional character, or any
25 other real or imaginary thing). The design element 121 is affixed to an exterior surface of the intermediate subshell 85₂ after forming the intermediate subshell 85₂ and prior to forming the external subshell 85₃. For instance, the design element 121 may be mechanically affixed (e.g., stapled, stitched, etc.), glued (e.g., via an adhesive), ultrasonically bonded, or affixed in any other suitable way to the exterior surface of the
30 intermediate subshell 85₂. While a single design element 121 is depicted in Figure 19, the shell 30 may comprise a plurality of such design elements which may be spaced

apart from one another. Moreover, in some cases, the reinforcement 115, which is depicted in Figure 19 spaced apart from the decoration 121, itself may act as a decoration in addition to its reinforcing functionality.

5 Once the reinforcement 115 (or multiple reinforcements 115) and/or the design element 121 (or multiple design elements 121) has been affixed to the exterior surface of the intermediate subshell 85₂, the molding process proceeds as described above. Notably, the next subshell, in this case the external subshell 85₃, is formed such that it covers the reinforcement 115 and/or the design element 121 thus trapping the
10 reinforcement 115 and/or the design element 121 between the intermediate subshell 85₂ and the external subshell 85₃. In some embodiments, the external subshell 85₃ may be clear (i.e., translucent) and may thus allow displaying the reinforcement 115 and/or the design element 121 through the external subshell 85₃. This may be particularly useful to display the design element 121 but may also be useful to display
15 the reinforcement 115 for aesthetic purposes.

In this embodiment, the molding process employed to form the shell 30 is low-pressure injection molding. That is, the polymeric materials M₁-M_N that constitute the subshells 85₁-85_L are injected into the mold cavity formed by each mold 154_i at a relatively low
20 pressure. In addition, the molding process employed to form the shell 30 may be characterized as a co-injection molding process since the polymeric materials M₁-M_N are injected into a same mold.

In this embodiment, no external heat is applied to the polymeric materials M₁-M_N of the
25 shell 30. Rather, in this embodiment, as shown in Figure 22, in order to form a subshell 85_i, two or more constituents of a given polymeric material M_x chemically react when combined to release heat. In other words, the two or more constituents have an exothermic reaction when combined. For instance, in one example, the material M_x is polyurethane and includes constituents 125, 127 that chemically react when combined.
30 The constituents 125, 127 may be polyols and isocyanates. The exothermic chemical reaction that characterizes the molding process of the shell 30 contrasts the

conventional method of forming a skate boot shell which involves thermoforming whereby heat is applied to a thermoformable sheet of material in a mold such that the thermoformable sheet of material acquires the shape of the mold.

- 5 The molding process of the shell 30 may be implemented in any suitable way in other embodiments. For example, in some embodiments, injection molding at higher pressure may be used. As another example, in some embodiments, two or more lasts such as the last 152 may be used (e.g., different lasts for molding respective ones of the subshells 85₁-85_L). Moreover, the last 152 may be configured differently than the
- 10 last shown in Figure 13. For instance, the last 152 may not comprise projections for forming the apertures 48 and rather one or more of the female molds 154₁-154_N may comprise such projections for forming the apertures 48. In other cases, the projections on the last 152 for forming the apertures 48 may be retractable. As another example, in some embodiments, the molding process of the shell 30 may be casting in which the
- 15 polymeric materials M₁-M_N are poured into one or more molds.

The skate boot 22 may comprise an overlay 102 on an external surface 65 of the shell 30 for aesthetic or functional purposes.

- 20 With additional reference to Figure 23, in this embodiment, the overlay 102 comprises a plurality of overlay elements 104₁-104_O that can be disposed at any suitable part of the shell 30. For example, in some cases, the overlay elements 104₁-104_O may be a graphic (e.g., a logo), a brand name, a pattern, a word, etc. While the overlay elements 104₁-104_O may improve an aesthetic appearance of the skate 10, in some cases,
- 25 certain overlay elements 104₁-104_O may also serve functional purposes. For instance, in some cases, the overlay elements 104₁-104_O may be configured to minimize wear of at least a portion of the external surface 65 of the shell 30. For example, an overlay element 104_x may be located close to a bottom portion of the medial and/or lateral sides of the shell 30 in order to prevent contact between the playing surface 12 and the
- 30 shell 30 of the skate boot 22. This may help in reducing undue wear of the skate 10.

The overlay 102 may be affixed to the external surface 65 of the shell 30 in various ways. For instance, each of the overlay elements 104₁-104₀ may be mechanically fastened to the external surface 65 of the shell 30 (e.g., via stitching, staples, etc.), glued thereto via an adhesive, or ultrasonically bonded. The overlay elements 104₁-
5 104₀ may be affixed to the external surface 65 of the shell 30 in any other suitable way.

The inner lining 36 of the skate boot 22 is affixed to an inner surface of the shell 30 and comprises an inner surface 96 for facing the heel HL and medial and lateral sides MS, LS of the player's foot 11 and ankle A in use. The inner lining 36 may be made of a soft
10 material (e.g., a fabric made of NYLON® fibers or any other suitable fabric). The footbed 38 is mounted inside the shell 30 and comprises an upper surface 106 for receiving the plantar surface PS of the player's foot 11 and a wall 108 projecting upwardly from the upper surface 106 to partially cup the heel HL and extend up to a medial line of the player's foot 11. The insole 40 has an upper surface 25 for facing the
15 plantar surface PS of the player's foot 11 and a lower surface 23 on which the shell 30 may be affixed.

In some embodiments, the skate boot 22 may not comprise an inner lining 36. For instance, the internal subshell 85₁ of the shell 30 of the skate boot 22 may serve as an
20 inner lining already and thus the addition of the inner lining 36 may be redundant. In other cases, the inner lining 36 may be inserted during the molding process using the molding apparatus 150. For example, a textile material may first be placed on the last 152 prior to forming the first subshell (i.e., the internal subshell 85₁) such as to serve as a pre-formed "sock" onto which the internal subshell 85₁ is formed.

25

The toe cap 32 of the skate boot 22 is configured to face and protect the toes T of the player's foot 11. As will be described in more detail below, in this example, at least part (i.e., part or all) of the toe cap 32 is formed integrally with the shell 30. As shown in
30 Figures 6, 8 and 9, the toe cap 32 comprises a bottom portion 116 for at least partially covering a front portion of the lower surface 23 of the insole 40, a lateral side portion 118 for facing a small toe of the foot 11 of the player, a medial side portion 120 for

facing a big toe of the foot 11 of the player, an end portion 122 between the lateral and medial side portions 118, 120, an upper portion 124 for facing a top of the toes T of the player's foot 11, and a top extension 126 for affixing the tongue 34 to the toe cap 32. The top extension 126 of the toe cap 32 may be affixed (e.g., glued and/or stitched) to a distal end portion of the tongue 34 in order to affix the tongue 34 to the toe cap 32.

The toe cap 32 may comprise a synthetic material 105 that imparts stiffness to the toe cap 32. For instance, in various embodiments, the synthetic material 105 of the toe cap 32 may comprise nylon, polycarbonate materials (e.g., Lexan®), polyurethane, thermoplastics, thermosetting resins, reinforced thermoplastics, reinforced thermosetting resins, polyethylene, polypropylene, high density polyethylene or any other suitable material. In some cases, the synthetic material 105 of the toe cap 32 may be a composite material comprising thermoset material, thermoplastic material, carbon fibers and/or fiberglass fibers. For example, the composite material may be a fiber-matrix composite material that comprises a matrix in which fibers are embedded. The matrix may include any suitable polymeric resin, such as a thermosetting polymeric material (e.g., polyester, vinyl ester, vinyl ether, polyurethane, epoxy, cyanate ester, etc.), a thermoplastic polymeric material (e.g., polyethylene, polyurethane, polypropylene, acrylic resin, polyether ether ketone, polyethylene terephthalate, polyvinyl chloride, polymethyl methacrylate, polycarbonate, acrylonitrile butadiene styrene, nylon, polyimide, polysulfone, polyamide-imide, self-reinforcing polyphenylene, etc.), or a hybrid thermosetting-thermoplastic polymeric material. The fibers may be made of any suitable material such as carbon fibers, polymeric fibers such as aramid fibers, boron fibers, glass fibers, ceramic fibers, etc.

The tongue 34 extends upwardly and rearwardly from the toe cap 32 for overlapping the top surface TS of the player's foot 11. In this embodiment, with additional reference to Figure 24, the tongue 34 comprises a core 140 defining a section of the tongue 34 with increased rigidity, a padding member (not shown) for absorbing impacts to the tongue 34, a peripheral member 144 for at least partially defining a periphery 145 of

the tongue 34, and a cover member 146 configured to at least partially define a front surface of the tongue 34. The tongue 34 defines a lateral portion 147 overlying a lateral portion of the player's foot 11 and a medial portion 149 overlying a medial portion of the player's foot 11. The tongue 34 also defines a distal end portion 151 for affixing to the toe cap 32 (e.g., via stitching) and a proximal end portion 153 that is nearest to the player's shin S.

The tendon guard 35 extends upwardly from the rear portion 82 of the ankle portion 64 of the shell 30 in order to protect the player's Achilles tendon AT. As will be described in more detail below, in this embodiment, at least part (i.e., part or all) of the tendon guard 35 is integrally formed with the shell 30 of the skate boot 22. In other embodiments, the tendon guard 35 may be a separate component from the shell 30 such that the tendon guard 35 is fastened to the shell 30 via a mechanical fastener (e.g., via stitching, stapling, a screw, etc.) or in any other suitable way.

15

The skate boot 22 may be constructed in any other suitable way in other embodiments. For example, in other embodiments, various components of the skate boot 22 mentioned above may be configured differently or omitted and/or the skate boot 22 may comprise any other components that may be made of any other suitable materials and/or using any other suitable processes.

20

As shown in Figure 25, the blade 26 comprises an ice-contacting material 220 including an ice-contacting surface 222 for sliding on the ice surface while the player skates. In this embodiment, the ice-contacting material 220 is a metallic material (e.g., stainless steel). The ice-contacting material 220 may be any other suitable material in other embodiments.

25

As shown in Figures 4, 5 and 7, the blade holder 24 comprises a lower portion 162 comprising a blade-retaining base 164 that retains the blade 26 and an upper portion 166 comprising a support 168 that extends upwardly from the blade-retaining base 164 towards the skate boot 22 to interconnect the blade holder 24 and the skate

30

boot 22. A front portion 170 of the blade holder 24 and a rear portion 172 of the blade holder 24 define a longitudinal axis 174 of the blade holder 24. The front portion 170 of the blade holder 24 includes a frontmost point 176 of the blade holder 24 and extends beneath and along the player's forefoot in use, while the rear portion 5 172 of the blade holder 24 includes a rearmost point 178 of the blade holder 24 and extends beneath and along the player's hindfoot in use. An intermediate portion 180 of the blade holder 24 is between the front and rear portions 170, 172 of the blade holder 24 and extends beneath and along the player's midfoot in use. The blade holder 24 comprises a medial side 182 and a lateral side 184 that are opposite one 10 another.

The blade-retaining base 164 is elongated in the longitudinal direction of the blade holder 24 and is configured to retain the blade 26 such that the blade 26 extends along a bottom portion 186 of the blade-retaining base 164 to contact the ice surface 15 12. To that end, the blade-retaining base 164 comprises a blade-retention portion 188 to face and retain the blade 26. In this embodiment, as shown in Figure 26A, the blade-retention portion 188 comprises a recess 190 in which an upper portion of the blade 26 is disposed.

20 The blade holder 24 can retain the blade 26 in any suitable way. For instance, in this embodiment, the blade 26 may be permanently affixed to the blade holder 24 (i.e., not intended to be detached and removed from the blade holder 24). For example, as shown in Figure 27, the blade 26 and the blade-retaining base 164 of the blade holder 24 may be mechanically interlocked via an interlocking portion 234 of one of 25 the blade-retaining base 164 and the blade 26 that extends into an interlocking void 236 of the other one of the blade-retaining base 164 and the blade 26. For instance, in some cases, the blade 26 can be positioned in a mold used for molding the blade holder 24 such that, during molding, the interlocking portion 234 of the blade-retaining base 164 flows into the interlocking void 236 of the blade 26 (i.e., the blade 30 holder 24 is overmolded onto the blade 26). In some embodiments, as shown in Figures 26 and 28, the blade holder 24 may retain the blade 26 using an adhesive

226 and/or one or more fasteners 228. For instance, in some embodiments, as shown in Figure 26, the recess 190 of the blade holder 24 may receive the upper portion of the blade 26 that is retained by the adhesive 226. The adhesive 226 may be an epoxy-based adhesive, a polyurethane-based adhesive, or any suitable adhesive. In some embodiments, instead of or in addition to using an adhesive, as shown in Figure 29, the recess 190 of the blade holder 24 may receive the upper part of the blade 26 that is retained by the one or more fasteners 228. Each fastener 228 may be a rivet, a screw, a bolt, or any other suitable mechanical fastener. In some embodiment, the blade holder 24 may retain the blade 26 via a press fit. For example, as shown in Figure 26B, the recess 190 of the blade holder 24 may be configured (e.g., sized) such as to enter into a press fit with the blade 26. More particularly, in this example of implementation, the blade 26 comprises an elastomeric coating 237 including an elastomeric material (e.g., polyurethane, rubber, or any other suitable elastomeric material) that forms at least part of an outer surface of the blade 26. The elastomeric coating 237 has a greater friction coefficient than the ice-contacting material 220 of the blade 26 when interacting with the blade holder 24 such as to improve retention of the blade 26 by the blade holder 24 in a press fit. Alternatively or additionally, in some embodiments, as shown in Figure 28, the blade-retention portion 188 of the blade holder 24 may extend into a recess 230 of the upper part of the blade 26 to retain the blade 26 using the adhesive 226 and/or the one or more fasteners 228. For instance, in some cases, the blade-retention portion 188 of the blade holder 24 may comprise a projection 232 extending into the recess 230 of the blade 26.

In this embodiment, the blade-retaining base 164 comprises a plurality of apertures 208₁-208₄ distributed in the longitudinal direction of the blade holder 24 and extending from the medial side 182 to the lateral side 184 of the blade holder 24. In this example, respective ones of the apertures 208₁-208₄ differ in size. The apertures 208₁-208₄ may have any other suitable configuration, or may be omitted, in other embodiments.

The blade-retaining base 164 may be configured in any other suitable way in other embodiments.

The support 168 is configured for supporting the skate boot 22 above the blade-retaining base 164 and transmit forces to and from the blade-retaining base 164 during skating. In this embodiment, the support 168 comprises a front pillar 210 and a rear pillar 212 which extend upwardly from the blade-retaining base 164 towards the skate boot 22. The front pillar 210 extends towards the front portion 56 of the skate boot 22 and the rear pillar 212 extends towards the rear portion 58 of the skate boot 22. The blade-retaining base 164 extends from the front pillar 210 to the rear pillar 212. More particularly, in this embodiment, the blade-retaining base 164 comprises a bridge 214 interconnecting the front and rear pillars 210, 212.

In this embodiment, at least part (i.e., part or all) of the blade holder 24 is integrally formed with the shell 30 of the skate boot 22. That is, at least part of the blade holder 24 and the shell 30 of the skate boot 22 constitute a monolithic one-piece structure. The blade holder 24 thus comprises a portion 215 that is integrally formed with the shell 30 of the skate boot 22 such that the portion 215 of the blade holder 24 and the shell 30 of the skate boot 22 are formed together as one-piece in the molding apparatus 150 during the molding process.

In this embodiment, the portion 215 of the blade holder 24 includes one or more of the polymeric materials M_1 - M_N of the subshells 85₁-85_L of the shell 30 of the skate boot 22. For instance, in this example, the portion 215 of the blade holder 24 includes the intermediate and external subshells 85₂, 85₃ and therefore comprises the polymeric materials M_2 , M_3 associated therewith. In particular, in this example, a majority of the blade holder 24 is constituted by the polymeric material M_2 of the intermediate subshell 85₂ such that the blade holder 24 consists primarily of a structural foam material. Alternatively, the portion 215 of the blade holder 24 may include one or more different materials.

In this embodiment, at least a majority (i.e., a majority or an entirety) of the blade holder 24 may be integrally formed with shell 30. That is, the portion 215 of the blade holder 24 may be a major portion or the entirety of the blade holder 24. In this embodiment, an entirety of the blade holder 24 is integrally formed with the shell 30.

5

Therefore, in this embodiment, the blade holder 24 is formed with the shell 30 in the molding apparatus 150 with the last 152. In particular, the blade holder 24 is initially formed during forming of the intermediate subshell 85₂ of the shell 30 and is completed by the forming of the external subshell 85₃ of the shell 30. That is, in this embodiment, as shown in Figure 73, the intermediate subshell 85₂ is the innermost subshell of the blade holder 24 while the external subshell 85₃ is the outermost subshell of the blade holder 24.

Moreover, in this embodiment, the blade 26 is attached to the blade holder 24 during the molding process by including the blade 26 in a given mold 154_i such that the blade holder 24 overmolds the blade 26 during the molding process. For instance, the mold 154_i may be designed specifically to hold the blade 26 during the molding process prior to the forming of the intermediate subshell 85₂.

In this embodiment, one or more other components (e.g., the toe cap 32, the tendon guard 35, the lace members 44₁, 44₂, the tongue 34, the footbed 38, etc.) of the skate boot 22 may be molded integrally with the shell 30 in the molding apparatus 150 during the molding process. The shell 30 and these one or more other components of the skate boot 22 may thus constitute a monolithic one-piece structure.

For example, in this embodiment, the toe cap 32, the tendon guard 35, and the lace members 44₁, 44₂ are molded integrally with the shell 30 in the molding apparatus 150 during the molding process.

30

For instance, in this embodiment, the toe cap 32 comprises a portion 217 that is integrally formed with the shell 30 such that the portion 217 of the toe cap 32 of the skate boot 22 and the shell 30 of the skate boot 22 are formed together as one-piece in the molding apparatus 150 during the molding process. As such, the portion 217
5 of the toe cap 32 of the skate boot 22 may include one or more of the polymeric materials M_1 - M_N of the subshells 85_1 - 85_L of the shell 30 of the skate boot 22.

In this embodiment, the portion 217 of the toe cap 32 includes one or more of the polymeric materials M_1 - M_N of the subshells 85_1 - 85_L of the shell 30 of the skate boot
10 22. For instance, in this example, the portion 217 of the toe cap 32 includes the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 and therefore comprises the polymeric materials M_1 , M_2 , M_3 associated therewith. Alternatively, the portion 217 of the toe cap 32 may include one or more different materials.

Moreover, in this embodiment, the tendon guard 35 comprises a portion 219 that is integrally formed with the shell 30 such that the portion 219 of the tendon guard 35 of the skate boot 22 and the shell 30 of the skate boot 22 are formed together as one-piece in the molding apparatus 150 during the molding process. As such, the portion 219 of the tendon guard 35 of the skate boot 22 may include one or more of
20 the polymeric materials M_1 - M_N of the subshells 85_1 - 85_L of the shell 30 of the skate boot 22. For instance, in this example, the portion 219 of the tendon guard 35 includes solely the external subshell 85_3 and therefore comprises the polymeric material M_3 associated therewith. Alternatively, the portion 219 of the tendon guard 35 may include one or more different materials. For example, in some embodiments,
25 the portion 219 of the tendon guard 219 may also comprise the internal subshell 85_1 and/or the intermediate subshell 85_2 such that the portion 219 of the tendon guard 35 also comprises the polymeric material M_1 and/or the polymeric material M_2 associated therewith.

Moreover, in this embodiment, each of the lace members 44_1 , 44_2 comprises a portion 221 that is integrally formed with the shell 30 such that the portion 221 of
30

each of the lace members 44₁, 44₂ of the skate boot 22 and the shell 30 of the skate boot 22 are formed together as one-piece in the molding apparatus 150 during the molding process. As such, the portion 221 of each lace member 44_i of the skate boot 22 may include one or more of the polymeric materials M₁-M_N of the subshells 85₁-85_L of the shell 30 of the skate boot 22. For instance, in this example, the portion 221 of the lace member 44_i includes solely the external subshell 85₃ and therefore comprises the polymeric material M₃ associated therewith. Alternatively, the portion 221 of the lace member 44_i may include one or more different materials. For example, in some embodiments, the portion 221 of the lace member 44_i may also comprise the internal subshell 85₁ and/or the intermediate subshell 85₂ such that the portion 221 of the lace member 44_i also comprises the polymeric material M₁ and/or the polymeric material M₂ associated therewith. Moreover, in this embodiment, the apertures 48 that extend through the lace members 44₁, 44₂ are formed during the molding process by appropriate structures (e.g., projections) of the last 152 and an associated female mold 154_i.

The skate 10 may be implemented in any other suitable manner in other embodiments.

For example, in some embodiments, as shown in Figures 30 to 32, only a limited part 225 of the blade holder 24 may be integrally formed with the shell 30. For instance, in some embodiments, the part 225 of the blade holder 24 may comprise a projection 227 projecting from an underside of the shell 30 to which another part 229 of the blade holder 24 may be secured. As shown in Figures 31 and 32, the projection 227 of the part 225 of the blade holder 24 may be secured to the other part 229 of the blade holder 24 via an adhesive 231 that is applied between the two parts 225, 229 or in some cases via mechanical fasteners such as a nut and bolt assembly 233 that traverses the parts 225, 229 to secure them together. The parts 225, 229 of the blade holder 24 may be secured to one another in any other suitable way in other embodiments. In other embodiments, a substantial part of the blade holder 24 may be molded integrally with the shell 30. For example, in some cases, at

least a majority of the blade holder 24 may be molded together with the shell 30. In some case, substantially an entirety of the blade holder 24 may be molded integrally with the shell 30.

5 For instance, in some embodiments, the blade holder 24 may retain the blade 26 in any other suitable way. For example, in other embodiments, as shown in Figure 33, the blade holder 24 comprises a blade-detachment mechanism 192 such that the blade 26 is selectively detachable and removable from, and attachable to, the blade holder 24 (e.g., when the blade 26 is worn out or otherwise needs to be replaced or
10 removed from the blade holder 24).

More particularly, in this embodiment, the blade 26 includes a plurality of projections 194, 196. The blade-detachment mechanism 192 includes an actuator 198 and a biasing element 200 which biases the actuator 198 in a direction towards the front
15 portion 170 of the blade holder 24. In this embodiment, the actuator 198 comprises a trigger. To attach the blade 26 to the blade holder 24, the front projection 194 is first positioned within a hollow space 202 (e.g., a recess or hole) of the blade holder 24. The rear projection 196 can then be pushed upwardly into a hollow space 204 (e.g., a recess or hole) of the blade holder 24, thereby causing the biasing element 200 to
20 bend and the actuator 198 to move in a rearward direction. The rear projection 196 will eventually reach a position which will allow the biasing element 200 to force the actuator 198 towards the front portion 170 of the blade holder 24, thereby locking the blade 26 in place. The blade 26 can then be removed by pushing against a finger-actuating surface 206 of the actuator 198 to release the rear projection 196 from the
25 hollow space 204 of the blade holder 24. Thus, in this embodiment, the blade-detachment mechanism 192 is free of any threaded fastener (e.g., a screw or bolt) to be manipulated to detach and remove the blade 26 from the blade holder 24 or to attach the blade 26 to the blade holder 24.

30 Further information on examples of implementation of the blade-detachment mechanism 192 in some embodiments may be obtained from U.S. Patent 8,454,030

hereby incorporated by reference herein. The blade-detachment mechanism 192 may be configured in any other suitable way in other embodiments.

The blade 26 may be implemented in any other suitable way in other embodiments.

5 For example, in some embodiments, as shown in Figures 34 and 35, the blade 26 may comprise a runner 238 that is made of the ice-contacting material 220 and includes the ice-contacting surface 222 and a body 240 connected to the runner 238 and made of a material 242 different from the ice-contacting material 220. The runner 238 and the body 240 of the blade 26 may be retained together in any
10 suitable way. For example, in some cases, the runner 238 may be adhesively bonded to the body 240 using an adhesive. As another example, in addition to or instead of being adhesively bonded, the runner 238 and the body 240 may be fastened using one or more fasteners (e.g., rivets, screws, bolts, etc.). As yet another example, the runner 238 and the body 240 may be mechanically interlocked
15 by an interlocking portion of one of the runner 238 and the body 240 that extends into an interlocking space (e.g., one or more holes, one or more recesses, and/or one or more other hollow areas) of the other one of the runner 238 and the body 240 (e.g., the body 240 may be overmolded onto the runner 238).

20 In some embodiments, one or more other components (e.g., the tongue 34, the footbed 38, etc.) of the skate boot 22 may be molded integrally with the shell 30 in the molding apparatus 150 during the molding process. The shell 30 and these one or more other components of the skate boot 22 may thus constitute a monolithic one-piece structure. A given component of the skate boot 22 may therefore
25 comprise a portion 235 that is integrally formed with the shell 30 such that the portion 235 of the given component of the skate boot 22 and the shell 30 of the skate boot 22 are formed together as one-piece in the molding apparatus 150 during the molding process.

30 As such, the portion 235 of the given component of the skate boot 22 may include one or more of the polymeric materials M_1 - M_N of the subshells 85₁-85_L of the shell 30

of the skate boot 22. For instance, the portion 235 of the given component may include one or more of the internal, intermediate and external subshells 85_1 , 85_2 , 85_3 and therefore may comprise one or more of the polymeric materials M_1 , M_2 , M_3 associated therewith. Alternatively, the portion 235 of the given component may
5 include one or more different materials.

For example, in some embodiments, with additional reference to Figure 36, the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44_1 , 44_2 may be molded integrally with the shell 30 of the skate boot 22. That is, at
10 least a portion of (i.e., a part or an entirety of) each of the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44_1 , 44_2 may be formed integrally with the shell 30 as one-piece in the molding apparatus 150 during the molding process.

15 As shown in Figure 42, in some embodiments, when the footbed 38 is formed integrally with the shell 30 during the molding process, one or more the subshells 85_1 - 85_L may form the footbed 38. Moreover, in some embodiments, as shown in Figure 43A, when the footbed 38 is formed integrally with the shell 30 during the molding process, a portion of the footbed 38 may project outwardly such as to fill a
20 gap of a subshell 85_i in the sole portion 69 of the shell 30.

In some embodiments, as shown in Figure 45, when the footbed 38 is formed integrally with the shell 30 during the molding process, the footbed 38 may be configured to project outwardly such as to fill respective gaps of the internal and
25 intermediate subshells 85_1 , 85_2 in the sole portion 69 of the shell 30.

In some embodiments, at least a portion of (i.e., part or an entirety of) the blade holder 24 may be attached to a given one of the subshells 85_1 - 85_L of the shell 30. For instance, the portion of the blade holder 24 may be joined to the given one of the
30 subshells 85_1 - 85_L during forming of the shell 30. For example, as shown in Figure 47A, the portion of the blade holder 24 may be affixed to an exterior surface of the

internal subshell 85₁ and the intermediate and external subshells 85₂, 85₃ may be formed around the portion of the blade holder 24.

5 In other embodiments, as discussed above, the portion of the blade holder 24 may be formed during the molding process of the shell 30. For example, as shown in Figure 47B, a majority or an entirety of the portion of the blade holder 24 may be constituted by the external subshell 85₃. Moreover, the footbed 38 may be formed or affixed directly on the portion of the blade holder 24 (i.e., on the external subshell 85₃ that makes up a majority or an entirety of the portion of the blade holder 24).

10

In some embodiments, as shown in Figure 48, the footbed 38 may be formed integrally with the shell 30 so as to project outwardly into a gap of the internal subshell 85₁ in the sole portion 69 of the shell 30.

15 In some embodiments, as shown in Figure 52, when the blade holder 24 is formed integrally with the shell 30 during the molding process, the portion of the blade holder 24 that is formed integrally with the shell 30 (e.g., a part or an entirety of the blade holder 24) may be constituted by the intermediate subshell 85₂ such that the intermediate subshell 85₂ is exposed at the blade holder 24. In other embodiments,
20 as shown in Figure 53, when the blade holder 24 is formed integrally with the shell 30 during the molding process, a given one of the subshells 85₁-85_L may be formed to envelop the blade holder 24. That is, a given one of the subshells 85₁-85_L may be formed around the blade holder 24 but not around the shell 30.

25 In some embodiments, with additional reference to Figure 54, the shell 30 and possibly one or more other components of the skate boot 22 may be manufactured separately from the blade holder 24, which may be manufactured separately and attached to the skate boot 22.

30 For example, in some embodiments, as shown in Figure 37, the shell 30 of the skate boot 22 may be formed alone in the molding apparatus 150, i.e., separately from the

toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂. As shown in Figure 38, the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂ may be attached to the shell 30 after the shell 30 has been formed. For instance, any given one of the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂ may be formed on the shell 30 in a separate molding process similar to the one described above in respect of the shell 30. For example, the given one of the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂ may be overmolded onto the shell 30. In some cases, the given one of the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂ may be formed separately from the shell 30 during another molding process (e.g., a thermoforming process) and attached to the shell 30 via a fastener (e.g., stitching, stapling, etc.) or via gluing (e.g., using an adhesive).

In other embodiments, as shown in Figure 46, the footbed 38 may be an insert that is placed between the internal subshell 85₁ and the intermediate subshell 85₂ and/or between the internal subshell 85₁ and the external subshell 85₃ during forming of the shell 30 in a manner similar to that described above in respect of the reinforcement 115 for example. In such embodiments, the player's foot 11 does not contact the footbed 38 directly, however the footbed 38 may still provide comfort to the player's foot 11 by interacting between the subshells.

As shown in Figures 49 and 51, in some embodiments, the blade holder 24 may be formed separately from the internal, intermediate and external subshells 85₁, 85₂, 85₃ of the shell 30.

In such embodiments where the shell 30 and possibly one or more other components of the skate boot 22 are manufactured separately from the blade holder 24, the skate boot 22 may comprise an outsole 42, as shown in in Figure 54. The outsole 42 is affixed to an underside of the shell 30 for forming the skate boot 22. The outsole 42 comprises a rigid material for imparting rigidity to the outsole 42.

More particularly, in this embodiment, the rigid material of the outsole 42 comprises a composite material. For example, the composite material may be a fiber-matrix composite material that comprises a matrix in which fibers are embedded. The matrix may include any suitable polymeric resin, such as a thermosetting polymeric material (e.g., polyester, vinyl ester, vinyl ether, polyurethane, epoxy, cyanate ester, etc.), a thermoplastic polymeric material (e.g., polyethylene, polypropylene, acrylic resin, polyether ether ketone, polyethylene terephthalate, polyvinyl chloride, polymethyl methacrylate, polycarbonate, acrylonitrile butadiene styrene, nylon, polyimide, polysulfone, polyamide-imide, self-reinforcing polyphenylene, etc.), or a hybrid thermosetting-thermoplastic polymeric material. The fibers may be made of any suitable material such as carbon fibers, polymeric fibers such as aramid fibers, boron fibers, glass fibers, ceramic fibers, etc. In other embodiments, the rigid material may comprise any other suitable material (e.g., nylon, polycarbonate materials, polyurethane, thermoplastics, thermosetting resins, reinforced thermoplastics, reinforced thermosetting resins, polyethylene, polypropylene, high density polyethylene).

Moreover, in such embodiments where the skate boot 22 and the blade holder 24 are manufactured separately, the support 168 of the blade holder 24 and the skate boot 22 may be affixed to one another in any suitable way. For example, in some embodiments, as shown in Figure 55, the front and rear pillars 210, 212 are fastened to the skate boot 22 by fasteners (e.g., rivets, screws, bolts). In this example, each of the front and rear pillars 210, 212 comprises a flange 216 including a plurality of apertures 218₁-218_F to receive respective ones of the fasteners that fasten the blade holder 24 to the skate boot 22. The support 168 may be affixed to the skate boot 22 in any other suitable manner in other embodiments (e.g., by an adhesive).

In some embodiments, the skate boot 22 may comprise a reinforcement 270 molded integrally with the shell 30 to enhance a torsional strength of the skate boot 22 and/or protection of the player's foot 11 against impacts (e.g., from a puck or hockey stick).

For instance, the reinforcement 270 may comprise an extension 272 that extends beyond the ankle portion 64 of the shell 30 of the skate boot 22 in the longitudinal direction of the skate 10. In contrast, Figure 56 illustrates a conventional configuration of the shell 30 without the reinforcement 270 and thus without the extension 272. As shown, in such a conventional configuration, no part of the shell extends beyond the ankle portion 64 of the shell 30 in the longitudinal direction of the skate.

10 With additional reference to Figures 57A and 57B, the extension 272 may be located in front of the ankle portion 64 of the shell 30 in the longitudinal direction of the skate 10. As such, the extension 272 may be configured to protect a front portion of the player's ankle A and the top surface TS of the player's foot 11. The extension 272 may extend in front of the ankle portion 64 of the shell 30 to different extents. For instance, as shown in Figure 57B, the extension 272 may extend from the medial ankle side 74 of the ankle portion 64 of the shell 30 and wrap around the player's ankle A such that the extension 272 crosses from a medial half 278 of the skate boot 22 over a centerline 274 that generally bisects a width the skate boot 22 and into a lateral half 280 of the skate boot 22. In some cases, as shown in Figure 57A, the extension 272 may be shorter and extend frontwards from the medial ankle side 74 of the ankle portion 64 of the shell 30 and wrap around over a portion of the player's foot 11 but does not cross over into the lateral half 280 of the skate boot 22. Alternatively, in some cases, rather than extending from the medial ankle side 74, the extension 272 may extend from the lateral ankle side 76 of the ankle portion 64 of the shell 30.

In an example of the variant, as shown in Figure 58, the extension 272 may connect the medial ankle side 74 of the ankle portion 64 of the shell 30 to the lateral ankle side 76 of the ankle portion 64 of the shell 30 in a direction frontwardly of the ankle portion 64 of the shell 30. In other words, the extension 272 may be configured such that the shell 30 wraps around a front and a rear of the player's ankle A. As such,

the shell 30 may be continuous in a region frontwardly of the ankle portion 64 of the shell 30, and may thus lack an opening in which the tongue 34 of the skate boot 22 is typically located. Consequently, in such embodiments, the skate boot 22 may not comprise a tongue 34 or lace members 44₁, 44₂. Moreover, the extension 272 may
5 create a gap 275 (i.e., a spacing) between the extension 272 and the player's foot 11 in the longitudinal direction of the skate 10 to facilitate motion (e.g., flexion) of the ankle A while skating. In other embodiments, as shown in Figure 59, the extension 272 may be configured to wrap around the player's foot 11 such that there is substantially no gap between the extension 272 and the player's foot 11 in the
10 longitudinal direction of the skate 10.

In some embodiments, the extension 272 may comprise a plurality of free ends 276₁, 276₂ that are movable relative to one another and converge toward one another. In some embodiments, as shown in Figure 60, the free ends 276₁, 276₂ of
15 the extension 272 may meet in front of the ankle portion 64 of the shell 30. For example, the free ends 276₁, 276₂ may meet symmetrically about the centerline 274 of the skate 10. In other embodiments, the free ends 276₁, 276₂ may meet in the medial half 278 or the lateral half 280 of the skate boot 22. While Figure 60 illustrates the free ends 276₁, 276₂ as leaving a gap 275 between the player's foot
20 11 and the free ends 276₁, 276₂ in the longitudinal direction of the skate 10, in some embodiments, the free ends 276₁, 276₂ may terminate relatively close to the player's foot 11 such that there is substantially no gap between the player's foot 11 and the free ends 276₁, 276₂.

25 In some embodiments, each free end 276_i of the extension 272 may comprise an overlapping portion 282 that overlaps another portion of the free end 276_i in the longitudinal direction of the skate 10. For example, as shown in Figure 61, the overlapping portion 282 of each free end 276_i may be a portion of the free end 276_i that faces rearwardly toward the player's ankle A.

30

In a variant, the extension 272 may be in the rear portion 82 of the ankle portion 64 of the shell 30. For instance, as shown in Figure 62, the extension 62 may be configured such that the gap 275 is between a rear portion of the ankle A of the player and the extension 272. In some cases, the reinforcement 270 may comprise
5 more than one extension. For instance, with additional reference to Figures 63, 64 and 70, the skate boot 22 may comprise a first extension 272 extending frontwardly of the ankle portion 64 of the shell 30 and a second extension 284 extending rearwardly of the ankle portion 64 of the shell 30. In some embodiments, as shown in Figure 63, the second extension 284 may comprise the free ends 276₁, 276₂ such
10 that the free ends 276₁, 276₂ extend rearwardly of the ankle portion 64 of the shell 30.

In some examples of the variant where an extension 272, 284 of the skate boot 22 extends rearwardly of the ankle portion 64 of the shell 30, the tendon guard 35 may
15 be omitted in order to provide additional flexibility when skating.

In another variant, the reinforcement 270 may comprise the lace members 44₁, 44₂ of the skate boot 22. That is, the lace members 44₁, 44₂ may be configured to enhance a torsional strength of the skate boot 22 and/or protection of the player's
20 foot 11 against impacts. For instance, as shown in Figures 66 to 68, a given one of the lace members 44₁, 44₂ extending in a given one of the medial half 278 and the lateral half 280 of the skate boot 22 may cross over to the other one of the medial half 278 and the lateral half 280 of the skate boot 22. The other one of the lace members 44₁, 44₂ may generally follow a direction defined by the given one of the
25 lace members 44₁, 44₂. This may be defined as a "twisted" configuration of the skate boot 22.

As shown in Figure 69, in some examples of the twisted configuration of the skate boot 22, the reinforcement 270 may also comprise the extension 272. For example,
30 the extension 272 may extend from the medial ankle side 74 to the lateral ankle side 76 of the ankle portion 64 of the shell 30 in a direction frontwardly of the player's

ankle A such that the gap 275 is present between the extension 272 and the player's foot 11 in the longitudinal direction of the skate 10.

The twisted configuration of the skate boot 22 may increase the torsional rigidity and frontal impact protection of the skate boot 22 and thus may allow the shell 30 and/or other components of the skate boot 22 (e.g., the toe cap 32) to have a reduced thickness compared to a conventional skate boot without the twisted configuration where the lace members are confined to a single one of the medial or lateral halves of the skate boot. Moreover, the twisted configuration of the skate boot 22 may allow the skate boot 22 to be flexed in a different direction compared to a conventional skate boot. For instance, the twisted configuration of the skate boot 22 may allow the player to flex the skate boot 22 in the medial half 278 of the skate boot 22 in an area around the toe cap 32. As a result, the twisted configuration of the skate boot 22 may allow better conservation of energy used by the player to propulse himself/herself on the ice 12.

In another variant, with additional reference to Figure 65, the reinforcement 270 may comprise an opening 285 in the rear portion 82 of the ankle portion 64 of the shell 30. The opening 285 may extend vertically for a substantial portion of a height of the skate boot 22. For instance, in some cases, a ratio between a height of the opening 285 and the height of the skate boot 22 may be at least 0.3, in some cases at least 0.4, in some cases at least 0.5, in some cases at least 0.6 and in some cases even more.

In another variant, with reference to Figure 74, the blade holder 24 may be configured such that there is no spacing between the front and rear pillars 210, 212. In such a variant, the support 168 of the blade holder 24 comprises a "single" pillar 213 which is constituted by material that extends from the front portion 170 of the blade holder 24 to a rear portion 172 of the blade holder 24. In particular, in this example, the blade holder 24 does not have any openings extending from its lateral side to its medial side.

In another variant, the shell 30 and/or the blade holder 24 and/or another component of the skate boot 22 that is made integrally with the shell 30 may comprise one or more inserts 315₁-315_N over which one or more of the subshells 85₁-85_L may be molded. For instance, as shown in Figure 75, in this example, the blade holder 24 comprises a front insert 315₁ and a rear insert 315₂ which respectively make up a part of the front and rear pillars 210, 212. More particularly, in this example of implementation, the front and rear inserts 315₁, 315₂ make up at least a majority (i.e., a majority or an entirety) of the front and rear pillars 210, 212 of the support 168 of the blade holder 24. In this example, the front and rear inserts 315₁, 315₂ are affixed to the shell 30 during the molding process of the shell 30 in order to make the blade holder 24 integrally with the shell 30. For example, once a given number of the subshells 85₁-85_L are molded, the front and rear inserts 315₁, 315₂ are affixed to the formed subshells 85₁-85_L (e.g., by gluing, taping, or any other suitable way) and one or more other ones of the subshells 85₁-85_L, in this case the exterior subshell 85₃, is molded over the front and rear inserts 315₁, 315₂ and the formed subshells 85₁-85_L such as to form a continuous subshell 85₃ extending from the shell 30 to the blade holder 24. In other cases, as shown in Figure 76, the blade holder 24 may comprise a single one of the inserts 315₁, 315₂ (e.g., only the front insert 315₁ or only the rear insert 315₂).

In other examples, the inserts 315₁-315_N may not be part of the blade holder 24 but may instead form part of the shell 30. For instance, as shown in Figures 78A, in this example, the shell 30 comprises an insert 315_M disposed between given ones of the subshells 85₁-85_L. For example, the insert 315_M may be disposed on an outer surface of the intermediate subshell 85₂ such that the exterior subshell 85₃ may be molded over the insert 315_M and the intermediate subshell 85₂. The insert 315_M may be disposed at any portion of the shell 30. In this example, the insert 315_M is disposed at a middle portion of the shell 30 corresponding to the intermediate portion 68 of the skate boot 22. In particular, the insert 315_M is disposed such as to extend from the lateral side portion 66 of the shell 30 to the medial side portion 68 of

the shell 30 and wrapping around under the sole portion 69 of the shell 30. As shown in Figure 78B, the insert 315_M may extend to various heights on the medial and lateral side portions 66, 68 of the shell 30. In some cases, the insert 315_M may extend substantially a full height of each of the lateral and medial side portions 66, 68. As shown in Figure 78C, in some cases, the insert 315_M may not extend to the lateral and medial side portions 66, 68 of the shell 30 but may rather be confined to be disposed under the sole portion 69 of the shell 30.

In this example, the inserts 315₁-315_N comprise a foam material. In particular, the foam material of the inserts 315₁-315_N has a density that is less than the density of the exterior subshell 85₃. This may be helpful to reduce the weight of the skate 10.

In another variant, as shown in Figure 79, a given subshell 85_x (or more than one of the subshells) may comprise one or more filled portions 415₁-415_N made of a material M_z different from the material M_x of the subshell 85_x. The filled portions 415₁-415_N constitute a portion of an other subshell 85_y that was formed such as to fill a void in the given subshell 85_x. As such the filled portions 415₁-415_N can be said to be “inserted” into voids formed in the subshell 85_x and may thus be referred to as “inserts”. To implement the inserts 415₁-415_N, the subshell 85_x is first molded to include a void. This may be achieved in various ways. For example, the void of the subshell 85_x may be formed by placing a molding insert in the mold during molding of the subshell 85_x. Once the subshell 85_x has been demolded, the molding insert is removed, leaving a void in the subshell 85_x. Alternatively or additionally, the void of the subshell 85_x may be formed by removing (e.g., cutting out) a portion of the subshell 85_x to form a void. The subshell 85_x, which now includes a void, is then re-inserted into a corresponding mold and the material M_z is injected to fill in the void in the subshell 85_x, effectively resulting in the subshell 85_x comprising distinct materials. This can be useful to replace the material M_x of the subshell 85_x at selected locations with another material with desired characteristics such as to modify characteristics of the subshell 85_x. For example, the material M_z may have a stiffness that is different (e.g., greater or less than) from a density of the material M_x

of the subshell 85_x. In this example, the material M_z is stiffer than the material M_x of the subshell 85_x. Moreover, the material M_z may have a density that is different (e.g., greater or less than) from a density of the material M_x of the subshell 85_x. In this example, the material M_z is denser than the material M_x of the subshell 85_x. In particular, the inserts 415₁-415_N may modify the torsional characteristics of the skate boot 22 such that the skate boot 22 responds to torsional forces differently than if the subshell 85_x did not comprise the inserts 415₁-415_N.

The inserts 415₁-415_N may thus be distributed to achieve a desired performance of the skate boot 22. For example, Figures 80A to 80F show different potential distributions of the inserts 415₁-415_N. It is understood that the inserts 415₁-415_N may be positioned differently in other embodiments.

In some cases, rather than filling the void formed in the subshell 85_x, the void may be left unfilled. This may modify the torsional characteristics of the skate boot 22. For example, as shown in Figure 89, the void left in the subshell 85_x may form an opening 550 that can extend to an edge of the shell 30, such as the lateral or medial edges 45, 47 of the shell 30. The opening 550 comprises opposite edges 551, 552 which converge towards one another at a proximal end and are distanced from one another at a distal end. In some cases, the torsional behavior of the skate boot 22 modified by the opening 550 may allow the opposite edges 551, 552 to contact one another at the distal end. The act of contacting one another may act as a limit to the movement of the shell 30 allowed by the opening 550 which was otherwise not possible by the shell 30 without the opening 550.

In another variant, with reference to Figures 81 and 82, the molding process of the shell 30 (and other components that are integrally made with the shell 30) may include using a sheet 615 (e.g., a film) which may be helpful to facilitate the molding process and/or to facilitate the addition of aesthetic features (e.g, designs) to the skate boot 22. In this embodiment, the sheet 615 is a polymeric sheet comprising a polymeric material such as a polycarbonate, polypropylene, polyethylene or any

other suitable polymeric material. Moreover, in this example, the sheet 615 is a clear sheet (e.g., transparent or translucent) through which a person can see. In other examples, the sheet 615 may be opaque, colored (e.g., black, white or any other color), partially transparent, homogenous, and/or different at different areas.

5

In an example, the sheet 615 is overlaid on one or more of the formed subshells 85₁-85_L such as to acquire a shape of the underlying subshell 85_x (e.g., by thermoforming the sheet 615). In this example, the sheet 615 extends over at least a majority of the subshell 85_x. In some cases, the sheet 615 may extend over
10 substantially an entirety of the subshell 85_x. The sheet 615 may then be sealed (e.g., heat sealed) to form a seam 617. A female mold 154_x is then installed over the formed subshells 85₁-85_L and a material M_y of the subsequent subshell 85_y is injected between the sheet 615 and the underlying subshell 85_x. Once the subshell 85_y has cured a desired amount, the subshell 85_y is demolded from the mold 154_x.
15 The sheet 615 may allow the molding process of the subshell 85_y to be faster than if no sheet was used. Notably, the presence of the sheet 615 between the material M_y and the female mold 154_x may allow faster removal of the subshell 85_y therefrom as the subshell 85_y can be removed from the mold 154_x without the material M_y having to have gone through its full polymerization. In contrast, if no sheet was used during
20 the molding process, early removal of the subshell 85_y from the mold 154_x may compromise the quality of the subshell 85_y (e.g., it may be deformed). Furthermore, due to the presence of the sheet 615 between the material M_y and the female mold 154_x, the molding process may not require the addition of a mold release agent on surfaces of the mold 154_x which is typically included to facilitate demolding. As such,
25 the presence of the sheet 615 facilitates demolding of the subshells 85₁-85_L from the female mold 154_x without using a mold release agent. This may also decrease imperfections in the subshell 85_y since mold release agents, while useful, have a tendency to introduce imperfections in a molded product. Moreover, if fewer imperfections are formed, this may improve bonding between a subsequent subshell
30 85_z (that is molded over the subshell 85_y) and the subshell 85_y,

Once the subshell 85_y is molded, the sheet 615 may be disposed of and a new sheet 615 used in a similar manner to mold a subsequent subshell if any. Due to the relatively low cost of manufacturing the sheet 615, using the sheet 615 in the molding process may inexpensively increase quality of the subshells 85₁-85_L formed
5 therewith.

In another example, the sheet 615 may not be disposed of after molding. Instead, as shown in Figure 82, the sheet 615 may be affixed to the shell 30 such as, for example, being integrated as a layer between given ones of the subshells 85₁-85_L. In
10 this example, the sheet 615 is formed over the subshell 85₁ and the subshell 85₃ is molded over the sheet 615. In examples where the subshell 85₃ overlying the sheet 615 is a clear subshell (e.g., transparent or translucent), this may be useful to display the sheet 615 in the finished product. Notably, the sheet 615 may comprise one or more design elements 618. The design element 618 may constitute a
15 graphic, a color, a pattern, a word, a letter, a symbol or any other desired visual element. The design element 618 may be provided on the sheet 615 in any suitable way. For example, the design element 618 may be provided on the sheet 615 via silk-screening, pad printing, flexo printing or offset printing, or any other printing (e.g., jet print, water decal, sublimation, ink transfer, laser, etc.). The presence of the
20 design element 618 may on the sheet 615 may allow to hide or otherwise obscure visual imperfections in the subshells 85₁-85_L which do not affect the mechanical properties of the subshells 85₁-85_L. In some cases, the sheet 615 with the design element 618 may be implemented as a permanent film. In other cases, the sheet 615 with the design element 618 may be implemented as a release film having a
25 releasable layer that is removable and ink constituting the design element 618 that remains on the shell 30. Alternatively or additionally, the sheet 615 may comprise the reinforcement 115 (such as the ribs 117₁-117_R or the reinforcing sheet 119) which may be affixed thereto in any suitable way (e.g., gluing, stitching, welding, mechanical interlock, etc.).

30

In the example of Figures 81 and 82, the sheet 615 is configured to span the shell 30 and the toe cap 32. In other examples, the sheet 615 may be configured to span the shell 30, the blade holder 24, the toe cap 32, the lace members 44₁, 44₂ or any other components of the skate boot 22. Furthermore, the sheet 615 may constitute at least part of an external surface of the skate boot 22. In other words, the sheet 615 may be exposed, not only visually, but physically (i.e., it can be touched). Moreover, in some cases, the sheet 615 may constitute a majority of the external surface of the skate boot 22. For example, the sheet 615 may constitute substantially an entirety of the external surface of the skate boot 22.

10

While in the examples given, the sheet 615 has been shown as being disposed between the subshells 85₁-85_L, in other examples the sheet 615 may be disposed between the inner lining 36 and the internal subshell 85₁.

15 As another example, in some embodiments, the sheet 615 may be placed in the cavity 156 of the female mold 154₁ on the inner surface of the female mold 154₁ before molding the polymeric material M₁ on the last 152 to form the internal subshell 85₁ of the shell 30. This may allow molding of the polymeric material M₁ to form the internal subshell 85₁ and subsequent demolding without using a mold
20 release agent.

As yet another example, in some embodiments, the sheet 615 may be placed on the last 152 before molding the polymeric material M₁ to form the internal subshell 85₁ of the shell 30.

25

In some cases, the sheet 615 may be applied in planar form onto the last 152 or a given one of the subshells 85₁-85_L that is already molded to acquire the shape of the last 152 or that given one of the subshells 85₁-85_L. In other cases, the sheet 615 may be preformed in a non-planar form conforming to the shape of the last 152 or a
30 given one of the subshells 85₁-85_L before being placed on the last 152 or the given one of the subshells 85₁-85_L.

The sheet 615 may reduce or eliminate parting lines on the shell 30 (i.e., internal and/or external parting lines). For example, the sheet 615 may be configured to avoid at least one parting line on the shell 30 that would otherwise result because of the portions 155, 157 of a given one of the female molds 154₁-154₃ if the sheet 615 was omitted. This allows one or more parting lines to be avoided as the sheet 615 overlies where these one or more parting lines would otherwise be located.

In another variant, as shown in Figure 83, the skate boot 22 may comprise a slash guard 515 configured to protect the player from cuts at a level above lateral and medial upper edges 45, 47 of the shell 30. The slash guard 515 is movable with respect to the tendon guard 35 (or with respect to the rear portion 82 of the ankle portion 64 of the shell 30 if no tendon guard is included). This may provide cut-resistant protection of the player's ankle and/or shin while also allowing mobility thereof.

The slash guard 515 comprises a cut-resistant material 516 that resists cutting from impacts. In this example, the cut-resistant material 516 is a fabric consisting of aramid (e.g., Kevlar®) or any other suitable cut-resistant material. As such, the slash guard 515 may be pliable due to its fabric nature. In this embodiment, the slash guard 515 is movable with respect to the tendon guard 35 (or the rear portion 82 of the ankle portion 64 of the shell 30) due to the pliability of the cut-resistant material.

In this embodiment, the slash guard 515 is integrated (i.e., built into) the shell 30 and is permanently affixed thereto. In other words, in this embodiment, the slash guard 515 is not intended to be disconnected from the shell 30 without causing damage to the slash guard 515 and/or the shell 30. In particular, in this example of implementation, the slash guard 515 is affixed to the shell 30 by disposing the slash guard 515 between the subshells 85₁-85_L of the shell 30 (i.e., at least one or more of the subshells is overmolded onto the slash guard 515). More specifically, in this embodiment, the slash guard 515 is overlaid over a subshell 85_x and a subsequent

subshell 85_y is molded over the slash guard 515. As such, the slash guard 515 overlaps a portion of the shell 30 sufficient for the slash guard 515 to be permanently affixed between the subshells 85_x, 85_y without the possibility of accidental removal of the slash guard 515. In this example, the slash guard 515 overlaps a significant
5 portion of the shell 30. In particular, the slash guard 515 extends over a majority of a length of the shell 30 (in the longitudinal direction of the skate 10). A portion of the slash guard 515 extending below the lateral and medial upper edges 45, 47 of the shell 30 may act as a reinforcement element (such as the reinforcement sheet 119) between the subshells 85_x, 85_y.

10

The slash guard 515 extends vertically above the lateral and medial upper edges 45, 47 of the shell 30 for a height HP that may be substantial. For example, the height HP of the slash guard 515 extending above lateral and medial upper edges 45, 47 of the shell 30 may be significant in relation to a height HT of the tendon guard 35
15 measured from a top of the tendon guard 35 to the lateral and medial upper edges 45, 47 of the shell 30. For instance, in some cases, a ratio of the height HP of the slash guard 515 over the height HT of the tendon guard 35 may be at least 0.5, in some cases at least 0.7, in some cases at least 0.9, in some cases at least 1, in some cases at least 1.2, in some cases at least 1.5, in some cases at least 2 and in
20 some cases even more.

As shown in Figure 85, which shows a top view of the portion of the slash guard 515 which extends vertically above the lateral and medial upper edges 45, 47 of the shell 30, in this embodiment, the slash guard 515 comprises a lateral portion 520 for
25 facing a lateral side of the skate boot 22, a medial portion 522 for facing a medial side of the skate boot 22, and a rear portion 524 for facing a rear side of the skate boot 22. As such, in this embodiment, the slash guard 515 at least partially wraps around the player's ankle A and/or shin S to provide cut-resistant protection from the sides and the rear of the skate boot 22. In other examples, the slash guard 515 may
30 wrap completely around the player's ankle A and/or shin S such that the slash guard 515 also comprises a front portion for facing a front side of the skate boot 22. In

such an example, the slash guard 515 may comprise a type of sleeve through which the player must insert his/her foot 11 in order to don the skate 10.

The slash guard 515 may be configured differently in other examples. For instance, 5 the slash guard 515 may not comprise the rear portion 524 if the tendon guard 35 is considered to provide sufficient protection to the player.

In other embodiments, as shown in Figure 84, the slash guard 515 may be removeably attachable to the skate boot 22. That is, the slash guard 515 may be 10 selectively attached to and detached from the skate boot 22. In this example, the slash guard 515 is removeably attachable to the shell 30 via interaction between an attachment member 519 of the slash guard 515 and a portion 517 of the slash guard 515. In particular, the attachment member 519 is configured to attach the portion 517 of the slash guard 515 to the shell 30. In this example, the slash guard 515 does 15 not overlap a substantial portion of the shell 30. The portion 517 of the slash guard 515 is an extension of the slash guard 515 which extends vertically below the lateral and medial upper edges 45, 47 of the shell 30. In this embodiment, the attachment member 519 is a fastener which fastens the slash guard 515 to the shell 30. For example, the attachment member 519 may be a pin, a nut and bolt assembly, a 20 hook-and-loop fastener or any other suitable fastener.

In this example of Figure 84, the cut-resistant material 516 of the slash guard 515 may be rigid and/or pliable. For example, the cut-resistant material 516 may comprise a polymer such as nylon, polyurethane and/or any other suitable polymer. 25 In other words, the cut-resistant material 516 is not limited to pliable fabrics. In this example, the slash guard 515 is movable with respect to the tendon guard 35 (or the rear portion 82 of the ankle portion 64 of the shell 30) by moving with respect to the attachment member 519. In some cases, the slash guard 515 may be pivotable about the attachment member 519. Thus, in cases where the cut-resistant material 30 516 is a rigid material, the slash guard 515 may still be movable with respect to the

tendon guard 35 or the rear portion 82 of the ankle portion 64 of the shell 30) by pivoting about the attachment member 519.

In a variant, as shown in Figures 86A to 86D, rather than integrally molding the shell 30 as a single piece, the shell 30 may be molded in a plurality of pieces 710, 712 and the pieces may then be joined together. For example, this may allow using processes other than injection molding, notably such as casting or other molding methods. Moreover, the pieces 710, 712 may be configured to interlock with one another. Notably, the pieces 710, 712 may comprise protrusions and corresponding recesses for fitting the protrusions such as to interlock the pieces 710, 712 with one another. An adhesive may be applied between the pieces 710, 712 to permanently affix the pieces 710, 712 to one another. As shown in Figure 86A, each of the pieces 710, 712 may constitute a part of the shell 30 and the blade holder 24. In some cases, as shown in Figure 86B, each of the pieces 710, 712 may constitute a part of only the shell 30 or only the blade holder 24. As shown in Figures 86C and 86D, the pieces may include three or more pieces 710, 712, 714.

In another variant, one or more of the subshells 85₁-85_L may be sprayed rather than injection molded. For instance, this may allow to more easily form thinner subshells 85₁-85_L (e.g., of 0.1 mm).

In another variant, as shown in Figure 87, the blade holder 24 may comprise an insert 750 configured to receive the blade 26. The insert 750 is affixed to the lower portion 162 of the blade holder 24 in any suitable manner. In this example, the insert 750 comprises projections that interlock into recesses 165 of the blade holder 24. The insert 750 further comprises a recess 752 configured to receive the blade 26. The insert 750 may be made integral with the lower portion 162 of the blade holder 24 by inserting it into a corresponding mold during molding of the blade holder 24. Alternatively, the insert 750 may be affixed to the lower portion 162 of the blade holder 24 after the lower portion 162 has already been formed. The insert 750 comprises a reinforced material that is stronger and/or stiffer than a material of the

lower portion 162 of the blade holder 24. For example, the reinforced material may be a composite material (e.g., a carbon fiber material).

In another variant, as shown in Figure 88, the blade holder 24 may comprise a void 5 350 in one of its front and rear pillars 210, 212. More particularly, in this example, the void 350 of the blade holder 24 may be formed by separately molding the blade holder 24 with a molding insert, and removing the molding insert after molding the blade holder 24 to obtain a cavity in the blade holder 24. Thus, once the blade holder 24 is assembled with the shell 30, the blade holder 24 comprises the void 350 10 which is contained between surfaces of the blade holder 24 and the sole portion 69 of the shell 30. In another example, rather than leaving the cavity of the blade holder 24 as a void, an insert, such as the insert 315₁, may be placed in the cavity and the blade holder 24 secured to the shell 30 such that the insert 315₁ is contained between inner surfaces of a body of the blade holder 24 and a surface of the sole 15 portion 69 of the shell 30.

In another variant, the exterior subshell 85₃ may be configured to extend into the recess 190 of the blade-retention portion 188 of the blade-retaining base 164 of the blade holder 24. As such, the subshell 85₃ may contact the blade 26 as it is inserted 20 into the recess 190. This may be useful in examples where the exterior subshell 85₃ is relatively rigid as it may provide compaction resistance when the blade 26 is inserted in the recess 190.

In some embodiments, as shown in Figures 90 and 91, the material M_i of a subshell 25 85_x of the skate boot 22 may comprise a mixture of a polymeric substance 52 and an expansion agent 53. This may help the material M_i to have desirable properties, such as being more shock-absorbent than it if was entirely made of the expansion agent 53 and/or being lighter than if it was entirely made of the polymeric substance 52.

30

The polymeric substance 52 constitutes a substantial part of the material M_i and substantially contributes to structural integrity to the subshell 85_x . For instance, in some embodiments, the polymeric substance 52 may constitute at least 40%, in some cases at least 50%, in some cases at least 60%, in some cases at least 70%,
5 in some cases at least 80%, and in some cases at least 90% of the material M_i by weight. In this example of implementation, the polymeric substance 52 may constitute between 50% and 90% of the material M_i by weight.

In this embodiment, the polymeric substance 52 may be an elastomeric substance.
10 For instance, the polymeric substance 52 may be a thermoplastic elastomer (TPE) or a thermoset elastomer (TSE).

More particularly, in this embodiment, the polymeric substance 52 comprises polyurethane. The polyurethane 52 may be composed of any suitable constituents
15 such as isocyanates and polyols and possibly additives. For instance, in some embodiments, the polyurethane 52 may have a hardness in a scale of Shore 00, Shore A, Shore C or Shore D, or equivalent. For example, in some embodiments, the hardness of the polyurethane 52 may be between Shore 5A and 95A or between Shore 40D to 93D. Any other suitable polyurethane may be used in other
20 embodiments.

The polymeric substance 52 may comprise any other suitable polymer in other embodiments. For example, in some embodiments, the polymeric substance 52 may
25 comprise silicon, rubber, etc.

The expansion agent 53 is combined with the polyurethane 52. In some cases, this may be done to enhance properties of the material M_i . Alternatively or additionally, in some cases, this may be done to enable expansion of the material M_i to a final shape of the subshell 85_x in the mold 154_x . For instance, in some embodiments, the
30 expansion agent 54 may constitute at least 10%, in some cases at least 20%, in some cases at least 30%, in some cases at least 40%, in some cases at least 50%, in some cases at least 60%, of the material M_i by weight and in some cases even

more. In this example of implementation, the expansion agent 54 may constitute between 15% and 50% of the material M_i by weight.

In this embodiment, as shown in Figure 91, the expansion agent 53 comprises an amount of expandable microspheres 63_1-63_M . Each expandable microsphere 63_i comprises a polymeric shell 67 expandable by a fluid encapsulated in an interior of the polymeric shell 67. In this example of implementation, the polymeric shell 67 of the expandable microsphere 63_i is a thermoplastic shell. The fluid encapsulated in the polymeric shell 67 is a liquid or gas (in this case a gas) able to expand the expandable microsphere 63_i when heated during manufacturing of the subshell 85_x . In some embodiments, the expandable microspheres 63_1-63_M may be Expancel™ microspheres commercialized by Akzo Nobel. In other embodiments, the expandable microspheres 63_1-63_M may be Dualite microspheres commercialized by Henkel; Advancell microspheres commercialized by Sekisui; Matsumoto Microsphere microspheres commercialized by Matsumoto Yushi Seiyaku Co; or KUREHA Microsphere microspheres commercialized by Kureha. Various other types of expandable microspheres may be used in other embodiments.

In this example of implementation, the expandable microspheres 63_1-63_M include dry unexpanded (DU) microspheres when combined with the polymeric substance 52 to create the material M_i before the material M_i is molded. For instance, the dry unexpanded (DU) microspheres may be provided as a powder mixed with one or more liquid constituents of the polymeric substance 52.

The expandable microspheres 63_1-63_M may be provided in various other forms in other embodiments. For example, in some embodiments, the expandable microspheres 63_1-63_M may include dry expanded, wet and/or partially-expanded microspheres. For instance, wet unexpanded microspheres may be used to get better bonding with the polymeric substance 52. Partially-expanded microspheres may be used to employ less of the polymeric substance 52, or mix with the polymeric substance 52 in semi-solid form.

In some embodiments, the expandable microspheres 63₁-63_M may constitute at least 10%, in some cases at least 20%, in some cases at least 30%, in some cases at least 40%, in some cases at least 50%, and in some cases at least 60% of the material M_i by weight and in some cases even more. In this example of
5 implementation, the expandable microspheres 63₁-63_M may constitute between 15% and 50% of the material M_i by weight.

The subshell 85_x comprising the material M_i with the polymeric substance 52 and the expandable microspheres 63₁-63_M may have various desirable qualities.

10 For instance, in some embodiments, the subshell 85_x may be less dense and thus lighter than if it was entirely made of the polyurethane 52, yet be more shock-absorbent and/or have other better mechanical properties than if it was entirely made of the expandable microspheres 63₁-63_M.

15 For example, in some embodiments, a density of the material M_i may be less than a density of the polyurethane 52 (alone). For instance, the density of the material M_i of the subshell 85_x may be no more than 70%, in some cases no more than 60%, in some cases no more than 50%, in some cases no more than 40%, in some cases
20 no more than 30%, in some cases no more than 20%, in some cases no more than 10% and in some cases no more than 5% of the density of the polyurethane 52 and in some cases even less. For example, in some embodiments, the density of the material M_i may be between 2 to 75 times less than the density of the polyurethane 52 (i.e., the density of the material M_i may be about 1% to 50% of the density of the
25 polyurethane 52).

The density of the material M_i may have any suitable value. For instance, in some embodiments, the density of the material M_i may be no more than 0.7 g/cm³, in some cases no more than 0.4 g/cm³, in some cases no more than 0.1 g/cm³, in
30 some cases no more than 0.080 g/cm³, in some cases no more than 0.050 g/cm³, in some cases no more than 0.030 g/cm³, and/or may be at least 0.010 g/cm³. In some examples of implementation, the density of the material M_i may be between 0.015

g/cm³ and 0.080 g/cm³, in some cases between 0.030 g/cm³ and 0.070 g/cm³, and in some cases between 0.040 g/cm³ and 0.060 g/cm³.

As another example, in some embodiments, a stiffness of the material M_i may be
5 different from (i.e., greater or less than) a stiffness of the expandable microspheres
63₁-63_M (alone). For instance, a modulus of elasticity (i.e., Young's modulus) of the
material M_i may be greater or less than a modulus of elasticity of the expandable
microspheres 63₁-63_M (alone). For instance, a difference between the modulus of
10 elasticity of the material M_i and the modulus of elasticity of the expandable
microspheres 63₁-63_M may be at least 20%, in some cases at least 30%, in some
cases at least 50%, and in some cases even more, measured based on a smaller
one of the modulus of elasticity of the material M_i and the modulus of elasticity of the
expandable microspheres 63₁-63_M. In some cases, the modulus of elasticity may be
evaluated according to ASTM D-638 or ASTM D-412.

15

As another example, in some embodiments, a resilience of the material M_i may be
less than a resilience of the expandable microspheres 63₁-63_M (alone). For instance,
in some embodiments, the resilience of the material M_i may no more than 70%, in
20 some cases no more than 60%, in some cases no more than 50%, in some cases
no more than 40%, in some cases no more than 30%, and in some cases no more
than 20%, and in some cases no more than 10% of the resilience of the expandable
microspheres 63₁-63_M according to ASTM D2632-01 which measures resilience by
vertical rebound. In some examples of implementation, the resilience of the material
25 M_i may be between 20% and 60% of the resilience of the expandable microspheres
63₁-63_M. Alternatively, in other embodiments, the resilience of the material M_i may
be greater than the resilience of the expandable microspheres 63₁-63_M.

The resilience of the material M_i may have any suitable value. For instance, in some
30 embodiments, the resilience of the material M_i may be no more than 40%, in some
cases no more than 30%, in some cases no more than 20%, in some cases no more
than 10%, and in some cases even less (e.g., 5%), according to ASTM D2632-01,

thereby making the subshell 85_x more shock-absorbent. In other embodiments, the resilience of the material M_i may be at least 60%, in some cases at least 70%, in some cases at least 80% and in some cases even more, according to ASTM D2632-01, thereby making the material M_i provide more rebound.

5

As another example, in some embodiments, a tensile strength of the material M_i may be greater than a tensile strength of the expandable microspheres 63_1-63_M (alone). For instance, in some embodiments, the tensile strength of the material M_i may be at least 120%, in some cases at least 150%, in some cases at least 200%, in some cases at least 300%, in some cases at least 400%, and in some cases at least 500% of the tensile strength of the expandable microspheres 63_1-63_M according to ASTM D-638 or ASTM D-412, and in some cases even more.

The tensile strength of the material M_i may have any suitable value. For instance, in some embodiments, the tensile strength of the material M_i may be at least 0.9 MPa, in some cases at least 1 MPa, in some cases at least 1.2 MPa, in some cases at least 1.5 MPa and in some cases even more (e.g., 2 MPa or more).

As another example, in some embodiments, an elongation at break of the material M_i may be greater than an elongation at break of the expandable microspheres 63_1-63_M (alone). For instance, in some embodiments, the elongation at break of the expandable material M_i may be at least 120%, in some cases at least 150%, in some cases at least 200%, in some cases at least 300%, in some cases at least 400%, and in some cases at least 500% of the elongation at break of the expandable microspheres 63_1-63_M according to ASTM D-638 or ASTM D-412, and in some cases even more.

The elongation at break of the material M_i may have any suitable value. For instance, in some embodiments, the elongation at break of the material M_i may be at least 20%, in some cases at least 30%, in some cases at least 50%, in some cases at least 75%, in some cases at least 100%, and in some cases even more (e.g. 150% or more).

In some embodiments, a material of the shell 30 (e.g., a given one of the materials M_1 - M_N) may be a composite material. For example, the composite material may be a fiber-matrix composite material that comprises a matrix in which fibers are
5 embedded. The matrix may include any suitable polymeric resin, such as a thermosetting polymeric material (e.g., polyester, vinyl ester, vinyl ether, polyurethane, epoxy, cyanate ester, etc.), a thermoplastic polymeric material (e.g., polyethylene, polyurethane, polypropylene, acrylic resin, polyether ether ketone, polyethylene terephthalate, polyvinyl chloride, polymethyl methacrylate,
10 polycarbonate, acrylonitrile butadiene styrene, nylon, polyimide, polysulfone, polyamide-imide, self-reinforcing polyphenylene, etc.), or a hybrid thermosetting-thermoplastic polymeric material. The fibers may be made of any suitable material such as carbon fibers, polymeric fibers such as aramid fibers, boron fibers, glass fibers, ceramic fibers, etc.

15

Although in embodiments considered above the skate 10 is designed for playing ice hockey on the skating surface 14 which is ice, in other embodiments, the skate 10 may be constructed using principles described herein for playing roller hockey or another type of hockey (e.g., field or street hockey) on the skating surface 14 which
20 is a dry surface (e.g., a polymeric, concrete, wooden, or turf playing surface or any other dry surface on which roller hockey or field or street hockey is played). Thus, in other embodiments, instead of comprising the blade 26, the skating device 28 may comprise a set of wheels to roll on the dry skating surface 14 (i.e., the skate 10 may be an inline skate or other roller skate). Moreover, in other embodiments, the skate
25 10 may be a figure skate constructed using principles described herein for figure skating.

Furthermore, although in embodiments considered above the footwear 10 is a skate for skating on the skating surface 14, in other embodiments, the footwear 10 may be
30 any other suitable type of footwear. For example, as shown in Figure 123, the footwear 10 may be a ski boot comprising a shell 830 which may be constructed in

the manner described above with respect to the shell of the skate. In particular, the ski boot 10 is configured to be attachable and detachable from a ski 802 which is configured to travel on a ground surface 8 (e.g., snow). To that end, the ski boot 10 is configured to interact with an attachment mechanism 800 of the ski 802. In
5 another example, as shown in Figure 124, the footwear 10 may be a boot (e.g., a work boot or any other type of boot) comprising a shell 930 which can be constructed in the manner described above with respect to the shell of the skate. For instance, in various embodiments, the boot 10 may be a motorcycle boot (e.g., for use with a motocross or other motorcycle), a work boot for protection, security or
10 other purposes (e.g., construction boot, police boot, military boot, etc.), or any other type of boot. In some cases, the shell 930 of the boot 10 may be flexible or semi-rigid, as opposed to rigid as in embodiments discussed above.

In some embodiments, any feature of any embodiment described herein may be
15 used in combination with any feature of any other embodiment described herein.

Certain additional elements that may be needed for operation of certain embodiments have not been described or illustrated as they are assumed to be within the purview of those of ordinary skill in the art. Moreover, certain
20 embodiments may be free of, may lack and/or may function without any element that is not specifically disclosed herein.

To facilitate the description, any reference numeral designating an element in one figure designates the same element if used in any other figures. In describing the
25 embodiments, specific terminology has been resorted to for the sake of description but the invention is not intended to be limited to the specific terms so selected, and it is understood that each specific term comprises all equivalents.

In case of any discrepancy, inconsistency, or other difference between terms used
30 herein and terms used in any document incorporated by reference herein, meanings of the terms used herein are to prevail and be used.

Although various embodiments have been illustrated, this was for the purpose of describing, but not limiting, the invention. Various modifications will become apparent to those skilled in the art and are within the scope of this invention, which is

5 defined more particularly by the attached claims.

CLAIMS

1. A last for molding a body of a skate boot of a skate, the skate comprising a skating device disposed beneath the skate boot to engage a skating surface, the skate boot being configured to receive a foot of a user, the last being configured to mold the body of the skate boot such that the body of the skate boot comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, the last being reconfigurable to facilitate demolding of the body of the skate boot from the last such that the last is changeable between a molding configuration to mold the body of the skate boot on the last and a demolding configuration to demold the body of the skate boot from the last, wherein: the last comprises a plurality of last members movable relative to one another to change between its molding configuration and its demolding configuration; and respective ones of the last members are movable relative to one another while remaining connected to one another as the last changes between its molding configuration and its demolding configuration.
2. The last of claim 1, wherein the last is contracted in its demolding configuration relative to its molding configuration.
3. The last of claim 1, wherein the last is configured to mold the body of the skate boot such that the body of the skate boot comprises a plurality of undercuts.
4. The last of claim 3, wherein respective ones of the undercuts are medial and lateral depressions of the ankle portion for receiving medial and lateral malleoli of the user.
5. The last of claim 3, wherein a given one of the undercuts is a recess defined by curvature of the heel portion.

6. The last of claim 3, wherein respective ones of the undercuts are recesses defined by curvature of the medial and lateral side portions.
- 5 7. The last of claim 1, wherein a volume occupied by the last is reduced from its molding configuration to its demolding configuration such that the volume occupied by the last in its demolding configuration is smaller than the volume occupied by the last in its molding configuration.
- 10 8. The last of claim 7, wherein the last comprises a cavity to receive a fluid to vary the volume occupied by the last by expanding and contracting the last.
9. The last of claim 1, wherein the last comprises a cavity containing particles and configured to receive a fluid such that the particles vary a rigidity of the last in response to flow of the fluid relative to the cavity.
- 15 10. The last of claim 1, wherein the last comprises a control system to control movement of the last members relative to one another.
11. The last of claim 1, wherein adjacent ones of the last members are translatable relative to one to change the last between its molding configuration and its demolding configuration.
- 20 12. The last of claim 11, comprising a linkage connecting the adjacent ones of the last members to one another, the linkage comprising a translation guide.
- 25 13. The last of claim 1, wherein adjacent ones of the last members are rotatable relative to one to change the last between its molding configuration and its demolding configuration.
- 30 14. The last of claim 13, comprising a linkage connecting the adjacent ones of the last members to one another, the linkage comprising a pivot.

15. The last of claim 1, wherein adjacent ones of the last members are translatable and rotatable relative to one to change the last between its molding configuration and its demolding configuration.
- 5 16. The last of claim 15, comprising a linkage connecting the adjacent ones of the last members to one another, the linkage comprising a translation guide and a pivot.
17. The last of claim 1, wherein the last members include at least three last
10 members.
18. The last of claim 1, wherein the last members include at least five last members.
19. The last of claim 1, wherein a first one of the last members is a front central last
15 member, a second one of the last members is a rear central last member, a third one of the last members is an intermediate central last member disposed between the front central last member and the rear central last member; a fourth one of the last members is a medial last member; and a fifth one of the last members is a lateral last member.
- 20 20. The last of claim 19, wherein the last is configured to mold the body of the skate boot such that the body of the skate boot comprises a sole portion for facing a plantar surface of the user's foot.
- 25 21. The last of claim 19, wherein the last is configured to mold the body of the skate boot such that the body of the skate boot comprises a toe portion for enclosing toes of the user's foot.
22. The last of claim 1, wherein the last is configured to mold the body of the skate
30 boot such that the body of the skate boot comprises a sole portion for facing a plantar surface of the user's foot.

23. The last of claim 1, wherein the last is configured to mold the body of the skate boot such that the body of the skate boot comprises a toe portion for enclosing toes of the user's foot.
- 5 24. The last of claim 1, wherein: the last comprises a base including the respective ones of the last members; and a given one of the last members is a removable covering configured to enclose the base and removable from the base.
25. The last of claim 24, wherein a thickness of the removable covering varies to
10 define a plurality of undercuts of the body of the skate boot.
26. The last of claim 24, wherein the removable covering is flexible.
27. The last of claim 26, wherein the removable covering comprises an elastomeric
15 material.
28. The last of claim 1, wherein the last is configured to injection mold the body of the skate boot.
- 20 29. The last of claim 1, wherein the body of the skate boot comprises a plurality of materials that are different and molded by flowing about the last.
30. The last of claim 1, wherein the last members are rigid.
- 25 31. The last of claim 1, wherein the demolding configuration of the last allows demolding the body of the skate boot from the last without deforming the body of the skate boot.
32. The last of claim 1, wherein the body of the skate boot is rigid.
- 30 33. A skate boot comprising a body molded using the last of claim 1.

34. A method of making a skate boot for a skate, the skate comprising a skating device disposed beneath the skate boot to engage a skating surface, the skate boot being configured to receive a foot of a user, the method comprising:
- 5 - providing a last changeable between a molding configuration and a demolding configuration;
 - molding a body of the skate boot on the last in the molding configuration such that the body of the skate boot comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot,
10 and an ankle portion to receive an ankle of the user;
 - changing the last from the molding configuration to the demolding configuration to facilitate removal of the body of the skate boot from the last; and
 - demolding the body of the skate boot from the last in the demolding
15 configuration;
- wherein: the last comprises a plurality of last members movable relative to one another; and the changing comprises moving respective ones of the last members relative to one another while maintaining a connection between
20 respective ones of the last members.
35. The method of claim 34, wherein the last members are rigid.
36. The method of claim 34, wherein the demolding is achieved without deforming
25 the body of the skate boot.
37. The method of claim 34, wherein the body of the skate boot is rigid.
38. A last for molding a body of an article of footwear to receive a foot of a user, the last being configured to mold the body of the article of footwear such that the
30 body of the footwear comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel

portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user, the last being reconfigurable to facilitate demolding of the body of the article of footwear from the last such that the last is changeable between a molding configuration to mold the body of the article of footwear on the last and a demolding configuration to demold the body of the article of footwear from the last, wherein: the last comprises a plurality of last members movable relative to one another to change between its molding configuration and its demolding configuration; and respective ones of the last members are movable relative to one another while remaining connected to one another as the last changes between its molding configuration and its demolding configuration.

39. The last of claim 38, wherein the last members are rigid.

40. The last of claim 38, wherein the demolding configuration of the last allows demolding the body of the skate boot from the last without deforming the body of the skate boot.

41. The last of claim 38, wherein the body of the skate boot is rigid.

42. A method of making an article of footwear to receive a user's foot, the method comprising:

- providing a last changeable between a molding configuration and a demolding configuration;
- molding a body of the article of footwear on the last in the molding configuration such that the body of the article of footwear comprises a medial side portion to face a medial side of the user's foot, a lateral side portion to face a lateral side of the user's foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user;
- changing the last from the molding configuration to the demolding configuration to facilitate removal of the body of the article of footwear from the last; and

- demolding the body of the article of footwear from the last in the demolding configuration;

wherein: the last comprises a plurality of last members movable relative to one another; and the changing comprises moving respective ones of the last members relative to one another while maintaining a connection between the
5 respective ones of the last members.

43. The method of claim 42, wherein the last members are rigid.

10 44. The method of claim 42, wherein the demolding is achieved without deforming the body of the skate boot.

45. The method of claim 42, wherein the body of the skate boot is rigid.

+

1/73

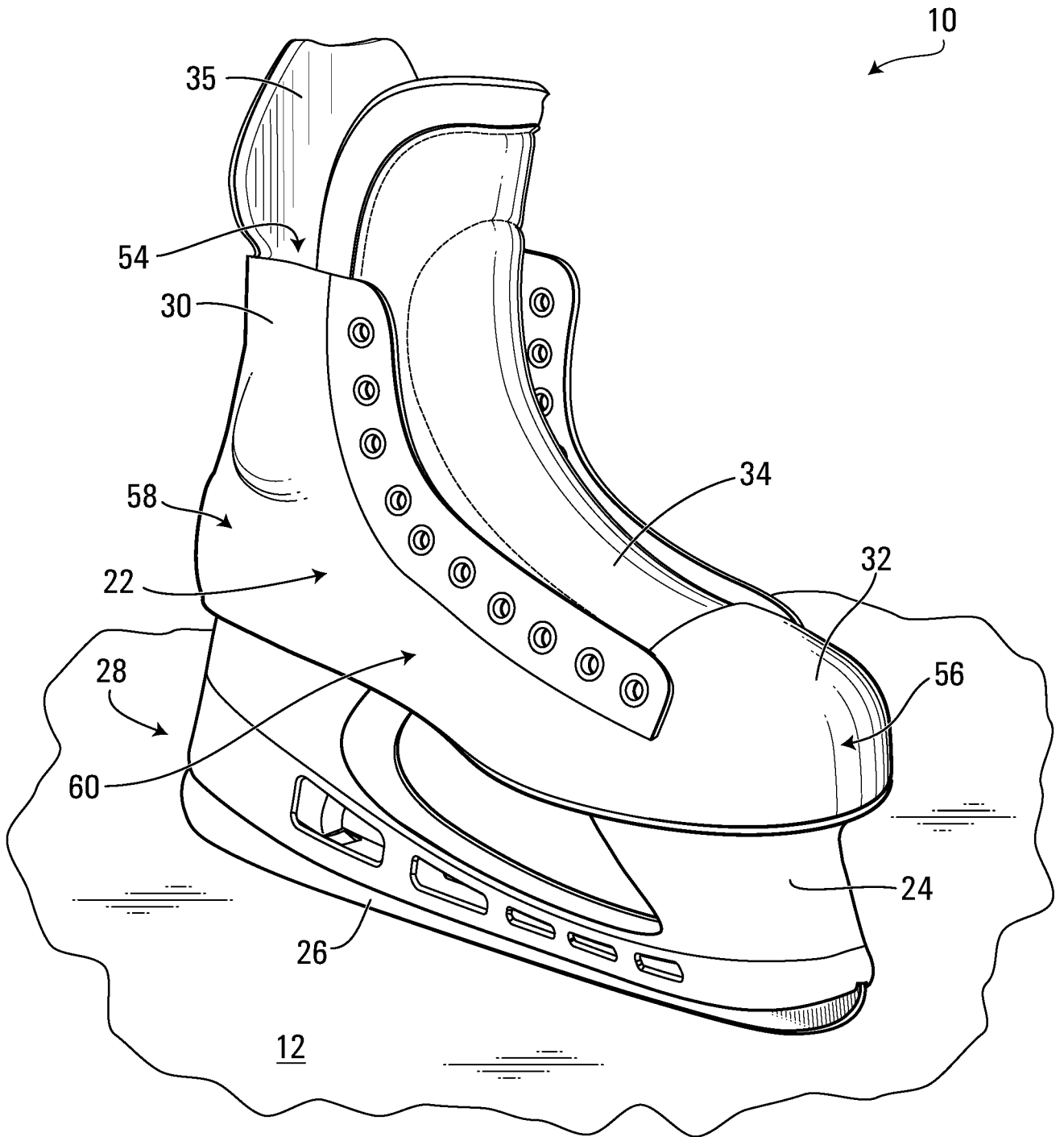


FIG. 1

+

+

2/73

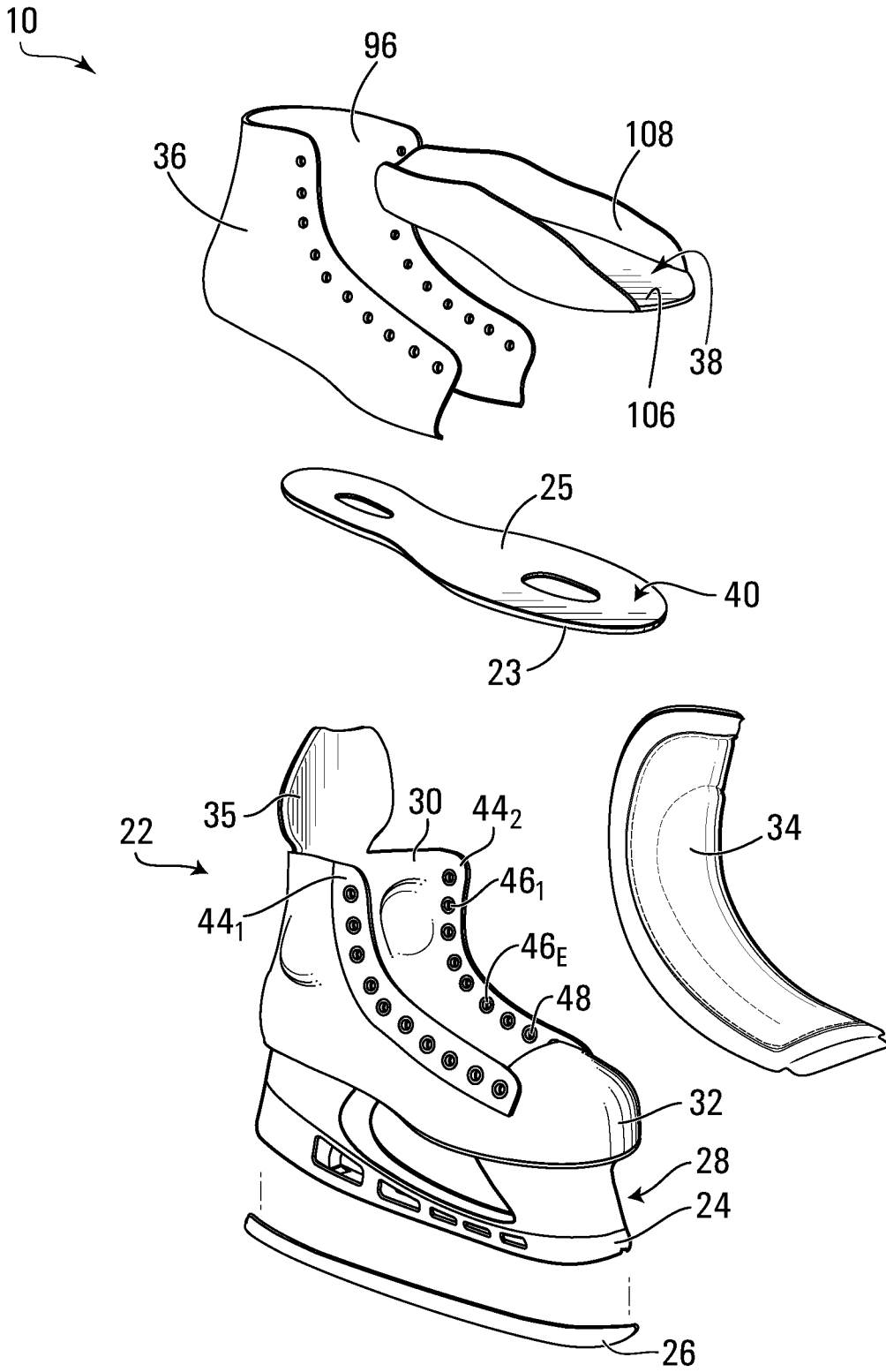


FIG. 2

+

+

3/73

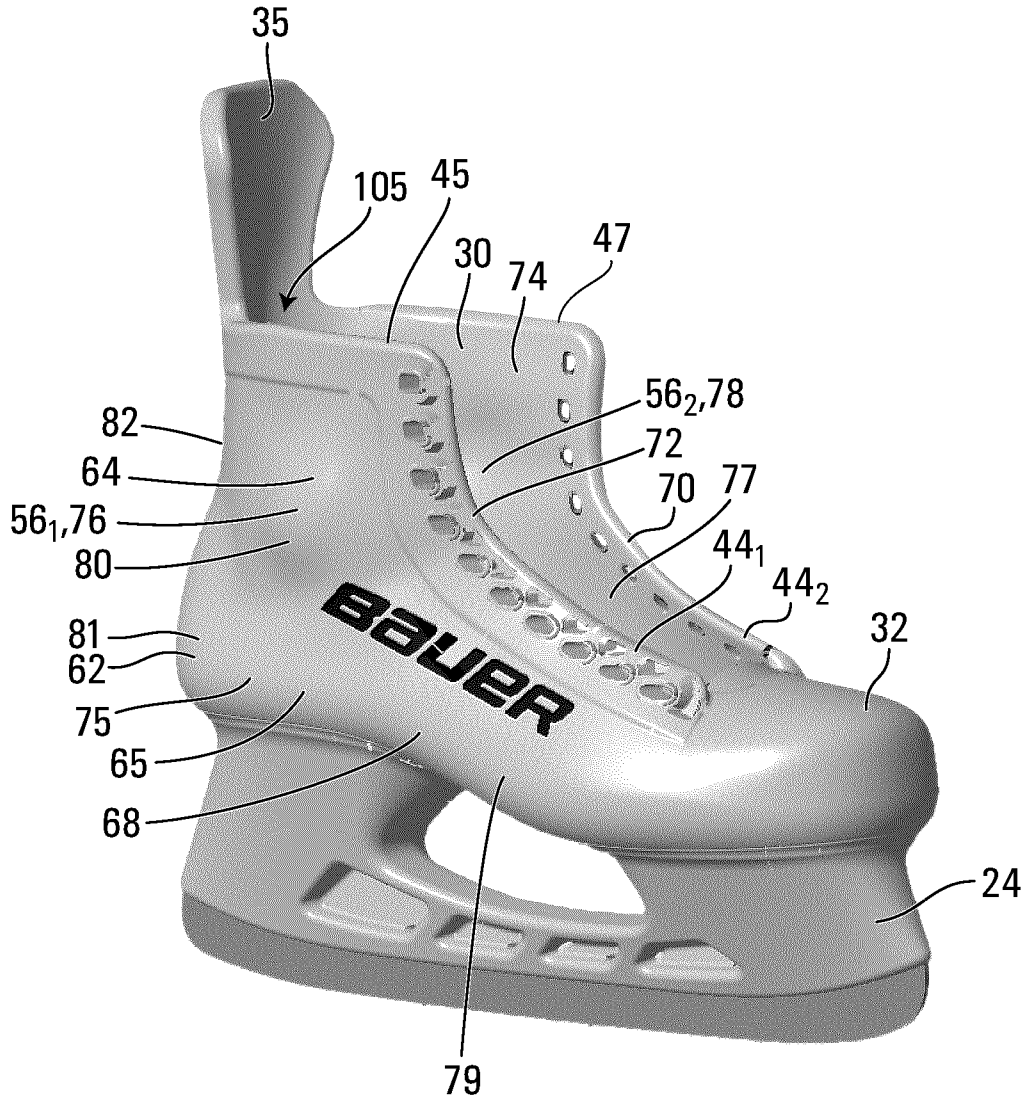


FIG. 3

+

+

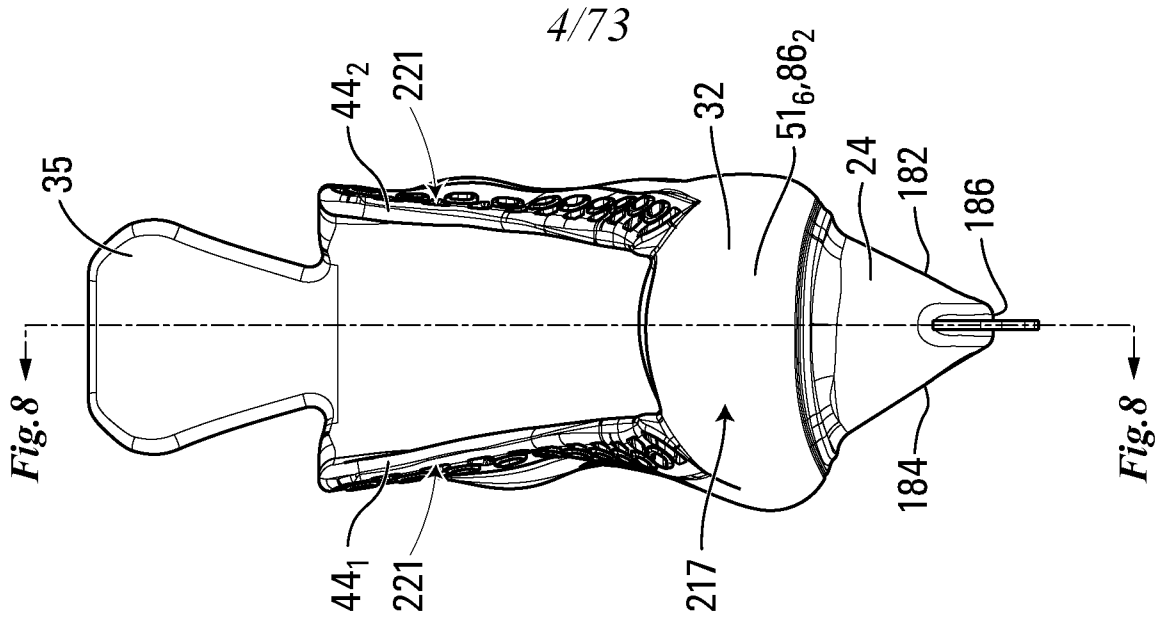


FIG. 5

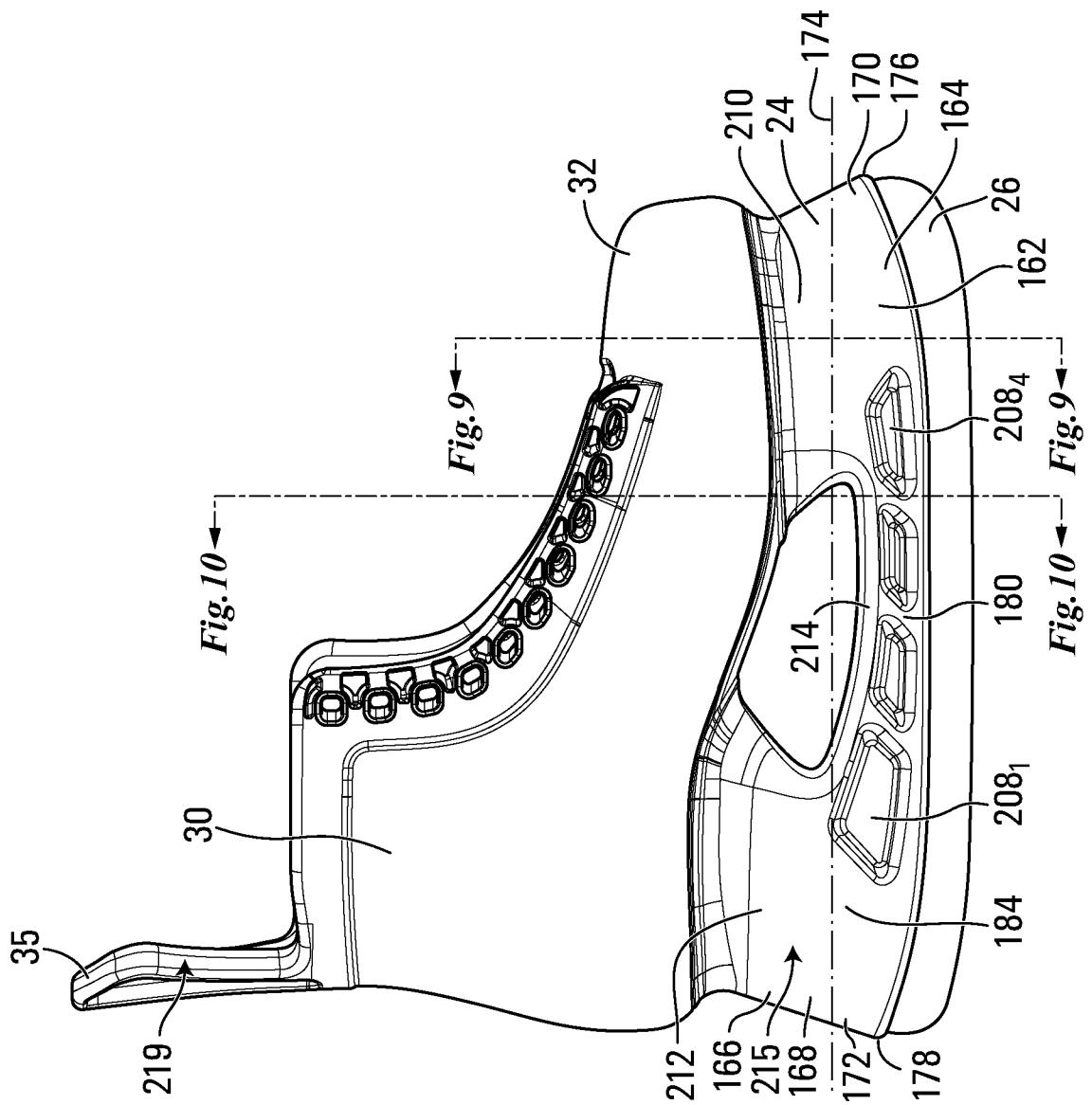


FIG. 4

+

+

5/73

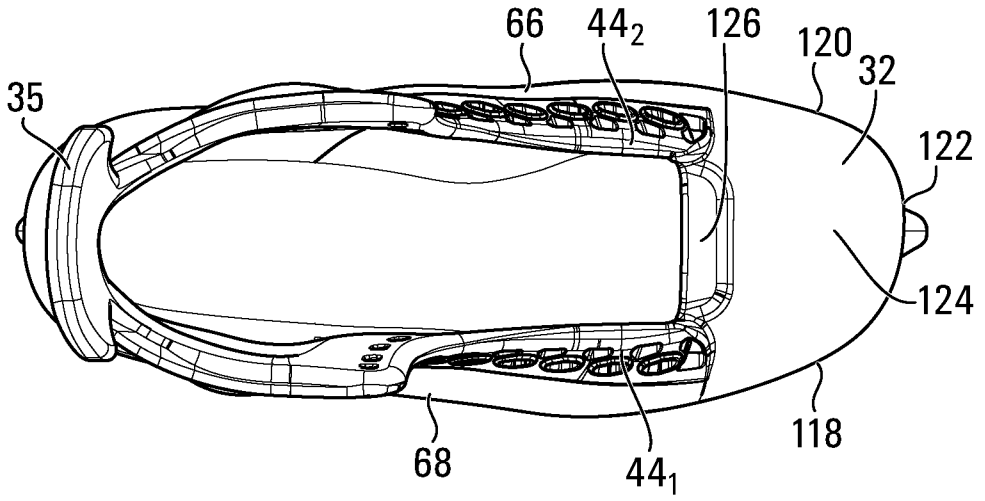


FIG. 6

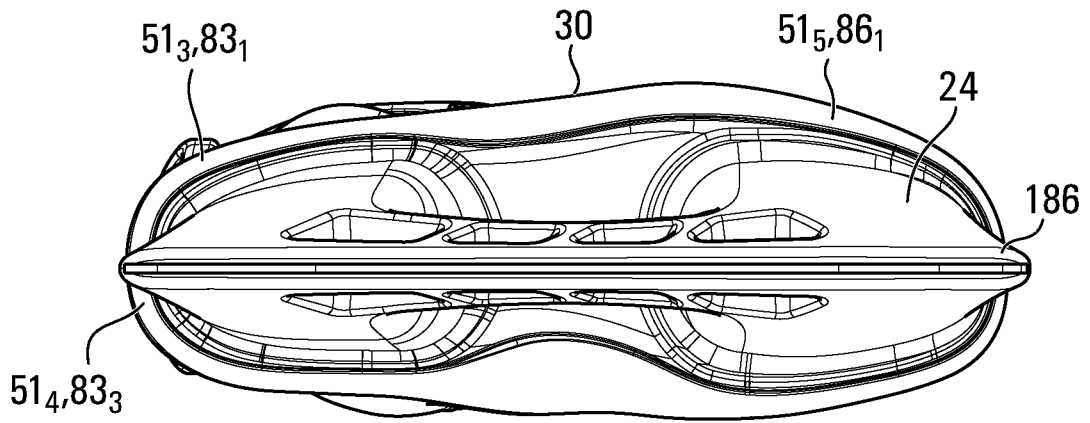


FIG. 7

+

+

6/73

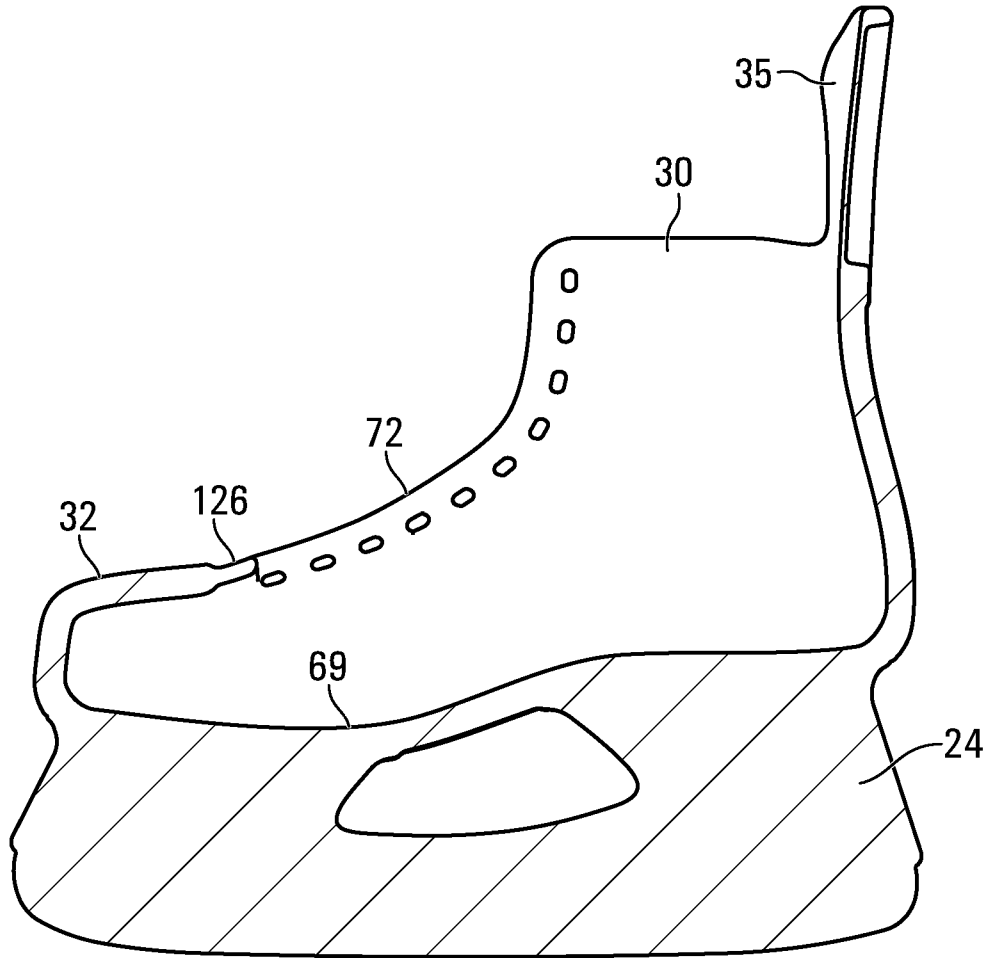


FIG. 8

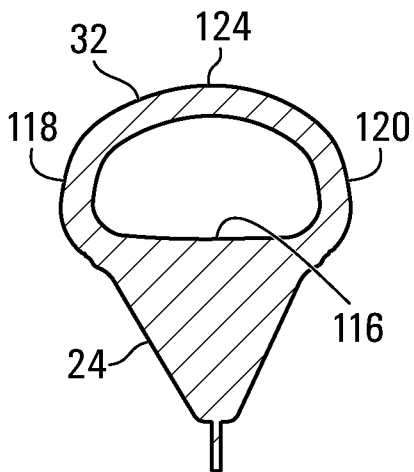


FIG. 9

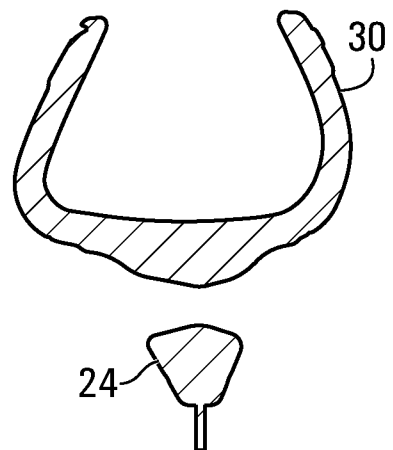


FIG. 10

+

+

7/73

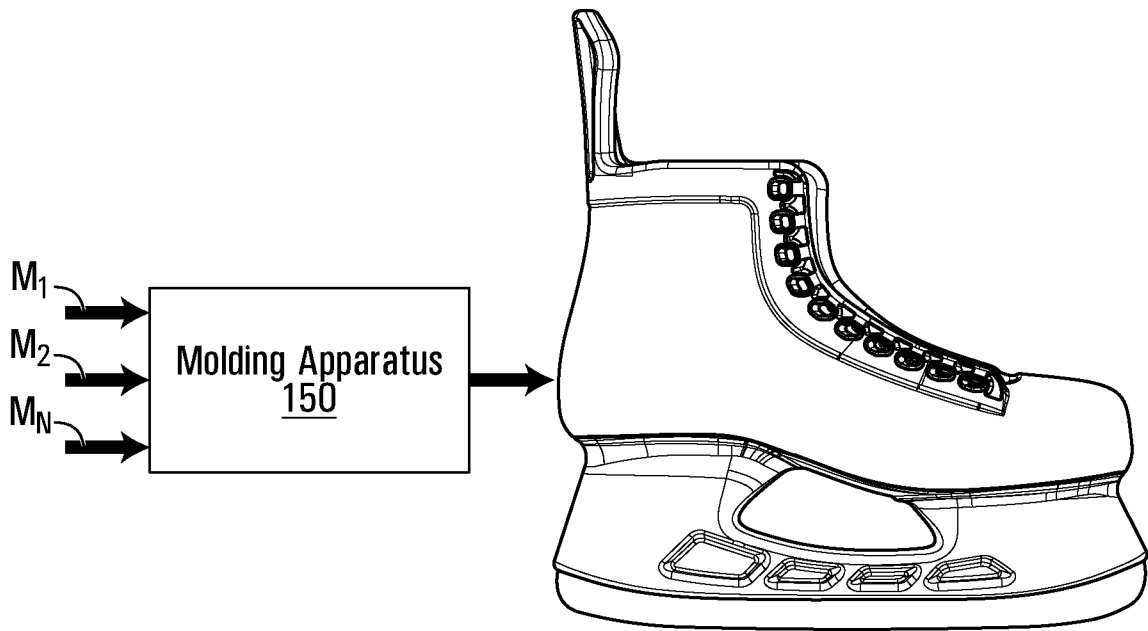


FIG. 11

+

+

8/73

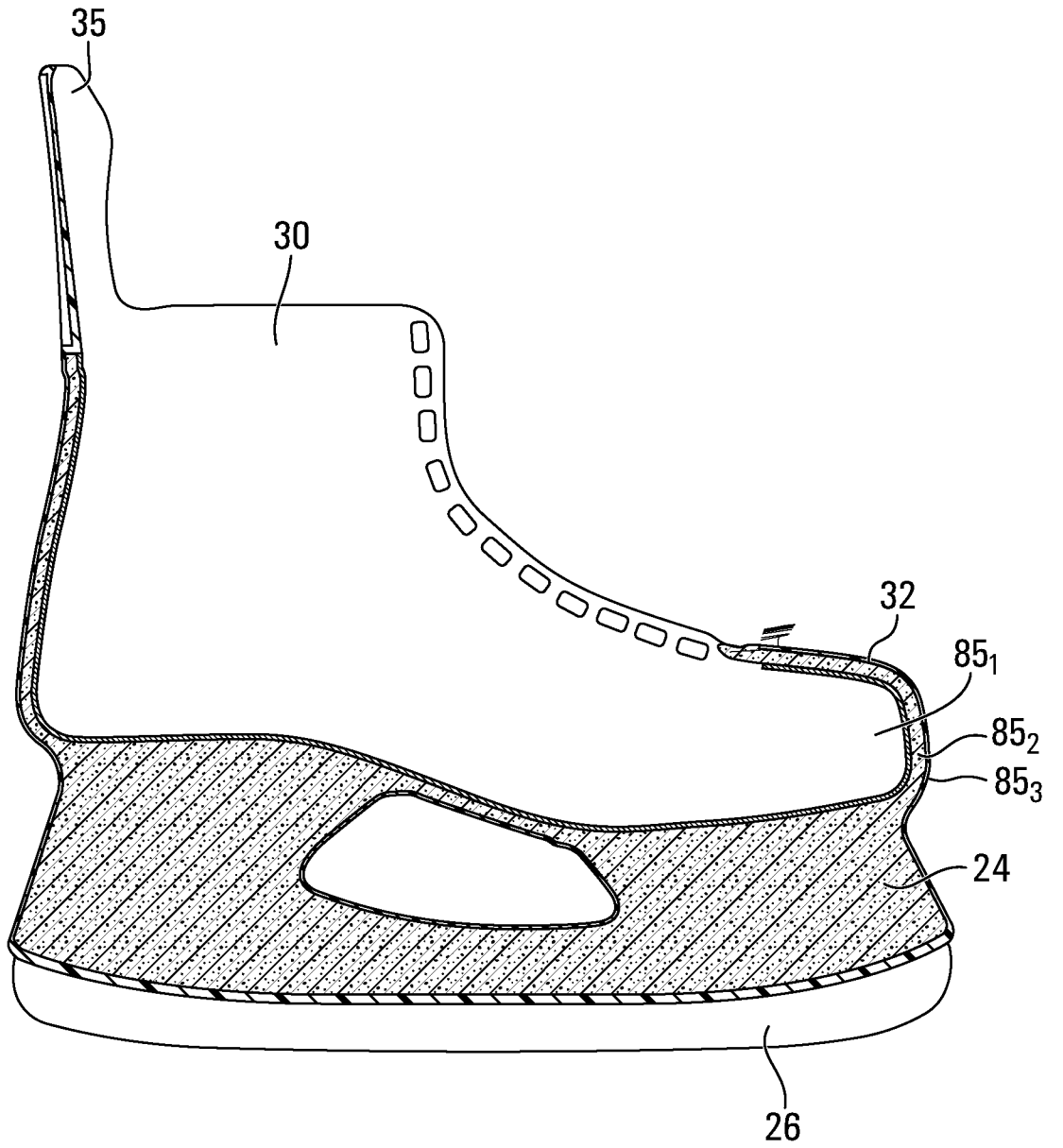


FIG. 12

+

+

9/73



FIG. 13

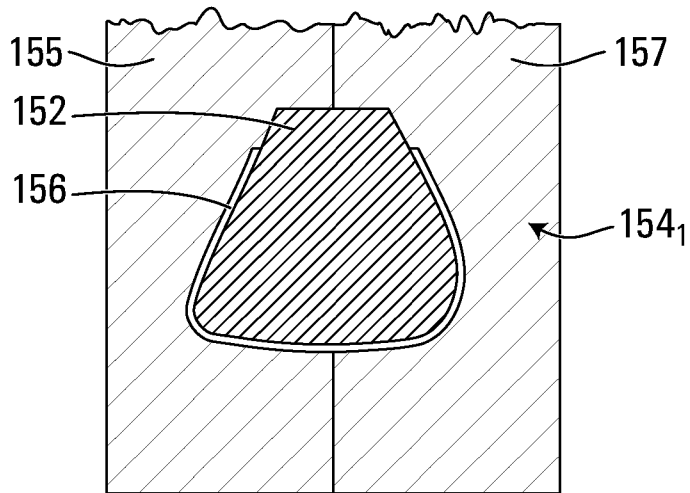


FIG. 14

+

+

10/73

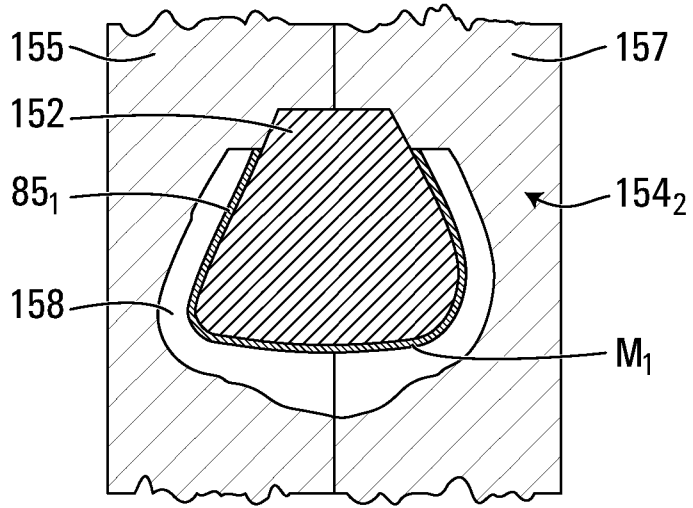


FIG. 15

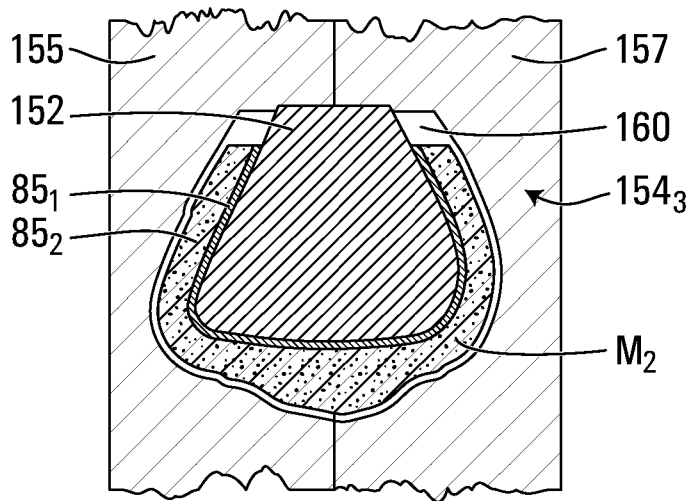


FIG. 16

+

+

11/73

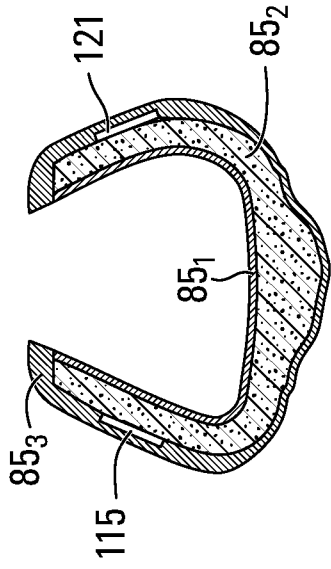


FIG. 19

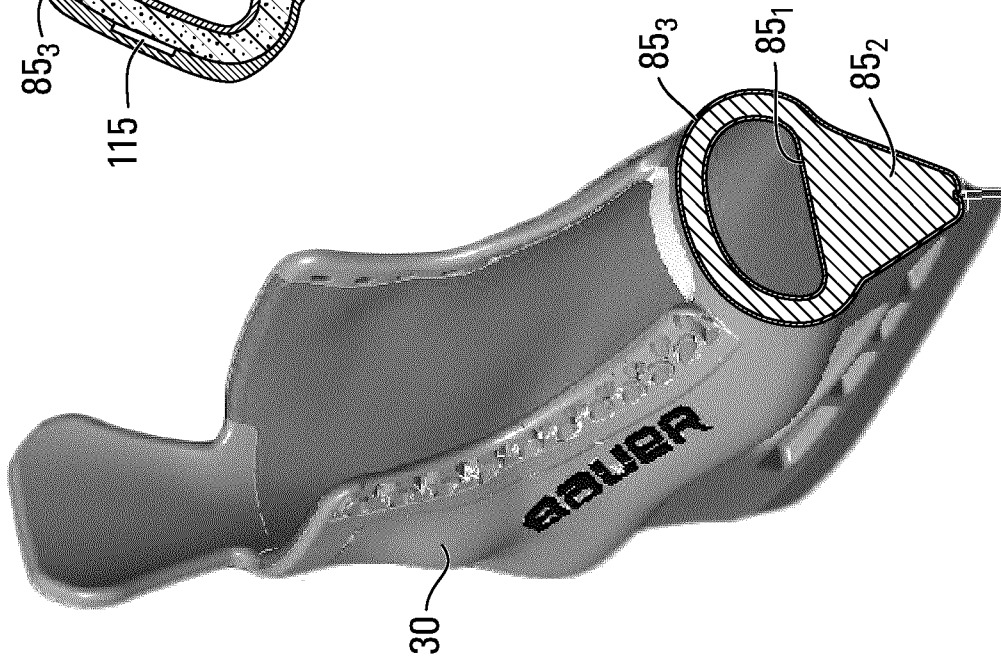


FIG. 18

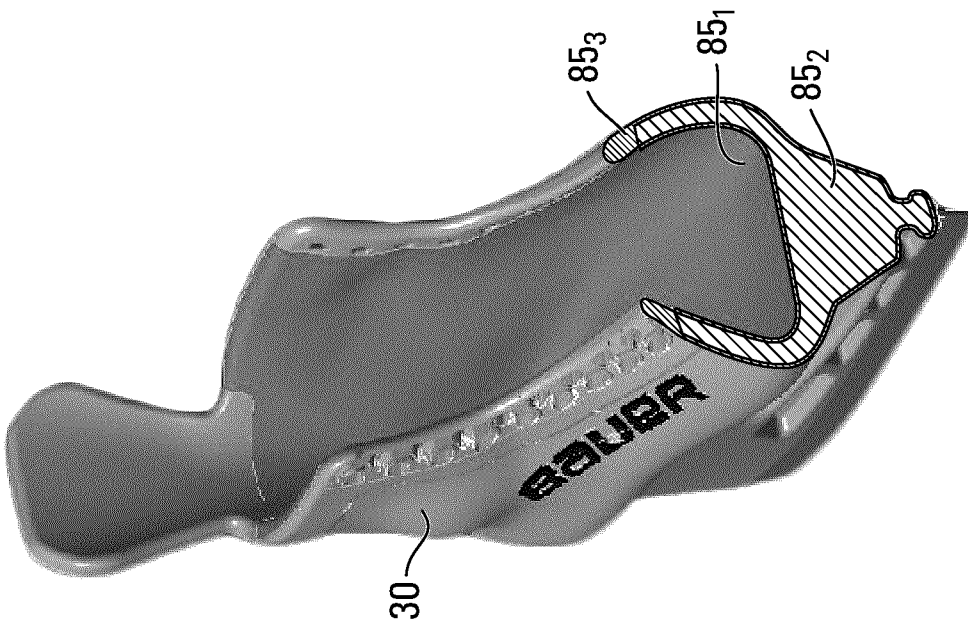
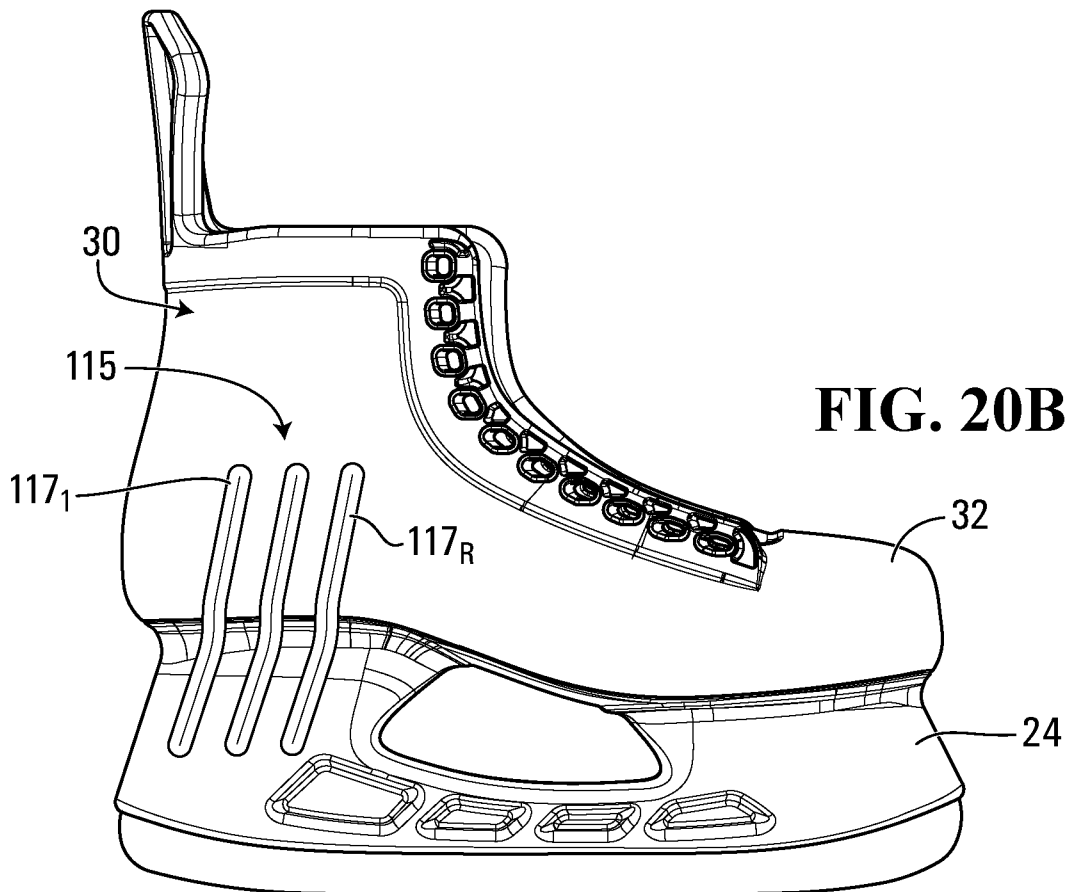
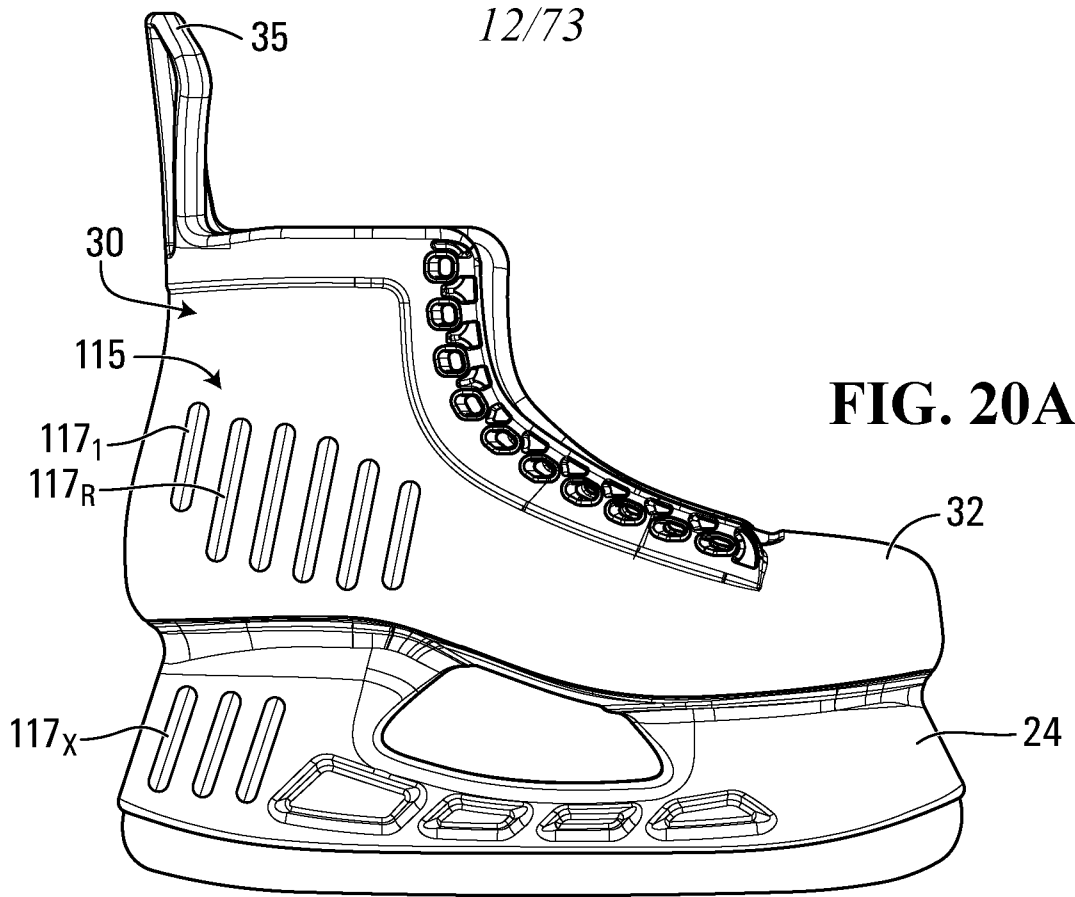


FIG. 17

+

+



+

+

13/73

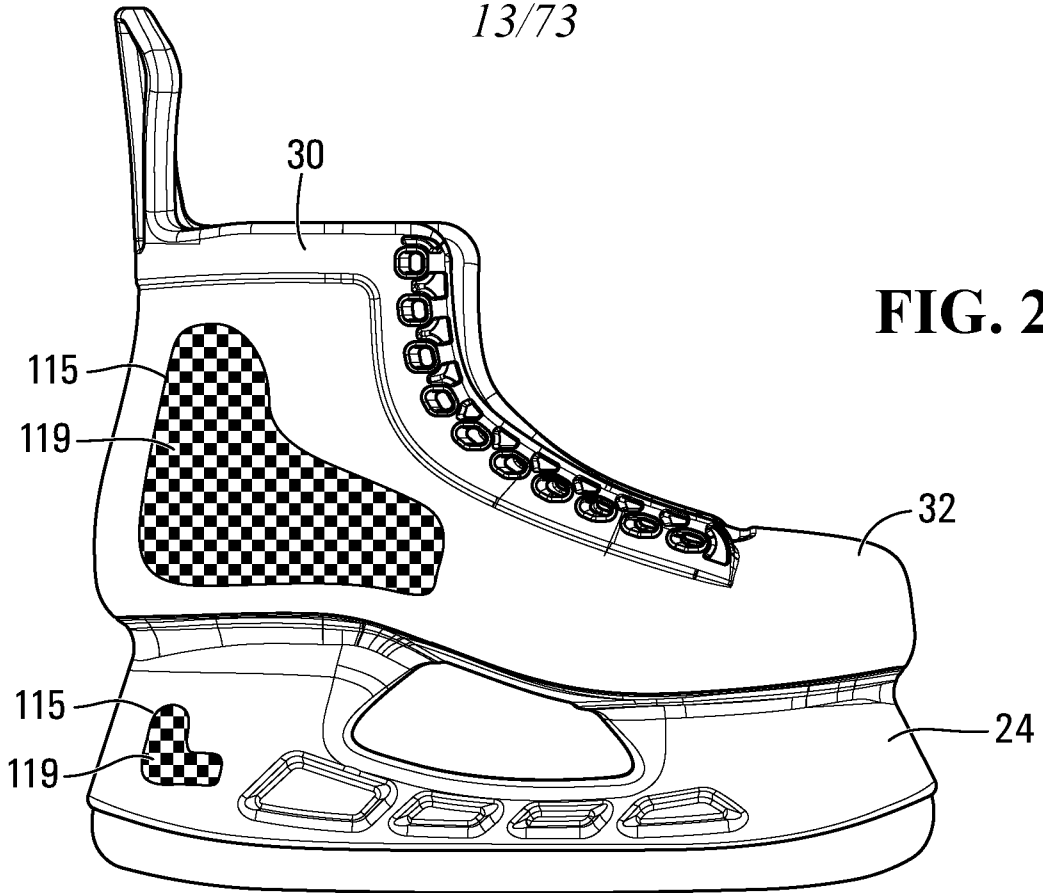


FIG. 21A

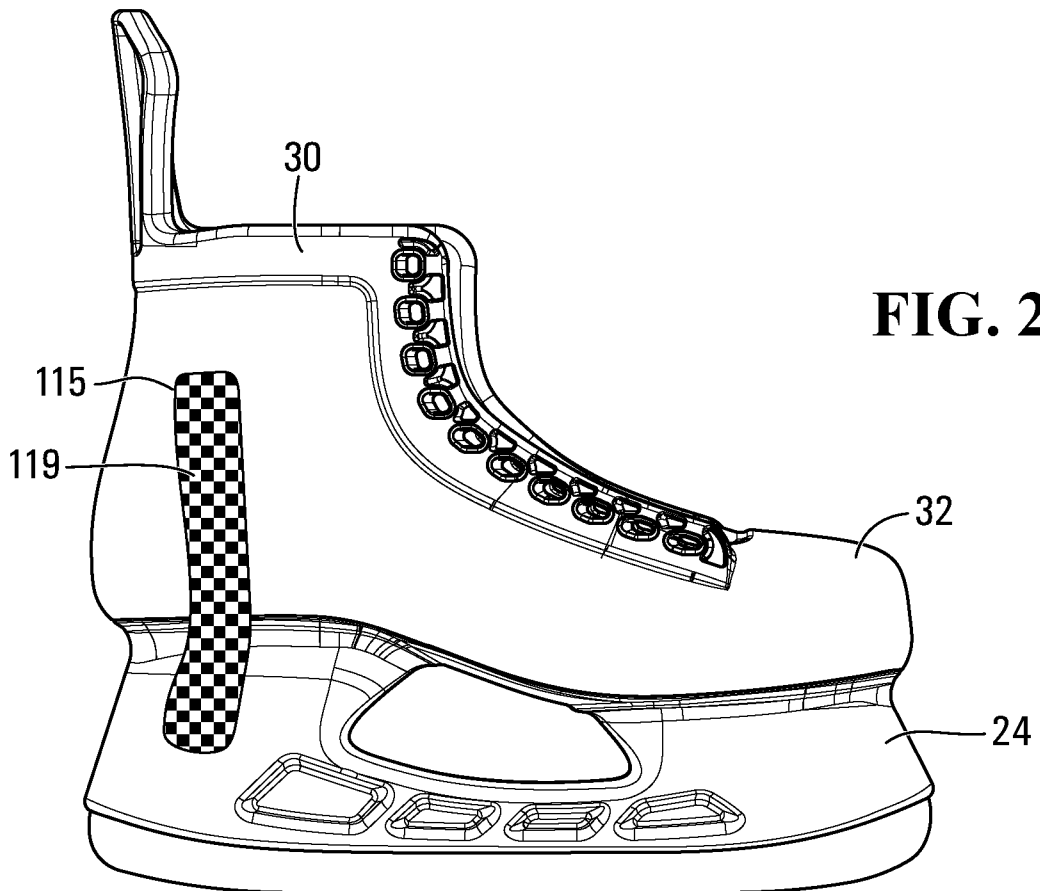


FIG. 21B

+

+

14/73

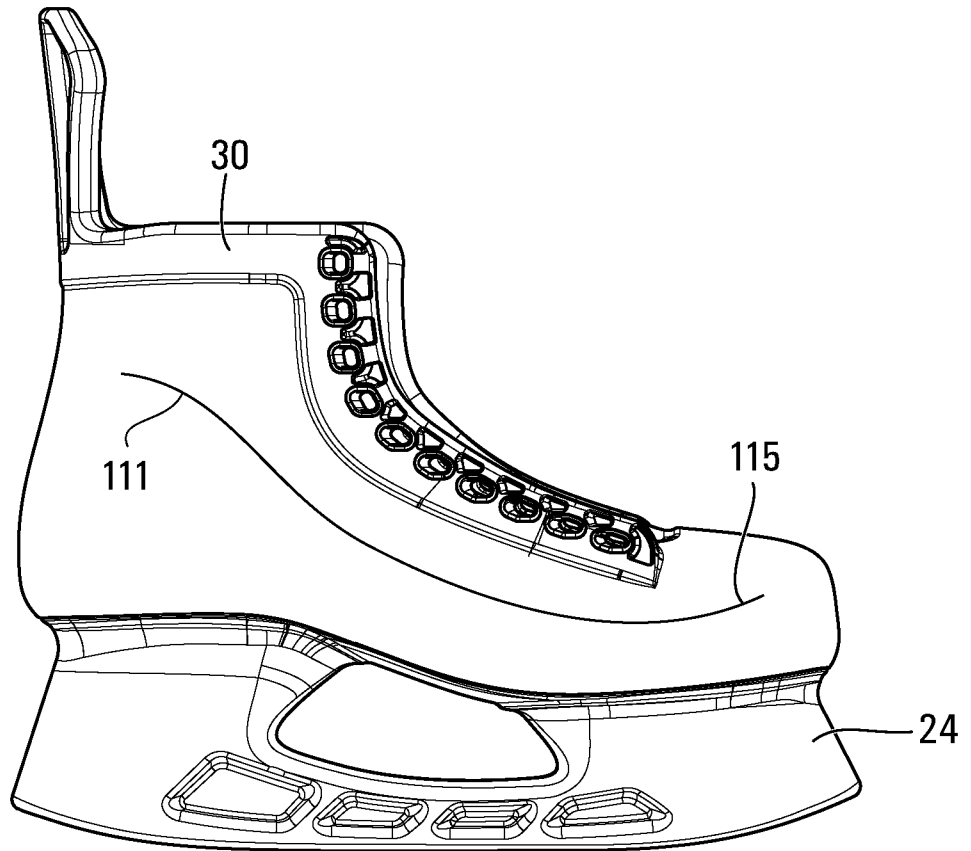


FIG. 21C

+

+

15/73

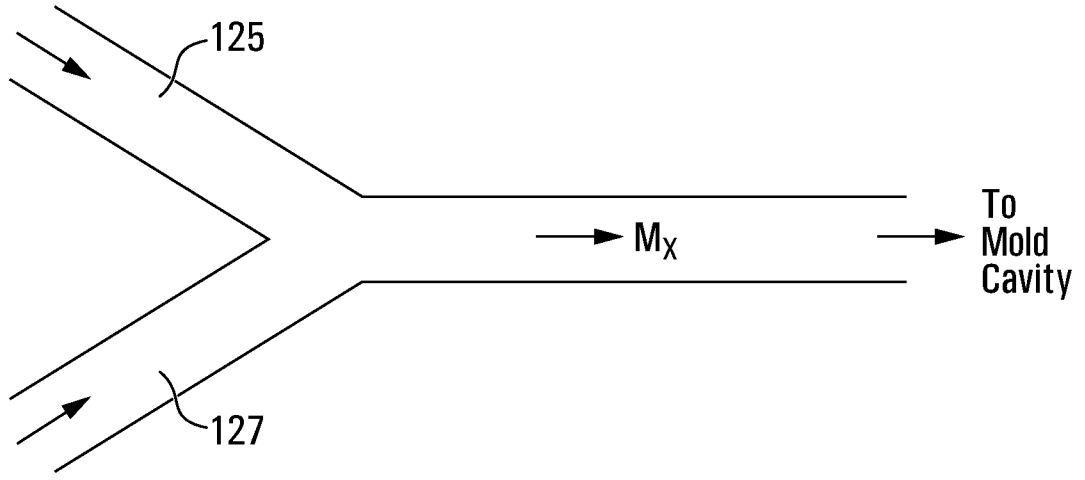


FIG. 22

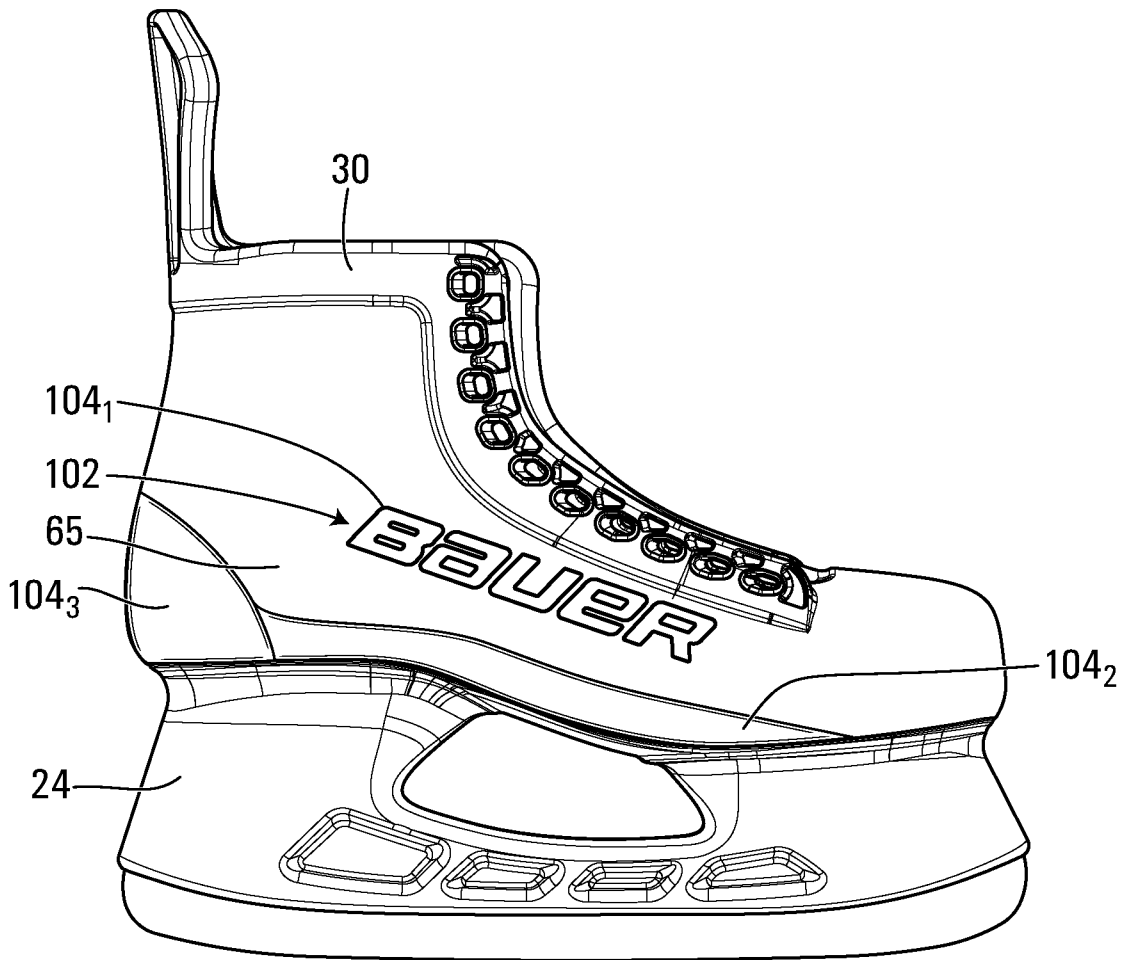


FIG. 23

+

+

16/73

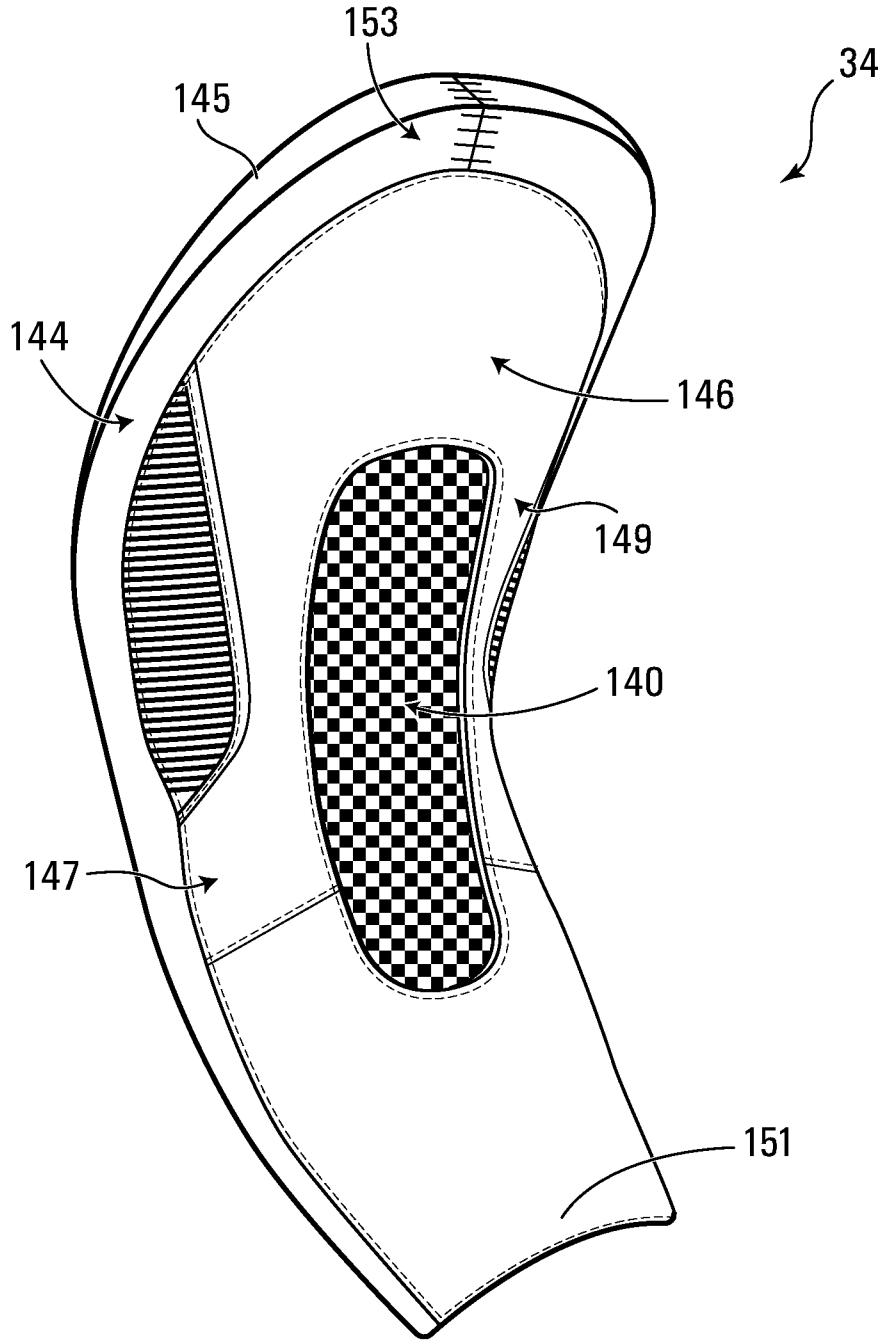


FIG. 24

+

+

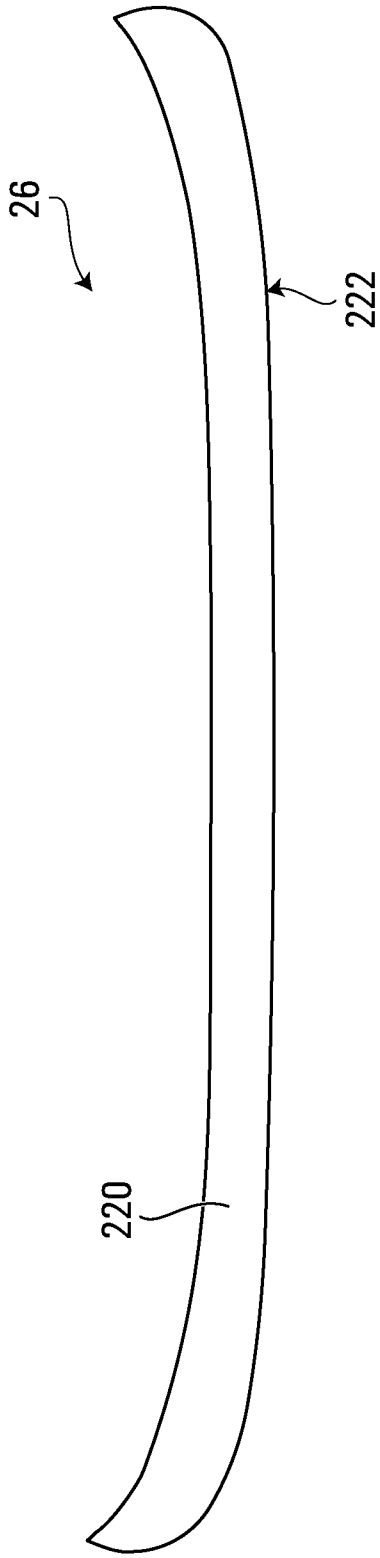


FIG. 25

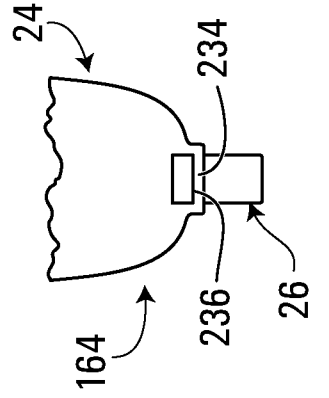


FIG. 27

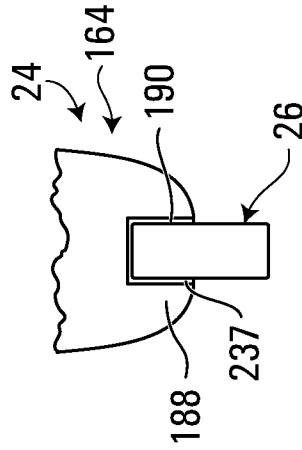


FIG. 26B

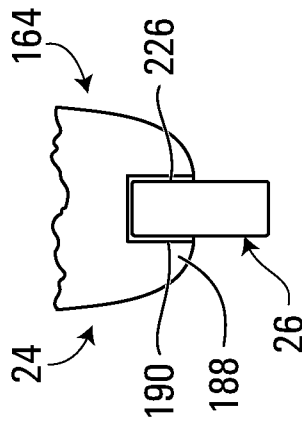


FIG. 26A

+

+

18/73

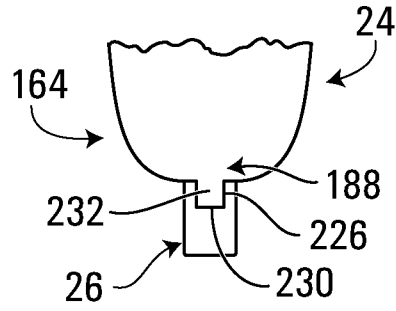


FIG. 28

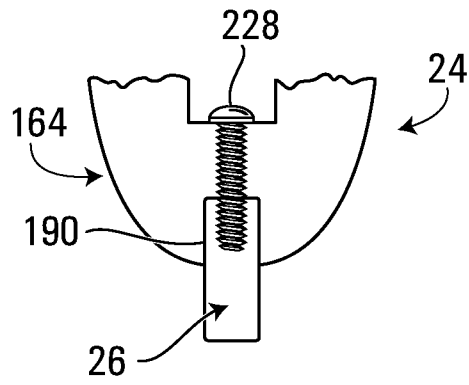


FIG. 29

+

+

19/73

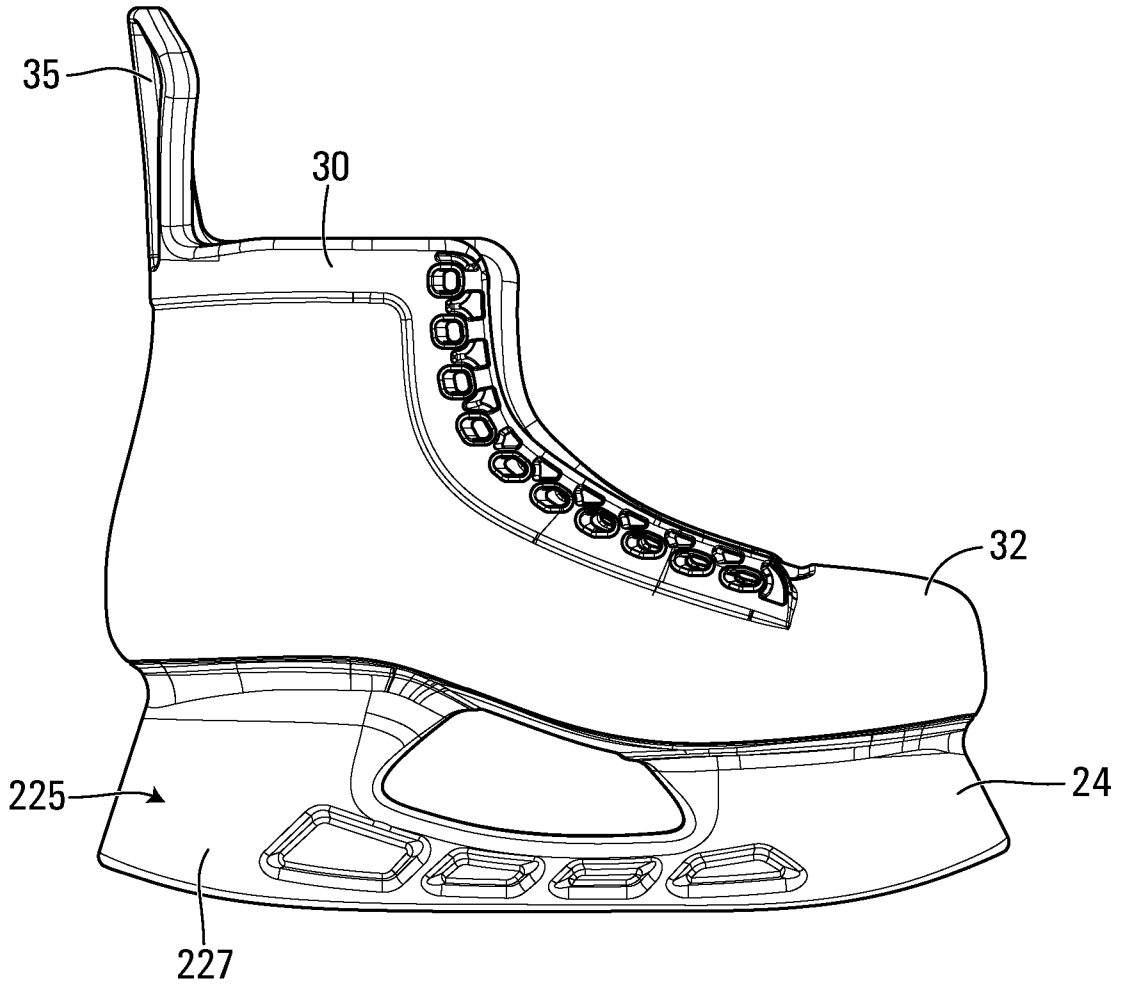


FIG. 30

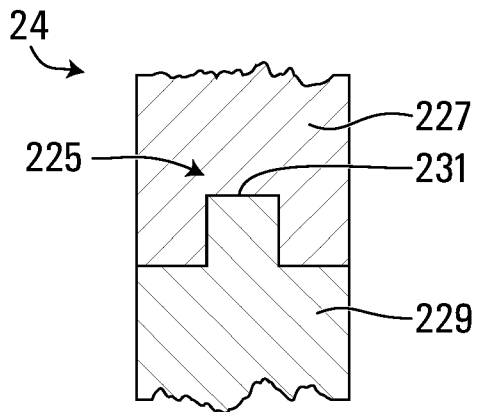


FIG. 31

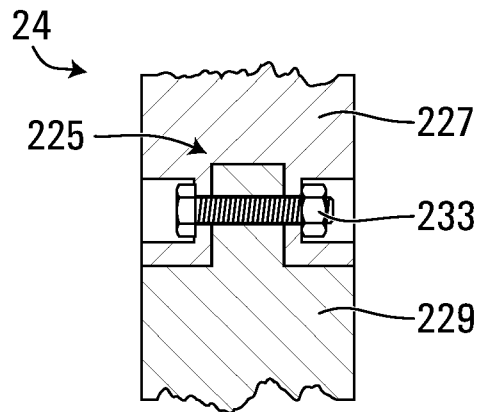


FIG. 32

+

+

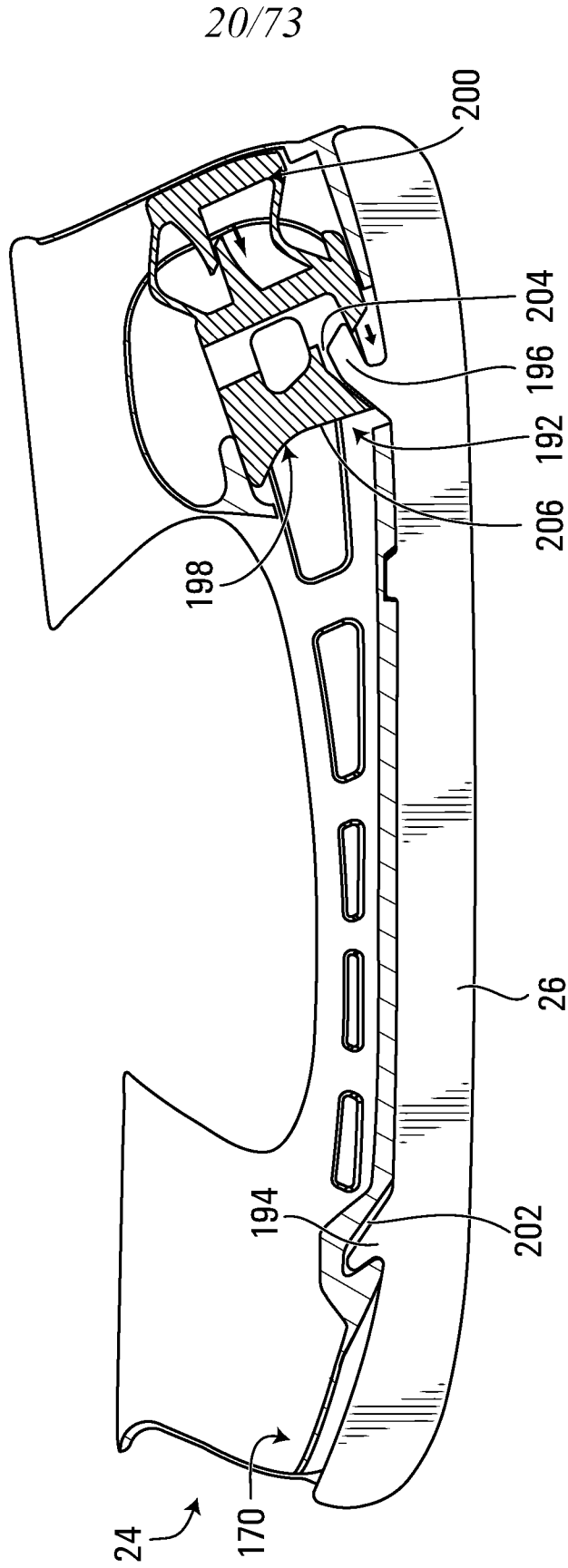


FIG. 33

+

+

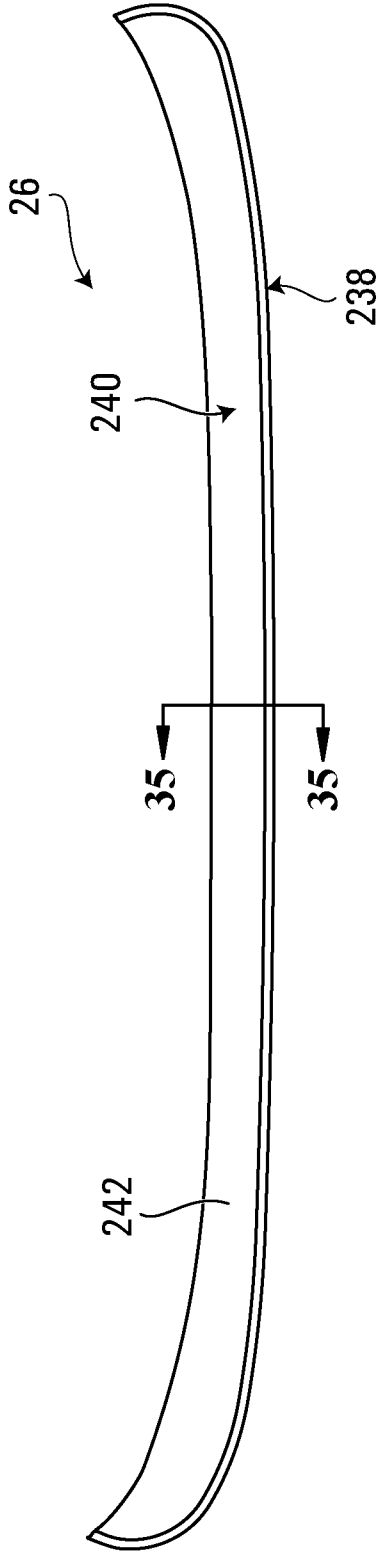


FIG. 34

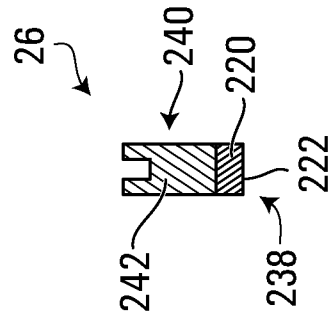


FIG. 35

+

+

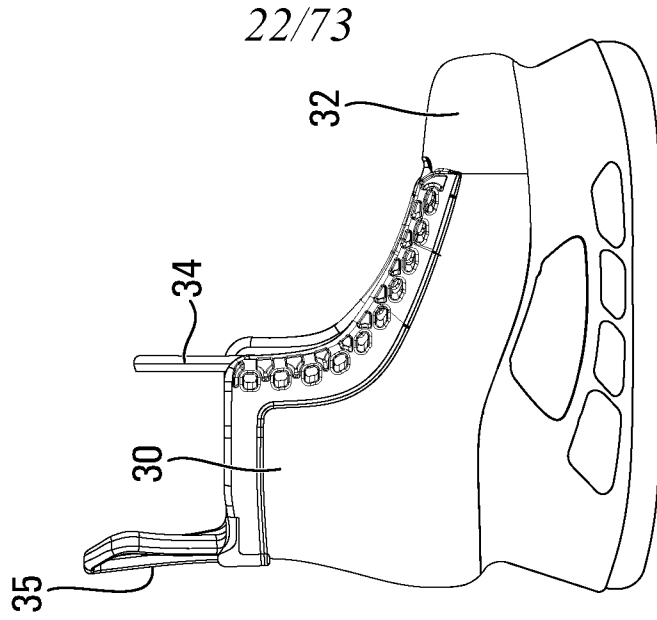


FIG. 36

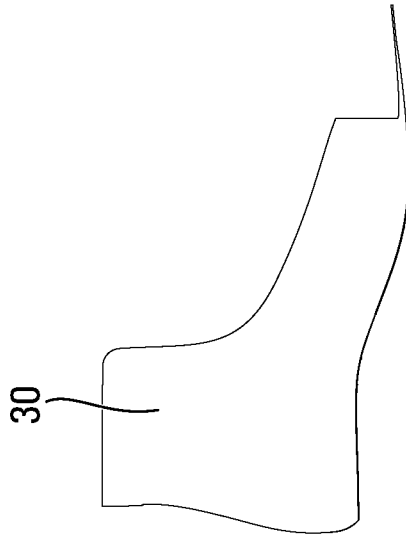


FIG. 37

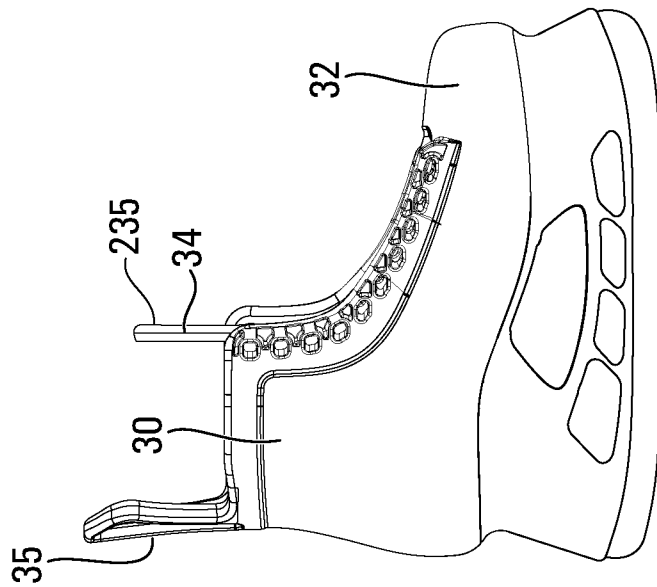


FIG. 38

+

+

23/73

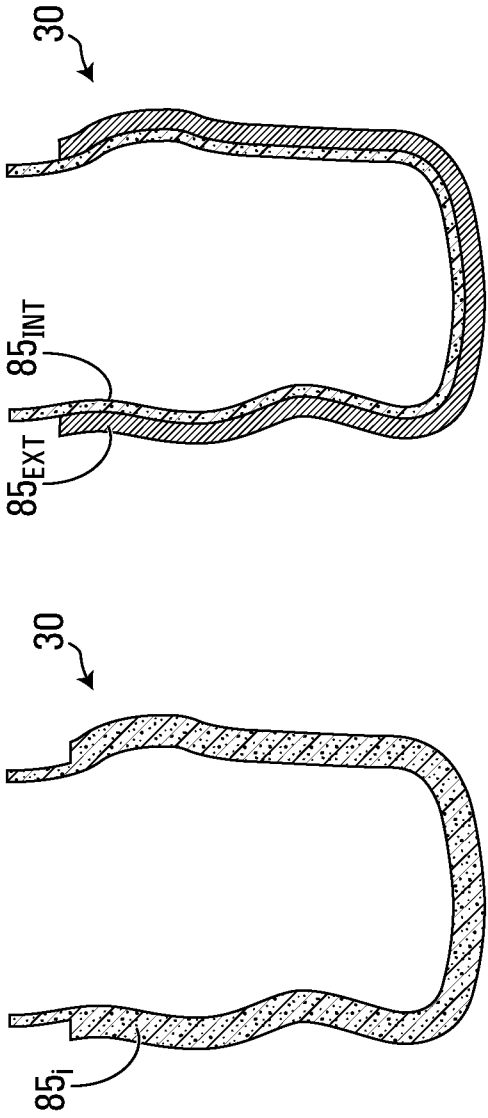


FIG. 40

FIG. 39

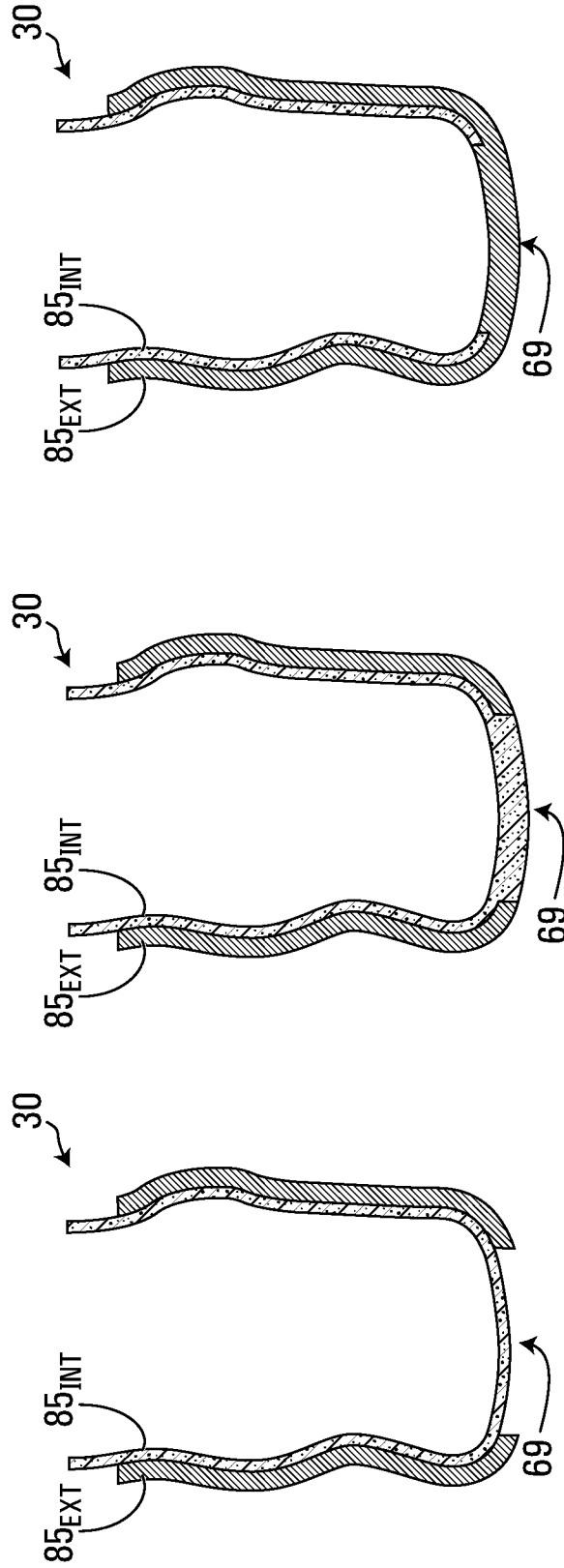


FIG. 41A

FIG. 41B

FIG. 41C

+

+

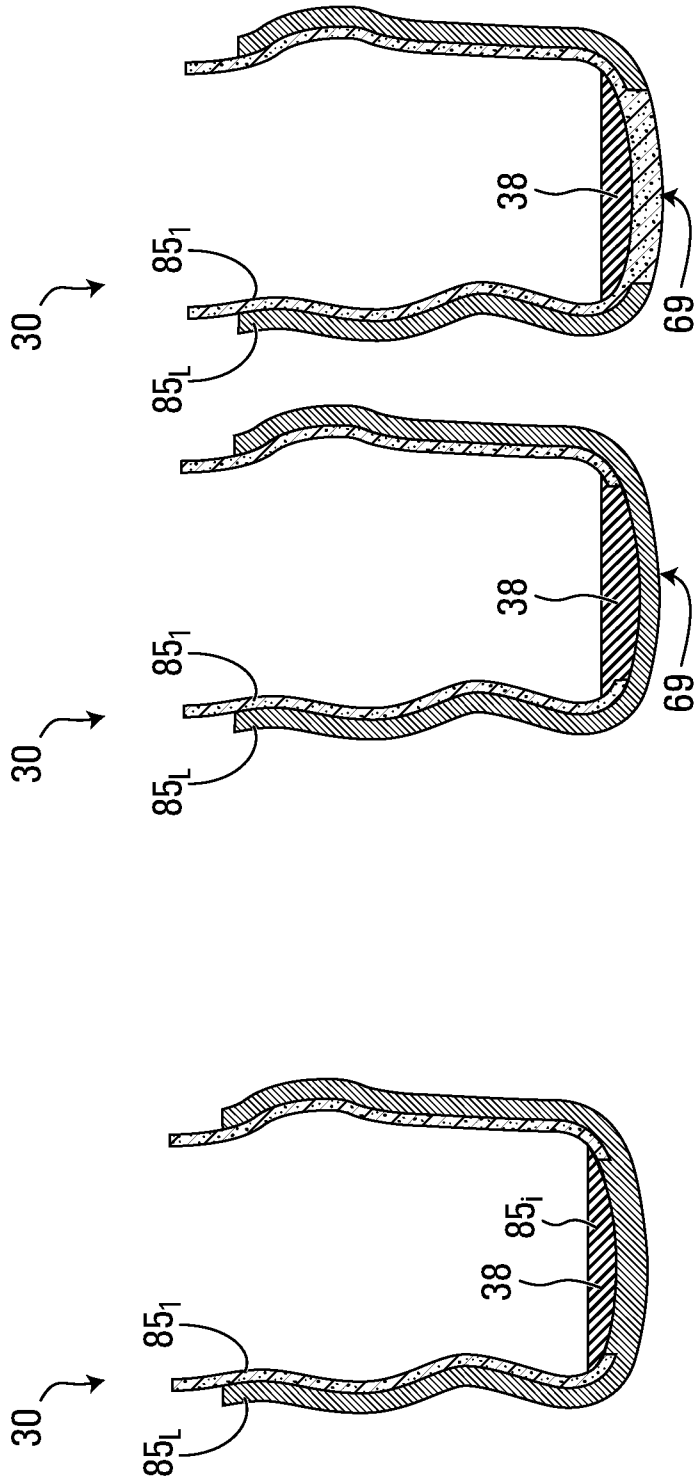


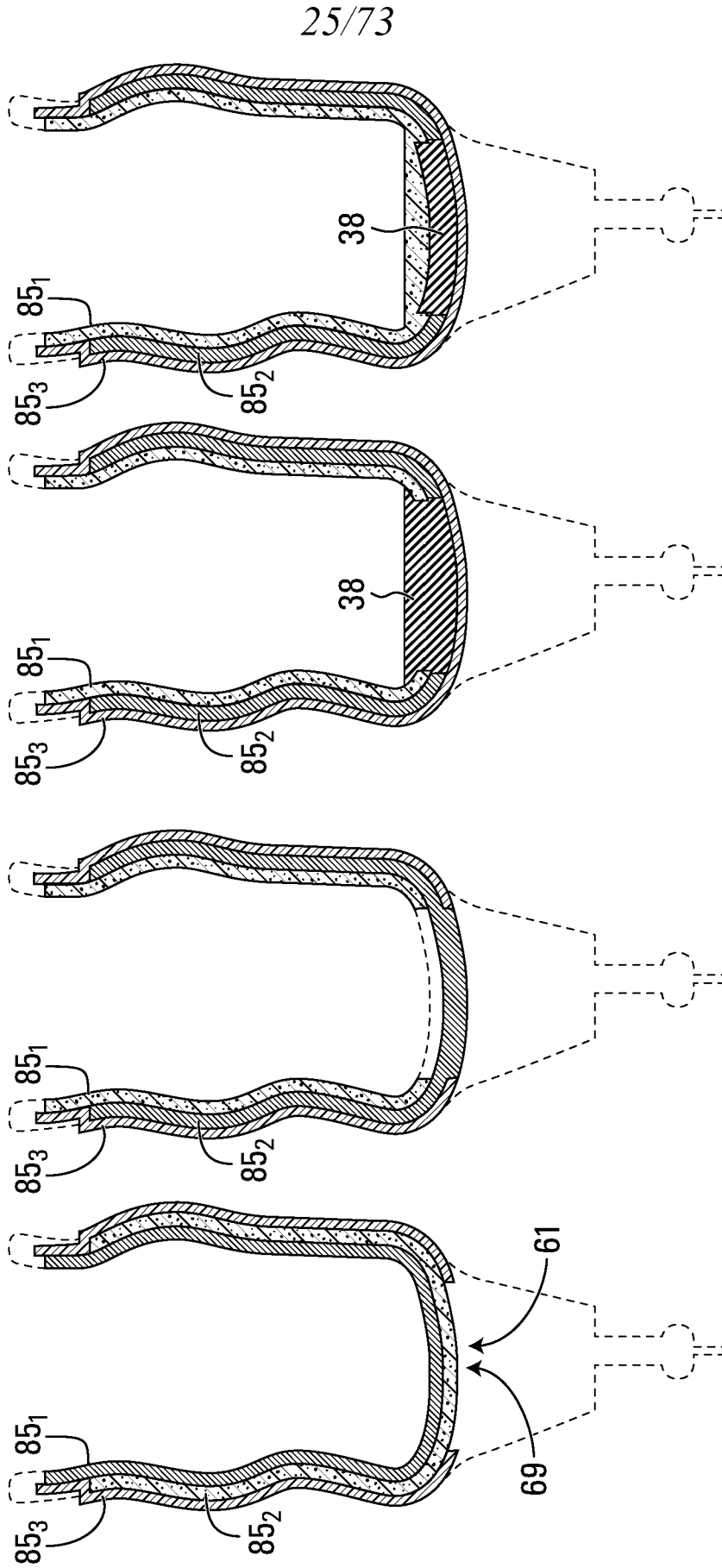
FIG. 43B

FIG. 43A

FIG. 42

+

+



+

+

26/73

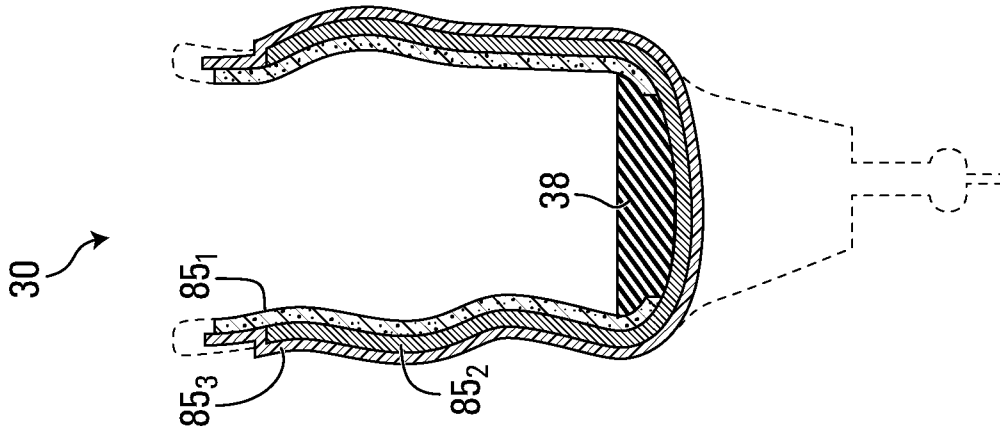


FIG. 48

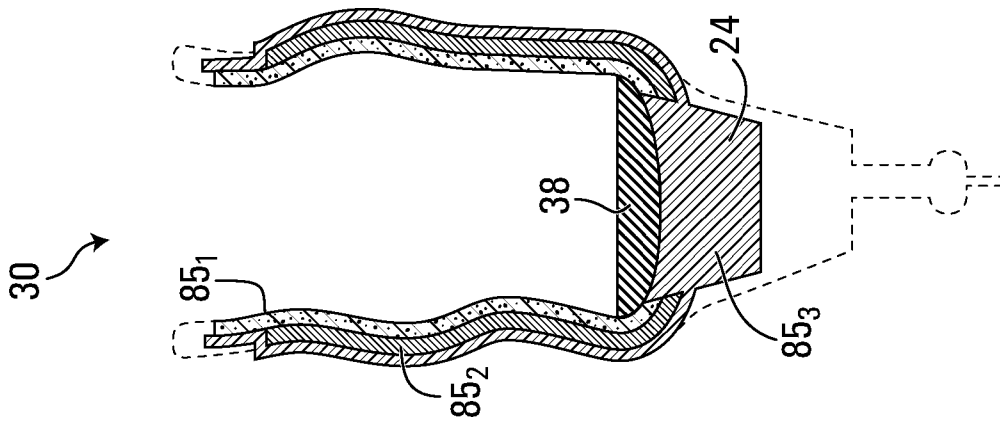


FIG. 47B

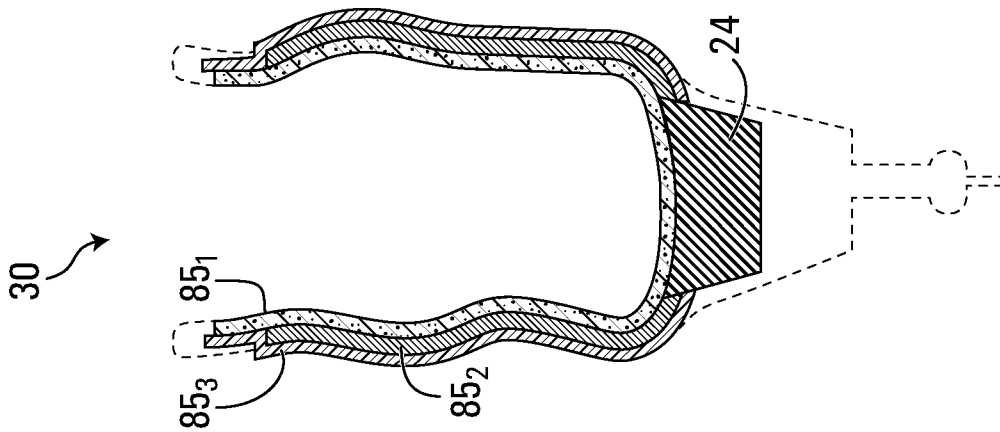


FIG. 47A

+

+

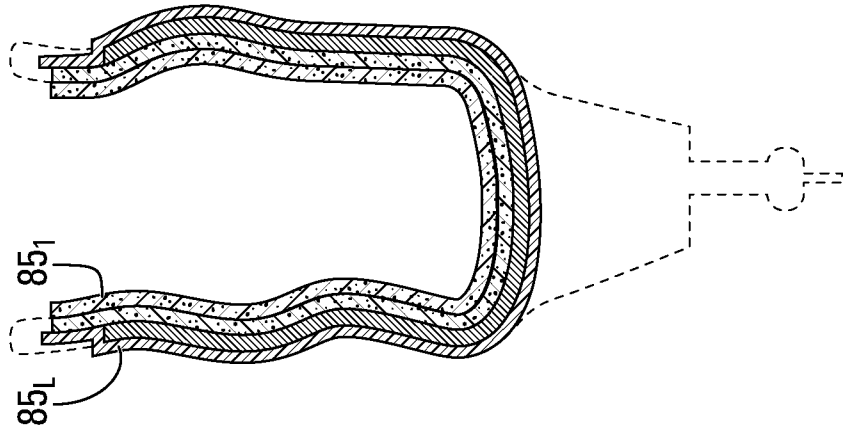


FIG. 50

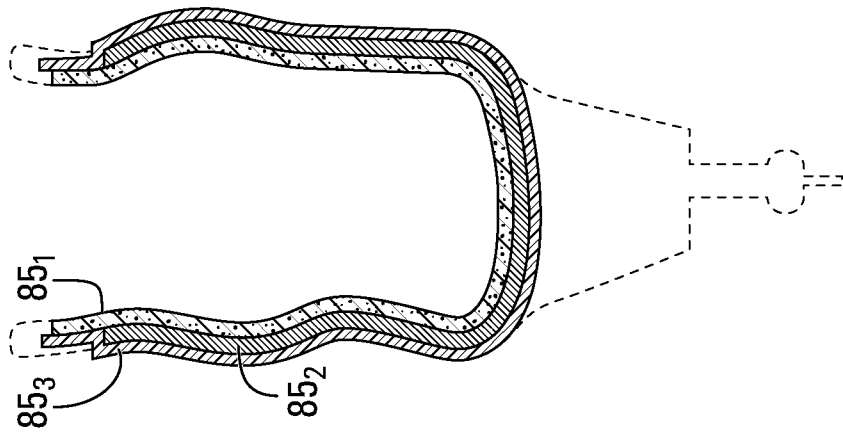


FIG. 49

+

+

28/73

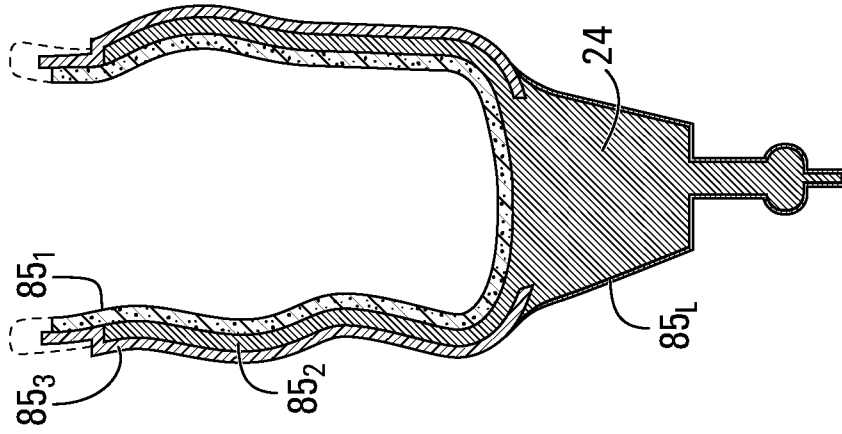


FIG. 51

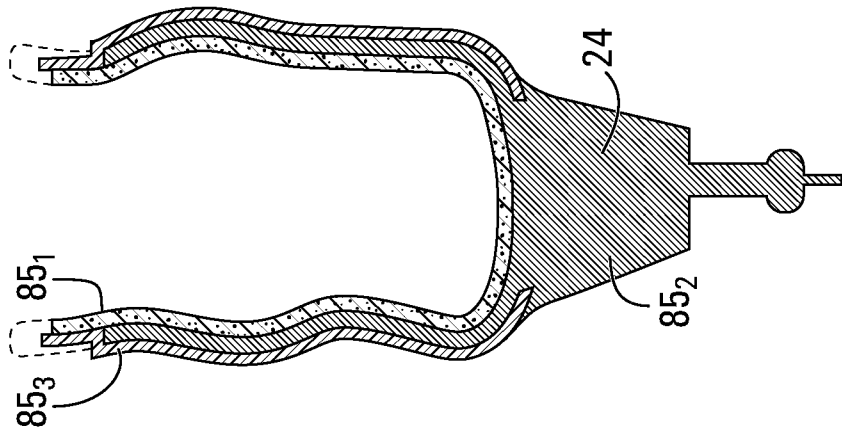


FIG. 52

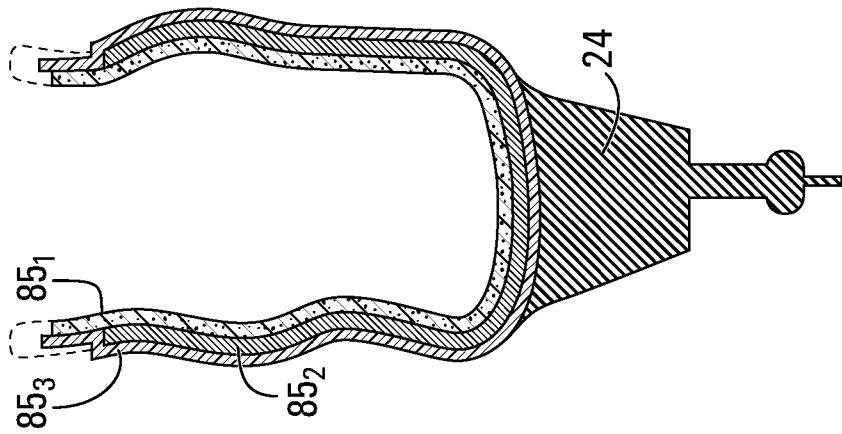


FIG. 53

+

+

29/73

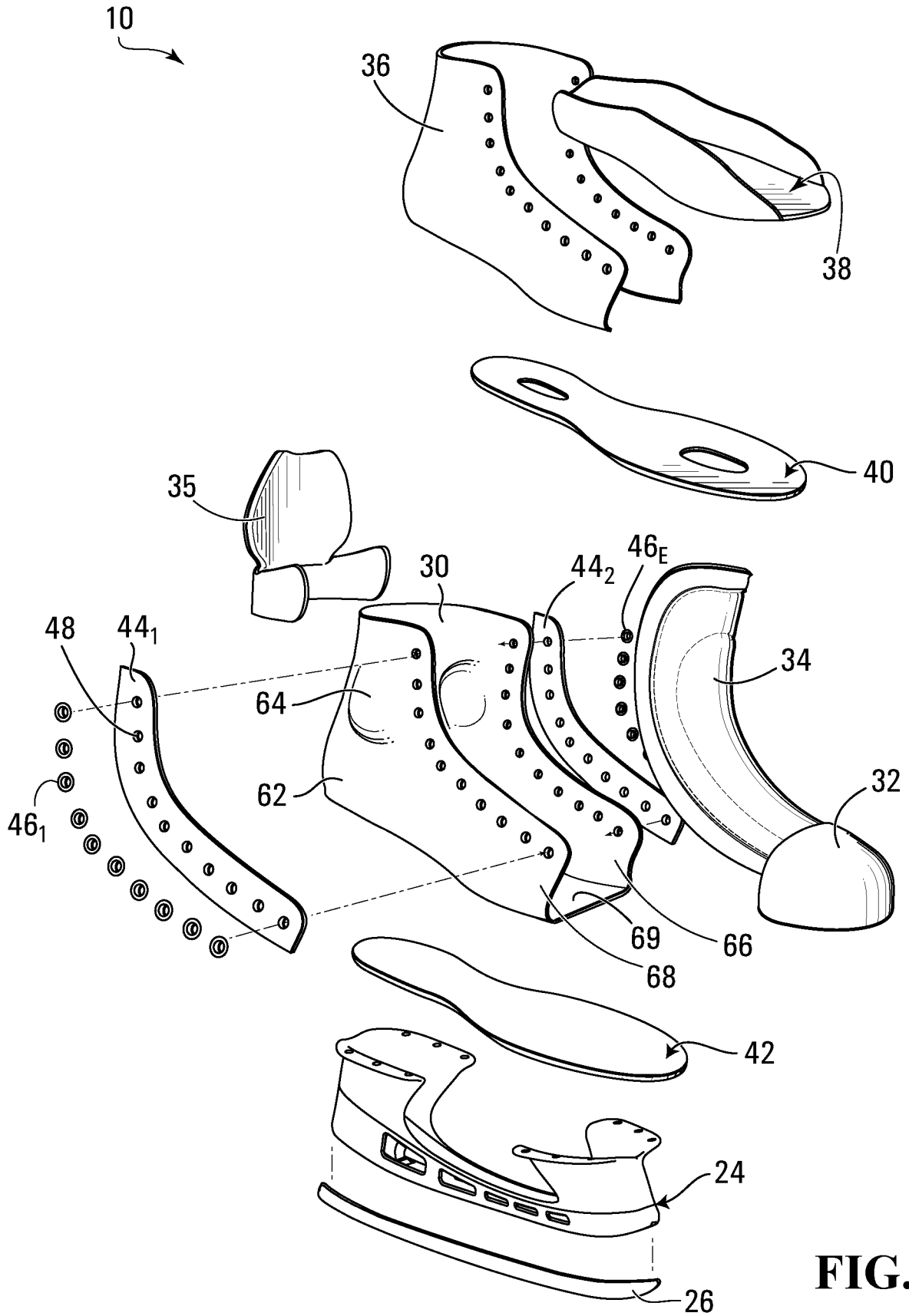


FIG. 54

+

+

30/73

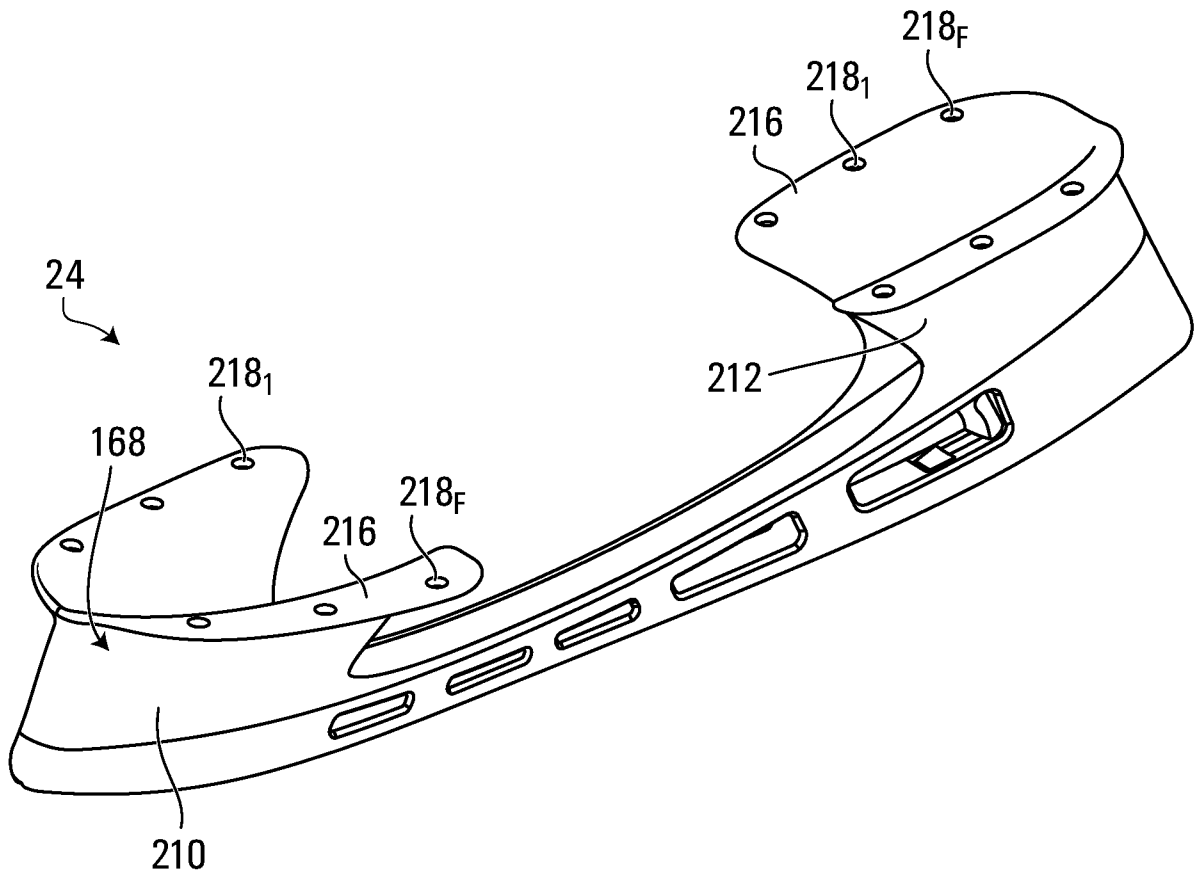


FIG. 55

+

+

31/73

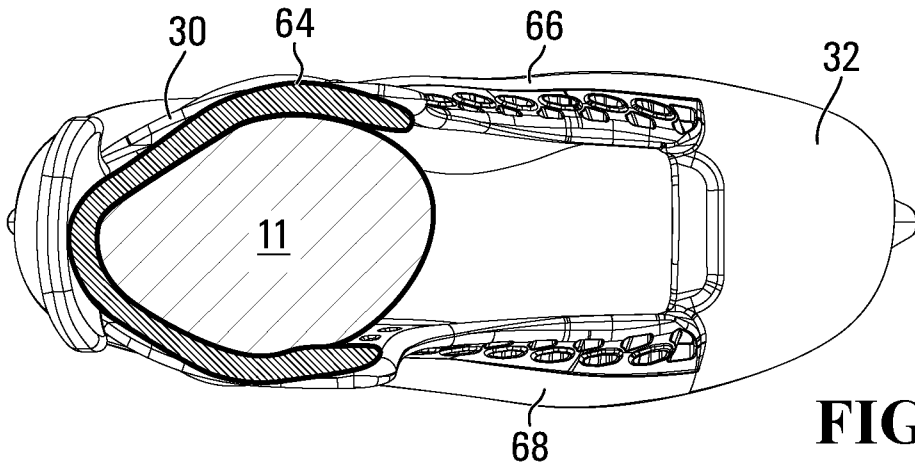


FIG. 56

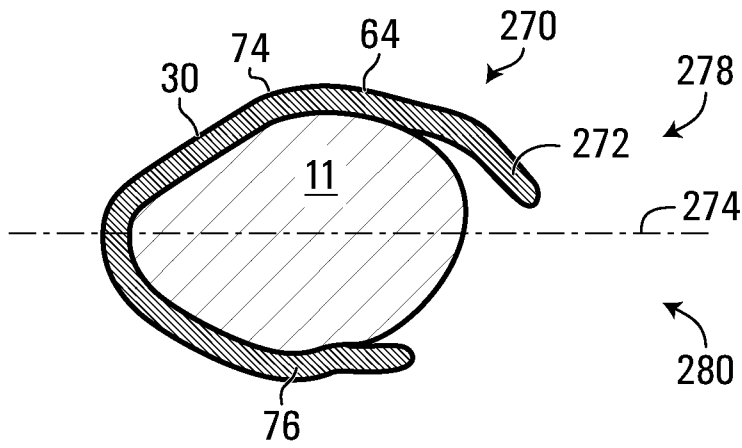


FIG. 57A

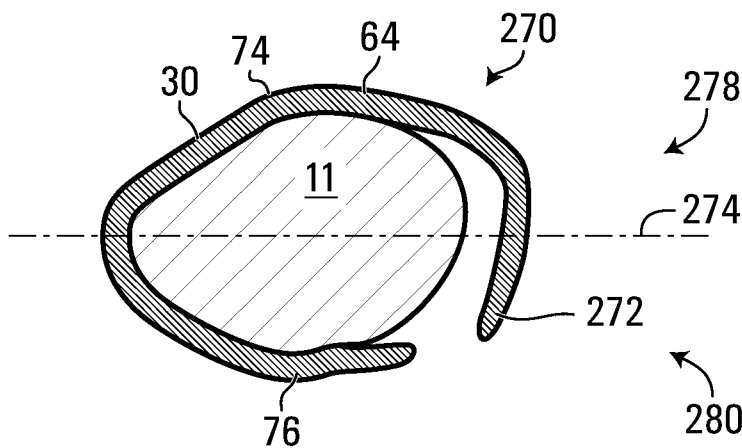


FIG. 57B

+

+

32/73

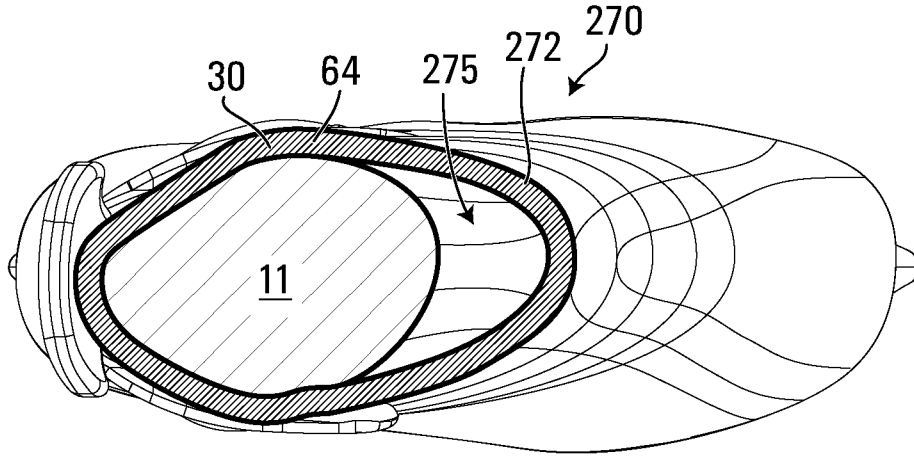


FIG. 58

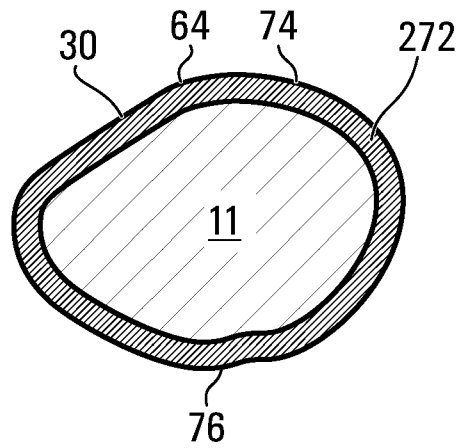


FIG. 59

+

+

33/73

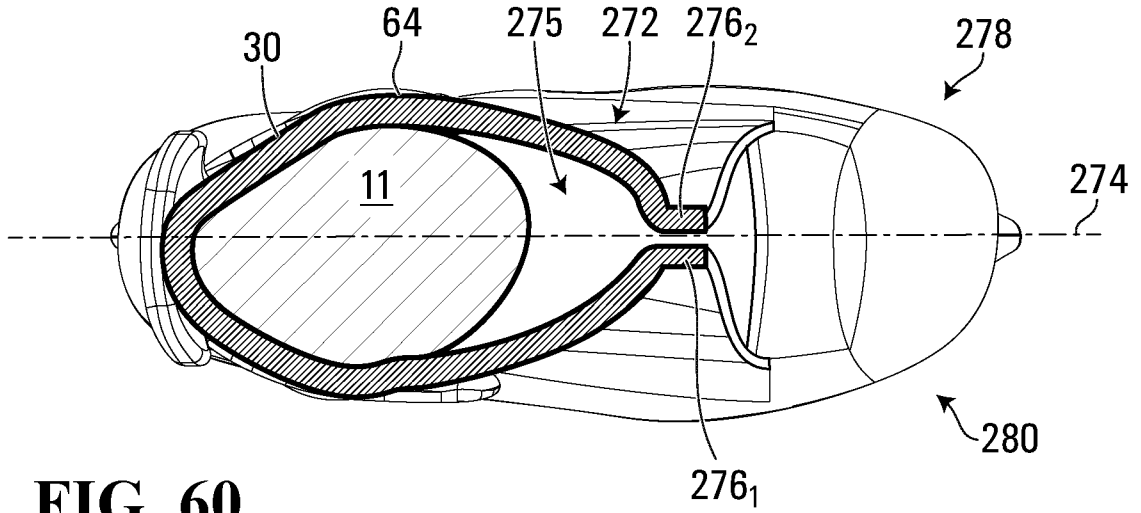


FIG. 60

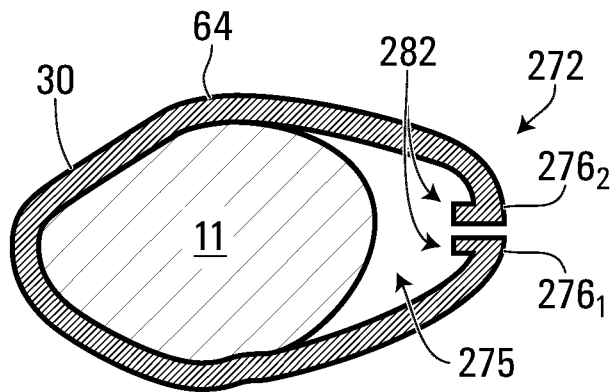


FIG. 61

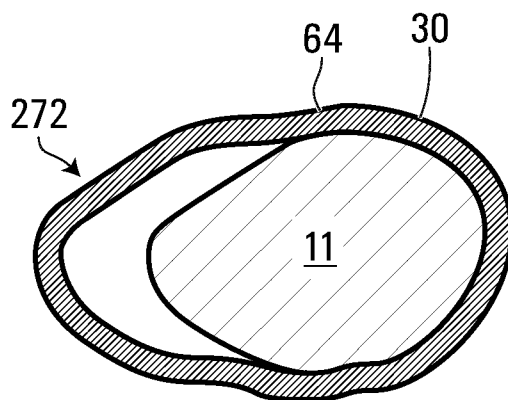


FIG. 62

+

+

34/73

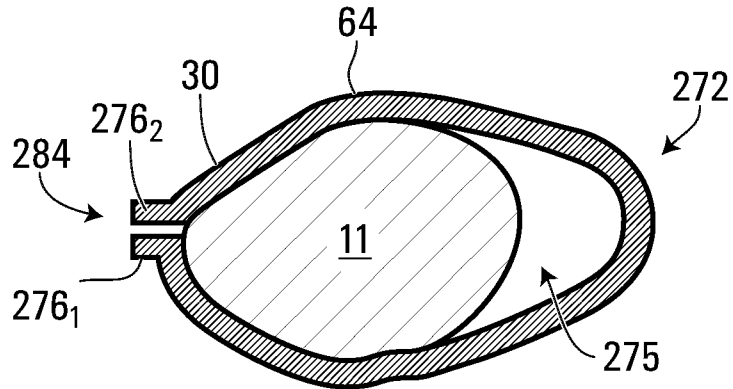


FIG. 63

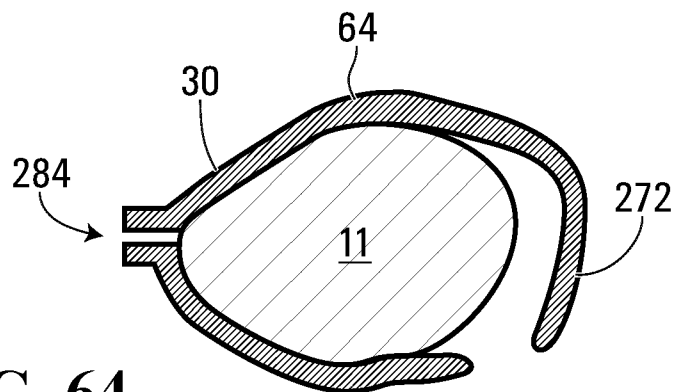


FIG. 64

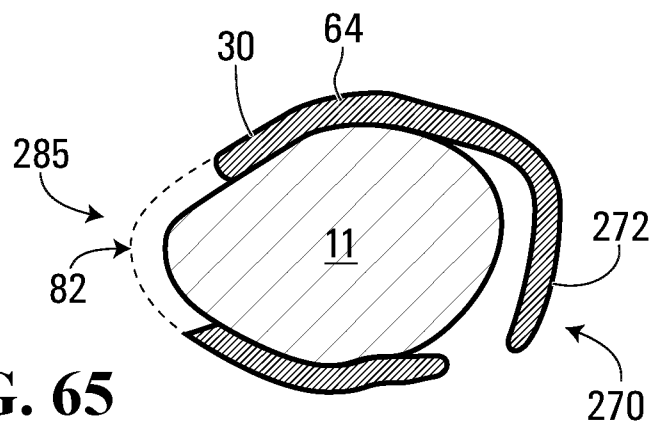


FIG. 65

+

+

35/73

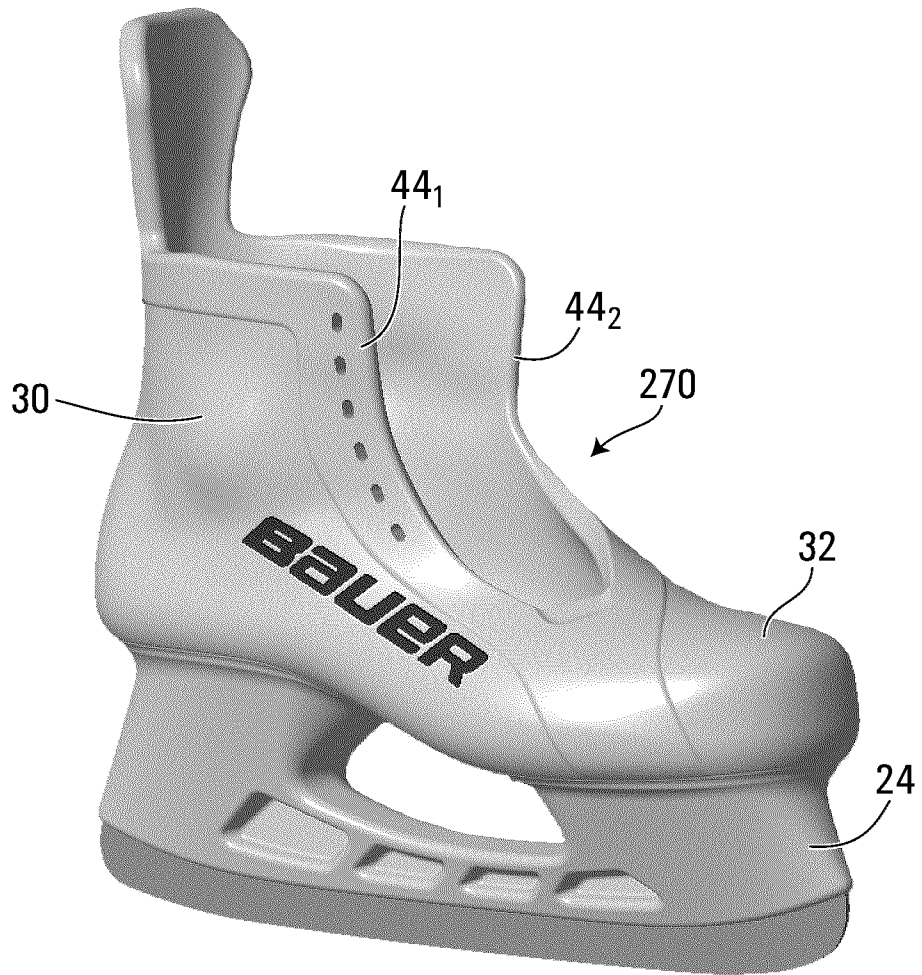


FIG. 66

+

+

36/73

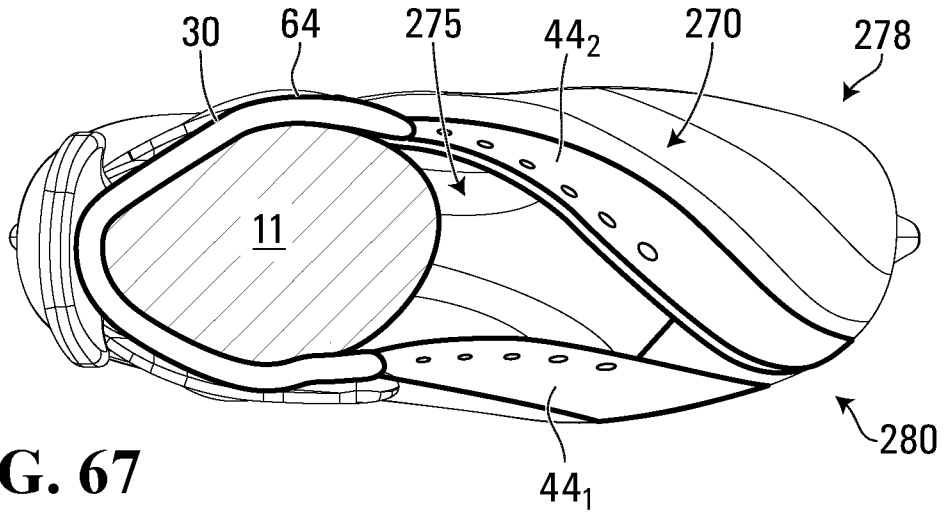


FIG. 67

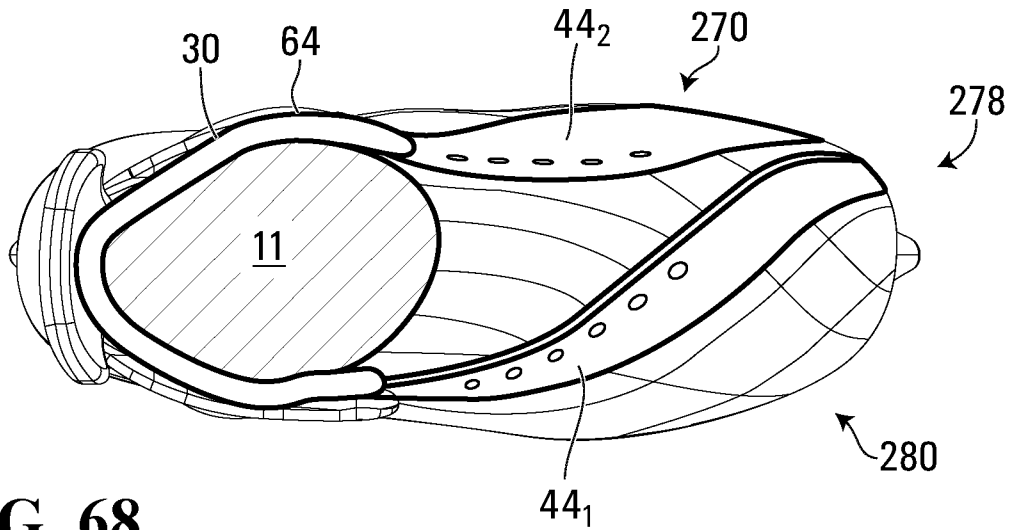


FIG. 68

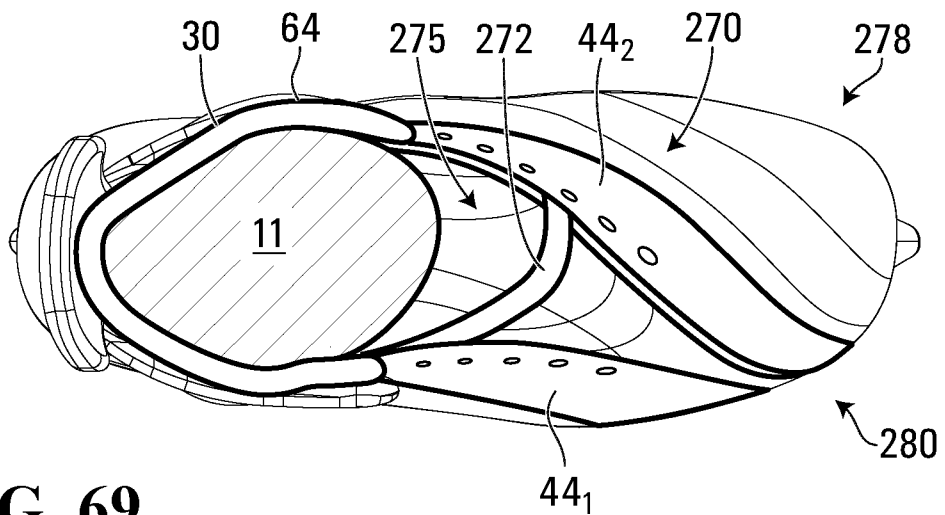


FIG. 69

+

+

37/73

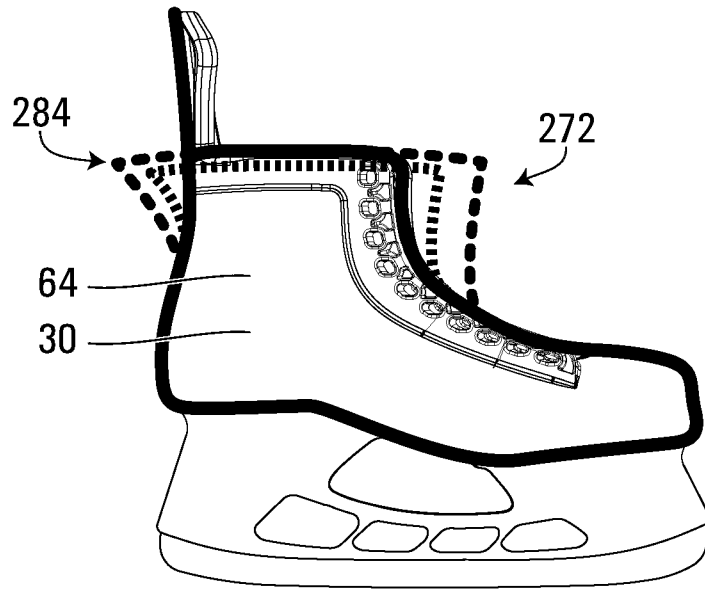


FIG. 70

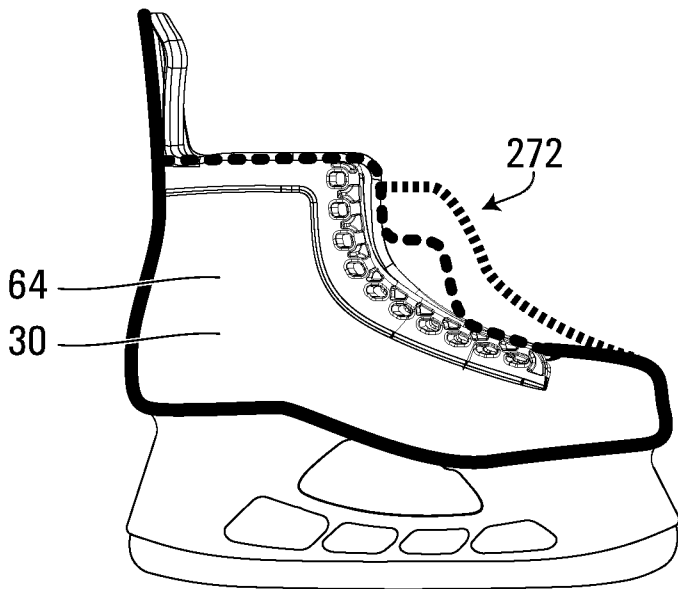


FIG. 71A

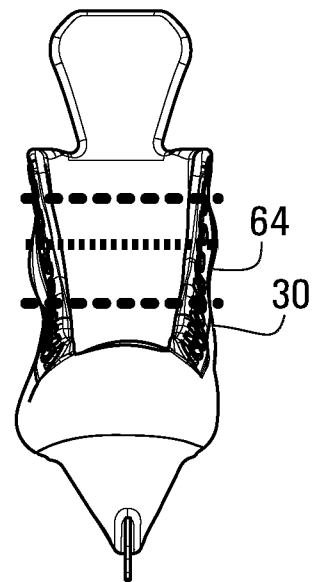


FIG. 71B

+

+

38/73

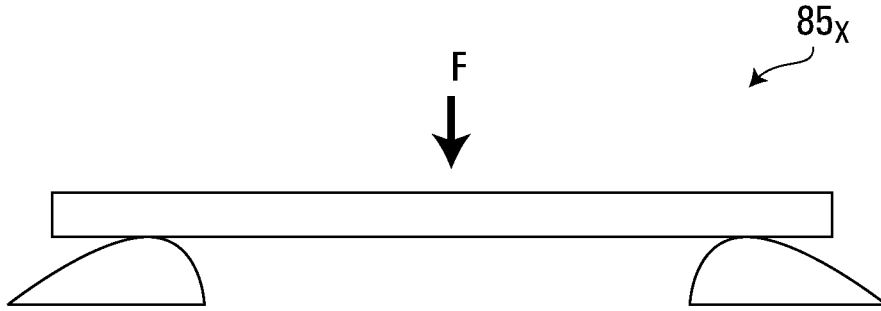


FIG. 72

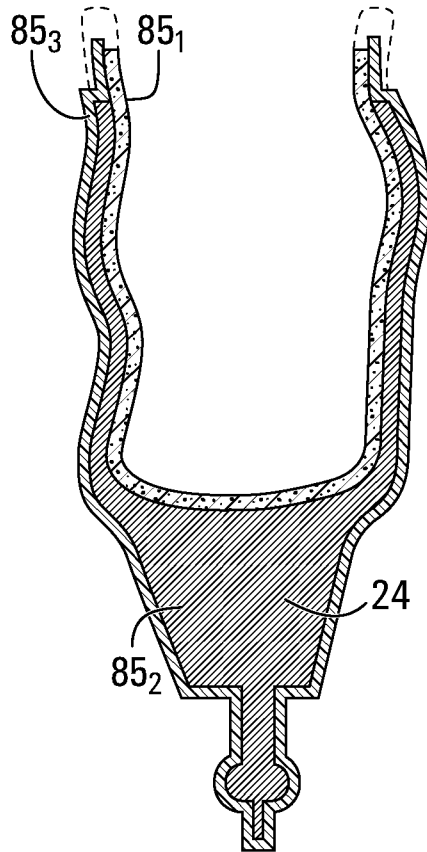


FIG. 73

+

+

39/73

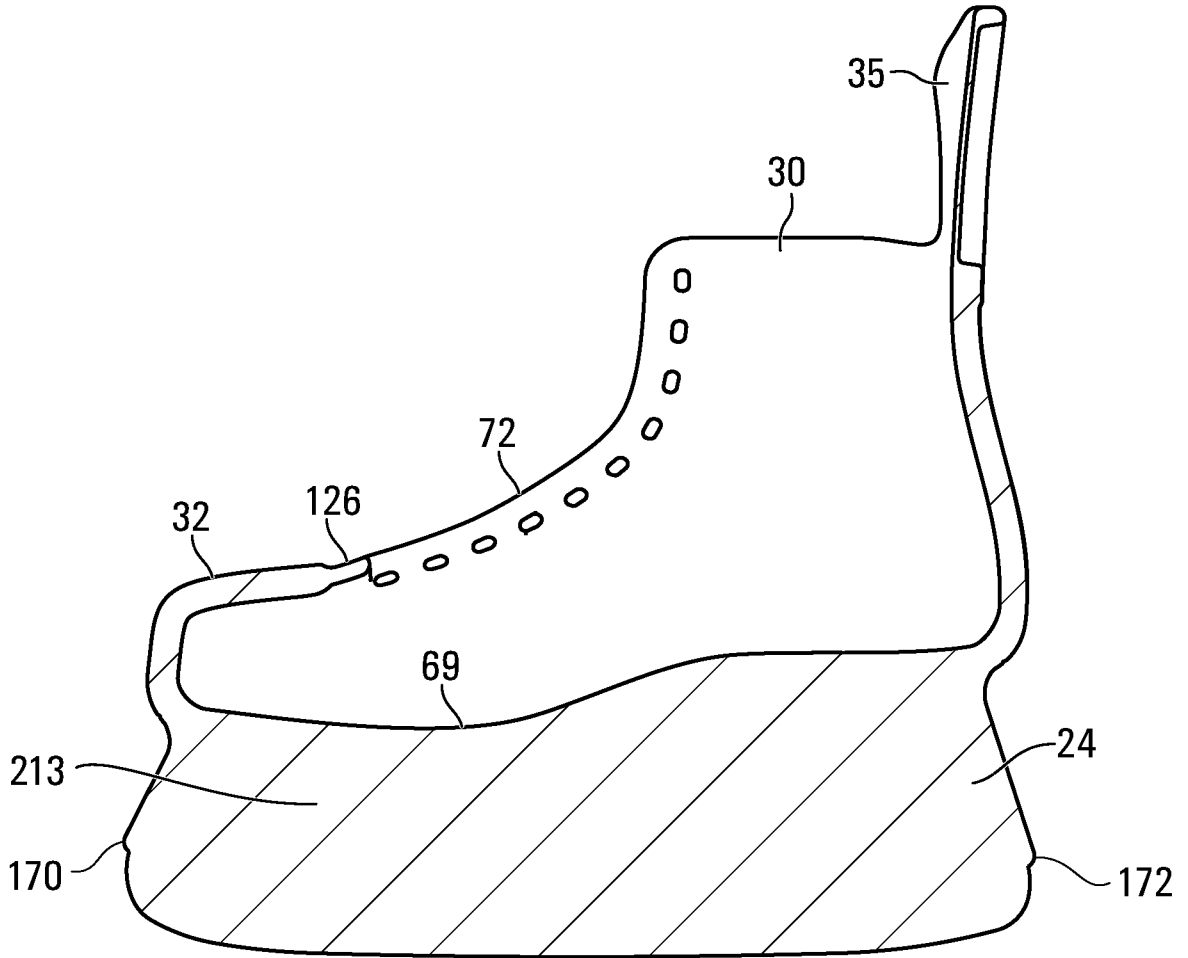
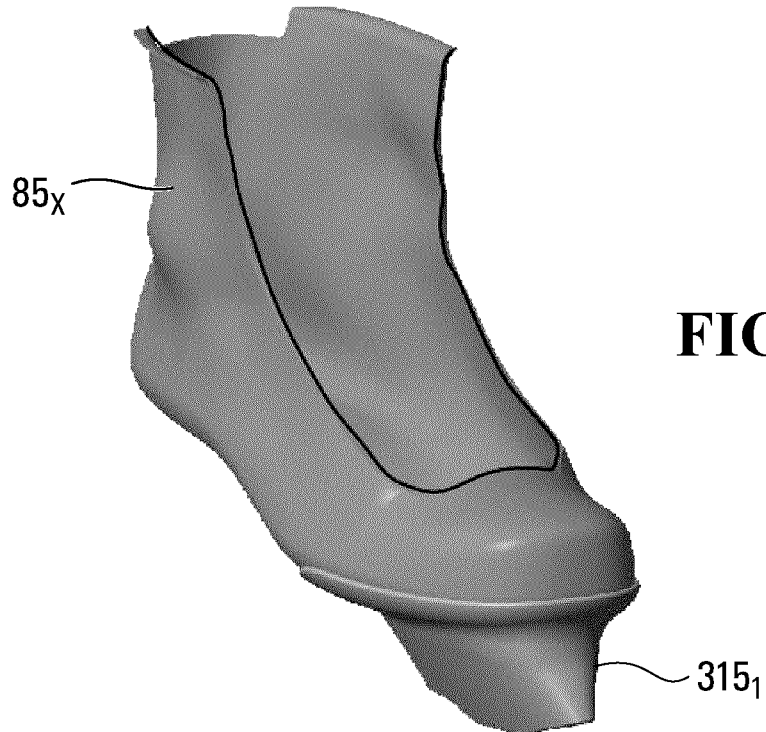
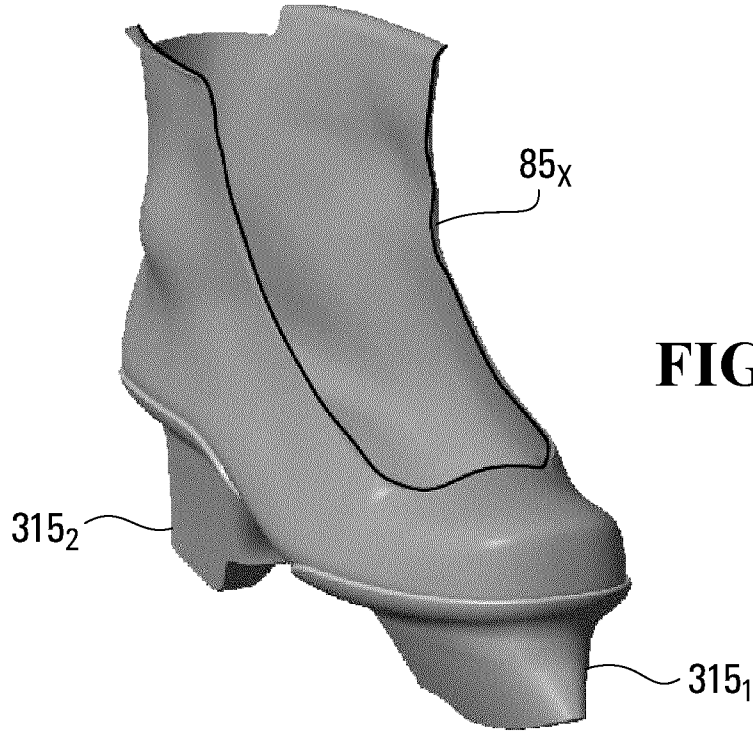


FIG. 74

+

+

40/73



+

+

41/73

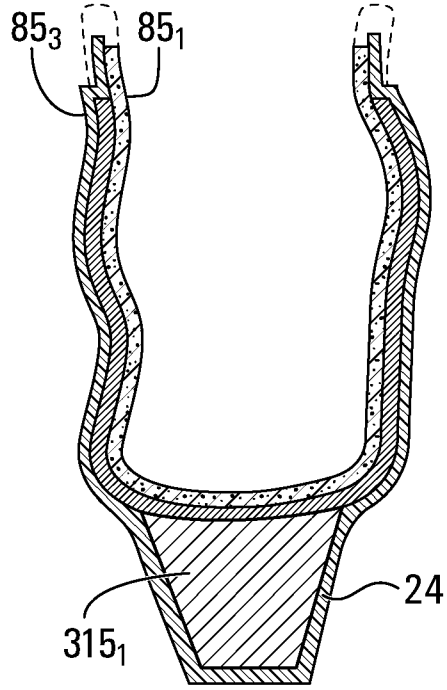


FIG. 77

+

+

42/73

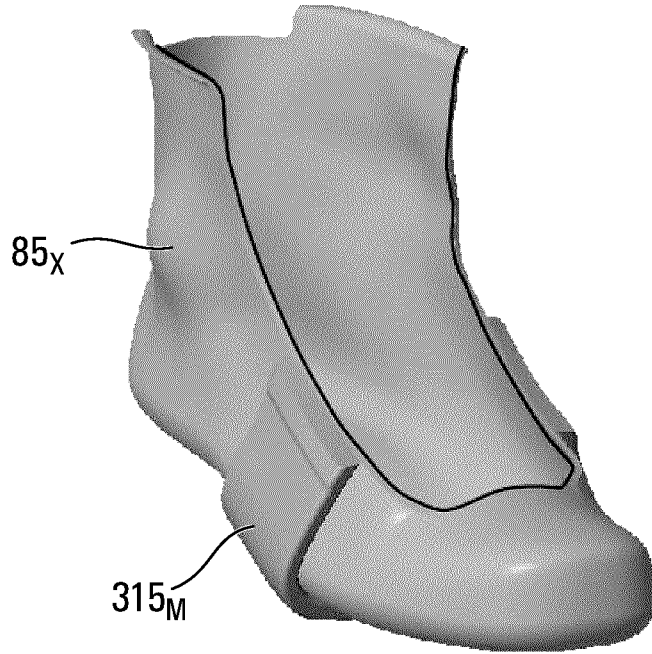


FIG. 78A

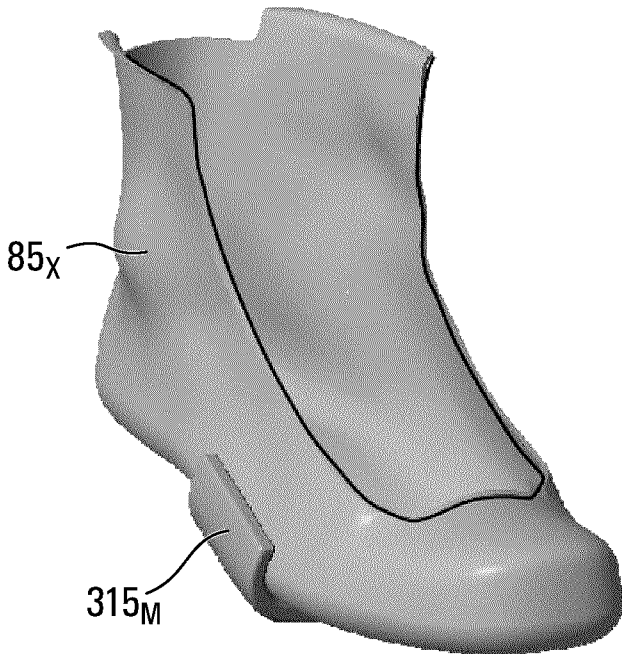


FIG. 78B

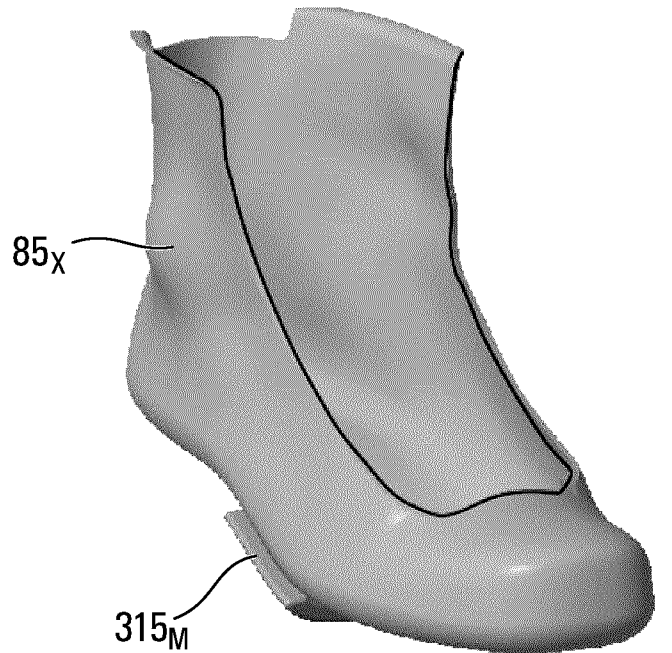


FIG. 78C

+

+

43/73

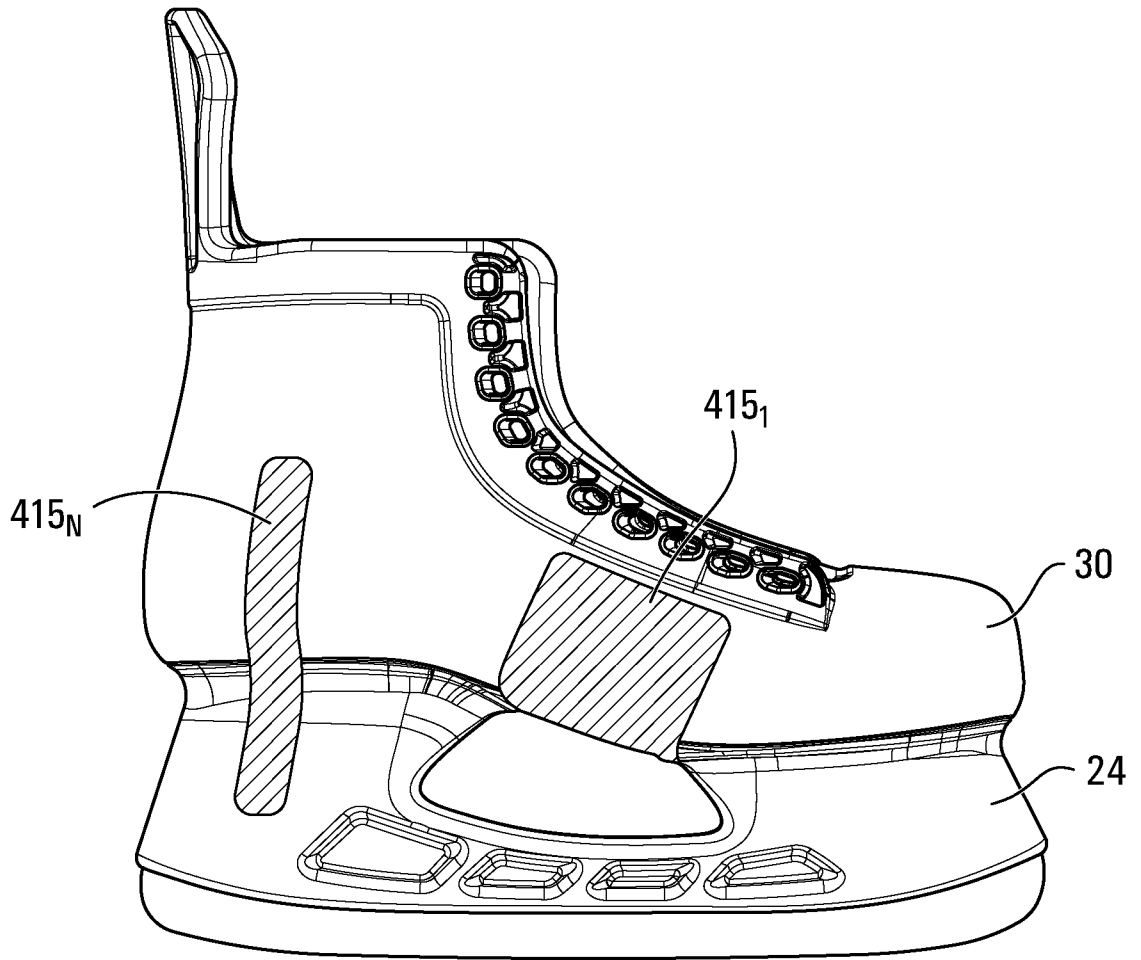


FIG. 79

+

+

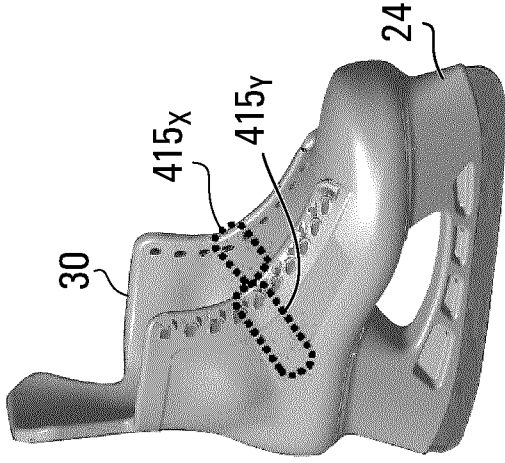


FIG. 80C

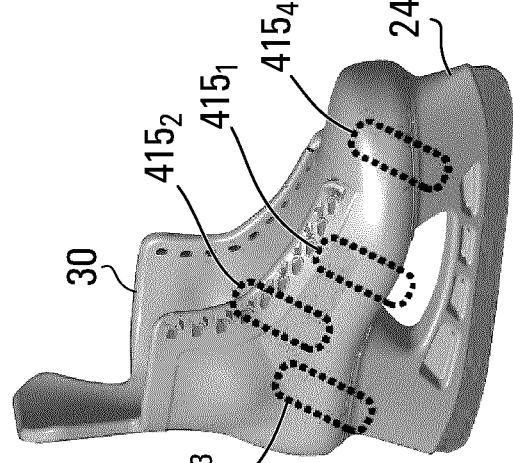


FIG. 80F

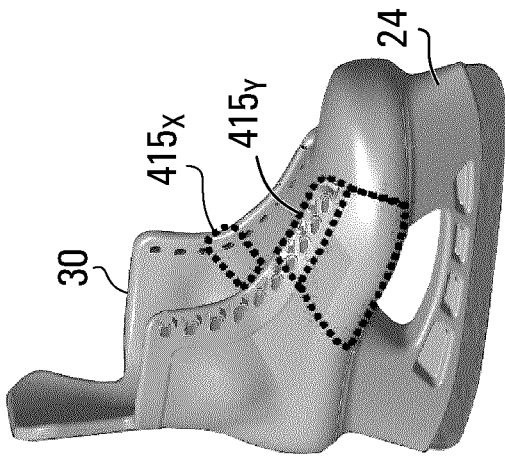


FIG. 80B

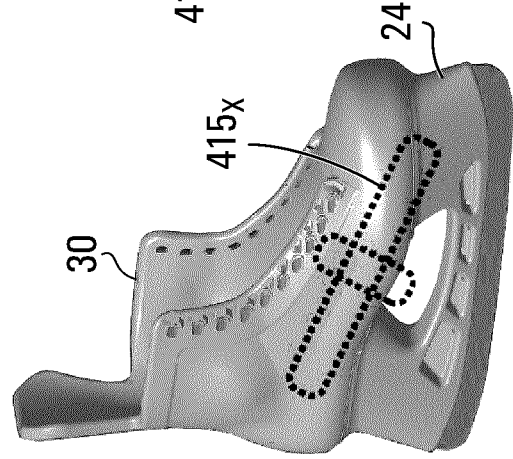


FIG. 80E

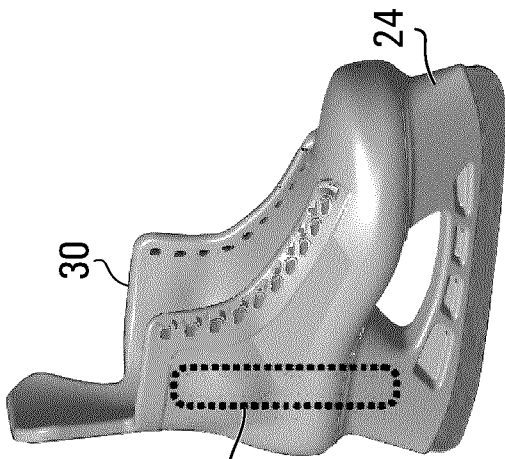


FIG. 80A

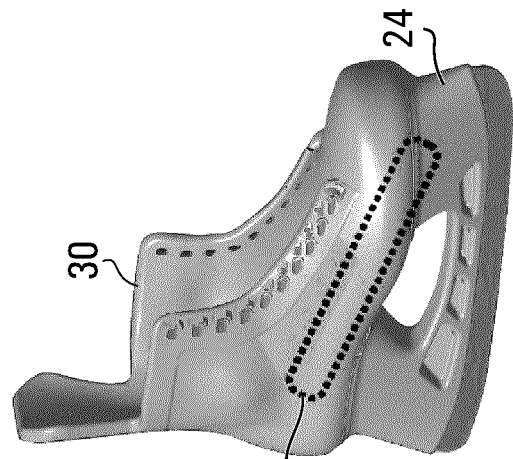


FIG. 80D

+

+

45/73

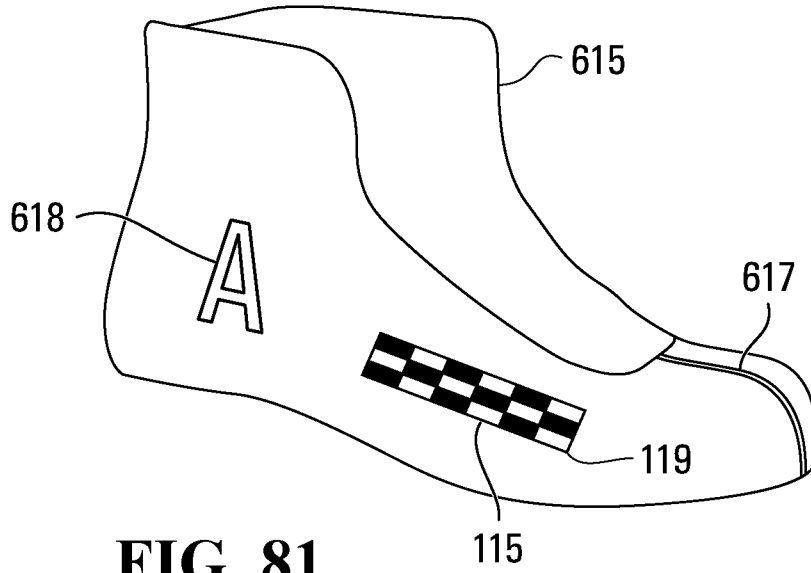


FIG. 81

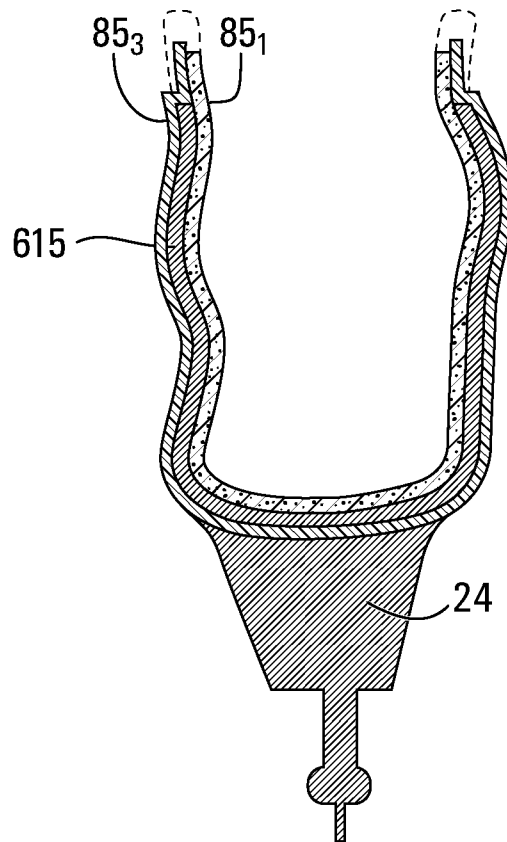


FIG. 82

+

+

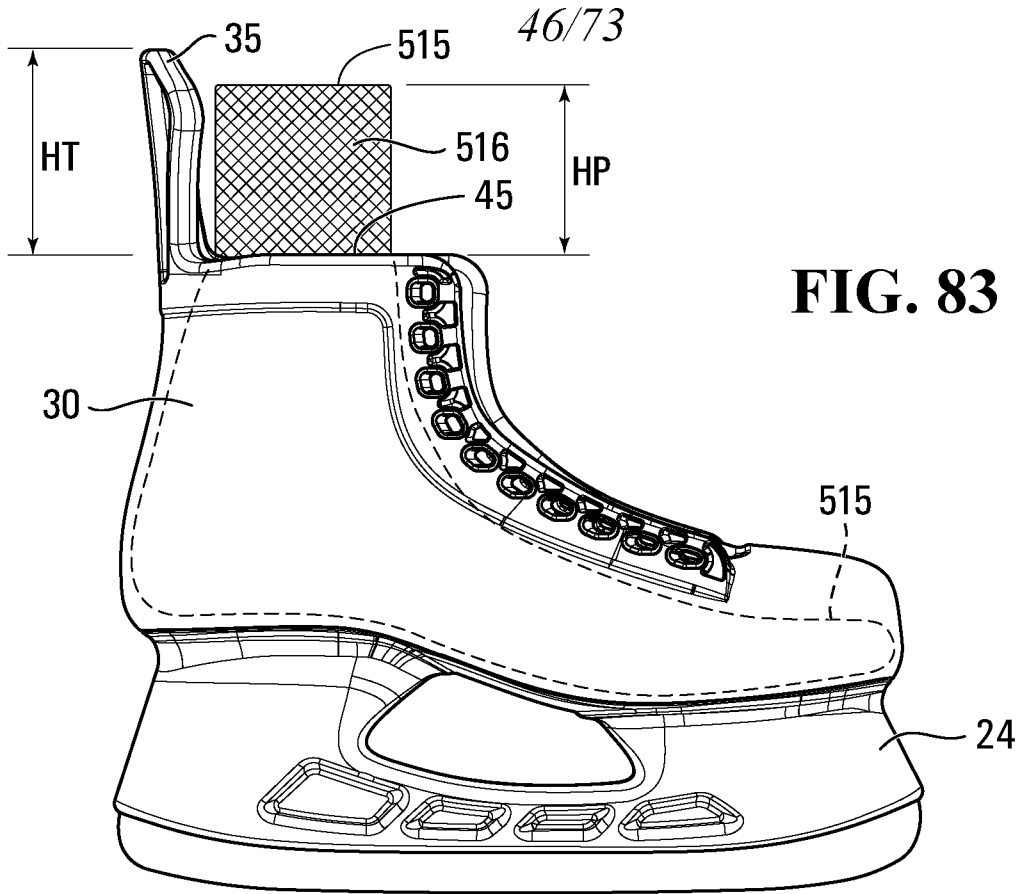


FIG. 83

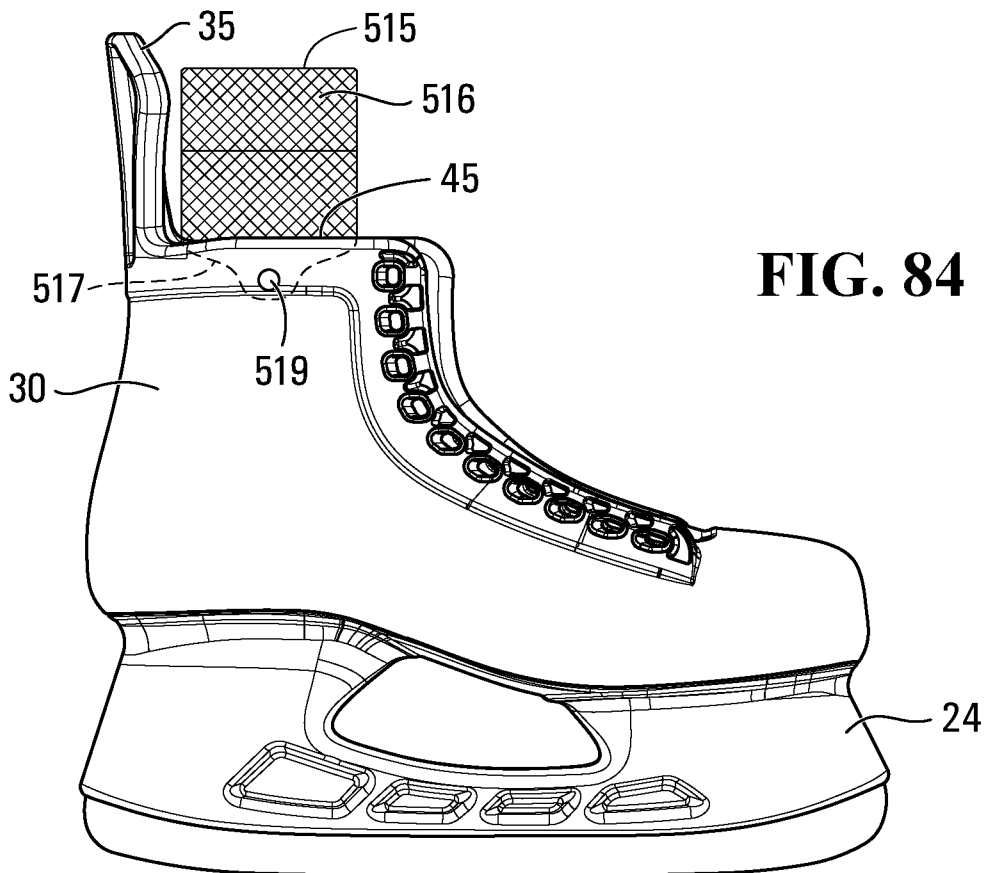


FIG. 84

+

+

47/73

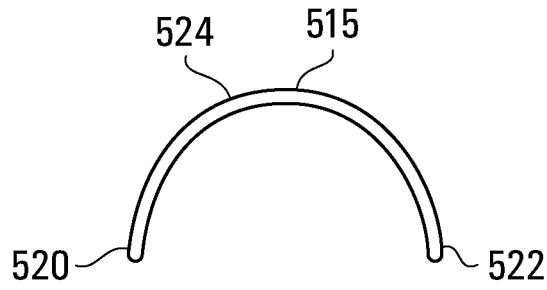


FIG. 85

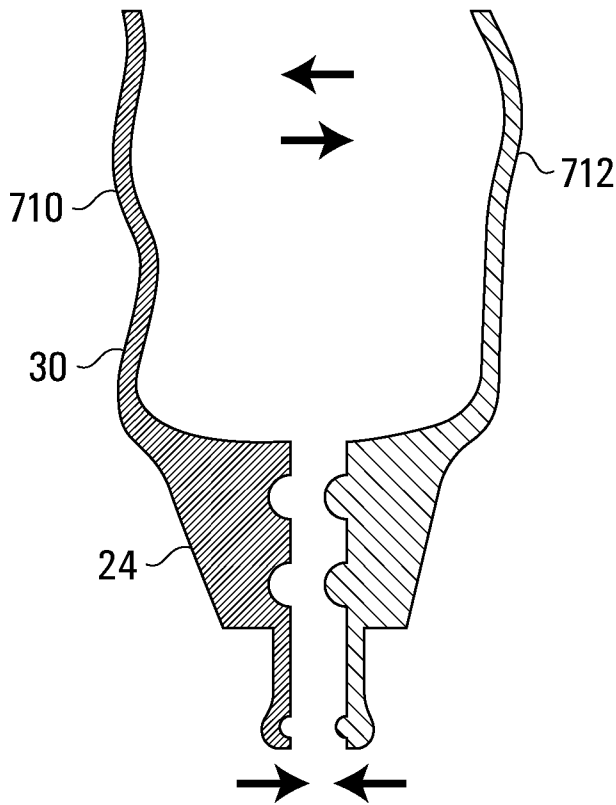


FIG. 86A

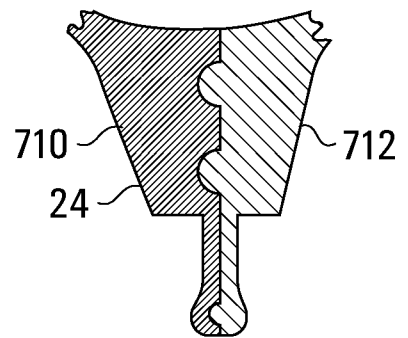


FIG. 86B

+

+

48/73

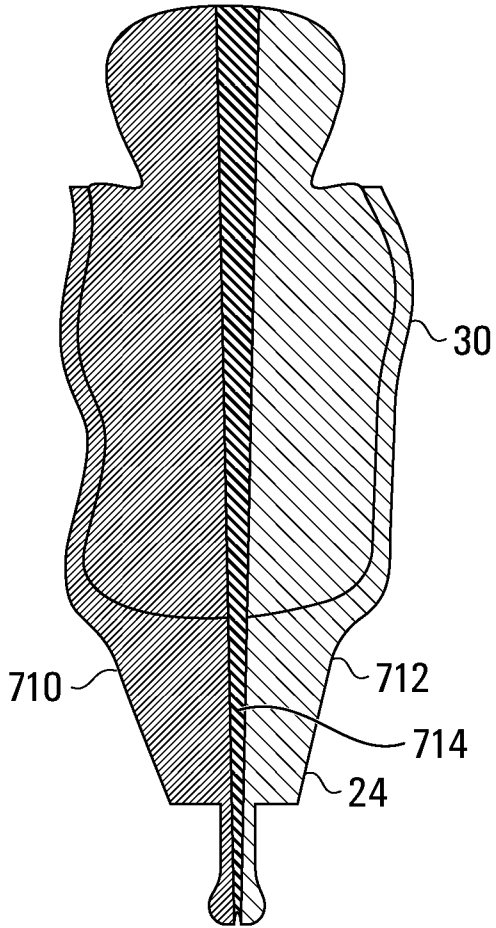


FIG. 86C

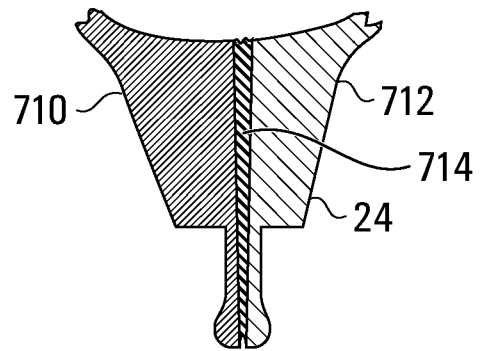


FIG. 86D

+

+

49/73

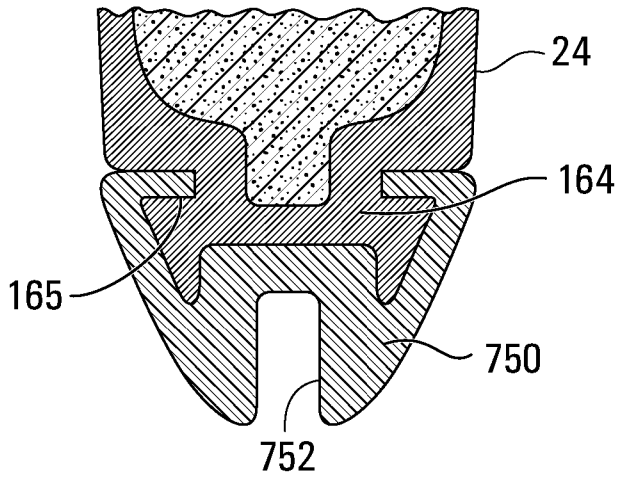


FIG. 87

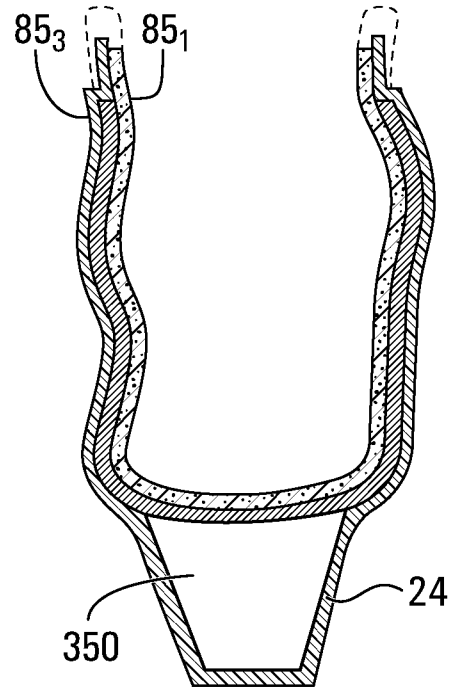


FIG. 88

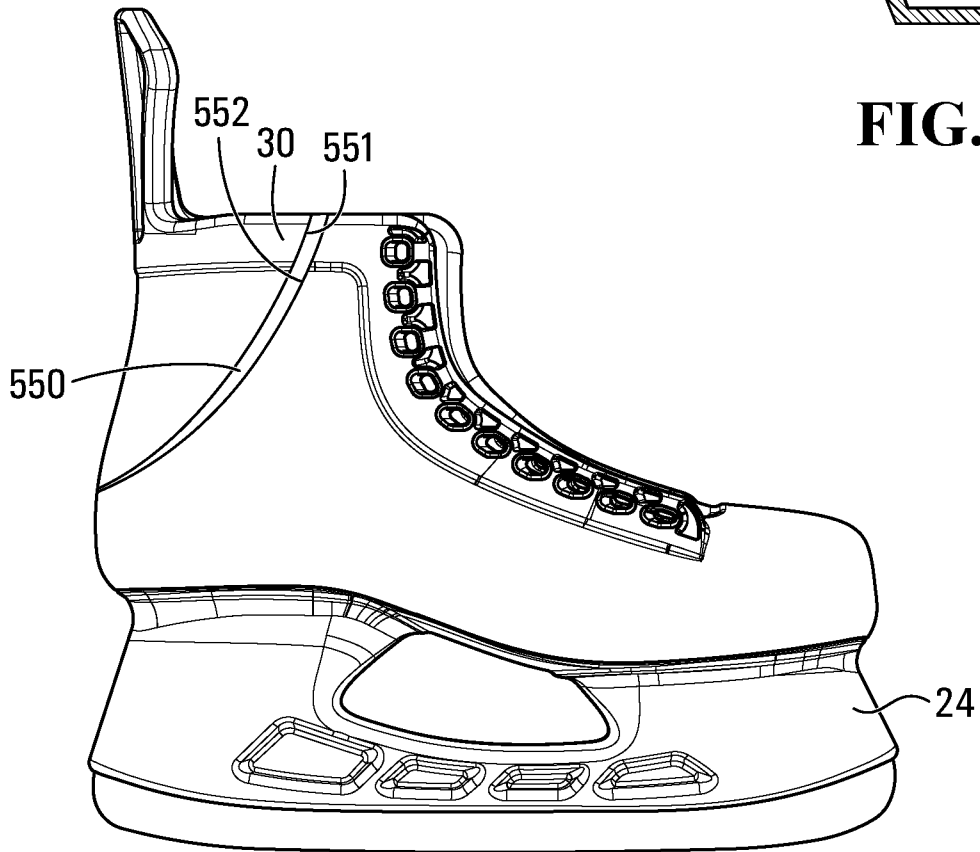
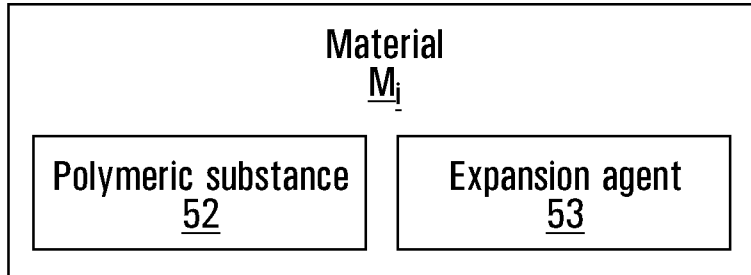
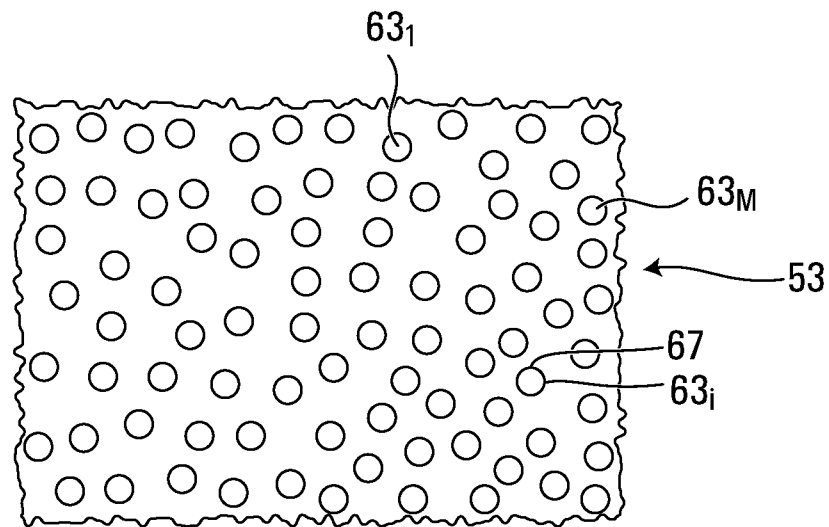


FIG. 89

+

+

50/73

**FIG. 90****FIG. 91**

+

+

51/73

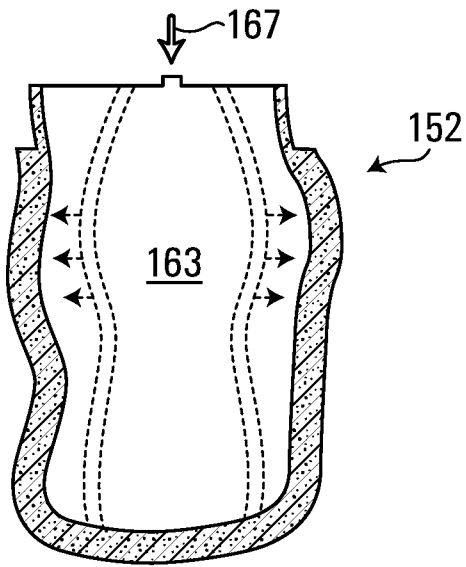


FIG. 92

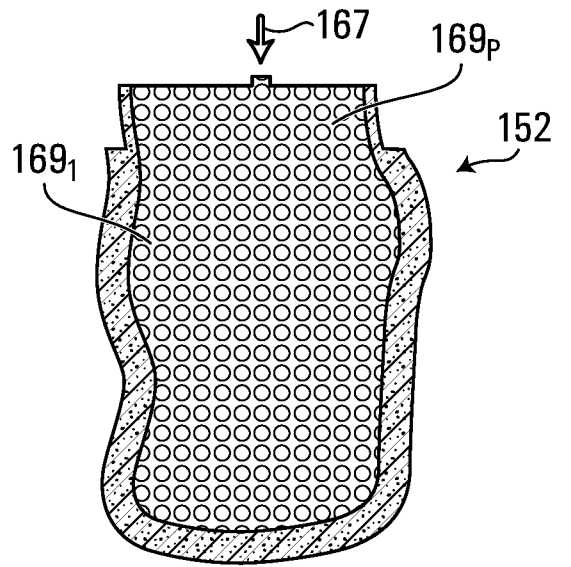


FIG. 93

+

+

52/73

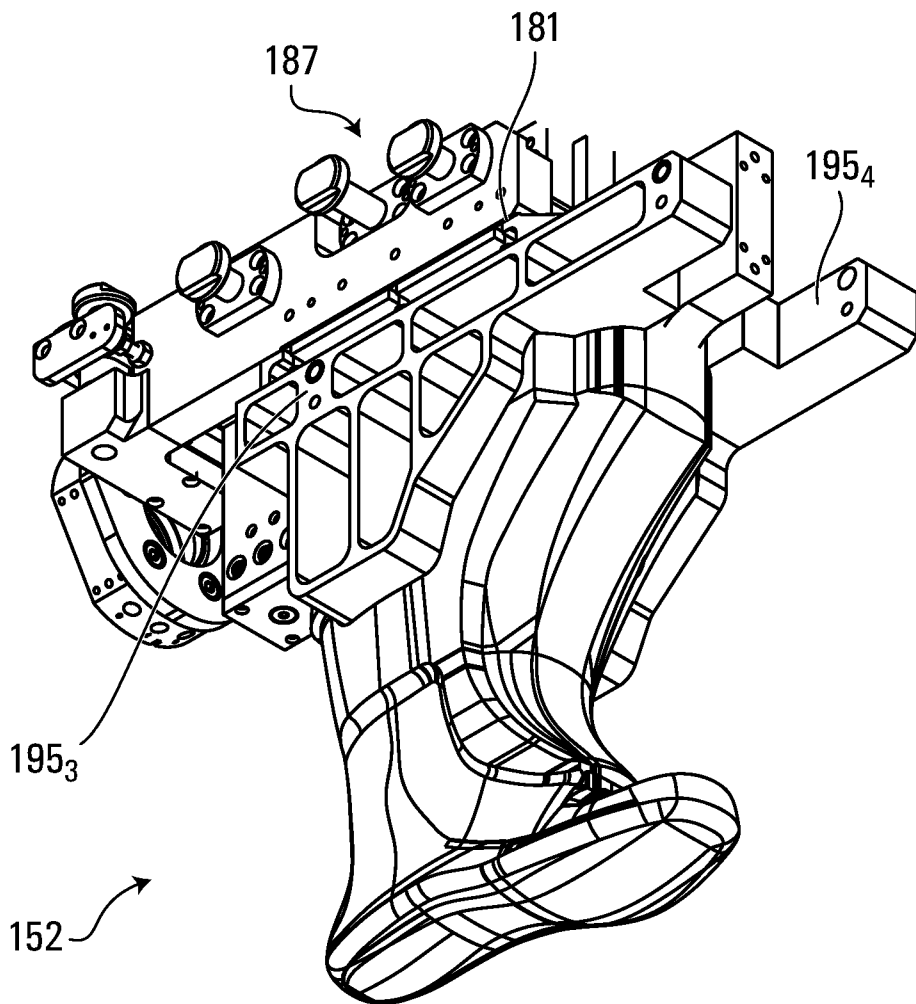


FIG. 94

+

+

53/73

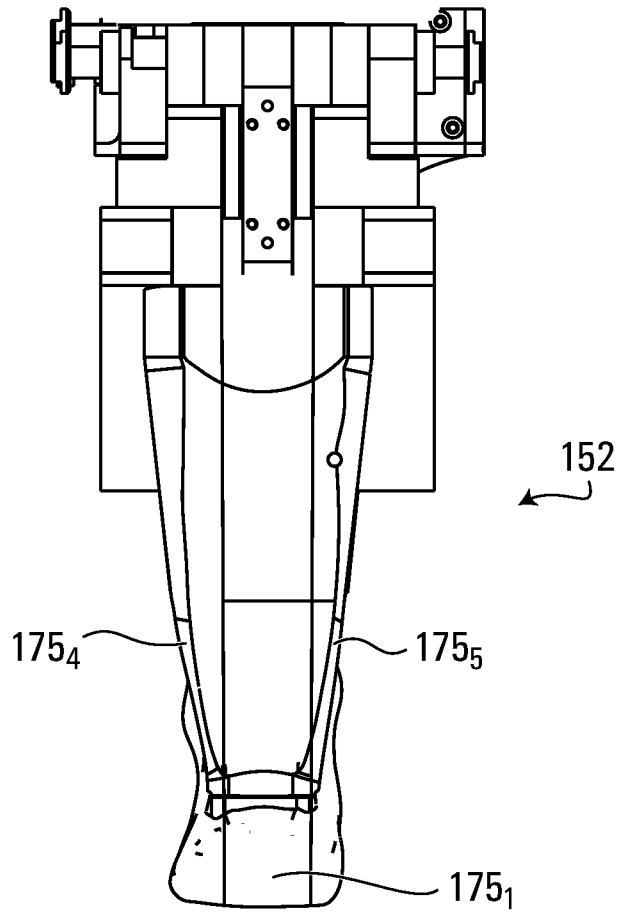


FIG. 95

+

+

54/73

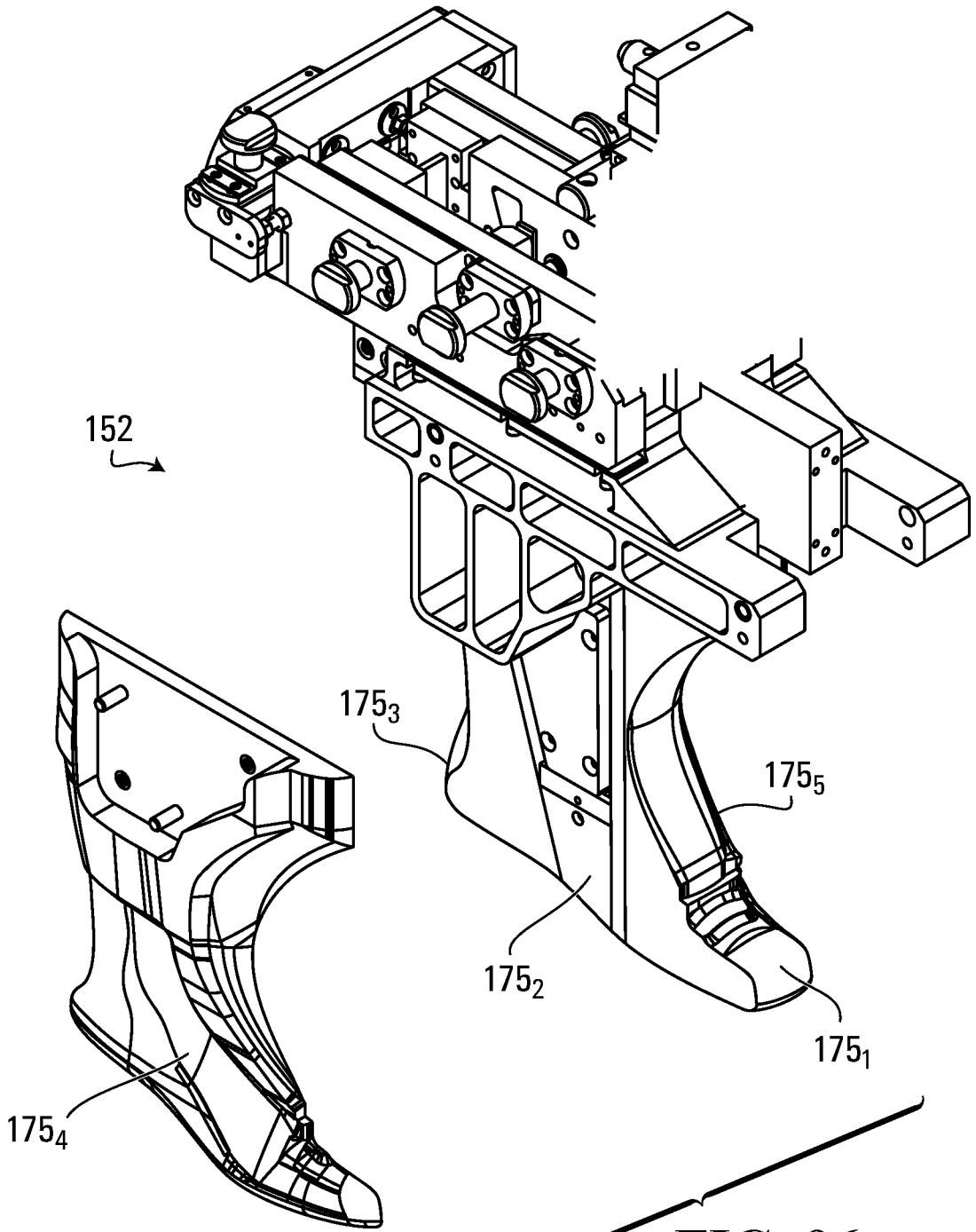


FIG. 96

+

+

55/73

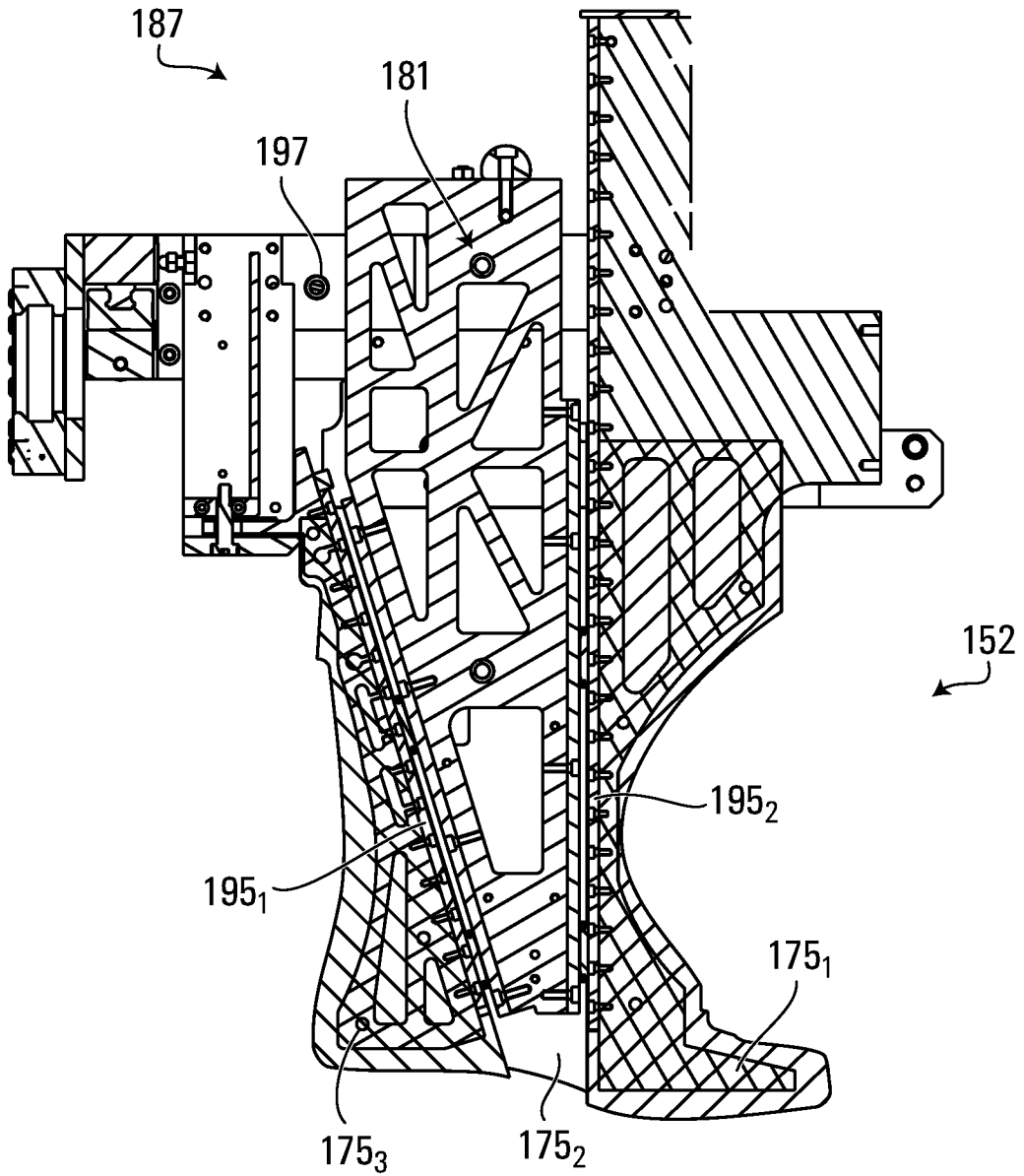


FIG. 97

+

+

56/73

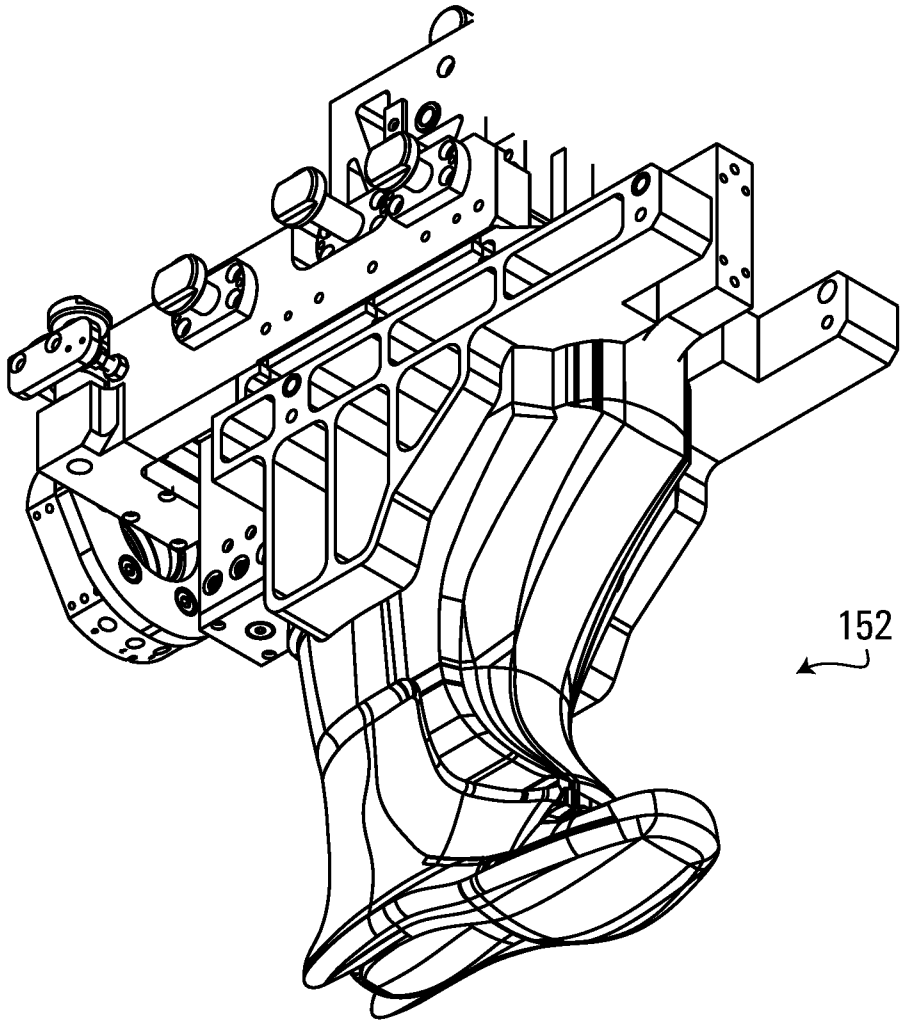


FIG. 98

+

+

57/73

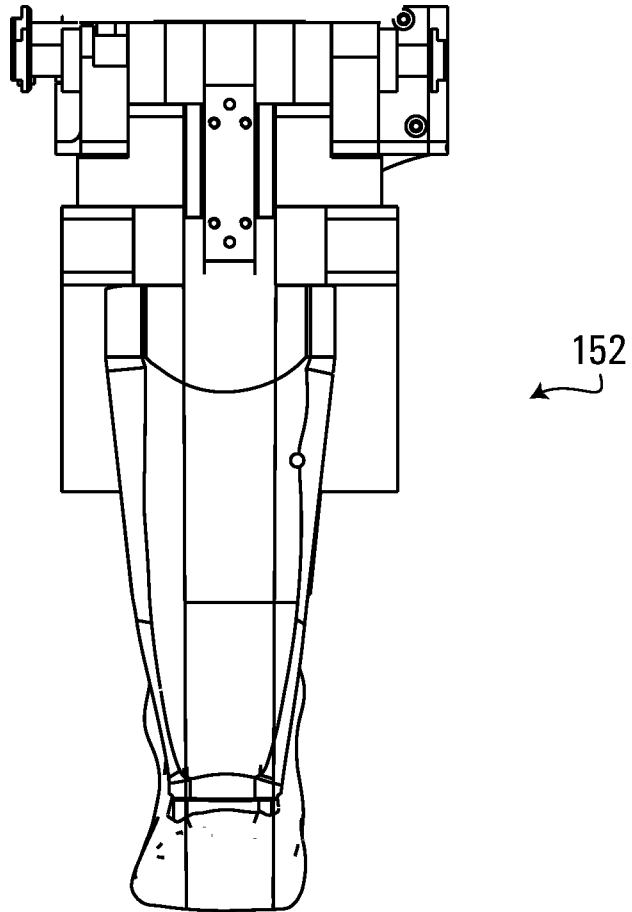


FIG. 99

+

+

58/73

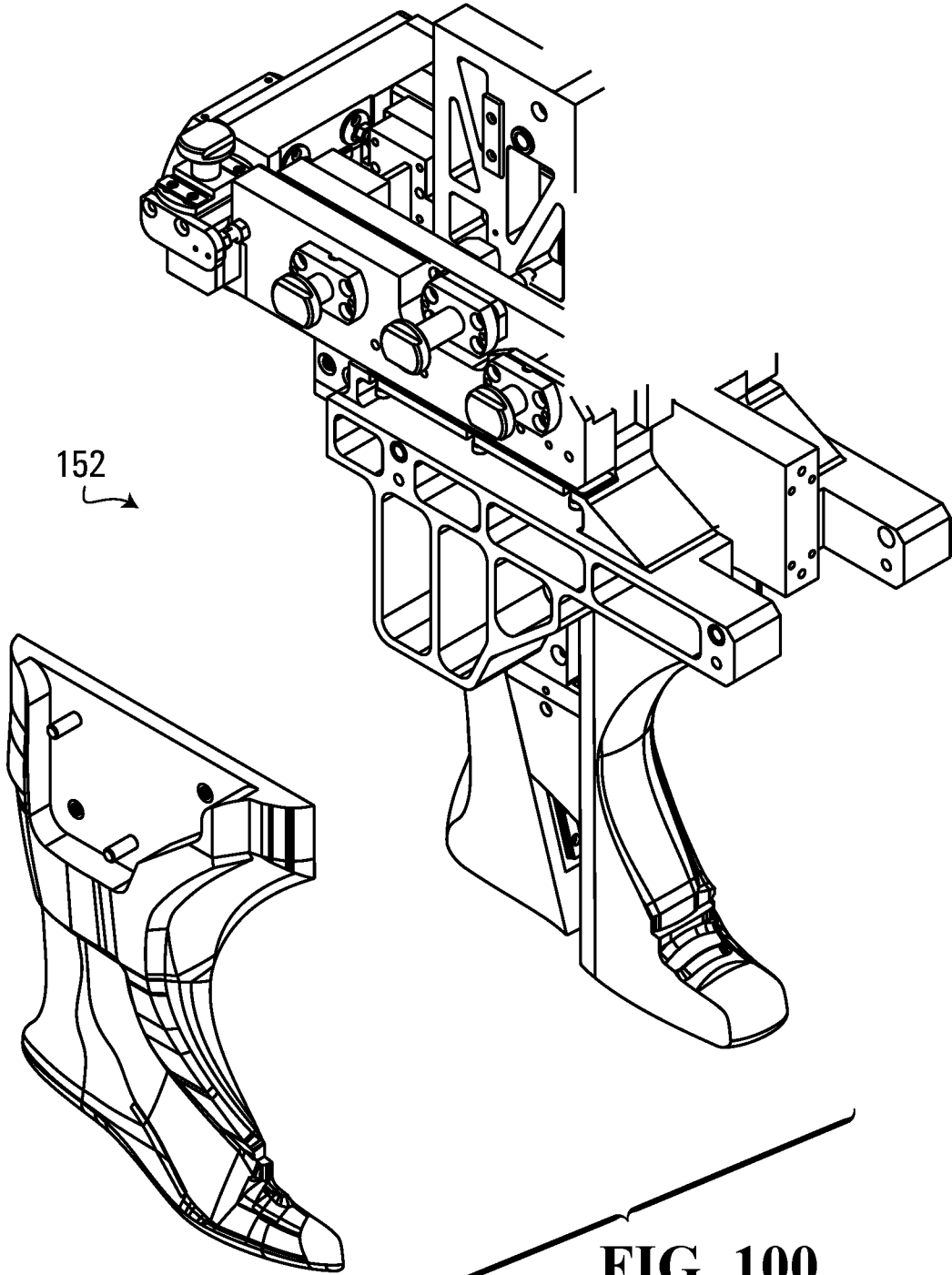


FIG. 100

+

+

59/73

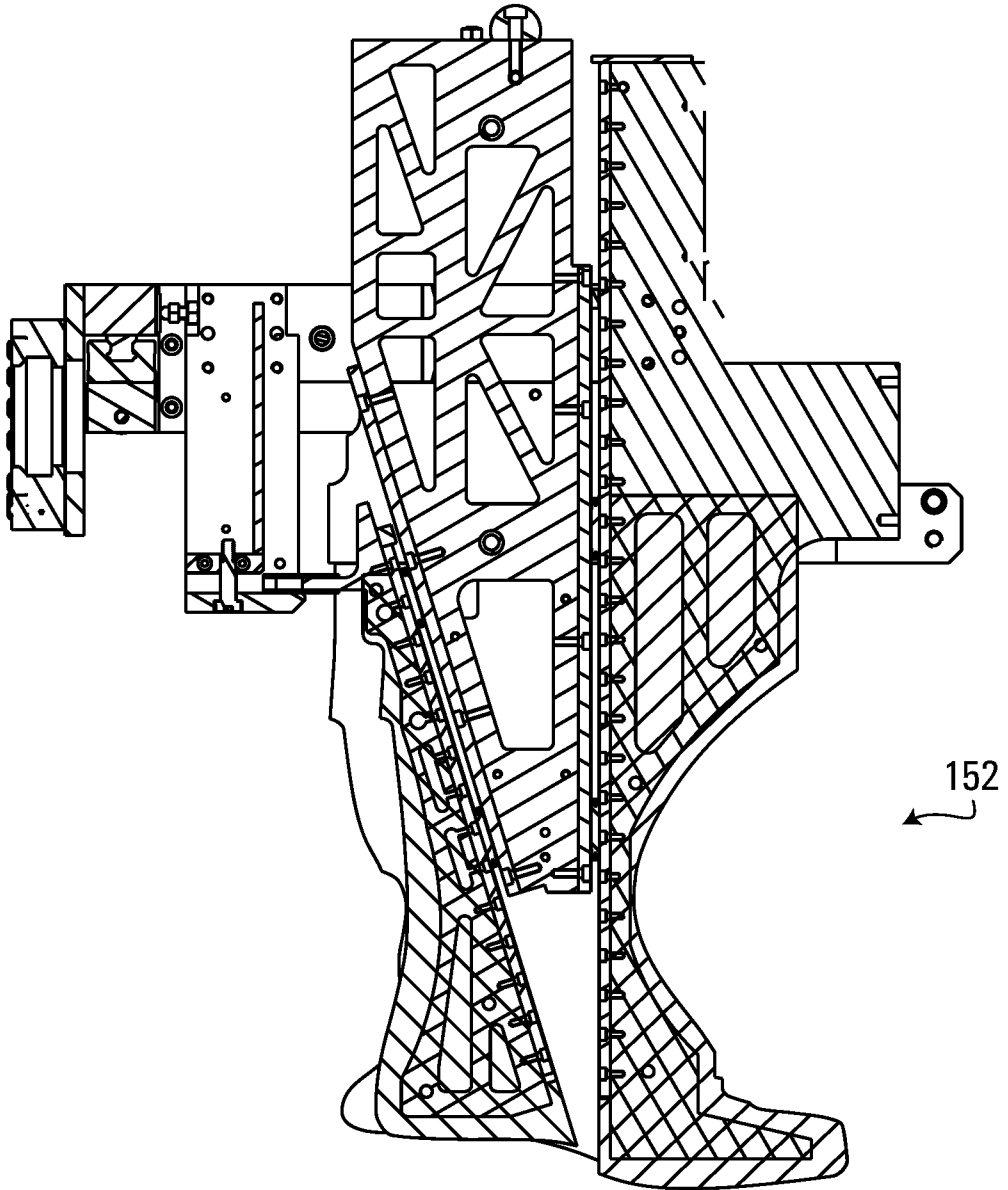


FIG. 101

+

+

60/73

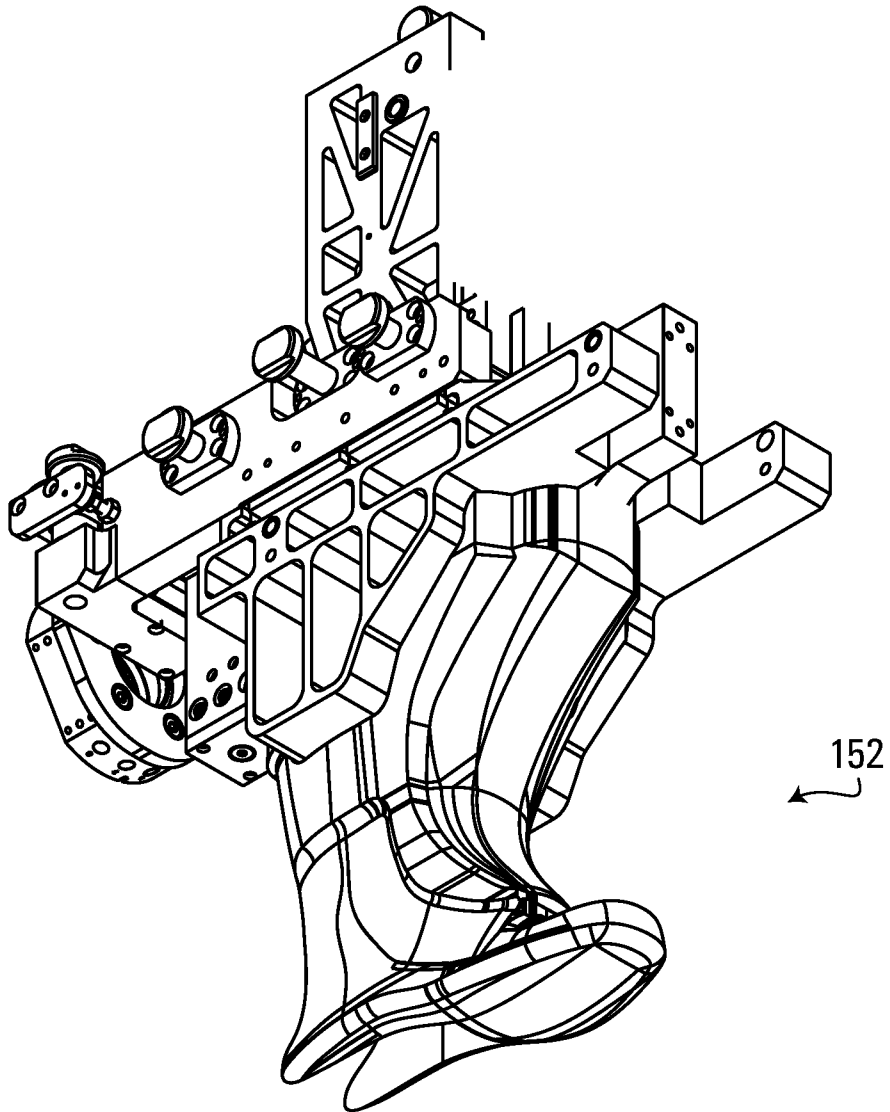


FIG. 102

+

+

61/73

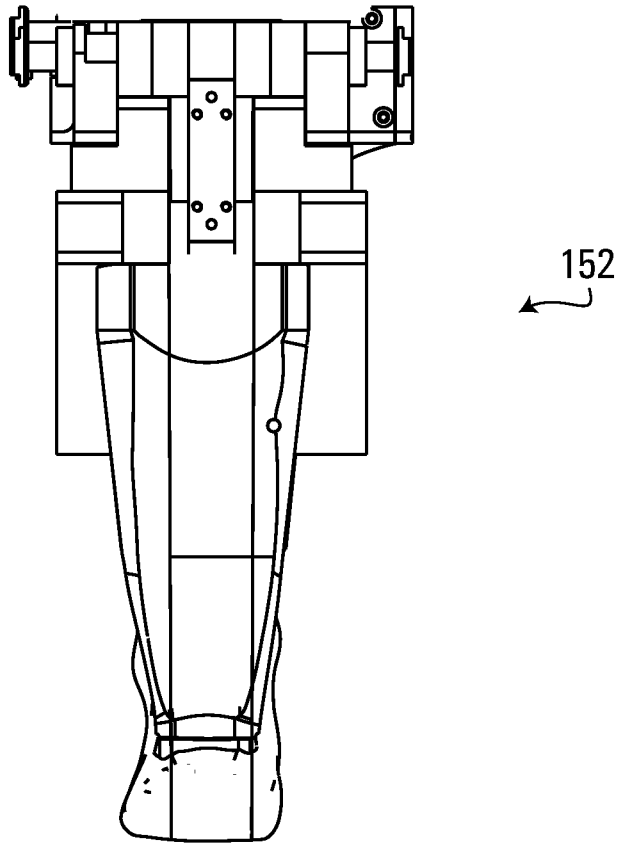


FIG. 103

+

+

62/73

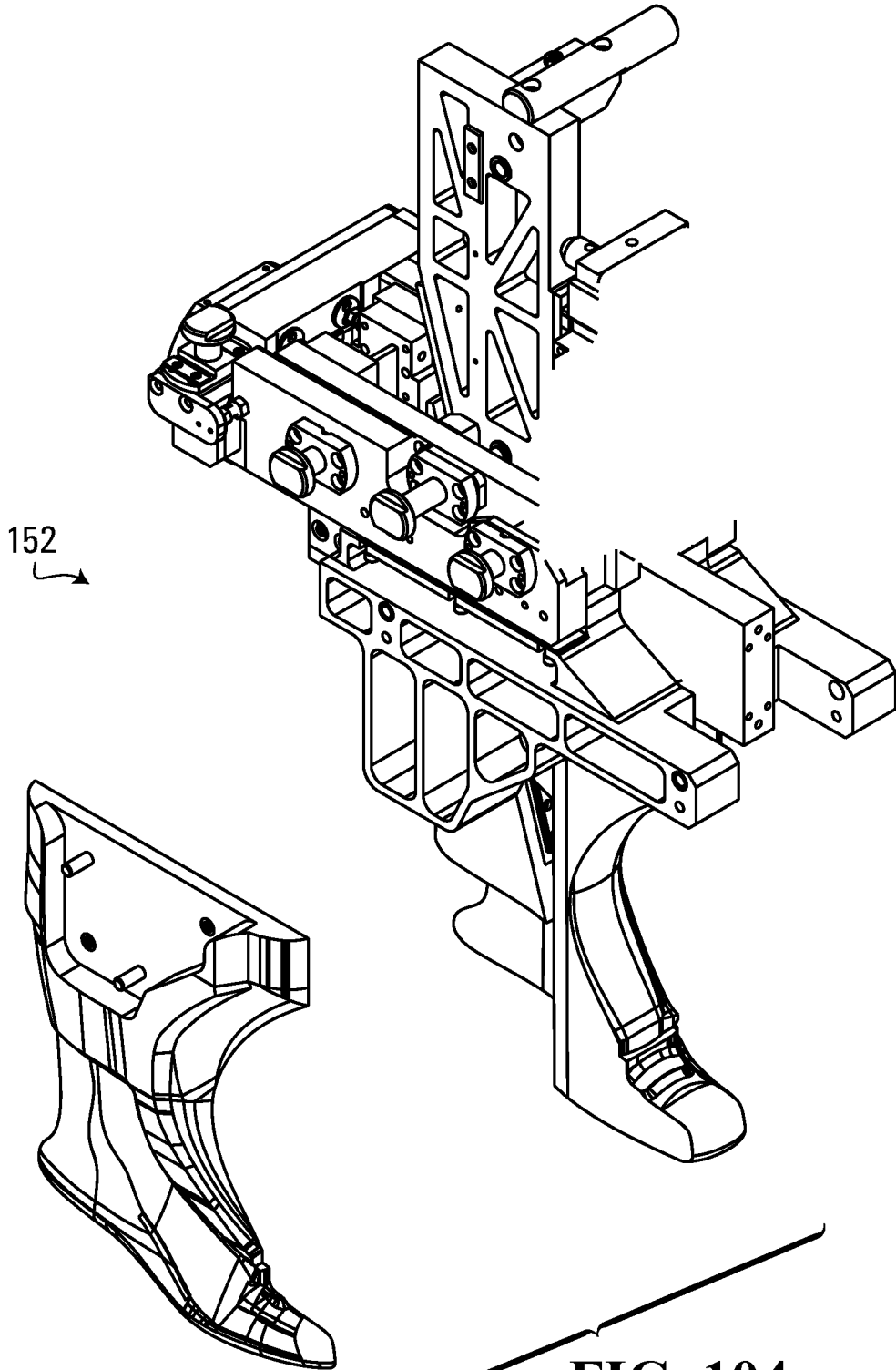


FIG. 104

+

+

63/73

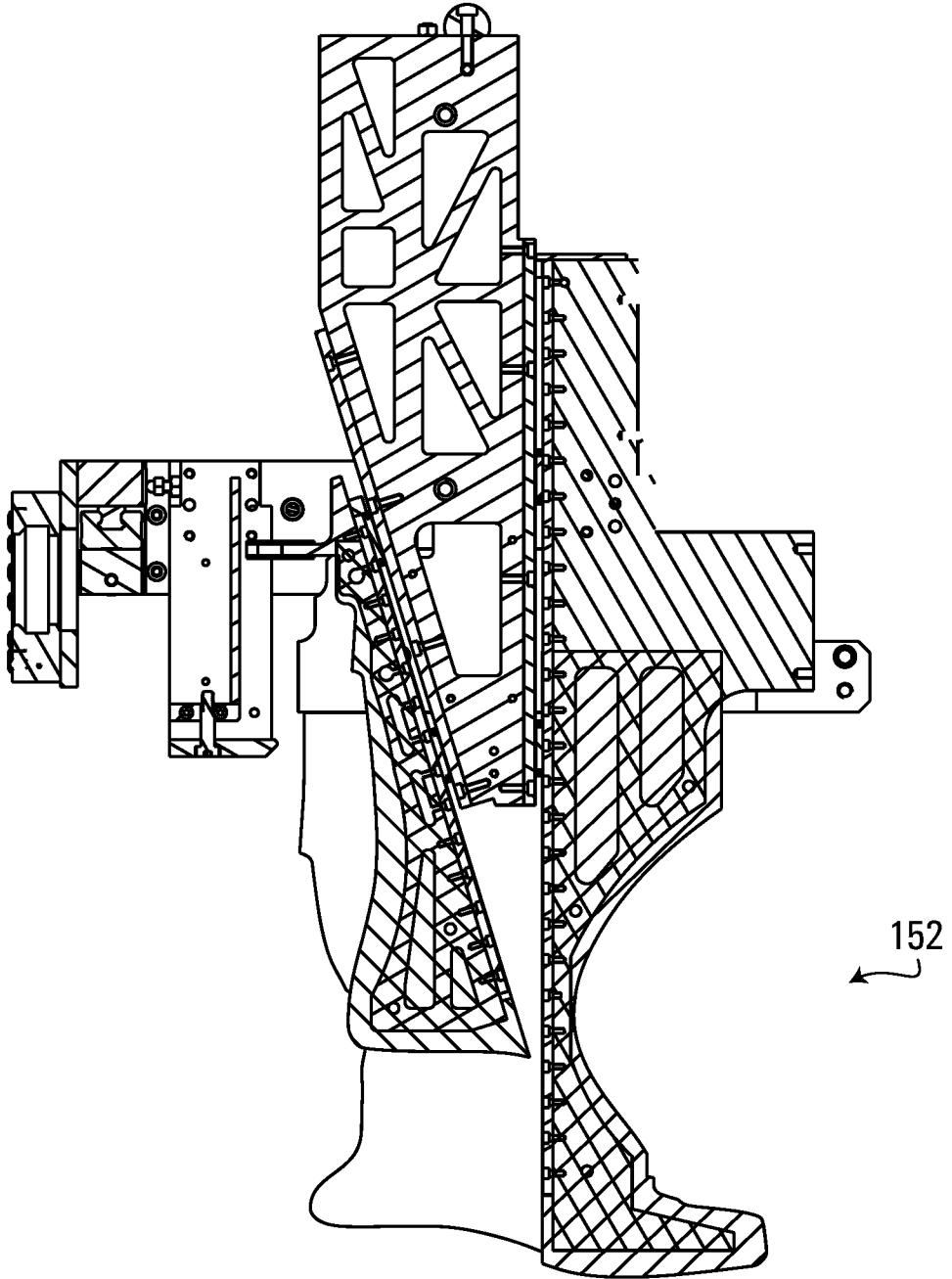


FIG. 105

+

+

64/73

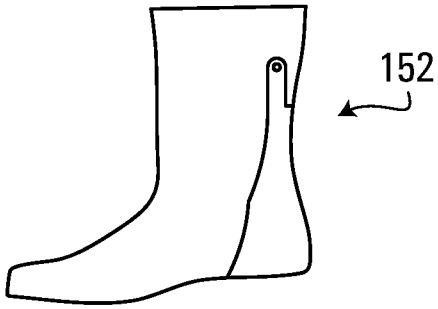


FIG. 106

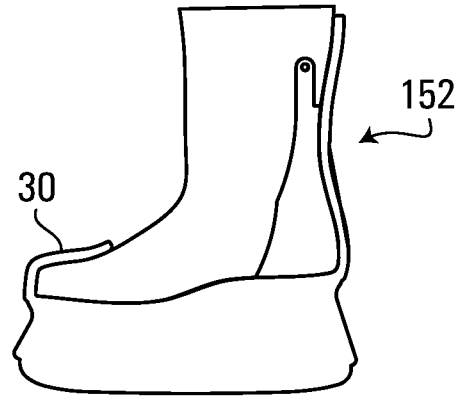


FIG. 107

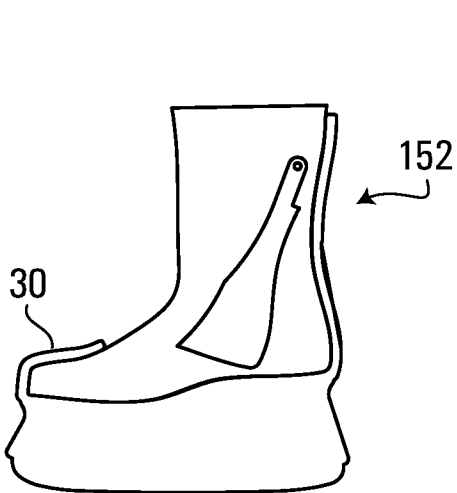


FIG. 108

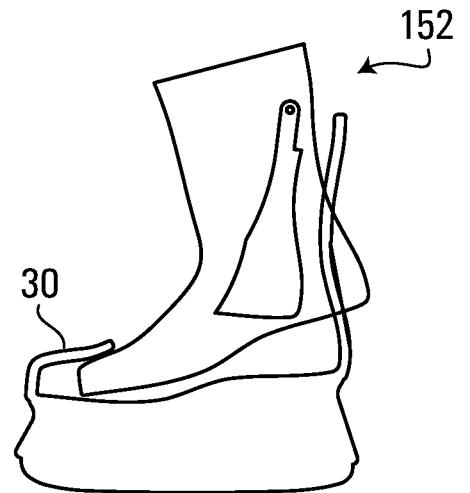


FIG. 109

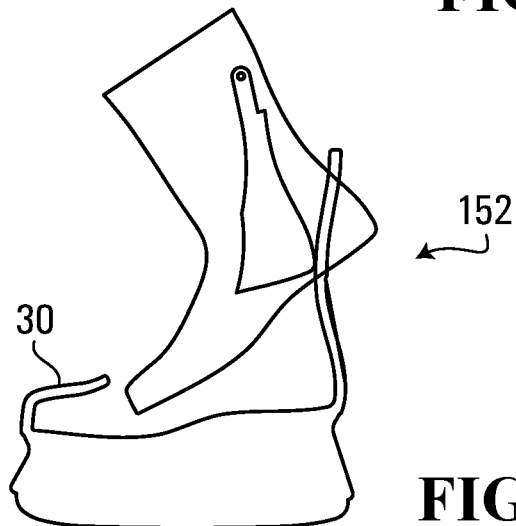


FIG. 110

+

+

65/73

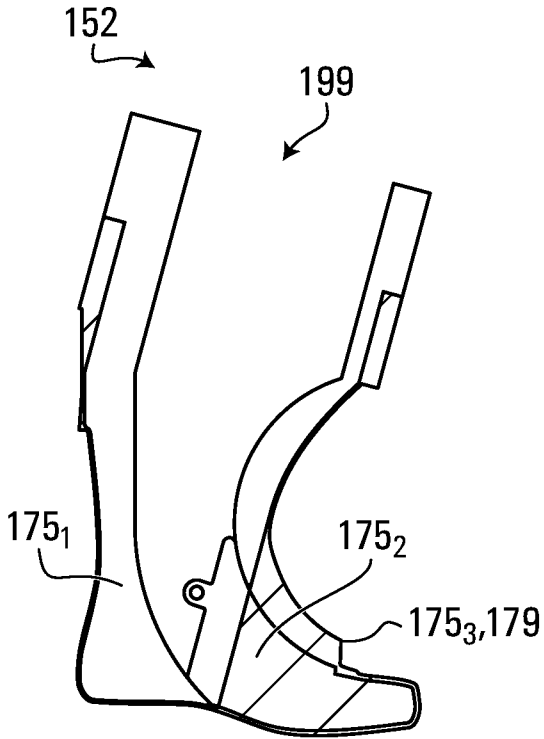


FIG. 111

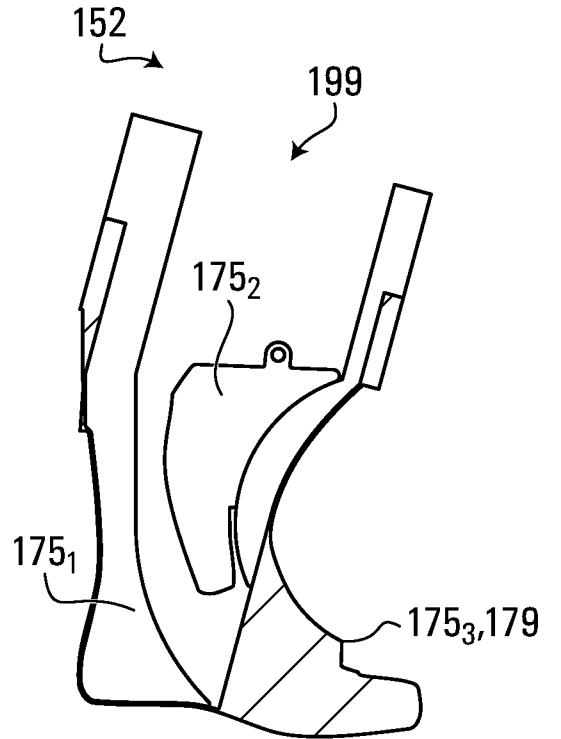


FIG. 112

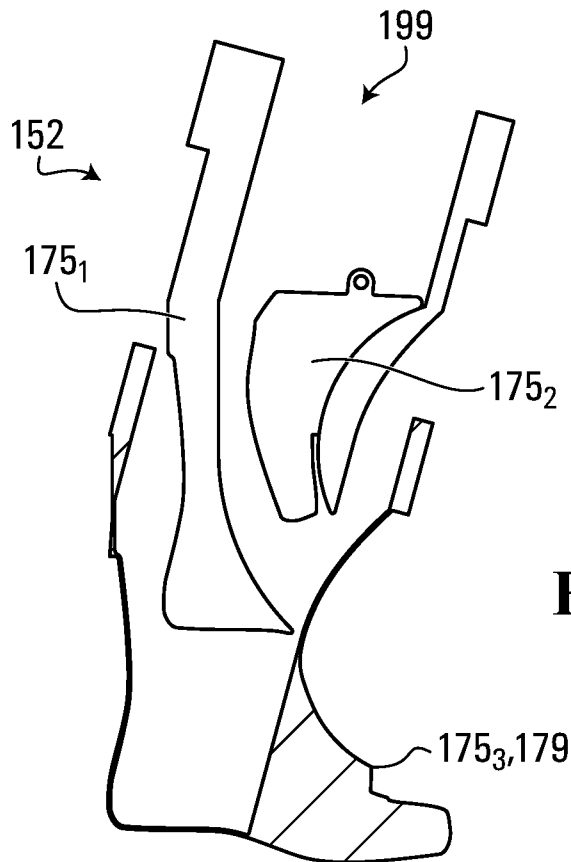


FIG. 113

+

+

66/73

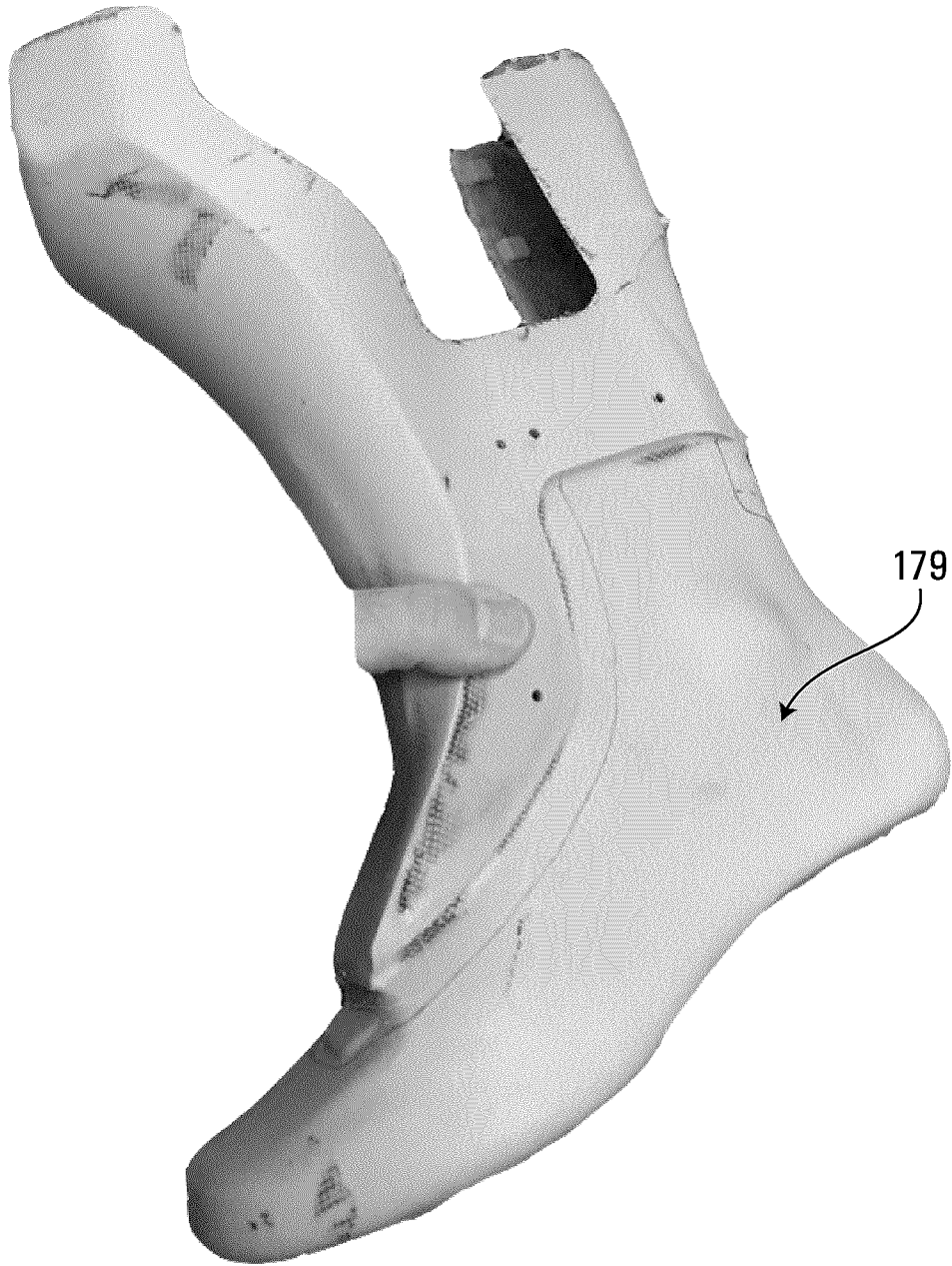


FIG. 114

+

+

67/73

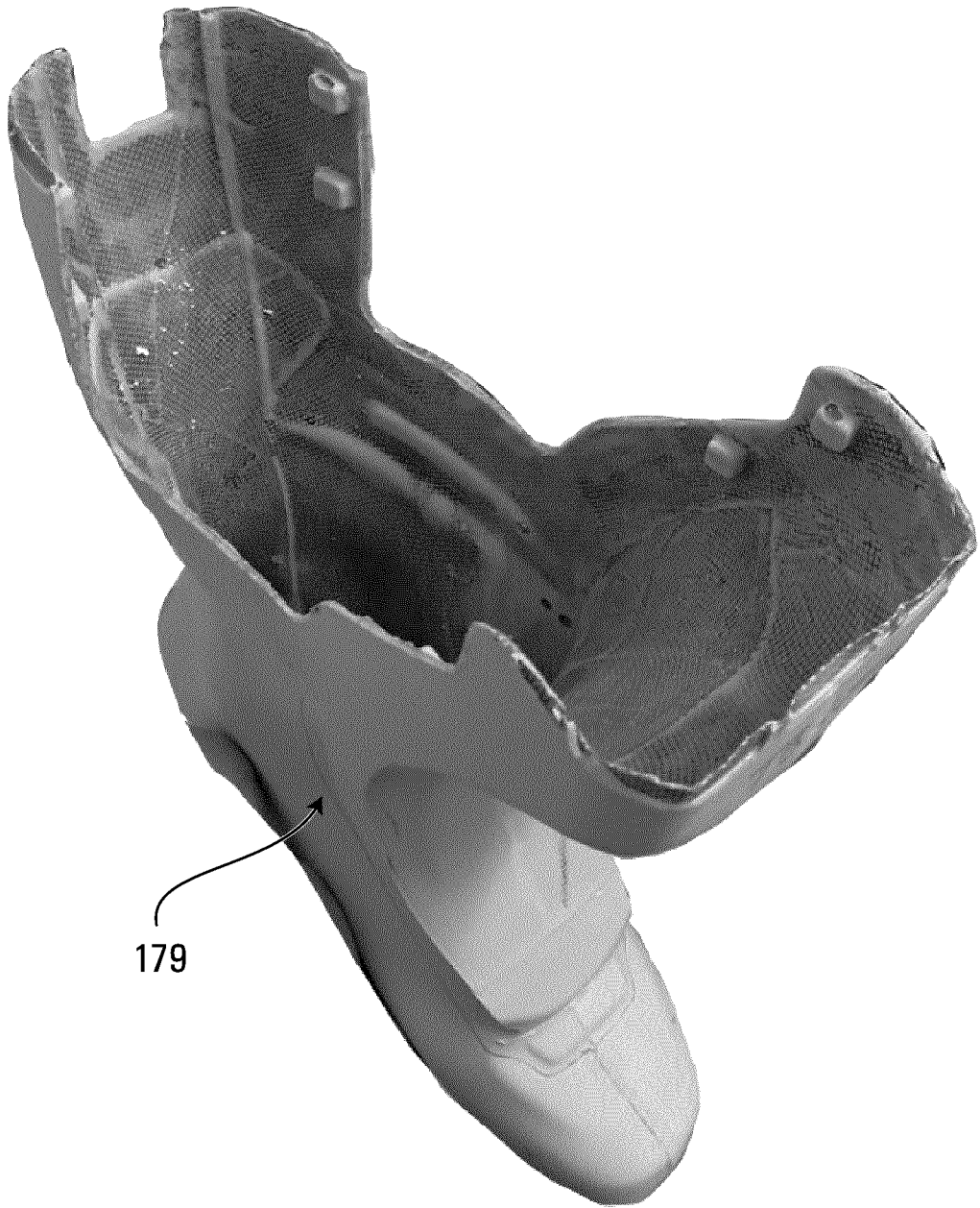


FIG. 115

+

+

68/73

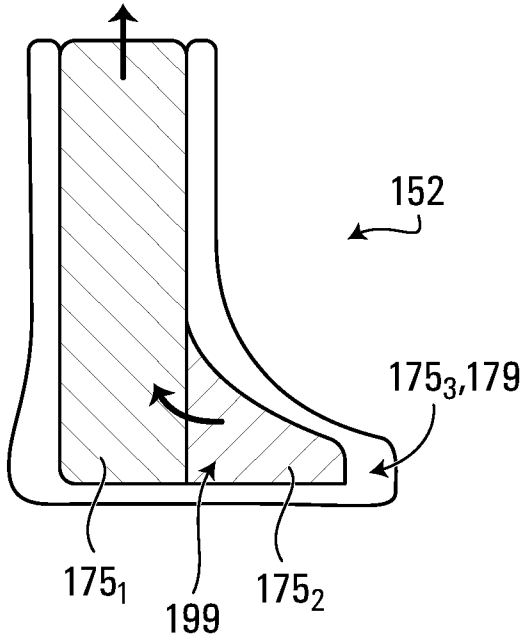


FIG. 116

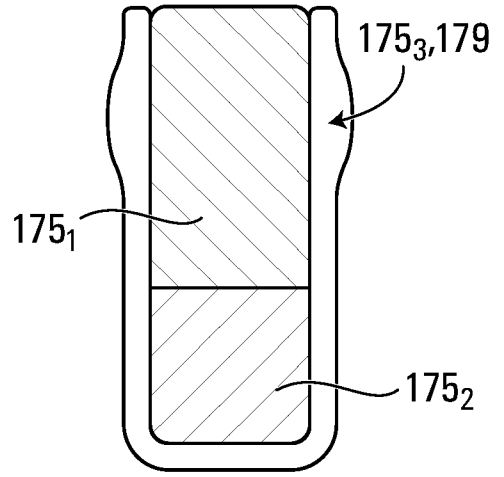


FIG. 117

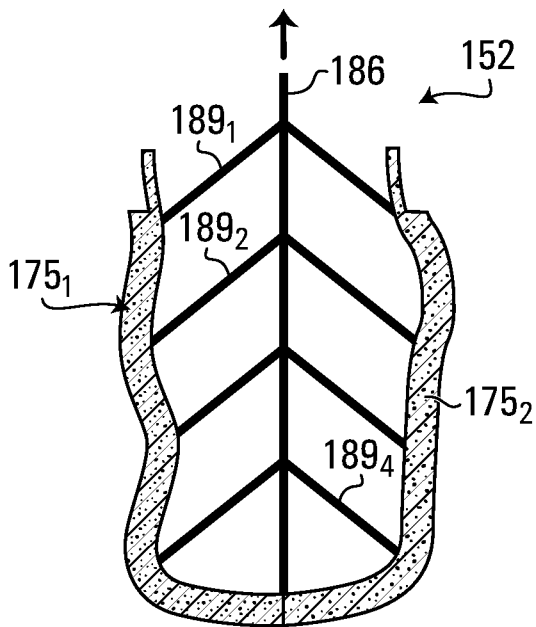


FIG. 118

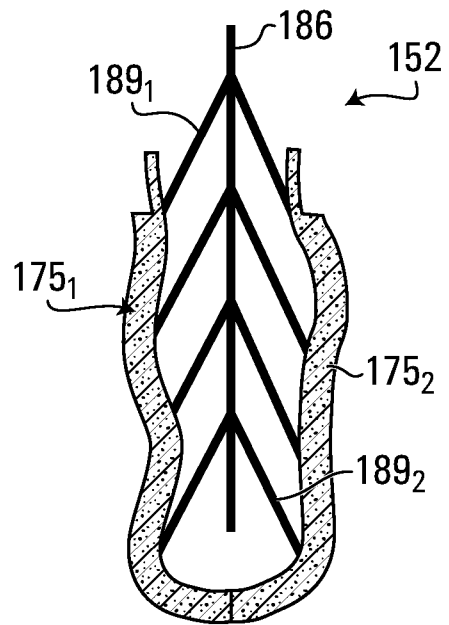


FIG. 119

+

+

69/73

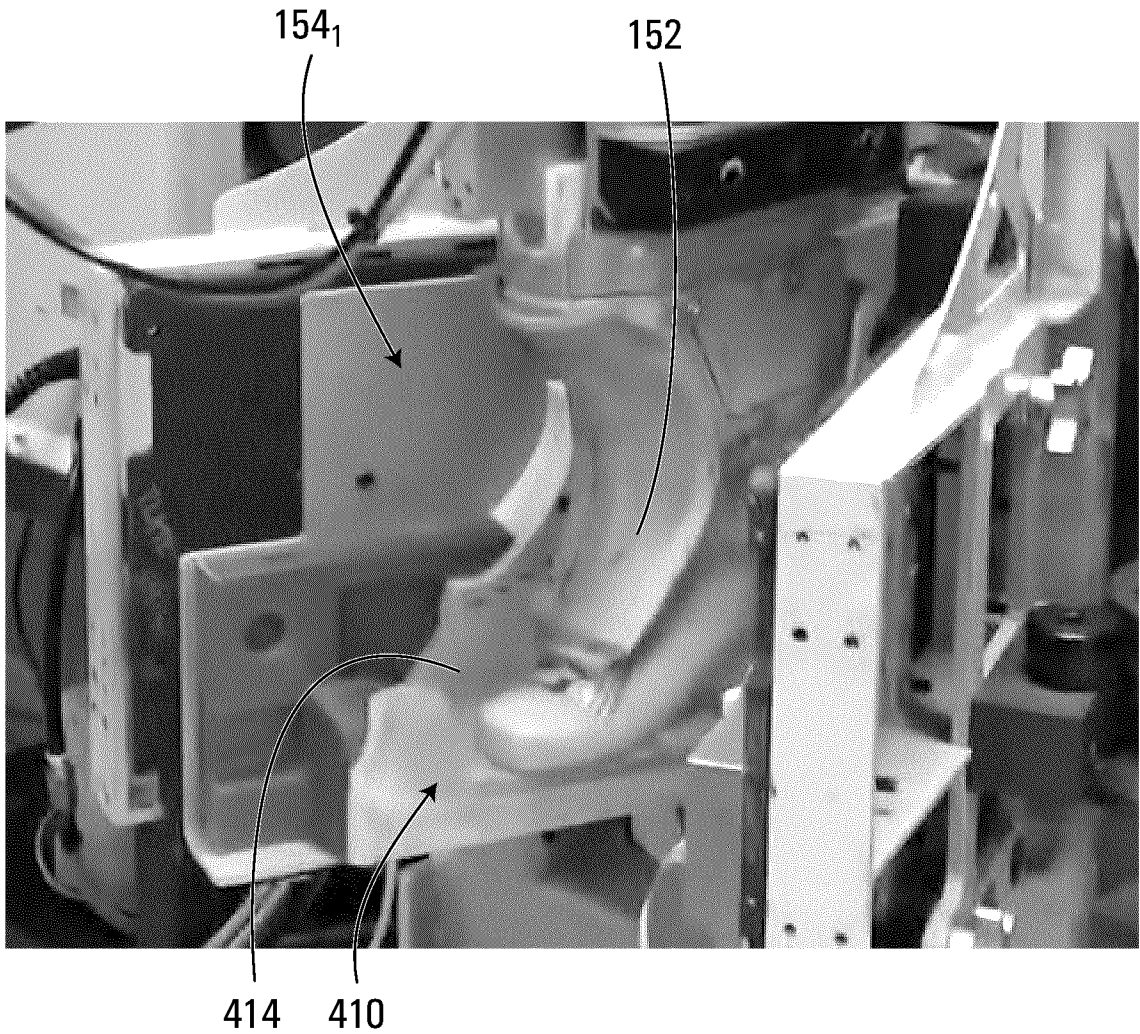


FIG. 120

+

+

70/73

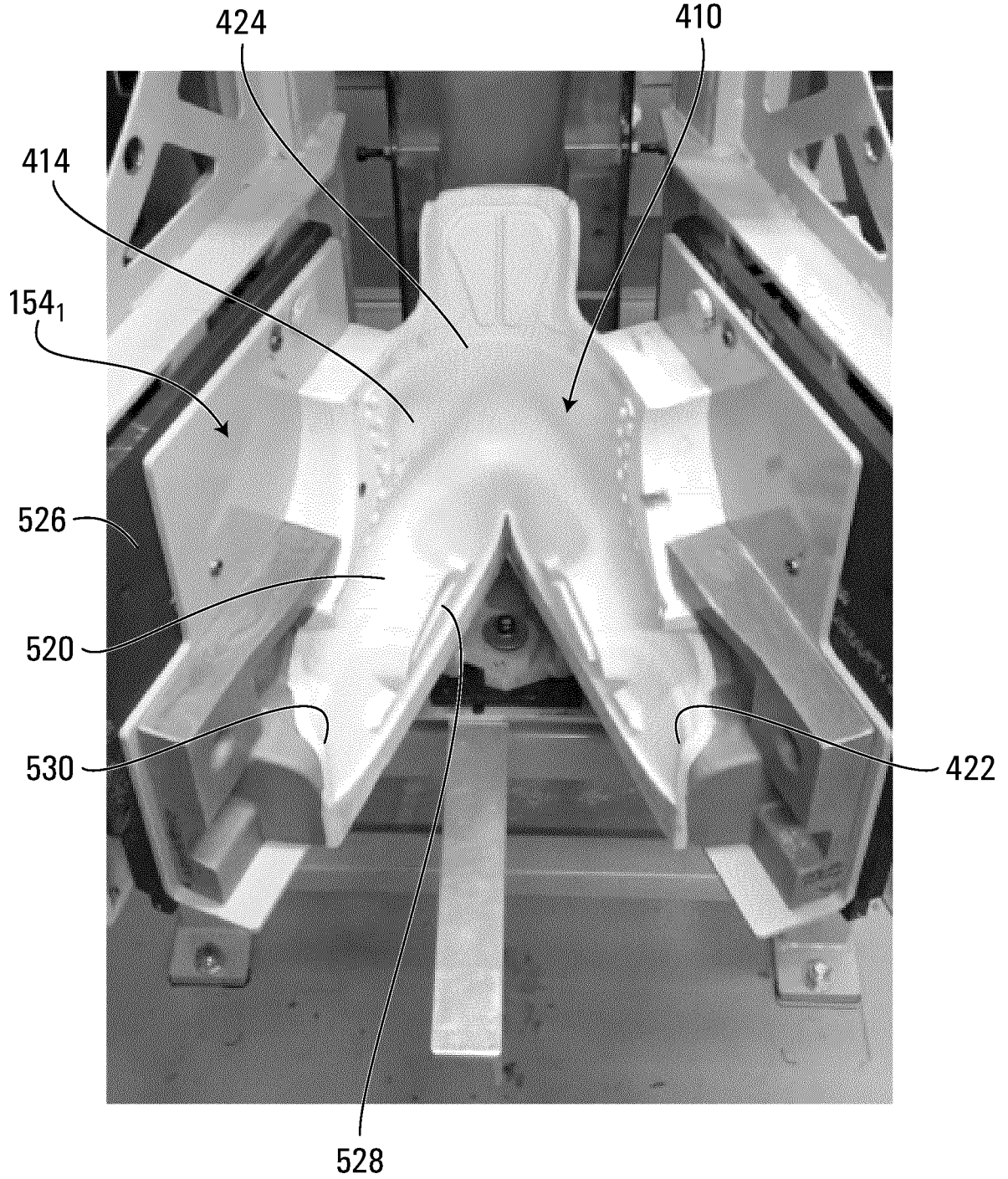


FIG. 121

+

+

71/73

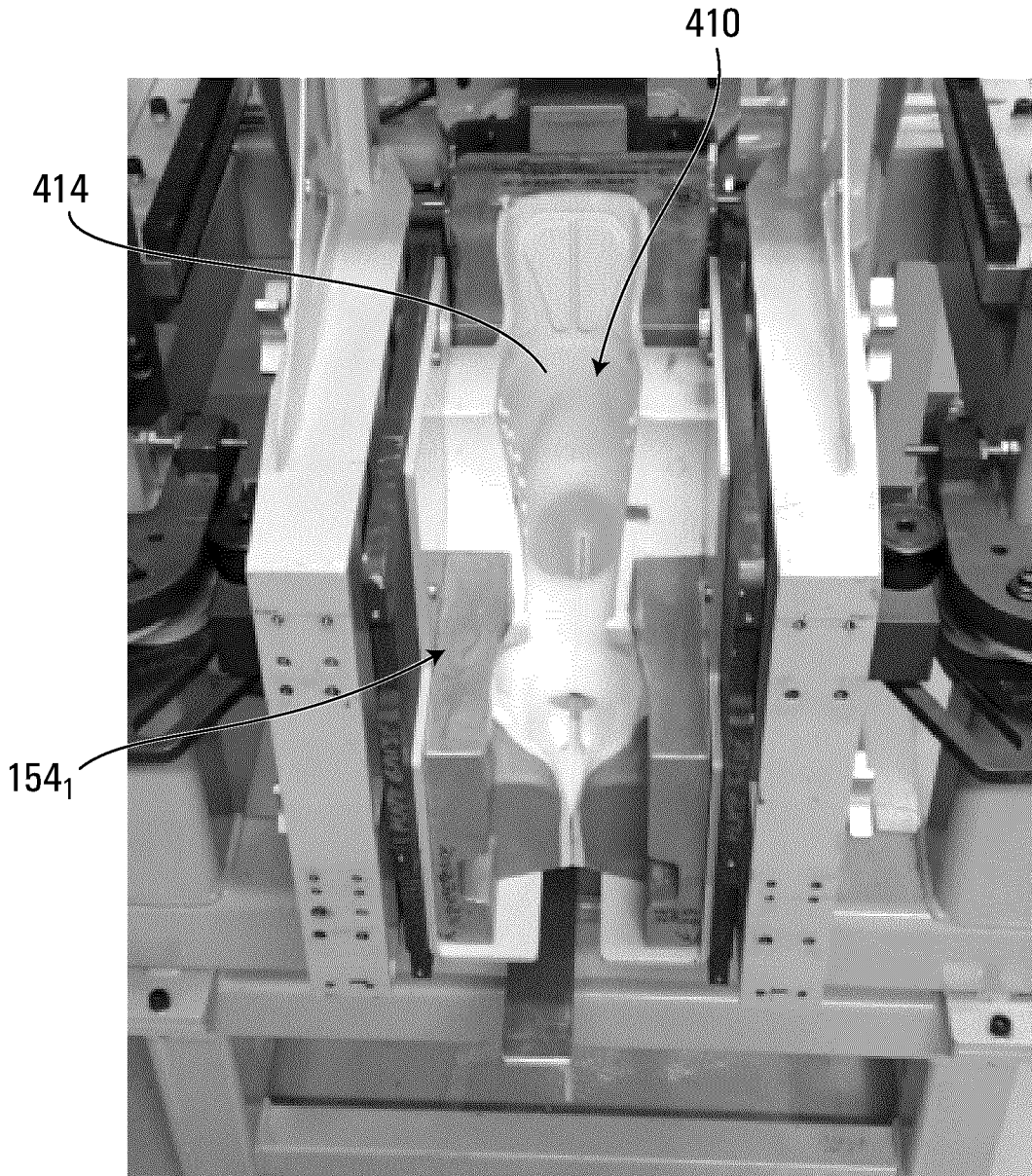


FIG. 122

+

+

72/73

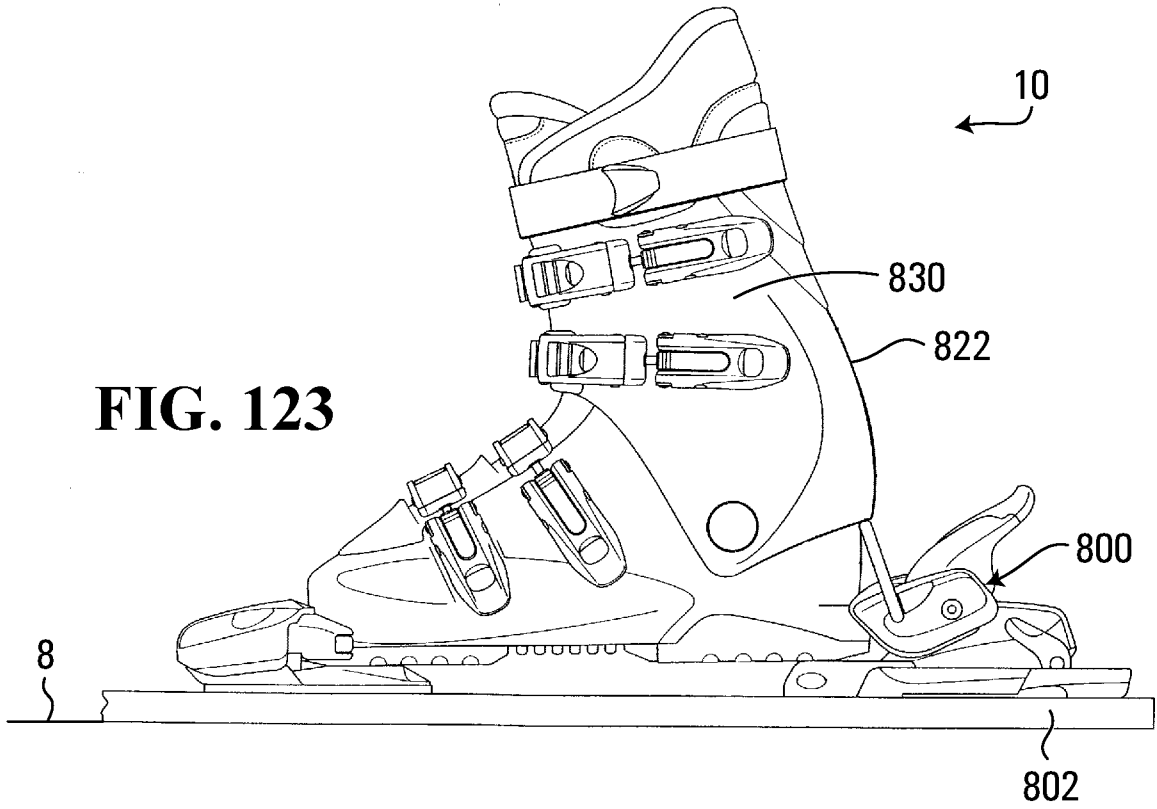


FIG. 123

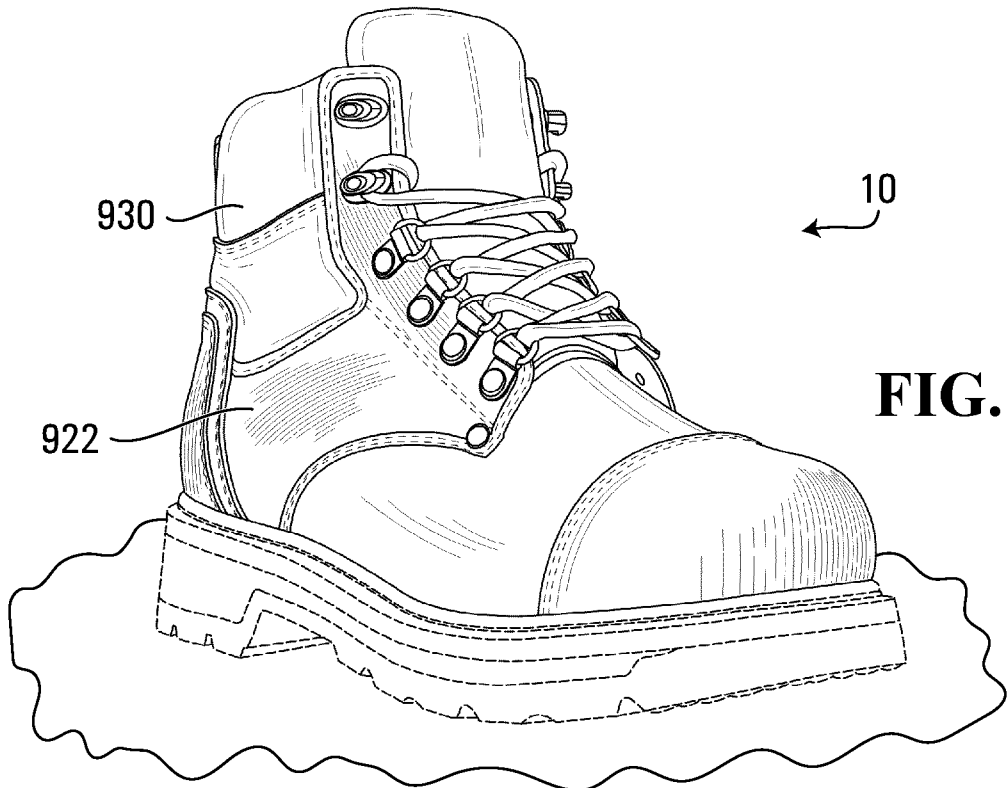


FIG. 124

+

+

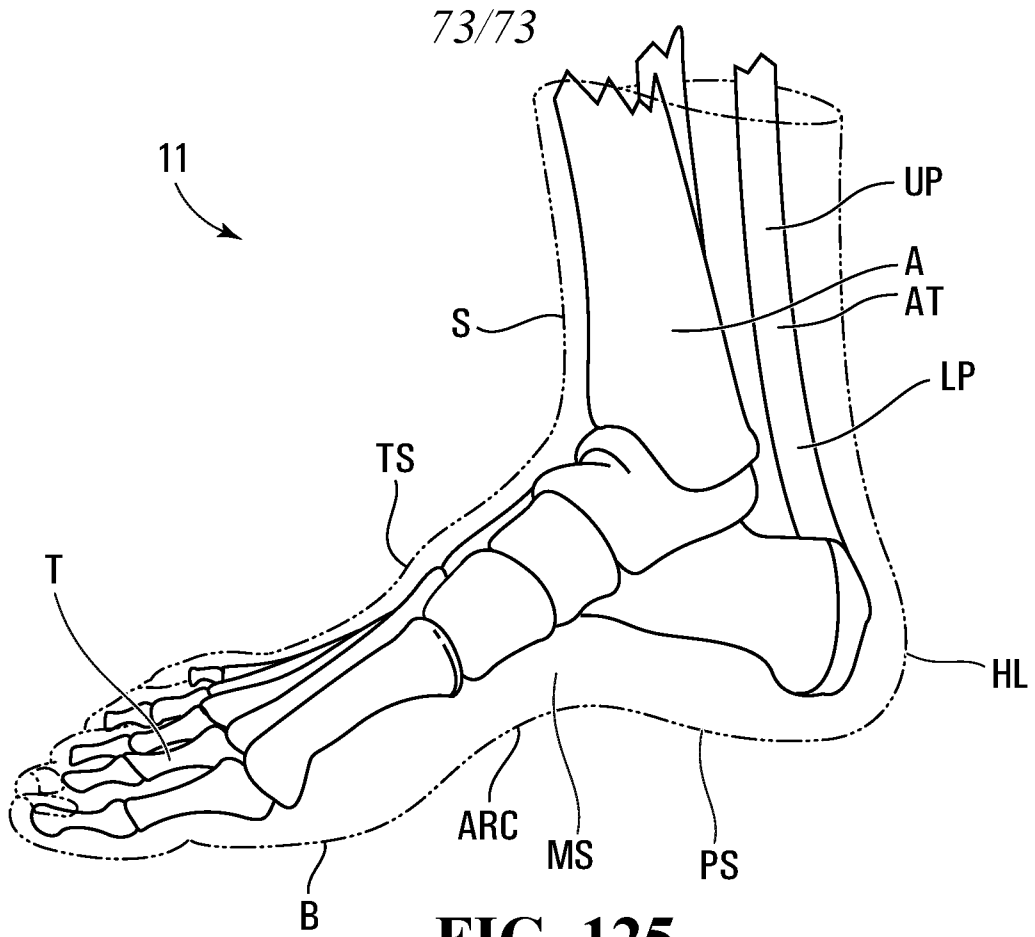


FIG. 125

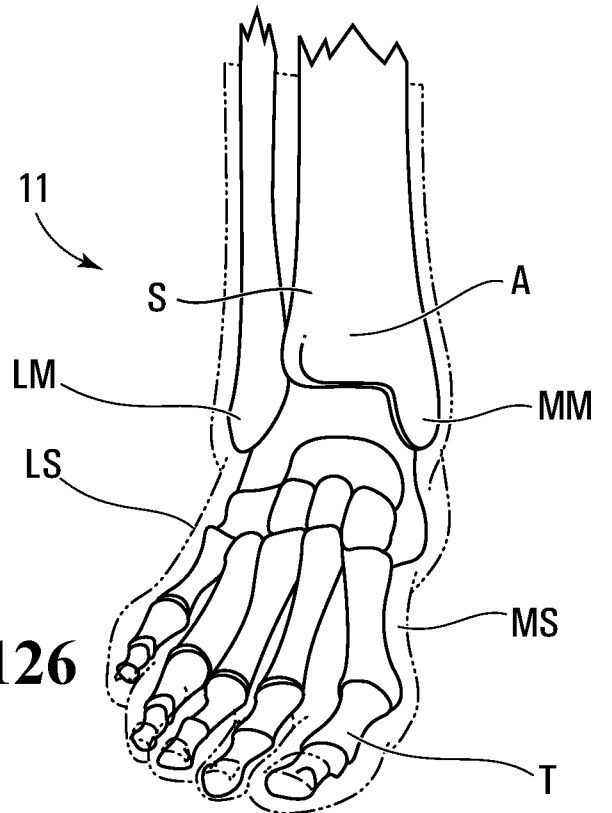


FIG. 126

+

