



(51) International Patent Classification:

B29D 35/06 (2010.01) A63C 1/42 (2006.01)
A43B 5/16 (2006.01) A63C 17/00 (2006.01)
A63C 1/02 (2006.01)

(21) International Application Number:

PCT/CA2021/050727

(22) International Filing Date:

28 May 2021 (28.05.2021)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

63/031,259 28 May 2020 (28.05.2020) US

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

(72) Inventors: LABONTE, Ivan; 6717, ave Christophe-Colomb #403, Montreal, Québec H2S 3H2 (CA). CORBEIL, Jean-Francois; 1281 Filiatrault, Prevost, Québec J0R 1T0 (CA). SEGUIN, Alexis; 102 rue de Pise, Laval, Québec H7M 4J1 (CA).

(74) Agent: SMART & BIGGAR LLP; 3300-1000 Rue De La Gauchetière O, Montréal, 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, IT, 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, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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).

Published:

— with international search report (Art. 21(3))

(54) Title: SKATE OR OTHER FOOTWEAR

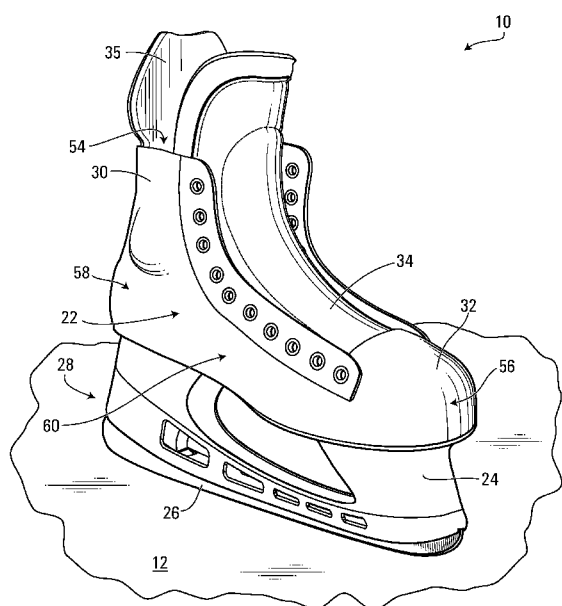


FIG. 1

(57) Abstract: A skate (e.g., an ice skate) or other footwear for a user. The skate or other footwear comprises a skate boot or other foot-receiving structure for receiving a foot of the user and possibly one or more other components, such as a skating device (e.g., a blade 5 and a blade holder) disposed beneath the skate boot to engage a skating surface (e.g., ice). In some cases, at least part of the skate boot or other foot-receiving structure 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 0 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.

SKATE OR OTHER FOOTWEAR

CROSS-REFERENCE TO RELATED APPLICATION

5

This application claims the benefit of United States Provisional Patent Application no. 63/031,259 filed on May 28, 2020, the entire content of which is incorporated by reference herein.

10

FIELD

This disclosure generally relates to footwear, including skates (e.g., ice skates) such as for playing hockey and/or other skating activities and other footwear.

15

BACKGROUND

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 body, sometimes
20 referred to as a “shell”, a toe cap, a tongue, a tendon guard, etc.

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
25 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 expensive to manufacture.

Also, a skating device, such as a blade holder holding a blade for ice skating or a
30 wheel holder holding wheels for roller skating (e.g., inline skating), is normally

fastened under a skate boot. This may add attachment, manufacturing, and/or other issues.

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

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

10

SUMMARY

In accordance with various aspects of this disclosure, there is provided a skate (e.g., an ice skate) or other footwear for a user. The skate or other footwear comprises a skate boot or other foot-receiving structure for receiving a foot of the user and possibly
15 one or more other components, such as a skating device (e.g., a blade and a blade holder) disposed beneath the skate boot to engage a skating surface. In some cases, at least part of the skate boot or other foot-receiving structure and optionally at least part of one or more other components (e.g., the skating device) of the skate or other footwear may be constructed from one or more materials (e.g., foams) molded by
20 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.

25 For example, in accordance with an aspect of the disclosure, there is provided a method of making a skate boot for a skate, the skate boot being configured to receive a foot of a user. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving constituents that are different; determining a desired property of a material of a body of the skate boot; injecting respective ones of the
30 constituents to produce the material of the body of the skate boot; and controlling

proportions of the respective ones of the constituents to impart the desired property to the material of the body of the skate boot.

In accordance with another aspect of the disclosure, there is provided a method of making a skate boot for a skate, the skate boot being configured to receive a foot of a user. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol; determining a desired property of a polyurethane of a body of the skate boot; injecting the isocyanate, the first polyol, and the second polyol to produce the polyurethane of the body of the skate boot; and controlling proportions of the isocyanate, the first polyol, and the second polyol to impart the desired property to the polyurethane of the body of the skate boot.

In accordance with another aspect of the disclosure, there is provided a method of making skate boots for skates. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving constituents that are different; for each skate boot, injecting respective ones of the constituents to produce a material of a body of the skate boot. Proportions of the respective ones of the constituents injected to produce the material of the body of a first one of the skate boots differ from proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the skate boots.

In accordance with another aspect of the disclosure, there is provided a method of making skate boots for skates. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol; for each skate boot, injecting the isocyanate, the first polyol, and the second polyol to produce a polyurethane of a body of the skate boot. Proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the skate boots differ from proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the skate boots.

In accordance with another aspect of the disclosure, there is provided a plurality of skate boots for skates. Each of the skate boots comprises a body including a material produced by injecting respective ones of a plurality of constituents. Proportions of the
5 respective ones of the constituents injected to produce the material of the body of a first one of the skate boots differ from proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the skate boots.

10 In accordance with another aspect of the disclosure, there is provided a plurality of skate boots for skates. Each of the skate boots comprises a body including a polyurethane produced by injecting an isocyanate, a first polyol, and a second polyol. Proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the skate boots differ from
15 proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the skate boots.

In accordance with another aspect of the disclosure, there is provided a method of making an article of footwear, the article of footwear being configured to receive a foot
20 of a user. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving constituents that are different; determining a desired property of a material of a body of the article of footwear; injecting respective ones of the constituents to produce the material of the body of the article of footwear; and controlling proportions of the respective ones of the constituents to impart the desired
25 property to the material of the body of the article of footwear.

In accordance with another aspect of the disclosure, there is provided a method of making an article of footwear, the article of footwear being configured to receive a foot of a user. The method comprises: providing a molding apparatus comprising a
30 plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol; determining a desired property of a polyurethane of a body of the

article of footwear; injecting the isocyanate, the first polyol, and the second polyol to produce the polyurethane of the body of the article of footwear; and controlling proportions of the isocyanate, the first polyol, and the second polyol to impart the desired property to the polyurethane of the body of the article of footwear.

5

In accordance with another aspect of the disclosure, there is provided a method of making articles of footwear. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving constituents that are different; for each article of footwear, injecting respective ones of the constituents to produce a material
10 of a body of the article of footwear. Proportions of the respective ones of the constituents injected to produce the material of the body of a first one of the articles of footwear differ from proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the articles of footwear.

15 In accordance with another aspect of the disclosure, there is provided a method of making articles of footwear. The method comprises: providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol; and for each article of footwear, injecting the isocyanate, the first polyol, and the second polyol to produce a polyurethane of a body
20 of the article of footwear. Proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the articles of footwear differ from proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the articles of footwear.

25

In accordance with another aspect of the disclosure, there is provided a method of making a plurality of articles of footwear. Each of the articles of footwear comprises a body including a material produced by injecting respective ones of a plurality of constituents. Proportions of the respective ones of the constituents injected to
30 produce the material of the body of a first one of the articles of footwear differ from

proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the articles of footwear.

In accordance with another aspect of the disclosure, there is provided a method of making a plurality of articles of footwear. Each of the articles of footwear comprises a body including a polyurethane produced by injecting an isocyanate, a first polyol, and a second polyol. Proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the articles of footwear differ from proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the articles of footwear.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising an integrally-formed portion formed integrally with the body of the skate boot, the blade holder comprising a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising an integrally-formed

portion formed integrally with the body of the skate boot, the blade holder comprising a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder. The blade holder comprises a blade-retaining base configured to retain the
5 blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot. The core of the blade holder comprises a pillar-forming member extending upwardly from the blade-retaining base and constituting at least part of a given one of the front pillar and the rear pillar. The core of the blade holder comprises a cavity defined at least partly by the pillar-forming member. The pillar-
10 forming member comprises a reinforcement.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured to receive a foot of a user, the skate boot comprising a body that comprises a medial side portion to face a
15 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising an integrally-formed portion formed integrally with the body of the skate boot, the blade holder comprising
20 a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder. The blade holder comprises a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot. The core of the blade holder comprises a pillar-forming
25 member extending upwardly from the blade-retaining base and constituting at least part of a given one of the front pillar and the rear pillar. The core of the blade holder comprises a cavity defined at least partly by the pillar-forming member. The core of the blade holder comprises a cap capping the cavity at least partly defined by the pillar-forming member. The pillar-forming member comprises a reinforcement. The
30 cap comprises a reinforcement.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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
5 foot, a heel portion to receive a heel of the user's foot, and an ankle portion to receive an ankle of the user; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that
10 extend upwardly from the blade-retaining base towards the skate boot, a given one of the front pillar and the rear pillar extending downwardly from a respective one of a front sole part of the skate boot and a rear sole part of the skate boot, a width of the given one of the front pillar and the rear pillar being at least 80% of a width of the respective one of the front sole part of the skate boot and the rear sole part of the
15 skate boot.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured to receive a foot of a user, the skate boot comprising a body that comprises a medial side portion to face a
20 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot, the blade holder comprising a blade-
25 retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot, a given one of the front pillar and the rear pillar extending downwardly from a respective one of a front sole part of the skate boot and a rear sole part of the skate boot and being at
least as wide as the respective one of the front sole part of the skate boot and the rear
30 sole part of the skate boot.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot, the blade holder being configured to hold the blade such that the blade is unsupported by the blade holder between the front pillar and the rear pillar.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising a blade-retaining base configured to retain the blade and a support extending upwardly from the blade-retaining base towards the skate boot, the blade-retaining base comprising a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade, the blade-receiving slot being wider in an intermediate portion of the blade-retaining base between the front portion of the blade-retaining base and the rear portion of the blade-retaining base than in the front portion of the blade-retaining base and in the rear portion of the blade-retaining base.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot, the blade-retaining base comprising a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade, the blade-receiving slot being wider between the front pillar and the rear pillar than beneath the front pillar and beneath the rear pillar.

In accordance with another aspect of the disclosure, there is provided a blade holder for a skate for skating on ice. The skate comprises a skate boot 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 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 blade holder is configured to be disposed below the skate boot and hold a blade for engaging the ice. The blade holder comprises: a blade-retaining base configured to retain the blade; and a front pillar and a rear pillar that extend upwardly from the blade-retaining base. The blade-retaining base comprises a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade. The blade-receiving slot is wider between the front pillar and the rear pillar than beneath the front pillar and beneath the rear pillar.

In accordance with another aspect of the disclosure, there is provided a blade holder for a skate for skating on ice. The skate comprises a skate boot 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 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 blade holder is configured to be disposed below the skate boot and hold a blade for engaging the ice. The blade holder comprises: a blade-retaining base configured to retain the blade; and a support extending upwardly from the blade-retaining base. The blade-retaining base comprises a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade. The blade-receiving slot is wider in an intermediate portion of the blade-retaining base between the front portion of the blade-retaining base and the rear portion of the blade-retaining base than in the front portion of the blade-retaining base and in the rear portion of the blade-retaining base.

In accordance with another aspect of the disclosure, there is provided a skate boot for a skate. The skate boot is configured to receive a foot of a user and comprises 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 face an ankle of the user. The body of the skate boot comprises graphical ink implementing graphics and provided by a film, the graphical ink covering at least a majority of a surface area of an ink-providing side of the film providing the graphical ink.

In accordance with another aspect of the disclosure, there is provided a method of making a skate boot for a skate, the skate boot being configured to receive a foot of a user. The method comprises: forming a body of the skate boot 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 face an ankle of the user; and positioning a film including graphical ink to implement graphics on the body of the skate boot, the graphical ink covering at least a majority of a surface area of an ink-providing side of the film providing the graphical ink.

In accordance with another aspect of the disclosure, there is provided a skate boot for a skate. The skate boot is configured to receive a foot of a user and comprises 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 face an ankle of the user. The body of the skate boot includes: a plurality of layers formed integrally with one another by flowing in a molding apparatus; and graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the skate boot, the graphical ink being solventless.

In accordance with another aspect of the disclosure, there is provided a skate boot for a skate. The skate boot is configured to receive a foot of a user and comprises 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 face an ankle of the user. The body of the skate boot includes: a plurality of layers formed integrally with one another by flowing in a molding apparatus; and graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the skate boot, a surface energy of the graphical ink being less than 32 dynes/cm.

In accordance with another aspect of the disclosure, there is provided an article of footwear configured to receive a foot of a user. The article of footwear comprises 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, and a heel portion to receive a heel of the user's foot. The body of the article of footwear includes: a plurality of layers formed integrally with one another by flowing in a molding apparatus; and graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the article of footwear, the graphical ink being solventless.

In accordance with another aspect of the disclosure, there is provided an article of footwear configured to receive a foot of a user. The article of footwear comprises 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, and a heel portion to receive a heel of the user's foot. The body of the article of footwear includes: a plurality of layers formed integrally with one another by flowing in a molding apparatus; and graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the article of footwear, a surface energy of the graphical ink being less than 32 dynes/cm.

In accordance with another aspect of the disclosure, there is provided a skate for skating on ice. The skate comprises: a skate boot configured 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; and a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot. The skate comprises a graphical element extending from the skate boot to the blade holder such that the skate boot comprises an upper portion of the graphical element and the blade holder comprises a lower portion of the graphical element visually continuous with the upper portion of the graphical element.

In accordance with another aspect of the disclosure, there is provided a skate boot for a skate. The skate boot is configured to receive a foot of a user. The skate boot comprises 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 face an ankle of the user. The body of the skate boot includes a plurality of layers formed integrally with one another by flowing in a molding apparatus. A given one of the layers comprises an opening that opens onto an adjacent one of the layers.

In accordance with another aspect of the disclosure, there is provided an article of footwear configured to receive a foot of a user. The article of footwear comprises a body comprising a medial side portion to face a medial side of the user's foot, a lateral
5 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 face an ankle of the user. The body of the article of footwear includes a plurality of layers formed integrally with one another by flowing in a molding apparatus. A given one of the layers comprises an opening that opens onto an adjacent one of the layers.

10 These and other aspects of this disclosure will now become apparent to those of ordinary skill in the art upon review of a description of embodiments that follows in conjunction with accompanying drawings.

15 BRIEF DESCRIPTION OF DRAWINGS

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

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

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;

25 Figure 4 is a block diagram showing a molding process implementing a molding apparatus to form the shell of the skate boot;

Figure 5 is a cross-sectional view of the shell showing a plurality of subshells of the shell,
30 including an internal, an intermediate and an external subshell of the shell;

Figure 6 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 7 is a cross-sectional view of the shell of the skate boot in an embodiment in which the shell comprises subshells;

Figures 8 to 10 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 11 is a cross-sectional view of the shell in embodiments in which a footbed of the skate boot is formed integrally with the shell of the skate boot;

Figures 12 and 13 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 14 is a cross-sectional view of the shell in an embodiment in which the shell comprises four subshells;

Figure 15 is an example of a last of the molding apparatus used to form the shell;

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

Figure 17 is a cross-sectional view of the last and a second female mold used to produce the intermediate subshell of the shell;

Figure 18 is a cross-sectional view of the last and a third female mold used to produce the external subshell of the shell;

Figures 19 and 20 show examples of the last to form the shell in other embodiments;

Figures 21 to 32 show an example of the last to form the shell in another embodiment;

Figures 33 to 37 show an example of the last to form the shell in another embodiment;

5

Figures 38 to 42 show an example of the last to form the shell in another embodiment;

Figures 43 and 44 show an example of the last to form the shell in another embodiment;

10 Figures 45 to 47 show an example of the last to form the shell in another embodiment;

Figures 48 to 52 show an example of a flexible female mold member in another embodiment;

15 Figures 53 and 54 are side views of the shell in embodiments in which the shell comprises a reinforcement and the reinforcement comprises a rib;

Figures 55A and 55B are side views of the shell in embodiments in which the reinforcement comprises a reinforcing sheet;

20

Figure 56 are side views of the shell in embodiments in which the shell comprises more than one reinforcements;

25 Figure 57 is a side view of the shell in accordance with an embodiment in which the reinforcement comprises a single fiber;

Figure 58 is a cross-sectional view of the shell in an embodiment in which the shell comprises a reinforcement and a graphical element disposed between the intermediate subshell and the external subshell;

30

Figure 59 is a side view of the shell in accordance with variant;

Figure 60 is a film having graphical ink on an ink-providing side;

Figure 61 shows the film after a molding process;

5

Figure 62 shows a cross-sectional view of the skate comprising the graphical ink;

Figure 63 shows a variant of the film after the molding process wherein the film is configured to cover eyelets of the skate boot;

10

Figure 64 is a conceptual illustration of constituents of a material flowing into a mold cavity to produce a resulting polymeric material;

Figure 65 is a perspective view of an embodiment in which the shell comprises an overlay;

15

Figures 66 to 68 are variants of the skate wherein an insole of the skate boot is affixed to the skate boot;

Figure 69A shows an example of an embodiment wherein an inner liner of the skate boot comprises a sole portion;

20

Figure 69B shows an example of an embodiment wherein an inner liner of the skate boot does not comprise a sole portion;

25

Figures 70A and 70B show a sheet of material used for manufacturing the inner liner in accordance with an embodiment;

Figure 71 shows the inner liner of Figures 66A and 66B;

30

Figures 72 to 75 are respective side, front, top and bottom views of the shell of Figure 3;

Figure 76 is a cross-sectional view of the shell taken along line 76-76 of Figure 73;

Figures 77 and 78 are cross-sectional views of the shell taken along lines 77-77 and 78-
5 78 of Figure 72;

Figure 79 is a perspective view of a tongue of the skate boot;

Figure 80 is a side view of a blade of a skating device of the skate;

10

Figure 81 shows embodiments in which the blade is affixed to a blade holder of the skating device of the skate;

Figures 82 and 83 show a blade-receiving slot of the blade holder;

15

Figures 84 and 85 show 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;

20 Figures 86 to 90 show an example of an embodiment in which the blade holder comprises a core;

Figures 91 to 97 show examples of an embodiment in which the skate comprises a connection system to attach a blade to and detach the blade from the skate;

25

Figures 98 to 100 show variants of the skate boot;

Figure 101 and 102 show variants of the blade holder;

30 Figure 103 shows a variant of the blade;

Figure 104 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;

5 Figures 105 and 106 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;

Figures 107 and 108 show examples of an embodiment in which the skate comprises graphical elements extending over the skate boot and the blade holder;

10

Figures 109 to 114 show an example of an embodiment in which the shell comprises of uneven surface elements;

Figures 115 to 119 show examples of an embodiment in which the shell comprises
15 openings;

Figures 120 to 124 show different examples of embodiments in which the blade is affixed to a blade holder of the skating device of the skate;

20 Figure 125 is a side view of the blade of the skating device;

Figure 126 is a cross-sectional view of the blade taken along line 126-126 of Figure 125;

25 Figure 127 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;

Figures 128 and 129 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;

30

Figure 130 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;

Figures 131 and 132 are cross-sectional views of the shell in embodiments in which a limited part of the blade holder is molded integrally with the shell;

Figure 133 is a cross-sectional of the shell in an embodiment in which the footbed of the skate boot is formed integrally with the shell;

Figure 134 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 135 is a cross-sectional view of the shell in an embodiment in which the blade holder is molded integrally with the shell and a given subshell envelops the blade holder but not the shell;

Figure 136 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, notably the toe cap, the tongue, the tendon guard, the footbed and the lace members of the skate boot;

Figures 137 to 139 show an example of an embodiment in which the skate comprises a connection system to attach the blade holder to and detach the blade holder from the skate boot;

Figures 140 to 144 show variants of the connection system;

Figures 145 to 147 show an example of an embodiment in which the skate comprises a blade-holder-connecting portion to attach the blade holder to and detach the blade holder from the skate boot;

Figure 148 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);

5

Figure 149 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;

10 Figure 150 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;

Figure 151 is a cross-sectional view of the shell in an embodiment in which the shell
15 comprises the internal, intermediate and external subshells and is molded separately from the blade holder;

Figure 152 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;

20

Figure 153 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;

Figures 154 and 155 show an example of a variant in which the shell and/or the blade
25 holder comprises one or more inserts over which a subshell is molded;

Figures 156 to 158 show other examples of the variant of Figure 154 in which the inserts form a part of the shell;

30 Figure 159 shows an example of a variant in which one or more of the subshells comprises a filled portion comprising a different material;

Figures 160 to 165 show other examples of the variant of Figure 159;

Figure 166 shows an example of a variant in which the shell and/or the blade holder
5 and/or other components made integrally with the shell comprises an opening configured
to modify a performance of the skate boot;

Figures 167 to 170 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
10 which are then assembled together;

Figure 171 shows an example of a variant in which the blade holder comprises an insert
for receiving the blade;

15 Figure 172 shows an example of a variant in which the blade holder comprises a void;

Figure 173 shows an example of an embodiment in which a material of a given subshell
comprises a polymeric substance and an expansion agent;

20 Figure 174 shows an example of the expansion agent of Figure 173;

Figures 175 to 177E show examples of variants in which the tendon guard is overmolded
on the shell;

25 Figures 178 to 180 show examples of variants in which the skate boot comprises
padding between the shell and the inner liner;

Figures 181 to 183 show an example of variant in which a given subshell covers a zone
of the shell but does not cover another zone of the shell;

30

Figures 184 to 186 show an example of variant in which a given subshell comprises a

plurality of different materials covering different zones of the subshell;

Figures 187 and 188 show examples of apparatus for manufacturing the given subshell of Figures 184 to 186;

5

Figure 189 shows an example of a variant in which one or more of the subshells comprises a thermoformable memory-shape material;

Figure 190 shows an example of a variant in which the skate boot comprises a toe cap and a graphic element occupying a significant portion of a surface of the toe cap;

10

Figure 191 shows an example of a test for determining the stiffness of a part of a subshell;

Figure 192 to 196 show examples of variants in which the footwear is a ski boot, a work boot, a snowboard boot, a sport cleat or a hunting boot; and

15

Figures 197 and 198 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 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 and should not be limitative.

25

DETAILED DESCRIPTION OF EMBODIMENTS

Figures 1 and 2 show an example of an embodiment of footwear 10 for a user. In this embodiment, the footwear 10 is a skate for the user to skate on a skating surface 12. More particularly, in this embodiment, the skate 10 is a hockey skate for the user 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.

30

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
5 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
10 blade holder 24), 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 10 to have useful performance characteristics (e.g., reduced weight, proper fit and comfort, etc.) while being more cost-effectively manufactured. Also, the skate 10 may facilitate installation and removal of the blade 26
15 and/or the blade holder 24, such as for replacement of the blade 26 and/or the blade holder 24, assemblage of the skate 10, and/or other purposes. For example, in some embodiments, the skate boot 22 and the blade holder 24 may be at least partly formed integrally with one another (e.g., by injection molding or other material flow), while the blade 26 may be readily attachable to and detachable from the blade holder 24.

20 The skate boot 22 is a foot-receiving structure defining a cavity 54 for receiving the player's foot 11. With additional reference to Figures 197 and 198, 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
25 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
30 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 body 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 through (e.g., punched into) the lace members 44₁, 44₂, the body 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 body 30 and the liner 36 via the apertures 48.

The body 30 of the skate boot 22 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 body 30 of the skate boot 22, which will be referred to as a "shell", 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 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 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 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.

In this embodiment, with additional reference to Figure 4, the shell 30 comprises one or
5 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
10 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
15 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
20 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
25 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
30 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 than 10 kg/m³ and in some cases even less. One or more of the polymeric materials M₁-M_N may not be foam in other examples of implementation.

5

In this embodiment, the materials M₁-M_N of the subshells 85₁-85_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 M₁-M_N constitute at least a majority (i.e., a majority or 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 M₁-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.

15 The subshells 85₁-85_L constituted by the polymeric materials M₁-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 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.

25 In some cases, a given one of the subshells 85₁-85_L may be configured to be harder than another one of the subshells 85₁-85_L. For instance, to provide a given subshell with more hardness than another subshell, the hardness of the polymeric materials M₁-M_N may vary. For example, a hardness of the polymeric material M_x may be greater 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

30

at least 3, in some cases at least 4, in some cases at least 5 and in some cases even more.

To observe the stiffness of a subshell 85_x, as shown in Figure 170, 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 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)).

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 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 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 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., Young's modulus) of the polymeric materials M₁-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 M₁-M_N may vary. For instance, in some
5 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
10 cases at least 5 and in some cases even more. This ratio may have any other suitable value in other embodiments.

In some cases, a given one of the subshells 85₁-85_L may be configured to be denser than another one of the subshells 85₁-85_L. For instance, to provide a given subshell with
15 more density than another subshell, the density of the polymeric materials M₁-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
20 2.5, in some cases at least 3 and in some cases even more.

In this embodiment, as shown in Figure 5, the subshells 85₁-85_L comprise an internal subshell 85₁, an intermediate subshell 85₂ and an external subshell 85₃. The internal subshell 85₁ is "internal" in that it is an innermost one of the subshells 85₁-85_L. That is,
25 the internal subshell 85₁ is closest to the player's foot 11 when the player dons the skate 10. In a similar manner, the external subshell 85₃ is "external" in that it is an outermost one of the subshells 85₁-85_L. That is, the external subshell 85₃ is furthest from the player's foot 11 when the player dons the skate 10. The intermediate subshell 85₂ is disposed between the internal and external subshells 85₁, 85₃.

30

The internal, intermediate and external subshells 85₁, 85₂, 85₃ 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 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, 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 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 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 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

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 85₁, 85₂, 85₃ 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 85₁, 85₂, 85₃ 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 85₁, 85₂, 85₃ with their different characteristics, the polymeric materials M₁, M₂, M₃ of the internal, intermediate and external subshells 85₁, 85₂, 85₃ may comprise different types of polymeric materials. For instance, in this example, the polymeric material M₁ comprises a generally soft and dense foam, the polymeric material M₂ comprises a structural foam that is more rigid than the foam of the polymeric material M₁ and less dense than the polymeric material M₁, and the polymeric material M₃ is a material other than foam. For example, the polymeric material M₃ of the external subshell 85₃ may consist of a clear polymeric coating.

The subshells 85₁-85_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 6, the shell 30 may be a single shell and therefore does not comprise any subshells. In other embodiments, as shown in Figure 7, the shell 30 may comprise two subshells 85₁-85_L.

Moreover, as shown in Figures 8 to 10, 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 8, 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

5 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 9, 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

10 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 10, 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

15 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 11, 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

20 process of the shell 30 has been completed.

In some embodiments, as shown in Figures 12 and 13, 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

25 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.

In some embodiments, as shown in Figure 14, 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 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.

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 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 "last") with which all the polymeric materials M₁-M_N are molded into shape, as shown in Figure 15. 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 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 reference

to Figures 16 to 18.

With additional reference to Figure 16, 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 17, 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 18, 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 M₃ via a sprue, runner and gate system (not shown) of the third female mold 154₃ and left to cure.

- 5 Once the polymeric material M₃ has cured for a sufficient amount of time to form the external subshell 85₃, the shell 30, including its now formed internal, intermediate and external subshells 85₁, 85₂, 85₃, is demolded from (i.e., removed from) the last 152. This may be achieved in various ways.
- 10 For instance, in some embodiments, the polymeric materials M₁, M₂, M₃ which constitute the internal, intermediate and external subshells 85₁, 85₂, 85₃ 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 85₁, 85₂, 85₃ of the shell 30. In some cases, the shell 30 may be removed from the last 152 while at least
- 15 a given one of the internal, intermediate and external subshells 85₁, 85₂, 85₃ 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 85₁, 85₂, 85₃ had fully cured.
- 20 Moreover, in some embodiments, with additional reference to Figures 19 to 46, 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
- 25 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
- 30 152 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.

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.).

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.

In some embodiments, as shown in Figure 19, 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
5 “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.

As a variant, in some embodiments, as shown in Figure 20, the cavity 163 of the last 152
10 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 flows out of the cavity 167 (e.g., by vacuum).

15 As another example, in some embodiments, as shown in Figures 21 to 32, 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 configuration. The last members 175₁-175_M may be viewed as last “modules” so that the last 152 is a
20 “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.

In this embodiment, respective ones of the last members 175₁-175_M are movable relative
25 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 includes links 183₁-183_C linking adjacent ones of the last members 175₁-175_M so that they are
30 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 configuration. For example, in this embodiment, the linkage 181 comprises translation guides 195₁-
10 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.

In this embodiment, the last member 175₁ is a front central last member to form part of
15 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 central part of the sole portion 69; the last member 175₂ is an intermediate central last
20 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 lateral parts of the sole portion 69, medial and lateral parts of the toe cap 32 integrally formed
25 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 demolding configuration by: (1) translating the intermediate central last member 175₂ upwardly
30 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 33 to 37, 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.

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
5 be made of metal, rigid plastic, wood, or any other suitable material.

In a variant, in some embodiments, as shown in Figures 38 to 42, the last 152 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
10 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 polymeric material M₁ during injection, and/or reduce or eliminate internal parting lines on the shell 30.

15 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 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
20 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 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.

25

Thus, in this embodiment, the sheath 179 is placed over the base 199 of the last 152 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
30 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 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.

5

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

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).

As another example, in some embodiments, as shown in Figures 43 and 44, 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 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 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.

30

As another example, in some embodiments, the sheath 179 may be a film placed (e.g.,

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.

5

As another example, in some embodiments, as shown in Figures 45 to 47, the sheath 179 may be covered with a film 159 prior to molding to protect the last 152 and increase its durability. In this embodiment, the film 159 may be a bag. The bag 159 may be connected the last 152 by using tape, by being pinched to the last 152, or by any suitable means.

10

In this embodiment, the bag 159 is a reusable bag, that is, the bag 159 may be used to mold more the shell 30 and one or more other shells similar to the shell 30. To this end, the bag 159 may be made of a material which eases installation of the bag 159 over the last 152 and the sheath 179, facilitates molding by being relatively smooth, and is relatively durable. In this example, the bag 159 is made of of an elastomeric material such as plastic or silicone.

15

In other embodiments, the bag 159 may not be reusable. That is, the bag 159 may be configured for being used for molding only one shell 30. For instance, the bag 159 may be configured such that it remains affixed with the skate shell 30 after molding. More specifically, during molding, the bag 159 binds with the shell 30 and when the shell 30 is removed from the molding apparatus, the bag 159 remains with the skate shell. In some cases, a portion of the bag 159 may need to be cut off from the shell 30 so that no loose portion of the bag 159 remains attached to the shell 30. In some embodiments, the bag 159 may include 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 other real or imaginary thing), to enhance the look of at least a portion of the shell 30, such as the inner side of the shell 30. In some embodiments, the bag

20

25

30

159 may be made of a polymeric material and may have a thickness between 0.01 mm and 1 mm, in some embodiments between 0.05 mm and 0.5 mm, in some embodiments about 0.1 mm.

- 5 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 48 and 49, the control system 187 may be configured to control movement of last members 175₁, 175₂ so that the last
10 152 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) causes the arms 189₁-
15 189_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.

- 20 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 last members 175₁-175_M may move in any other way relative to one another, etc. Also, in
25 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 50 to 52, in some embodiments, a given one of the female molds 154₁-154₃ may comprise a flexible female mold member 410 comprising
30 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 M_1 - M_3 is injected to mold a given one of the subshells 85_1 - 85_3 such that the inner surface 414 creates an outer surface of the given one of the subshells 85_1 - 85_3 . The flexible female mold member 410, which will also be referred to as a “membrane”, is configured
5 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 154_1 - 154_3 if the membrane 410 was omitted.

For example, in this embodiment, the membrane 410 is part of the female mold 154_1
10 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 M_1 is injected to mold the subshell 85_1 such that the inner surface 414 creates the outer surface of the subshell 85_1 .

The inner surface 414 of the membrane 410 is preformed in that it is formed to define
15 the mold cavity 156 to mold the subshell 85_1 and create the outer surface of the subshell 85_1 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.

The membrane 410 is flexible to flex during movement of the portions 155, 157 of the
20 female mold 154_1 when closing and opening the female mold 154_1 and overlies one or more spaces where the portions 155, 157 of the female mold 154_1 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.

25 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 154_1 and to create at least a majority of the outer surface of the subshell 85_1 . More particularly, in this embodiment, the membrane 410 comprises medial and lateral side portions 420, 422, an ankle portion 424, a heel portion 426, and a sole portion 428 that are integral
30 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 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.

5

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 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 to enclose toes of the user's foot, but is free of any parting line opposite to the parting line 263, i.e., at an
10 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.

In this embodiment, the membrane 410 may comprise an elastomeric material, such as
15 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 suitable value.

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

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
25 during movement of the portions 155, 157 of the female mold 154₁ when closing and opening the female mold 154₁. 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
30 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. 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 154₁ when closing and opening the female mold 154₁.

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 may be vertically distributed such as being stacked vertically over one another, which may be more efficient space-wise.

- With additional reference to Figures 53 and 54, in some embodiments, the shell 30 may comprise a reinforcement 115 disposed between certain ones of the subshells 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
- 5 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 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
- 10 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 other suitable way to the exterior surface of the intermediate subshell 85₂.
- 15 The reinforcement 115 may be configured in any suitable way. For instance, as shown in Figure 53, 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 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.
- 20 As shown in Figure 54, 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 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.
- 25 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.

Alternatively, as shown in Figures 55A to 57, the reinforcement 115 may comprise a

30 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 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, 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.

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 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 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 57, the reinforcement 115 may comprise a single fiber 111 rather than a fabric mesh. The single fiber 111 is configured to apply 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 another example, as shown in Figure 56 the shell 30 may comprise more than one reinforcements 115₁-115_r disposed between certain ones of the subshells 85₁-85_L of the shell 30 and each one of the reinforcements 115₁-115_r may comprise a material
5 that is different from the material of another one of the reinforcements 115₁-115_r. For instance, the materials of different ones of the reinforcements 115₁-115_r may differ in rigidity, in density, etc., such as to provide desired properties to different parts of the skate boot 22 and blade holder 24.

10 In some embodiments, multiple reinforcements 115 may be included between the 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.

15 Moreover, in some embodiments, rather than or in addition of the reinforcement 115, the shell 30 may comprise a decoration 121, which can be referred to as a graphical element or 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 58. The design element 121 constitutes an aesthetic element that is
20 produced separately from the shell 30 and may be included in the shell 30 in order to affect its 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
25 imaginary objects (e.g., a person, an animal, a vehicle, an imaginary or fictional character, or any 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),
30 ultrasonically bonded, or affixed in any other suitable way to the exterior surface of the intermediate subshell 85₂. While a single design element 121 is depicted in Figure 58,

the shell 30 may comprise a plurality of such design elements which may be spaced apart from one another.

5 The one or more design elements 121 may be disposed over various portions of the shell 30 and/or over various other portions of the skate boot 22, for instance over the medial side portion 68 , over the lateral side portion 66, over a top portion and/or over the toe portion 32 of the shell 30, and may also be disposed over the tongue 34, over the tendon guard 35, over the liner 36, over the footbed 38, over the insole 40, over the lace members 44₁, 44₂, over the eyelets 46₁-46_E, and so on, as shown in Figure 59. For
10 instance, the design elements 121 may be disposed at least on a side of the toe portion 32. In this example, the design elements 121 are disposed on a medial side, on a lateral side and on a top side of the toe portion 32.

The design elements 121 may cover at least a substantial part (i.e., a substantial part or
15 an entirety) of a surface area of the portion of the skate boot 22 (e.g., the toe portion 32) over which they are disposed and that is externally visible (i.e., visible from outside of the skate boot 22). For instance, in some embodiments, the design elements 121 covers at least a quarter (i.e., 25%), in some embodiments at least a third (i.e., 33%), in some embodiments at least a majority (i.e., at least 50%), in some embodiments at least 75%,
20 and in some embodiments an entirety of the toe portion 32.

Some of the design elements 121 may also be continuous with other design elements 121 of adjacent portions of the skate boot 22. That is, there may be a continuity of the design element 121 between the toe portion 32 and a given one of the medial side
25 portion 68 and the lateral side portion 66 of the shell 30, thus providing an impression that the design elements 121 extend from a given one of the toe portion 32, the medial side portion 68 and the lateral side portion 66 to another one of the toe portion 32, the medial side portion 68 and the lateral side portion 66. In this embodiment, there is continuity of design elements 121 between the toe portion 32, the medial side portion 68
30 and the lateral side portion 66 of the shell 30.

In this embodiment, an external one of the layers 85₁-85_L of the shell 30 may be a clear layer overlying the design elements 121 such that the design elements 121 are visible through the clear layer and such that the clear layer protects the design elements 121 from flying pucks, sticks, etc.

5

The design elements 121 may include a design pattern, a printed image, and so on. In this embodiment, the design element is a graphic element which includes one or many different colors.

10 In this embodiment, at least some of (e.g., some of, a majority of, or an entirety of) the design elements 121 of the shell 30 may comprise graphical ink 632 implementing graphics 635. These graphics 635 may include any desired color(s), shape(s), pattern(s), character(s), image(s), etc.

15 More specifically, in this embodiment, as shown in Figures 60 to 62, the graphical ink 632 may be provided by a film 615. In this embodiment, the film 615 is a sheet comprising a polymeric material such as a polycarbonate, polypropylene, polyethylene or any other suitable polymeric material. The film 615 may comprise an ink-providing side 319 that provides the graphical ink 632 and a plain side 321
20 opposite the ink-providing side 319. In this embodiment, the ink-providing side 319 is an outer side of the film 615 and the plain side 321 is an inner side of the film 615.

The graphical ink 632 may cover a substantial part of a surface area of the ink-providing side 319 of the film 615. For example, in some embodiments, the graphical
25 ink 632 may cover a majority, in some embodiments at least 60%, in some embodiments at least 80%, and in some embodiments substantially an entirety of the surface area of the ink-providing side 319 of the film 615.

In some cases, the film 615 may be a clear film (e.g., transparent or translucent) through
30 which a person can see. For instance, in some cases, it may be clear at areas free of the graphical ink 632. In other examples, the film 615 may be opaque, colored (e.g.,

black, white or any other color), partially transparent, homogenous, and/or different at different areas.

5 In this embodiment, the film 615 is configured to be positioned on at least part of (i.e. part of, a majority of or an entirety of) the shell 30 to provide the design elements 121 of the shell 30. For instance, in this embodiment, the film 615 is configured to cover the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the shell 30 of the skate boot 22 and the graphical ink 632 is configured to cover the medial side portion, the lateral side portion, the heel portion, and the ankle portion
10 of the shell 30 of the skate boot 22 when the film 615 is positioned on the shell 30 to provide the design elements 121 of the shell 30. The film 615 may also be configured to cover various other portions of the skate boot 22, including the toe cap 32, the lace members 44₁, 44₂, the eyelets 46₁-46_e, and so on, as shown in Figure 63.

15 In particular, in this embodiment, the film 615 is configured to be positioned between consecutive layers 85₁-85_L of the shell 30. Specifically, the film 615 may be configured to be positioned over a layer 85_x prior to, during or after molding of that layer 85_x, and the layer 85_y external to the layer 85_x may be molded over the layer 85_x and over the graphical ink 632 of the design elements 121. In this embodiment, the layer 85_y may
20 be an external layer of the shell 30 and may be a clear layer.

In some embodiments, the film 615 may be configured to remain on the shell 30 after molding of the layer 85_x and during molding of the layer 85_y, such that the skate boot 20, as an end product, comprises the film 615.

25

The graphical ink 632 may be provided on the film 615 in any suitable way. For example, the graphical ink 632 may be provided on the film 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, airbrushing, etc.).

30

- The graphical ink 632 may be any suitable graphical ink. For instance, in some embodiments, the graphical ink 632 may be solventless (i.e., may not comprise and may have been provided without any solvent). In some embodiments, a surface energy of the graphical ink 632 may be less than 32 dynes/cm, in some embodiments less than 28 dynes/cm, in some embodiments less than 24 dynes/cm, and in some embodiments even less. Furthermore, in this embodiment, graphical ink 632 may have any suitable elongation to rupture (elasticity), opacity, opacity when stretched. In particular, in this embodiment, the graphical ink 632 may be configured to have a relatively high elongation to rupture at room temperature on a relatively thin substrate.
- 10 The graphical ink 632 may be substantially free of volatile solvents and may be configured to prevent inhibiting chemical reaction with polyurethane, in particular with one or more isocyanate components of the polyurethane, while having a good bonding and a good chemical affinity with polyurethane.
- 15 In some embodiments, an entirety of the graphical ink 632 may comprise a relatively flexible ink (e.g. configured to have a relatively high elongation to rupture at room temperature on a relatively thin substrate). In some embodiments, the graphical ink 632 may comprise inks of different elasticities: for instance, in this example, a majority of the graphical ink 632 may comprise a relatively flexible ink and the graphical ink
- 20 632 may comprise a relatively stiff ink in areas where stretch is minimal.

For example, in some embodiments, the graphical ink 632 comprises one or more of a latex-based ink, a UV/LED cured ink, a flexography ink, a silkscreen ink, etc. In variants, the graphical ink 932 may comprise a water-and-solvent-based ink (e.g., a

25 dried water-and-solvent-based ink free of residual water and solvents).

Moreover, in some cases, the reinforcement 115, which is depicted in Figure 58 spaced apart from the decoration 121, itself may act as a decoration in addition to its reinforcing functionality.

30

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 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 the reinforcement 115 for aesthetic purposes.

In some embodiments, the reinforcement 115 may be pre-shaped before being placed in the molding apparatus 150 with the subshells 85₁-85_L of the skate boot 22. For example, in some embodiments, the reinforcement 115 may be thermoformed before being placed in the molding apparatus 150 with the subshells 85₁-85_L of the skate boot 22.

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 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, as shown in Figure 64, the molding apparatus 150 comprises a plurality of ports 125₁-125_P for receiving constituents 127₁-127_C that are different from one another to injection mold a given one of the layers 85₁-85_L, referred-to as layer 85_x hereinbelow. In particular, in this example, the molding apparatus 150 may comprise at least three ports 125₁-125₃ for receiving three different constituents 127₁-127₃, such as from containers 143₁-143₃ containing supplies of the constituents 127₁-127₃. A desired property (e.g., stiffness) of the polymeric material M_x of the layer 85_x of the shell 30 of

the skate boot 22 may be determined (e.g., based on input received from a user or from a component of a computer system). Respective ones of the constituents 127₁-127₃ may be injected to produce the polymeric material M_x while proportions of these respective ones of the constituents 127₁-127₃ (e.g., relative to one another and/or to their total) are controlled to impart the desired property of the polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22.

In this embodiment, the molding apparatus 150 may be configured to allow customization of the shell 30 of the skate boot 22 by controlling the proportions of the respective ones of the constituents 127₁-127_c of the layer 85_x according to the desired property of the polymeric material M_x. Thus, in some embodiments, the shells 30 of a plurality of similar skate boots 22 manufactured by the molding apparatus 150 may have different proportions of the respective ones of the constituents 127₁-127_c of their layer 85_x. In particular, without changing in its configuration, the molding apparatus 150 may be configured to control the proportions of the respective ones of the constituents 127₁-127_c such that these proportions for the layer 85_x of the shell 30 of a first skate boot 22 manufactured by the molding apparatus 150 are different from these proportions for the layer 85_x of the shell 30 of a second skate boot 22 manufactured by the molding apparatus 150 immediately after the first skate boot 22 without changing the physical configuration of the molding apparatus 150.

For instance, in this embodiment, the molding apparatus 150 may comprise a controller 192 configured to control an injected amount for each one of the constituents 127₁-127_c. The controller 192 may thus control the proportions of the respective ones of the constituents 127₁-127_c of the polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22. The controller 192 may be combined with any suitable device and/or system. For example, in some embodiments, the controller 192 comprises a user interface with a display allowing an operator to enter a parameter value related to the desired property of the polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22, and the controller 192 may be configured to control the proportions of the respective ones of the constituents 127₁-127_c to obtain the polymeric material M_x with

the desired property. In some embodiments, parameter data related to the desired property of the polymeric material M_x may be provided via an internet connection to the controller 192 and the controller 192 may be configured to control the proportions of the respective ones of the constituents 127₁-127_C to obtain the polymeric material M_x with the desired property.

In particular, in this embodiment, the constituents 127₁-127_C include at least three constituents and the respective ones of the constituents 127₁-127_C which are injected with their proportions controlled include at least three constituents. In other embodiments, the constituents 127₁-127_C may include more than three constituents, and so may the respective ones of the constituents 127₁-127_C which are injected with their proportions controlled. In some cases, a given one of the constituents 127₁-127_C may not be injected to produce the material M_x of the shell 30 of the skate boot 22.

Specifically, in this embodiment, the material polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22 is a polyurethane. More specifically, the polyurethane is a polyurethane foam. In this embodiment, the constituents 127₁-127_C include an isocyanate, a first polyol, and a second polyol different from the first polyol. In examples that follow, for ease of reference, they may respectively be referred to as the isocyanate "A", the first polyol "B1", and the second polyol "B2".

In some cases, the proportion of the polyol B1 injected in the molding apparatus 150 to obtain the polymeric material M_x may be different from the proportion of the polyol B2 injected in the molding apparatus 150 to obtain the polymeric material M_x . In some cases, also, the respective ones of the constituents 127₁-127_C may include the isocyanate A and the polyol B1 but not the polyol B2. In other cases, the respective ones of the constituents 127₁-127_C may include the isocyanate A, the polyol B1 and the polyol B2.

The desired property of the material M_x of the shell 30 of the skate boot 22 may be a stiffness (i.e., rigidity) of the material M_x of the shell 30 of the skate boot 22. For example,

in this embodiment, the stiffness of the material M_x of the shell 30 of the skate boot 22 may be expressed as a modulus of elasticity of the material M_x .

In this embodiment, the molding apparatus 150 allows controlling the rigidity of the M_x over a certain rigidity range. For example, in some embodiments, the molding apparatus 150 and the constituents 127₁-127_C may allow controlling the rigidity of the material M_x over a rigidity range which represents at least 10%, in some embodiments at least 40%, in some embodiments at least 70%, and in some embodiments even more, of a maximal rigidity that is achievable with the molding apparatus 150 and the constituents 127₁-127_C.

The shell 30 of the skate boot 22 may comprise more than one of its layers 85₁-85_L manufactured in the fashion of the layer 85_x. For example, in some embodiments, the shell 30 of the skate boot 22 may comprise at least two of the layers 85₁-85_L manufactured likewise, in some embodiments at least three of the layers 85₁-85_L manufactured likewise, in some embodiments at least four of the layers 85₁-85_L manufactured likewise, etc. In this embodiment, prior to or after molding the layer 85_x of the shell 30 of the skate boot 22, the molding apparatus 150 may be configured to mold a second one of the layers 85₁-85_L, referred-to as layer 85_y hereinbelow, in a similar fashion.

In particular, in this embodiment, the respective ones of the constituents 127₁-127_C used to form the polymeric material M_x are first ones of the constituents 127₁-127_C, and second respective ones of the constituents 127₁-127_C may be injected in the molding apparatus 150 with their proportions controlled to form the polymeric material M_y of the layer 85_y of the shell 30 of the skate boot 22.

In this embodiment, the layer 85_y of the shell 30 of the skate boot 22 may be disposed outwardly of the layer 85_x of the shell 30 of the skate boot 22. Specifically, in this embodiment, the layer 85_y of the shell 30 of the skate boot 22 is an outermost layer of the shell 30 of the skate boot 22.

The material M_y of the layer 85_y of the shell 30 of the skate boot 22 may be a second polyurethane. More specifically, the material M_y of the layer 85_y of the shell 30 of the skate boot 22 may be foamless. Also, in this embodiment, the material M_y of the layer 85_y of the shell 30 of the skate boot 22 may be clear. For instance, in this embodiment,
5 the material M_y of the layer 85_y of the shell 30 may effectively constitute a clear coating.

In this embodiment, no external heat is applied to the polymeric materials M_1 - M_N of the shell 30. Rather, in this embodiment, in order to form a subshell 85_i , the constituents of a given polymeric material M_x chemically react when combined to release heat. In other
10 words, the two or more constituents have an exothermic reaction when combined. Thus, in this embodiment, a layer 85_i of the shell 30 is formed by reaction injection molding of respective ones of the constituents 127₁-127_C. 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
15 thermoformable sheet of material in a mold such that the thermoformable sheet of material acquires the shape of the mold.

In other embodiments, external heat may be applied to one or more of the polymeric materials M_1 - M_N of the shell 30, such as, for instance, to facilitate a chemical reaction
20 of the constituents of a given polymeric material M_x . Heat may be applied by radiation, by air convection, by steam convection, by heating the last 152 and/or the associated female mold 154_i prior to molding and/or by any other suitable means. The constituents may have an exothermic reaction or an endothermic reaction when combined and sufficiently heated. In this example, the external heat may furnish
25 triggering energy to initiate the reaction of the two or more constituents and optionally catalyzing energy to catalyze the reaction. Although in this embodiment heat is applied, this manufacturing process still 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
30 material acquires the shape of the mold.

In other embodiments, no external heat is applied to some of the polymeric materials M_1 - M_N of the shell 30 (e.g., the polymeric material M_2 of the intermediate subshell 85₂, which may be injected and blown into its final form without external heat), while external heat is applied to other ones of the polymeric materials M_1 - M_N of the shell 30 (e.g., the
5 polymeric material M_3 of the external subshell 85₃, the polymeric material M_i of an insert 315_M between the intermediate subshell 85₂ and the external subshell 85₃, etc.).

In other embodiments, energy in a different form from heat may be applied to the polymeric materials M_1 - M_N of the shell 30 in addition to or in replacement to heat. For
10 instance, the polymeric materials M_1 - M_N may be radiated using electromagnetic radiation (e.g., UV, x-rays, microwaves) and/or acoustic radiation (e.g., ultrasound).

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
15 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 last shown in Figure 15. 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
20 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 polymeric materials M_1 - M_N are poured into one or more molds. In some embodiments, the last 152 may be customizable and/or otherwise configurable such as by adding or removing last
25 attachments (e.g. shims), which may be created by additive manufacturing (e.g., 3D-printed), as described in U.S. Patent Application No. 16/448,622, which is incorporated herein.

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

With additional reference to Figure 65, 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-
5 104_o may improve an aesthetic appearance of the skate 10, in some cases, 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
10 30 in order to prevent contact between the playing surface 12 and the 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 104₁-104_o may be mechanically fastened to
15 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 104₁-104_o may be affixed to the external surface 65 of the shell 30 in any other suitable way, such as by means of air brushing, by means of water printing (e.g., water dripping), using a flexible membrane comprising the overlay, the flexible membrane being placed in the mold prior to molding,
20 etc.

The inner liner 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. In some embodiments, as shown in Figure
25 69A, the inner liner 36 may comprise a sole portion for facing the plantar surface of the user's foot 11, while in other embodiments the inner liner 36 does not comprise a sole portion, as shown in Figure 69B. The inner liner 36 may be made of a soft 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
30 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 plantar surface PS of the player's foot 11 and a lower surface 23 on which the shell 30 may be affixed.

- 5 In some embodiments, the insole 40 may be affixed to the shell 30 of the skate boot 22. For instance, in some embodiments, as shown in Figure 66, the lower surface 23 of the insole 40 may be overmolded to the shell 30 of the skate boot 22. In other embodiments, as shown in Figure 67, the insole 40 may be joined mechanically to the shell 30 of the skate boot 22 by a mechanical fastener 141 (e.g., a clip, a rivet, or any suitable fastener).
- 10 In other embodiments, as shown in Figure 68, the insole 40 may be adhesively bonded to the shell 30 of the skate boot 22 via an adhesive 142.

In some embodiments, as shown in Figures 70A to 71, the inner liner 36 of the skate boot may be a "3D liner", i.e., may be formed of a three-dimensional sheet 130 of material (e.g., fabric). This may allow reducing the use of stitching and tape for manufacturing the inner liner 36, thereby reducing weight, improving comfort and reducing manufacturing cost of the inner liner 36. The 3D inner liner 36 may be manufactured in any suitable way. For instance, in some embodiments, the 3D inner liner 36 may be formed using a standard 2D sheet 130' of fabric that is thermoformed over a 3D last such that the 3D last imparts its shape to the sheet of fabric. The sheet of fabric, now having the 3D shape of the 3D last, may then be cut to pre-determined dimensions and finalized by affixing (e.g., by stitching, taping, etc.) portions of its edges to one another. As a result, a ratio of the amount of stitches and/or tape required for manufacturing the 3D inner liner 36 over the amount of stitches and/or tape required for manufacturing a standard inner liner 36 may be no more than 0.9, in some cases no more than 0.8, in some cases no more than 0.7, in some cases even less.

In some embodiments, the skate boot 22 may not comprise an inner liner 36. For instance, the internal subshell 85₁ of the shell 30 of the skate boot 22 may serve as an inner lining already and thus the addition of the inner liner 36 may be redundant. In other cases, the inner liner 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.

- 5 With additional reference to Figures 72 to 78, 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 and can thus be referred to as a toe portion of the shell 30. As shown in Figures 74, 76 and 77, the toe cap 32 comprises a bottom portion 116
10 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
15 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
20 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
25 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,
30 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
5 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, as shown in Figure 79, the tongue 34 comprises a core 140 defining a section of the tongue 34 with increased
10 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
15 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
20 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.

25

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
30 and/or using any other suitable processes.

As shown in Figure 80, 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
5 other embodiments.

As shown in Figures 72, 73 and 75, the blade holder 24 comprises a body 132 including 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
10 from the blade-retaining base 164 towards the skate boot 22 to interconnect the blade holder 24 and the skate 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
15 rear portion 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
20 one 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 12. To
25 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 81, the blade-retention portion 188 comprises a recess 190, which can be referred to as a "blade-receiving slot", extending from the front portion 170 to the rear portion 172 of the blade holder 24 in which an upper portion of the blade 26 is disposed. The blade-retaining base
30 164 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 respectively
5 towards a front sole part 95 and a rear sole part 97 of the skate boot 22. The front pillar 210, which can be referred to as a front “pedestal”, extends towards the front portion 56 of the skate boot 22 and the rear pillar 212, which can be referred to as a rear “pedestal”, 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
10 particularly, in this embodiment, the blade-retaining base 164 comprises a bridge 214 interconnecting the front and rear pillars 210, 212.

In this embodiment, as shown in Figures 75, 82 and 83, the blade-receiving slot 190 may be wider in the intermediate portion 180 of the blade-retaining base 164 between
15 the front portion 170 of the blade-retaining base 164 and the rear portion 172 of the blade-retaining base 164 than in the front portion 170 of the blade-retaining base 164 and in the rear portion 172 of the blade-retaining base 164. In particular, in this embodiment, the blade-receiving slot 190 may be wider between the front pillar 210 and the rear pillar 212 than beneath the front pillar 210 and beneath the rear pillar
20 212.

The blade-receiving slot 190 may be wider in the intermediate portion 180 by any suitable extent. Specifically, in some embodiments a ratio of a width W_{SI} of the blade-receiving slot 190 in the intermediate portion 180 of the blade-retaining base 164 over
25 the width W_{SI} of the blade-receiving slot 190 in a given one of the front portion 170 of the blade-retaining base 164 and the rear portion 172 of the blade-retaining base 164 is at least 1.3, in some embodiments at least 1.5, in some embodiments at least 2, and in some embodiments even more (e.g., at least 2.5).

30 In some embodiments, a ratio of the width W_{SI} of the blade-receiving slot 190 in the intermediate portion 180 of the blade-retaining base 164 over a narrowest dimension

of the blade-receiving slot 190 in a widthwise direction of the blade holder 24 is at least 1.5, in some embodiments at least 2, in some embodiments at least 3, in some embodiments at least 5, in some embodiments at least 7.5, and in some embodiments even more.

5

In some embodiments, the width W_{SI} of the blade-receiving slot 190 in the intermediate portion 180 of the blade-retaining base 164 is greater than 3 mm, in some embodiment at least 4 mm, in some embodiments at least 5 mm, in some embodiments at least 6 mm, in some embodiments at least 7 mm, in some embodiments at least 15 mm, in
10 some embodiments at least 23 mm, in some embodiments even more. In some embodiments, the width W_{SI} of the blade-receiving slot 190 is configured to create a gap G between each lateral surface of the blade 26 and the lateral surfaces of the blade-receiving slot 190 of at least 1.5 mm, in some embodiments at least 3 mm, in some embodiments of at least 5 mm, in some embodiments of at least 10 mm, and in
15 some embodiments of even more.

The configuration of the blade-receiving slot 190 may allow the blade 26 to bend laterally when the skater turns on the ice, providing a parabolic feature to the blade 26 and facilitating the turn of the skater. For example, in some embodiments, the blade-
20 receiving slot 190 may allow the blade 26 to have a ~~maximal~~ minimum radius of no more than 1700 mm, in some embodiments no more than 1000 mm, in some embodiments no more than 300 mm, and in some embodiments even more. In some cases, if the blade-receiving slot 190 is sufficiently wide in the intermediate portion 180 of the blade-retaining base 164, the blade holder 24 may hold the blade 26 while
25 the blade 26 is unsupported by the blade holder 24 in at least part of the intermediate portion 180 of the blade-retaining base 164.

With additional reference to Figure 73, in this embodiment, the front pillar 210 and the rear pillar 212 of the support 168 may be relatively wide. For instance, in some
30 embodiments, a width W_P of the front pillar 210 may be at least 80%, in some embodiments at least 90%, in some embodiments at least 95%, in some embodiments

at least 100%, of a width W_s of the front sole part 95 of the skate boot 22, and in some embodiments, the width W_P of the rear pillar 212 may be at least 80%, in some embodiments at least 90%, in some embodiments at least 95%, in some embodiments at least 100%, of a width W_s of the rear sole part 97 of the skate boot 22. In this
5 embodiment, the front pillar 210 and the rear pillar 212 of the support 168 are at least as wide as the respective one of the front sole part 95 of the skate boot and the rear sole part 97 of the skate boot.

In particular, in this embodiment, an external surface 224 of the pillars 210, 212 is
10 continuous with an external surface 194 of the skate boot 22 such that there may be no sharp angle or no angle at all between the external surface 224 of the pillars 210, 212 and the external surface 194 of the skate boot 22.

The pillars 210, 212 may comprise any suitable material. For instance, in some
15 embodiments, the pillars 210, 212 may comprise a material having a modulus of elasticity of at least 300 MPa, in some embodiments at least 1000 MPa, in some embodiments at least 10 GPa, and in some embodiments even more. As another example, in some embodiments, the pillars 210, 212 may comprise a material having a hardness of at least 55 Shore D, in some embodiments of at least 60 Shore D, in
20 some embodiments of at least 65 Shore D, and in some embodiments even more.

The blade holder 24 may provide enhanced stiffness characteristics, notably since the pillars are relatively wider. One way to characterize stiffness of the blade holder is by doing a lateral force test on a dynamometer on the skate 10. A force required to
25 produce a 2 mm deformation on a specific point of the blade 26 is observed. This test is repeated to observe the force when the specific point of the blade 26 is under the front pillar 210, when the specific point of the blade 26 is under the rear pillar 212, and when the specific point of the blade 26 is under a midpoint between the front pillar 210 and the rear pillar 212. For instance, in some embodiments, the stiffness of the blade
30 holder 24 is such that: a lateral force required to deflect the blade holder 24 by 2 mm at the front pillar 210 is at least 205 N, in some

embodiments at least 330 N, in some embodiments at least 420 N and in some embodiments even more; and a lateral force require to deflect the blade holder 24 by 2 mm at the rear pillar 212 is at least 130 N, in some embodiments at least 225 N, in some embodiments 450 N and in some embodiments even more.

5

In this embodiment, at least part (i.e., part or all) of the body 132 of the blade holder 24 is integrally formed with the shell 30 of the skate boot 22. That is, at least part of the body 132 of the blade holder 24 and the shell 30 of the skate boot 22 constitute a monolithic one-piece structure. The body 132 of the blade holder 24 thus comprises
10 an integrally-formed portion 215 that is integrally formed with the shell 30 of the skate boot 22 such that the portion 215 of the body 132 of the blade holder 34 and the shell 30 of the skate boot 22 are formed together as one-piece in the molding apparatus 150 during the molding process.

15 In this embodiment, the integrally-formed portion 215 of the body 132 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 body 132 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.
20 In particular, in this example, a majority of the body 132 of the blade holder 24 is constituted by the polymeric material M_2 of the intermediate subshell 85₂ such that the body 132 of the blade holder 24 consists primarily of a structural foam material. Alternatively, the portion 215 of the body 132 of the blade holder 24 may include one or more different materials.

25

In this embodiment, at least a majority (i.e., a majority or an entirety) of the body 132 of the blade holder 24 may be integrally formed with shell 30 of the skate boot 22. That is, the integrally-formed portion 215 of the body 132 of the blade holder 24 may be a major portion or the entirety of the body 132 of the blade holder 24. In this
30 embodiment, an entirety of the body 132 of the blade holder 24 is integrally formed with the shell 30 of the skate boot 22.

Therefore, in this embodiment, the body 132 of the blade holder 24 is formed with the shell 30 of the skate boot 22 in the molding apparatus 150 with the last 152. In particular, the body 132 of the blade holder 24 is initially formed during forming of the intermediate subshell 85₂ of the shell 30 of the skate boot 22 and is completed by the forming of the external subshell 85₃ of the shell 30 of the skate boot 22. That is, in this embodiment, as shown in Figures 84 and 85, the intermediate subshell 85₂ is the innermost subshell of the body 132 of the blade holder 24 while the external subshell 85₃ is the outermost subshell of the body 132 of the blade holder 24.

In some embodiments, with additional reference to Figures 86 to 97, the body 132 of the blade holder 24 comprises a core 260 which may be manufactured prior to the molding of the skate boot 22 and the integrally-formed portion 215 of the body 132 of the blade holder 24 and which may be placed in the mold used during the molding process of the skate boot 22 and the integrally-formed portion 215 of the body 132 of the blade holder 24, such that the skate boot 22 and the integrally-formed portion 215 of the body 132 of the blade holder 24 are overmolded onto the core 260. This may, for instance, allow use of materials that could not be used during the molding process of the skate boot 22; reduce geometric tolerances and increase standardisation of the skate boot 22, increase stiffness of the blade holder 24, reduce energy losses during skating, etc.

In this embodiment, the core 260 constitutes at least a substantial part (e.g., a majority) of the blade-retaining base 164 and comprises a front portion 262 configured to be disposed in the front pillar 210 of the blade holder 24, a rear portion 264 configured to be in the rear pillar 212 of the blade holder 24 and a bridge portion 266 extending between the front and rear portions 262, 264 and configured to be at least part of the bridge 214 of the blade holder 24. In this embodiment, the bridge 266 of the core 260 defines the bridge 214 of the blade holder 24.

The core 260 has a structural geometry to enhance properties of the blade holder 24 such as lightness, stiffness and energy conservation during skating. In this embodiment, the core 260 also comprises interfaces 270 at the front and rear portions 262, 264 of the core 260 to interface with the intermediate and external subshells 85₂, 85₃ and with the polymeric materials M₂, M₃ associated therewith during and after the molding process. In particular, in this embodiment, the interfaces 270 are interlocking portions to mechanically interlock the intermediate and external subshells 85₂, 85₃ and the polymeric materials M₂, M₃ associated therewith. For instance, the interlocking portions 270 may comprise projections (e.g., ridges), recesses (e.g., grooves), and the like. During molding of the skate boot 22, the polymeric materials M₂, M₃ may fill recesses and/or engage projections to mechanically interlock the core 260 with the intermediate and external subshells 85₂, 85₃.

The core 260 comprises a material 267 that may allow the core 260 to be light and stiff and limit energy losses in some embodiments. For instance, in some embodiments, a modulus of elasticity of the material 267 may be at least 1 GPa, in some embodiments at least 2 GPa, in some embodiments at least 3 GPa, in some embodiments at least 4 GPa, in some embodiments even more.

The material 267 of the core 260 may be of any suitable kind. In this embodiment, the material 267 comprises a polymeric material. More particularly, in this embodiment, the material comprises nylon.

In some embodiments, the front and rear portions 262, 264 of the core 260 of the body 132 of the blade holder 24 comprise upwardly-extending parts 282, 284 extending towards the sole portion 69 of the shell 30 of the skate boot 22. In this example, the upwardly-extending parts 282, 284 of the core 260 are pillar-forming members that constitute at least part of the front and rear pillars 210, 212 of the blade holder 24. Also, in this example, the pillar-forming members 282, 284 extend to the sole portion 69 of the shell 30 of the skate boot 22. The pillar-forming members parts 282, 284 may increase flexural stiffness, torsional stiffness, or area of surface of the interlock.

In some embodiments, the pillar-forming members 282, 284 may be integrally made with lower parts 272, 274 of the front and rear portions 262, 264 (i.e., the pillar-forming member 282 and the lower part 272 may be unitary while the pillar-forming member 284 and the lower part 274 may be unitary) or, in other embodiments, the pillar-forming members 282, 284 may be affixed to respective ones of the lower parts 272, 274 of the front and rear portions 262, 264. Similarly, in some embodiments, the pillar-forming members 282, 284 comprise a material 287 which may be identical to or different (e.g. having a higher or a lower modulus of elasticity) from the material 267 of the core 260.

In this embodiment, the front and rear portions 262, 264 of the core 260, including their pillar-forming members 282, 284, define front and rear cavities 296, 298 of the core 260. These cavities 296, 298 may be empty or may contain one or more materials in various embodiments.

In some embodiments, each of the front and rear portions 262, 264 of the core 260 comprises a cap 290 that engages a respective one of the pillar-forming members 282, 284 and caps a respective one of the front and rear cavities 296, 298 of the core 260. For instance, in some embodiments, the cap 290 may close the respective one of the cavities 296, 298 to create an enclosure 265 which may be hermetic. The caps 290 may be connected to respective ones of the front and rear portions 262, 264 by any suitable way. For instance, in this embodiment, the caps 290 comprise clips 311 configured to engage and clip to the front and rear portions 262, 264 of the core 260. In this embodiment, the enclosure 265 may be left empty, i.e., may not be filled by another material, in order to reduce weight of the blade holder 24.

The front and rear portions 262, 264 of the core 260 may facilitate the manufacturing of the blade holder 24. For instance, in this embodiment, the front and rear portions 262, 264 of the core 260 have a shape configured for facilitating the flowing of liquid and/or viscous material during the molding by flowing process. More specifically, by occupying a significant volume of the pillars 210, 212, the front and rear portions 262,

264 of the core 260 may reduce the volume of material required for forming the pillars 210, 212 of the blade holder 24 and may also reduce an average thickness of the material required for forming the pillars 210, 212 of the blade holder 24, thereby reducing the occurrence of jams of material being flowed or any other irregularities.

- 5 Moreover, a surface of the front and rear portions 262, 264 of the core 260 may facilitate the flowing of liquid and/or viscous material during the molding by flowing process by being smooth.

In particular, in this embodiment, the pillar-forming members 282, 284 and the caps
10 290 of the front and rear portions 262, 264 of the core 260 comprises reinforcements 306. During molding of the skate boot 22, injection of the constituents of the polymeric materials M_2 , M_3 may exert a pressure on the pillar-forming members 282, 284 which could lead to crushing or other deformation of the members 282, 284. The pressure may be caused for example by an injection pressure and/or by a chemical reaction
15 between components of the polymeric materials M_2 , M_3 .

In this embodiment, the reinforcements 306 comprise reinforcing projections 309 in the caps 290 and projections 308 in the pillar-forming members 282, 284 of the core 260. The reinforcements 306 may be configured to maintain an internal volume of the
20 cavities 296, 298 during molding of the skate boot 22 in order to have sufficient space for disposing a connector of a quick-connect system of the blade holder 24 in the front and/or rear cavities 282, 284 of the core 260, as discussed below.

For instance, the projections 308, 309 may comprise elongated projections (e.g., ribs)
25 and/or other shapes of projection such as projecting areas. Specifically, in this embodiment, the projections 308, 309 of the caps 290 and the pillar-forming members 282, 284 of the core 260 comprise reinforcing ribs 317.

In this embodiment, with additional reference to Figures 89, 90, 93 to 95A, 96 and 97,
30 the blade holder 24 comprises a connection system 320 configured to attach the blade 26 to and detach the blade 26 from the blade holder 24. The connection system 320

facilitates installation and removal of the blade 26, such as for replacement of the blade 26, assemblage of the skate 10, and/or other purposes.

More particularly, in this embodiment, the connection system 320 of the blade holder
5 24 is a quick-connect system configured to attach the blade 26 to and detach the blade 26 from the blade holder 24 quickly and easily.

Notably, in this embodiment, the quick-connect system 320 of the blade holder 24 is configured to attach the blade 26 to and detach the blade 26 from the blade holder 24
10 without using a screwdriver when the blade 26 is positioned in the blade holder 24. In this example, the quick-connect system 320 is configured to attach the blade 26 to and detach the blade 26 from the blade holder 24 screwlessly (i.e., without using any screws) when the blade 26 is positioned in the blade holder 24. It is noted that although the quick-connect system 320 is configured to attach the blade 26 to and detach the
15 blade 26 from the blade holder 24 screwlessly, the quick-connect system 320 may comprise screws that are not used (i.e. manipulated) for attachment or detachment of the blade 26. Thus, in this embodiment, the quick-connect system 320 is configured to attach the blade 26 to and detach the blade 26 from the blade holder 24 without using a screwdriver and screwlessly when the blade 26 is positioned in the longitudinal
20 recess 190 of the blade holder 24.

In this example, the quick-connect system 320 of the blade holder 24 is configured to attach the blade 26 to and detach the blade 26 from the blade holder 24 toollessly
(i.e., manually without using any tool) when the blade 26 is positioned in the blade
25 holder 24. That is, the blade 24 is attachable to and detachable from the blade holder 24 manually without using any tool (i.e., a screwdriver or any other tool). Thus, in this example, the quick-connect system 320 is configured to attach the blade 26 to and detach the blade 26 from the blade holder 24 toollessly when the blade 26 is positioned in the longitudinal recess 190 of the blade holder 24.

In this embodiment, the quick-connect system 320 of the blade holder 24 comprises a plurality of connectors 330, 332 to attach the blade 26 to and detach the blade 26 from the blade holder 24. The blade 26 comprises a plurality of connectors 350, 352 configured to engage respective ones of the connectors 330, 332 of the quick-connect
5 system 320 of the blade holder 24 to be attached to and detached from the blade holder 24. The connectors 330, 332 of the quick-connect system 320 of the blade holder 24 are spaced apart in the longitudinal direction of the skate 10, and so are the connectors 350, 352 of the blade 26.

10 In this embodiment, the connectors 350, 352 comprise hooks 53₁, 53₂ that project upwardly from a top edge of the blade 26, with the hook 53₁ being a front hook and the hook 53₂ being a rear hook. The connector 330 of the quick-connect system 320 may include an actuator 336 and a biasing element 337 which biases the actuator 36 in a direction towards the front portion 170 of the blade holder 24. To attach the blade
15 26 to the blade holder 24, the front hook 53₁ is first positioned within a hollow space 342 (e.g., a recess or hole) of the blade holder 24. The rear hook 53₂ can then be pushed upwardly into a hollow space 344 (e.g., a recess or hole) of the blade holder 24, thereby causing the biasing element 337 to bend and the actuator 336 to move in a rearward direction. The rear hook 53₂ will eventually reach a position which will allow
20 the biasing element 337 to force the actuator 336 towards the front portion 66 of the blade holder 24, thereby locking the blade 52 in place. The blade 52 can then be removed by pushing against a finger-actuating surface 338 of the actuator 336 to release the rear hook 53₂ from the hollow space 344 of the blade holder 24. The quick-connect system 320 may be configured in any other suitable way in other
25 embodiments.

The quick-connect system 320 of the blade holder 24 may be connected to the body 132 of the blade holder 24 in any suitable way. In particular, in this embodiment, the connector 330 of the quick-connect system 320 of the blade holder 24 may be
30 received in the rear cavity 298 of the core 260 of the body 132 of the blade holder 24. In particular, in this embodiment, the connector 330 of the quick-connect system 320

may be installed in the rear cavity 298 of the core 260 of the body 132 of the blade holder 24 prior to molding of the skate boot 22 such that molded material of the shell 30 covers the cavities 296, 298, thereby protecting the connector 330 of the quick-connect system 320.

5

The quick-connect system 320 of the blade holder 24 may be implemented in various other ways in other embodiments. For example, in some embodiments, the quick-connect system 320 of the blade holder 24 may be implemented as described in International Patent Application No. PCT/CA2019/051531 filed on October 29, 2019
10 and incorporated by reference herein. As another example, in some embodiments, as shown in Figure 95B, the biasing element may comprise a spring part 341 and a sliding surface 343 configured to slide onto a sliding surface 339 of the actuator 336.

In this embodiment, one or more other components (e.g., the toe cap 32, the tendon
15 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.

20 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.

For instance, in this embodiment, the toe cap 32 comprises a portion 217 that is
25 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 of the toe cap 32 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.

30

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 85₁-85_L of the shell 30 of the skate boot 22. For instance, in this example, the portion 217 of the toe cap 32 includes the internal, intermediate and external subshells 85₁, 85₂, 85₃ and therefore comprises
5 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
10 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 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 219 of the tendon guard 35 includes
15 solely the external subshell 85₃ 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, the portion 219 of the tendon guard 219 may also comprise the internal subshell 85₁ and/or the intermediate subshell 85₂ such that the portion 219 of the tendon guard 35 also
20 comprises the polymeric material M_1 and/or the polymeric material M_2 associated therewith.

Moreover, in this embodiment, each of the lace members 44₁, 44₂ comprises a portion 221 that is integrally formed with the shell 30 such that the portion 221 of each of the
25 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 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 221 of the lace
30 member 44_i includes solely the external subshell 85₃ and therefore comprises the polymeric material M_3 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

5 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.

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

For example, in some embodiments, the constituents 127₁-127_C of the polyurethane foam M_x include a first isocyanate, a second isocyanate different from the first

15 isocyanate, and one or more polyols. In examples that follow, for ease of reference, they may respectively be referred to as the first isocyanate "A1", second isocyanate "A2", and the one or more polyols "B".

In some cases, the proportion of the isocyanate A1 injected in the molding apparatus

20 150 to obtain the polymeric material M_x may be different from the proportion of the isocyanate A2 injected in the molding apparatus 150 to obtain the polymeric material M_x. In some cases, also, the respective ones of the constituents 127₁-127_C may include the isocyanate A1 and the polyol B but not the isocyanate A2. In other cases, the respective ones of the constituents 127₁-127_C may include the isocyanates A1 and A2 and the one

25 or more polyols B.

In particular, proportions of the isocyanates A1, A2 and the polyols B may be monitored and controlled in a similar fashion as proportions of the polyols B1, B2 are controlled, as described above, in order to control and customize one or more characteristics (e.g.,

30 stiffness) of the polymeric material M_x.

As another example, in some embodiments, rather than determining a desired property of the polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22 prior to molding the layer 85_x of the shell 30 of the skate boot 22, a desired property of the skate boot 22 or of the skate 10 in their entirety may be determined and the desired property of the polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22 may be inferred from the desired property of the skate 10 and/or the skate boot 22. In this example, depending on the determination of the desired property of the skate boot 22 and/or the skate 10 as a whole, respective ones of the constituents 127₁-127₃ may be injected to produce the polymeric material M_x at proportions to impart the desired property of the polymeric material M_x of the layer 85_x of the shell 30 of the skate boot 22.

As another example, in some embodiments, as shown in Figures 98 and 99, the film 615 may carry at least some of (i.e., some of, a majority of, or an entirety of) the reinforcements 115. In this variant, the reinforcement 115 (such as the ribs 117₁-117_R or the reinforcing sheet 119) may be affixed to the film 615 (e.g., by gluing, stitching, welding, mechanical interlock, etc.) before the film 615 is positioned between consecutive layers 85₁-85_L of the shell 30.

As another example, in some embodiments, as shown in Figure 100, the film 615 may be configured to provide the graphical ink 632 and be removed after molding of the layer 85_x while the graphical ink 632 remains in the skate boot 22, thus providing a layer of graphical ink without adding the weight of the film 615 to the weight of the skate boot 22.

As another example, the quick-connect system 320 of the blade holder 24 and the blade 26 may be configured in any other suitable way to attach the blade 26 to and detach the blade 26 from the blade holder 24.

As another example, in some embodiments, as shown in Figures 95B, 101 and 107 to 109, the bridge 266 of the blade holder 24 may comprise an upper bridge element 392, a lower bridge element 390 and a void 394 between the lower bridge element

390. In particular, in this embodiment, the void 394 has a length in the longitudinal direction of the blade holder 24 that is substantial relative to the length of the bridge 266 and relative to the blade holder 24. In this embodiment, the void 394 has a length that is at least a majority of a length of the bridge 266 in the longitudinal direction of the blade holder 24. In particular, in this embodiment, the length of the void 394 is greater than the length of the bridge of the blade holder 24. In this embodiment, also, the length of the void 394 may be at least a majority of the length of the blade holder 24. In some embodiments, a ratio of the length of the void 394 over the length of the blade holder 24 may be at least 55%, in some embodiments at least 60%, in some embodiments at least 65% and in some embodiments even more. In this embodiment, the void 394 allows a reduction of a weight of the blade holder 24 and the upper and lower bridge elements 390, 392 contribute to the stiffness of the blade holder 24 and to the stiffness of the skate 10.

15 As another example, in some embodiments, as shown in Figure 102, the blade holder 24 may be configured to hold the blade 26 such that the blade 26 is unsupported by the blade holder 24 between the front pillar 210 and the rear pillar 212 when the blade 26 is at rest. In particular, in this embodiment, the blade holder 24 may be free of a bridge interconnecting the front pillar 210 and the rear pillar 212. More specifically, in this embodiment, the front pillar 210 and the rear pillar 212 are stiff enough for being use without being interconnected and/or rigidified by a bridge. In this embodiment, the blade holder 24 still displays a relatively high stiffness. For example, in some embodiments, a stiffness of the blade holder 24 is such that: a lateral force require to deflect the blade holder 24 by 2 mm at the front pillar 210 is at least 206 N, in some embodiments at least 220 N, in some embodiments 236 N and in some embodiments even more; a lateral force require to deflect the blade holder 24 by 2 mm at a midpoint between the front pillar 210 and the rear pillar 212 is at least 180 N, in some embodiments at least 185 N, in some embodiments 190 N and in some embodiments even more; and a lateral force require to deflect the blade holder 24 by 2 mm at the rear pillar 212 is at least 131 N, in some embodiments at least 245 N, in some embodiments 380 N and in some embodiments even more.

With additional reference to Figure 103, in some embodiments, the upper portion of the blade 26 may comprise a silkscreen 329 that may serve as a visual indicator of the adjustment and alignment of the blade 26 relative to the blade holder 24 to ease
5 attachment of the blade 26 to the blade holder 24.

In some embodiments, a lower portion of the blade 26 may also comprise the silkscreen 329, for example as a visual indicator of the use and condition of the blade 26. For instance, when the blade 26 is used for play, it needs to be sharpened and
10 sharpening of the blade 26 reduces height of the blade 26 and the ice-contacting surface 222 of the blade 26 gets closer to the upper portion of the blade 26. In this example, the silkscreen 329 may comprise a mark indicating that the blade 26 needs to be changed for a new blade when the ice-contacting surface 222 meets the mark.

15 In some embodiments, the silkscreen 329 may be three-dimensional. As such, the silkscreen 329 may help reducing lateral movements of the blade 26 relative to the blade holder 24 and reduce loss of energy caused by these movements. For instance, the silkscreen 329 may comprise a material of the blade 26. In other cases, the silkscreen 329 may comprise a material that is softer and/or less rigid than the material
20 of the blade 26, for instance aluminium or polymeric material. In some cases, the polymeric material may comprise an adhesive material.

As another example, in some embodiments, as shown in Figures 104 to 106, only a limited part 225 of the blade holder 24 may be integrally formed with the shell 30. For
25 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 105 and 106, 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
30 225, 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,
5 substantially an entirety of the blade holder 24 may be molded integrally with the shell 30.

As another example, in some embodiments, as shown in Figures 107 and 108, the skate 10 may comprises one or more graphical elements 621 (and-or, in some embodiments, design elements) extending from the skate boot 22 to the blade holder
10 24 such that the skate boot 22 comprises an upper portion 635 of the graphical element 621 and the blade holder 24 comprises a lower portion 633 of the graphical element 621 visually continuous with the upper portion 635 of the graphical element 621. In particular, as shown in Figure 107, the front pillar 210 of the blade holder 24 may comprise the lower portion 633 of the graphical element 621, and the rear pillar
15 212 of the blade holder 24 may also comprise the lower portion 633 of another one of the graphical elements 621. In other cases, as shown in Figure 108, the front and rear pillars 210, 212 of the blade holder may comprise lower portions 633 of a single graphical element 621.

20 The graphical elements 621 may exhibit a plurality of different colors. For instance, the upper portion 635 of each graphical element 621 may exhibit the different colors of the graphical elements 621 and the lower portion 633 of each graphical element 621 may exhibit the different colors of the graphical elements 621.

25 As another example, in some embodiments, as shown in Figures 109 to 114, the shell 30 may comprise uneven surface elements 645 to increase a stiffness of the shell 30 and to reduce thickness of denser layers for weight reduction.

In some embodiments, at least one of (i.e., one of, some of, a majority of, or an entirety
30 of) the surface elements 645 may be an edge at the intersection of a first portion 651 of the shell 30 and a second portion 652 of the shell 30, a thickness of a given one of

the layers 85₁-85_L being greater in the first portion 651 of the shell 30 than in the second portion 652 of the shell 30. In particular, in this example, the given one of the layers 85₁-85_L is the intermediate layer 85₂. In this example, the thickness of the layers 85₁-85_L that are positioned outwardly from the intermediate layer 85₂ (such as the external layer 85₃) is constant over the portions 651, 652 and the edge 645 of the shell 30, such that the edge 645 is visible from an outside of the shell 30, as shown in Figure 111. In other cases, the thickness of the layers 85₁-85_L that are positioned outwardly from the intermediate layer 85₂ (such as the external layer 85₃) may vary over the portions 651, 652 and the edge 645 of the shell 30, such that the edge 645 is not visible from the outside of the shell 30, as shown in Figure 112.

In some embodiments, at least one of (i.e., one of, some of, a majority of, or an entirety of) the surface elements 645 may be a rib. A thickness of a given one of the layers 85₁-85_L may be greater at the rib 645 than in adjacent portions 661 adjacent to the rib 645. In particular, in this example, the given one of the layers 85₁-85_L is the intermediate layer 85₂. In this example, the thickness of the layers 85₁-85_L that are positioned outwardly from the intermediate layer 85₂ (such as the external layer 85₃) is constant over the rib 645 and over the adjacent portions 661, such that the rib 645 is visible from the outside of the shell 30, as shown in Figure 113. In other cases, the thickness of the layers 85₁-85_L that are positioned outwardly from the intermediate layer 85₂ (such as the external layer 85₃) may vary over the rib 645 and over the adjacent portions 661, such that the rib 645 is not visible from the outside of the shell 30, as shown in Figure 114.

In some embodiments, at least one of (i.e., one of, some of, a majority of, or an entirety of) the surface elements 645 may be a recess. A thickness of a given one of the layers 85₁-85_L may be lower at the recess 645 than in adjacent portions 661 adjacent to the recess 645. In particular, in this example, the given one of the layers 85₁-85_L is the intermediate layer 85₂. In this example, the thickness of the layers 85₁-85_L that are positioned outwardly from the intermediate layer 85₂ (such as the external layer 85₃) is constant over the recess 645 and over the adjacent portions 661, such that the

recess 645 is visible from the outside of the shell 30. In other cases, the thickness of the layers 85₁-85_L that are positioned outwardly from the intermediate layer 85₂ (such as the external layer 85₃) may vary over the recess 645 and over the adjacent portions 661, such that the recess 645 is not visible from the outside of the shell 30.

5

In this embodiment, the skate boot 22 comprises at least some of the surface elements 645 of the shell 30 and the blade holder 24 also comprises at least some of the surface elements 645 of the shell 30. Each one of the skate boot 22 and the blade holder 24 may comprise any suitable number of surface elements 645.

10

As another example, in some embodiments, as shown in Figures 115 to 119 a given one of the layers 85₁-85_L may comprise openings 678 that open onto an adjacent one of the layers 85₁-85_L. In particular, in this embodiment, the given one of the layers 85₁-85_L may be disposed outwardly of the adjacent one of the layers 85₁-85_L and may be the outermost one of the layers 85₁-85_L – in this case the external layer 85₃. In this example, the adjacent one of the layers 85₁-85_L is the film 615 comprising the graphical elements 621 which are configured to be visible through the openings 678 from the outside of the shell 30. In this embodiment, the external layer 85₃ is a clear layer.

15

The openings 678 may have any suitable shape and may comprise circular openings, elliptical openings, elongate openings, rectangular openings and/or square openings. The shell 30 may comprise any suitable number of openings 678 having any suitable dimensions.

20

The openings 678 may allow weight reduction and may cover any suitable area of surface. For instance, in some embodiments, a ratio of a total area of surface of the openings 678 (i.e. a sum of areas of surface of each openings 678) over a total external area of surface of the shell 30 may be at least 0.1%, in some embodiments 10%, in some embodiments 50%, and in some embodiments even more.

25

30

The openings 678 may be created by the use of pushers 688 during manufacturing of the skate 10. Practically, in this embodiment, the female mold 154₃ that is used for injection molding the external subshell 85₃ may comprise pushers 688. The pushers 688 may facilitate positioning the internal and intermediate subshells 85₁, 85₂ and the
5 film 615 in the cavity 156 of the female mold 154₃ accurately by engaging an external surface of the subshells 85₁, 85₂ and film 615, which were previously formed. While in this embodiment, the pushers 688 are shown as being distinct from the bodies of the portions 155, 157 of the female mold 154₃ (for instance, the pushers 688 may be attachable to and removable from the bodies of the portions 155, 157), in other
10 embodiments, the pushers 688 may be integrally formed with the bodies of the portions 155, 157 of the female mold 154₃.

For instance, in some embodiments, the blade holder 24 may retain the blade 26 in any other suitable way. For example, in some embodiments, the blade 26 may be
15 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 120, 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 the blade-retaining base 164 and the blade 26 that extends into an interlocking void 236 of the other one of the blade-
20 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 holder 24 is overmolded onto the blade 26). For example, in some embodiments, the blade 26 may be attached to the blade holder
25 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.

30 In some embodiments, as shown in Figures 121 and 122, 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 121, 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
5 addition to using an adhesive, as shown in Figure 123, 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 124, the recess 190 of
10 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
15 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 122, 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
20 226 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.

The blade 26 may be implemented in any other suitable way in other embodiments.
25 For example, in some embodiments, as shown in Figures 125 and 126, 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 suitable way.
30 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 by an interlocking portion of one of the runner 238 and the body 240 that extends into an interlocking space (e.g.,
5 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).

In some embodiments, one or more other components (e.g., the tongue 34, the
10 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 comprise a portion 235 that is integrally formed with the shell 30 such that the portion 235 of the
15 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.

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
20 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 85₁, 85₂, 85₃ 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 include one or more different materials.

25

For example, in some embodiments, with additional reference to Figure 127, the toe cap 32, the tongue 34, the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂ may be molded integrally with the shell 30 of the skate boot 22. That is, at least a portion of (i.e., a part or an entirety of) each of the toe cap 32, the tongue 34,
30 the tendon guard 35, the footbed 38 and the lace members 44₁, 44₂ may be formed

integrally with the shell 30 as one-piece in the molding apparatus 150 during the molding process.

As shown in Figure 11, in some embodiments, when the footbed 38 is formed
5 integrally with the shell 30 during the molding process, one or more the subshells 85₁-85_L may form the footbed 38. Moreover, in some embodiments, as shown in Figures 128 and 129, 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 gap of a subshell 85_i in the sole portion 69 of the shell 30.

10 In some embodiments, as shown in Figure 130, 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 intermediate subshells 85₁, 85₂ in the sole portion 69 of the shell 30.

15 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 85₁-85_L of the shell 30. For instance, the portion of the blade holder 24 may be joined to the given one of the subshells 85₁-85_L during forming of the shell 30. For example, as shown in Figure 131,
20 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.

In other embodiments, as discussed above, the portion of the blade holder 24 may be
25 formed during the molding process of the shell 30. For example, as shown in Figure 132, 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).

In some embodiments, as shown in Figure 133, 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.

- 5 In some embodiments, as shown in Figure 134, 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,
- 10 as shown in Figure 135, 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.
- 15 In some embodiments, with additional reference to Figure 145, 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.
- 20 For example, in some embodiments, as shown in Figures 137 to 139, the shell 30 of the skate boot 22, the tendon guard 35, the lace members 44₁, 44₂, the toe cap 32 and the tongue 34 may be formed integrally with one another in the molding apparatus 150, while the blade holder 24 may be manufactured separately and connected to the skate boot 22 after the shell 30 of the skate boot 22 and these other components have
- 25 been molded together in the molding apparatus 150. To that end, the skate boot 22 comprises a connection system 480 configured to attach the blade holder 24 to the skate boot 22.

In this embodiment, the connection system 480 comprises a connecting member 484

30 that is an insert placed in the molding apparatus 150 to mold the shell 30 of the skate boot 22 onto the connecting member 484 and configured to be fastened to the blade

holder 24. The connecting member 484 is therefore retained in the skate boot 22 by molding of the shell 30 of the skate boot 22 over it, i.e., the shell 30 of the skate boot 22 is overmolded on the connecting member 484. More specifically, in this example, the sole portion 69 of the skate boot 22 is molded on the connecting member 484. In this case, the connecting member 484 extends from a heel region of the skate boot 22 to a toe region of the skate boot 22.

In some embodiments, the overmolding of the shell 30 of the skate boot 22 over the connecting member 484 covers a portion only of the connecting member 484, while in other embodiments, the overmolding of the shell 30 of the skate boot 22 over the connecting member 484 covers an entirety of the connecting member 484, i.e., the connecting member 484 is entirely enclosed within the shell 30.

In this embodiment, the connecting member 484 comprises a plurality of fastening voids 492₁-492_v to receive a plurality of fasteners 494₁-494_f to fasten the blade holder 24 to the skate boot 22. In this example, the fastening voids 492₁-492_v are enlarged adjacent to an inner surface 488 of the connecting member 484, the inner surface 488 being configured to face the user's foot. More specifically, the fastening voids 492₁-492_v may be countersunk or counterbore holes. The blade holder 24 may also comprise a plurality of fastening voids 497₁-497_v to receive the plurality of fasteners 494₁-494_f to fasten the blade holder 24 to the skate boot 22.

In this embodiment, a dimension W_C of the connecting member 484 in a widthwise direction of the skate boot 22 may vary along the longitudinal direction of the skate boot 22. The connecting member 484 may be larger in the widthwise direction of the skate boot 22 where the connecting member overlies the front pedestal 210 and the rear pedestal 212 of the blade holder 24 than where the connecting member 484 overlies the bridge 214 of the blade holder 24. Also, in this example, the connecting member 484 is larger in the widthwise direction of the skate boot 22 where the connecting member 484 overlies the front pedestal 210 than where the connecting member 484 overlies the rear pedestal 212.

The connecting member 484 may be relatively rigid to provide a relatively rigid connection between the skate boot 22 and the blade holder 24. This may allow the ice skate 10 to be more reactive and to more effectively transmit forces between the ice 12 and the user's foot. As such, the connecting member 484 may comprise a material 487 that is stiffer, i.e., more rigid, than the material Mx of the skate boot 22. For instance, in some embodiments, a ratio of a modulus of elasticity of the material 487 of the connecting member 484 over the modulus of elasticity of the material Mx of the skate boot 22 may be at least 1.5, in some embodiments at least 2, in some embodiments at least 3, in some embodiments even more.

In this embodiment, the connecting member 484 may comprise a front projection 496 configured to project downwardly towards the front pedestal 210 and a rear projection 498 configured to project downwardly towards the rear pedestal 212, for reinforcing connection between the skate boot 22 and the blade holder 24.

In some embodiments, as shown in Figures 140 and 141, the front projection 496 may be configured to project downwardly into the front pedestal 210 and the rear projection 498 may be configured to project downwardly into the rear pedestal 212. The projections 496, 498 may underlie a front projection 502 of the skate boot 22 configured to project downwardly into the front pedestal 210 and a rear projection 504 of the skate boot 22 configured to project downwardly into the rear pedestal 212.

The projections 496, 498 may be configured to position the connecting member 484 relative to the blade holder 24. Because the projections 496, 498 are overmolded by the skate boot 22, the projections 496, 498 may also be configured to position the skate boot 22 relative to the blade holder 24. For instance, the blade holder 24 may comprise a front void 506 at the front pillar 210 and a rear void 508 at the rear pillar 212 and the projections 496, 498, may be configured to project into respective ones of the voids 506, 508 in a relatively tight fit. In some embodiments, the connecting member 484 and the blade holder 24 may be affixed to one another at the projections

496, 498 and voids 506, 508 by being pressed into and over one another, fastened to one another, glued to one another, etc.

- The connecting member 484 may be configured to allow the shell 30 of the skate boot 22 to be molded in different positions relative to the connecting member 484 in the molding apparatus 150, thereby allowing the blade holder 24 to be connected to the skate boot 22 in accordance with these different positions and/or allowing the user to choose between different sizes of the blade holder 24 to be connected to the skate boot 22, based on preferences of the user. For example, in some embodiments, these different positions may be offset in the longitudinal direction of the skate 10 and/or the widthwise direction of the skate 10. As another example, in some embodiments, these different positions allow the user to select a smaller or larger blade holder 24, compared to the blade holder 24 that would normally be used with the skate boot 22.
- In some embodiments, wherein the projections 496, 498 are configured to position the connecting member 484 relative to the blade holder 24, this may be achieved by using inserts 625₁-625_s placeable in the molding apparatus 150 to allow the shell 30 of the skate boot 22 to be molded in a desirable position relative to the connecting member 484 in the molding apparatus 150, as shown in Figures 142 to 144. For instance, the inserts may determine a position of the connecting member 484 relative to the skate boot 22 in the molding apparatus. The molding apparatus 150 may comprise a void 622 having a shape that corresponds to the shape of the skate boot 22 and voids 623₁-623_v to receive each one of the inserts 625₁-625_s. During the molding process, inserts 625₁-625_s may be chosen according to preferences of the user and placed in the respective ones of the voids 623₁-623_v. The connecting member 484 may be placed in the molding apparatus 150 and may engage partially or completely a surface of the inserts 625₁-625_s. The molding by flowing may then proceed to form the skate boot 22 comprising the connecting member 484, thereby overmolded by the shell 30.
- In other embodiments, wherein the positioning of the fastening voids 492₁-492_v are configured to position the connecting member 484 relative to the blade holder 24, this

may be achieved by using a connecting member 484 that has fastening voids 492₁-492_v positioned and configured to fit with the blade holder 24 of the desired size and at the desired position relative to the skate boot.

- 5 In some embodiments, the fastening voids 497₁-497_v of the blade holder 24 may be oversized, e.g., oblong, to allow a given blade holder 24 of a pre-determined size to be used with skate boots 22 of different sizes.

In this embodiment, the connection system 480 may be configured for removably
10 attaching the blade holder 24 to the skate boot 22, i.e., once the blade holder 24 is attached to the skate boot 22, the user may detach the blade holder 24 from the skate boot 22, such that when the blade holder 24 is used, broken or needs to be changed for any reason, it may be changed for another blade holder 24. In other embodiments, the connection system 480 may be configured for attaching the blade holder 24 to the
15 skate boot 22 in a manner such that the user may not be able to detach the blade holder 24 from the skate boot 22, but such an operation may be doable by re-manufacturing the skate boot 22 in a manufacture facility. This could be achieved, notably, by using rivets as fasteners 494₁-494_f. In other embodiments, the connection system 480 may be configured for attaching the blade holder 24 to the skate boot 22
20 in a permanent manner.

As another example, in some embodiments, as shown in Figures 145 to 147, the shell
30 of the skate boot 22 may comprise a blade-holder-connecting portion 378 projecting downwardly from and formed integrally with the sole portion 69, while the
25 skate boot 22 comprises a plurality of connecting member 588₁, 588₂ disposed between the blade holder 24 and the blade-holder-connecting portion 378 of the shell 30 of the skate boot 22 to fasten the blade holder 24 to the skate boot 22.

In this embodiment, the connecting member 588₁, 588₂ are separated from one
30 another and spaced apart in the longitudinal direction of the skate boot 22. The blade-holder-connecting portion 378 of the shell 30 of the skate boot 22 comprises a front

projection 582 configured to project downwardly towards the void 506 of the front pedestal 210 and a rear projection 584 configured to project downwardly into towards void 508 of the rear pedestal 212 of the blade holder 24. The front projection 582 is configured to connect with the first connecting member 588₁ and the rear projection
5 584 is configured to connect with the second connecting member 588₂. The first connecting member 588₁ is configured to engage the front projection 582 of the blade-holder-connecting portion 378 of the shell 30 and the second connecting member 588₂ is configured to engage the rear projection 584 of the blade-holder-connecting portion 378 of the shell 30.

10

In other embodiments, the connecting members 588₁, 588₂ may be integrally formed with one another, i.e., may form one connecting member.

The connecting members 588₁, 588₂ may be relatively rigid to provide a relatively rigid
15 connection between the skate boot 22 and the blade holder 24. This may allow the ice skate 10 to be more reactive and to more effectively transmit forces between the ice 12 and the user's foot. As such, the connecting members 588₁, 588₂ may comprise a material 589 that is stiffer, i.e., more rigid, than the material M_x of the skate boot 22. For instance, in some embodiments, a ratio of a modulus of elasticity of the material
20 589 of the connecting members 588₁, 588₂ over the modulus of elasticity of the material M_x of the skate boot 22 may be at least 1.5, in some embodiments at least 2, in some embodiments at least 3, in some embodiments even more.

In this embodiment, the connecting members 588₁, 588₂ comprise a plurality of
25 fastening voids 595₁-595_v, 597₁-597_v to receive a plurality of fasteners 601₁-601_f, 603₁-603_f to fasten the blade holder 24 to the skate boot 22. More particularly, each of the fastening voids 595₁-595_v, 597₁-597_v is disposed to receive a corresponding one of the fasteners 601₁-601_f, 603₁-603_f. For example, a first fastening void 595₁ may be disposed to receive a first fastener 601₁ extending from the blade holder 24 to the
30 connecting members 588₁, 588₂; and a second fastening void 597₁ may be disposed to receive a second fastener 603₁ extending from the blade holder 24 to the blade-

holder-connecting portion 378 of the shell 30. The first and second fasteners 601₁, 603₁ are oriented orthogonally to one another. As another example, the first ones of the fastening voids 595₁-595_v, 597₁-597_v may be disposed to receive first ones of the fasteners 601₁-601_f, 603₁-603_f extending from the blade holder 24 to the connecting
5 members 588₁, 588₂; and second ones of the fastening voids 595₁-595_v, 597₁-597_v may be disposed to receive second ones of the fasteners 601₁-601_f, 603₁-603_f extending from the blade holder 24 to the blade-holder-connecting portion 378 of the shell 30.

10 In this example, the connecting members 588₁, 588₂ comprise a recess 592 to receive the blade-holder-connecting portion 378 of the shell 30. The connecting members 588₁, 588₂ comprise an extension 593 projecting away from the recess 592. The first fastening voids 595₁-595_v are disposed in the extension 593 of the connecting members 588₁, 588₂ to receive the first fasteners 601₁-601_f extending from the blade
15 holder 24 to the connecting members 588₁, 588₂; and the second fastening voids 597₁-597_v open into the recess 592 to receive the second fasteners 603₁-603_f extending from the blade holder 24 to the blade-holder-connecting portion 378 of the shell 30 of the skate boot 22.

20 In this embodiment, the blade holder 24 comprises fastening voids 611₁-611_v configured to receive the fasteners 601₁-601_f extending from the blade holder 24 to the connecting members 588₁, 588₂. The projections 582, 584 of the blade-holder-connecting portion 378 of the shell 30 of the skate boot 22 comprise fastening voids 613₁-613_v configured to receive the fasteners 603₁-603_f extending from the blade
25 holder 24 to the blade-holder-connecting portion 378 of the shell 30.

In this embodiment also, the connecting members 588₁, 588₂ may be configured to connect the blade holder 24 to the skate boot 22 in a specific position desirable by the user and/or may allow the user to choose between different sizes of the blade holder
30 24 to be connected to the skate boot 22, based on preferences of the user. In some embodiments, the connecting members 588₁, 588₂ may be preselected from a

selection of connecting members 588₁, 588_c, each pair of connecting members 588₁, 588₂ corresponding to a size of blade holder or skate boot, and/or corresponding to a position of the blade holder 24 relative to the skate boot 22. In some embodiments, the fastening voids 611₁-611_v of the blade holder 24 may be oversized, e.g., oblong, to allow a given blade holder 24 of a pre-determined size to be used with skate boots 22 of different sizes.

In this embodiment, the blade-holder-connecting portion 378 and the connecting member 588₁, 588₂ may be configured for removably attaching the blade holder 24 to the skate boot 22, i.e., once the blade holder 24 is attached to the skate boot 22, the user may detach the blade holder 24 from the skate boot 22, such that when the blade holder 24 is used, broken or needs to be changed for any reason, it may be changed for another blade holder 24. In other embodiments, the blade-holder-connecting portion 378 and the connecting member 588₁, 588₂ may be configured for attaching the blade holder 24 to the skate boot 22 in a manner such that the user may not be able to detach the blade holder 24 from the skate boot 22, but such an operation may be doable in by re-manufacturing the skate boot 22 in a manufacture facility. This could be achieved, notably, by using rivets as fasteners 601₁-601_f. In other embodiments, the blade-holder-connecting portion 378 and the connecting member 588₁, 588₂ may be configured for attaching the blade holder 24 to the skate boot 22 in a permanent manner.

As another example, in some embodiments, as shown in Figure 148, 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 149, 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 150, 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 151 and 152, 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 Figure 123. 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
5 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).

10 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 153, 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
15 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).

20 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 154, in this example, the blade holder 24 comprises a front insert 315₁ and a rear insert 315₂ which respectively make up a part
25 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
30 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 155, 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 156, 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 157, 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 158, 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 159, 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 160 to 165 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 166, 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, rather than being disposed between the subshells 85₁-85_L, in other examples the sheet 615 may be disposed between the inner liner 36 and the internal subshell 85₁.

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 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.

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 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 a variant, as shown in Figures 167 to 170, 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 167, 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 168, 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 169 and 170, 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 or painted rather than injection molded. For instance, this may allow to more easily form thinner subshells 85₁-85_L (e.g., of 0.1 mm). Similarly, in another variant, material may be applied between some of the subshells 85₁-85_L to enhance bonding of the subshells 85₁-85_L. For instance, in some embodiments, the material comprises an adhesive which may be sprayed over a given one of the subshells 85₁-85_L before a subsequent one of the subshells 85₁-85_L is molded. For instance, the subshell 85₃ may be a coating and the

adhesive may be sprayed over the subshell 85₂ before the subshell 85₃ is formed to enhance bonding of the coating 85₃. In this example, the adhesive is compatible with polyurethane plastics. More specifically, the adhesive may be compatible with thermoplastic polyurethanes and may comprise relatively low solvent contents. In
5 some embodiments, the adhesive comprises a primer.

In another variant, as shown in Figure 171, 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
10 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
15 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 172, the blade holder 24 may comprise a void 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
20 assembled with the shell 30, the blade holder 24 comprises the void 350 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
25 of a body of the blade holder 24 and a surface of the sole portion 69 of the shell 30.
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 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 173 and 174, the material M_i of a subshell 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.

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%, 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. 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 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 embodiments.

The polymeric substance 52 may comprise any other suitable polymer in other
5 embodiments. For example, in some embodiments, the polymeric substance 52 may
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
10 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
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
15 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 174, the expansion agent 53 comprises an
amount of expandable microspheres 63_1 - 63_M . Each expandable microsphere 63_i
20 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
25 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
30 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 63₁-63_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 63₁-63_M may be provided in various other forms in other embodiments. For example, in some embodiments, the expandable microspheres 63₁-63_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 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.

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.

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 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
5 density of the material M_i may be about 1% to 50% of the density of the 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
10 cases no more than 0.4 g/cm³, in some cases no more than 0.1 g/cm³, in 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
15 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 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
20 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 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
25 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.

30 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

- 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 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.
- 10 The resilience of the material M_i may have any suitable value. For instance, in some 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
- 15 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.

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 63₁-63_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 63₁-63_M according to ASTM D-638 or

25 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

30 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_I-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_I-63_M according to ASTM D-638 or ASTM D-412, and in some cases even more.

- 10 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).
- 15 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 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.

As another example, as shown in Figures 175 to 177E, in some embodiments, the tendon guard 35 may be affixed to the shell 30 of the skate boot 22 by overmolding.

- 30 This may provide various advantages, such as: allowing the use of a material for the tendon guard 35 that is different from the materials of the shell 30 of the skate boot

22; allowing the tendon guard 35 to have a stiffness that is more appropriate (e.g., lower) for its use; enhancing durability and reducing occurrence of breakage of the tendon guard 35; etc. In this example, the tendon guard 35 is overmolded on a portion 732 of the shell 30 of the skate boot 22. More specifically, the body 30 of the skate boot 22 comprises the portion 732 having a shape facilitating overmolding such as by being configured for creating a mechanical interlock after overmolding. In this example, the portion 732 is an interlocking hollow space and the tendon guard 35 comprises an interlocking part extending in the interlocking hollow space 732 to interlock the tendon guard 35 and the shell 30. More specifically, in some embodiments, the portion 732 of the shell 30 comprises recesses and projection creating a mechanical interlock holding the tendon guard 35 and the shell 30 together after the tendon guard 35 is overmolded on the shell 30, as shown in Figure 176A. In some embodiments, also, the portion 732 of the shell 30 comprises voids or holes creating the mechanical interlock holding the tendon guard 35 and the shell 30 together after the tendon guard 35 is overmolded on the shell 30, as shown in Figure 176B.

In some embodiments, instead of having the tendon guard 35 being overmolded on the shell 30 of the skate boot 22, the shell 30 of the skate boot 22 is overmolded onto the tendon guard 35. More specifically, in this embodiment, respective ones of the subshells 85₁-85₃ are overmolded onto the tendon guard 35. For instance, the tendon guard 35 may comprise a portion 744 having a shape facilitating overmolding such as by being configured for creating a mechanical interlock after overmolding. In this example, the portion 744 is an interlocking hollow space and the shell 30 of the skate boot 22 comprises an interlocking part extending in the interlocking hollow space to interlock the tendon guard 35 and the shell 30. More specifically, in some embodiments, the portion 744 of the tendon guard 35 comprises recesses and projection creating a mechanical interlock holding the tendon guard 35 and the shell 30 together after the respective ones of the subshells 85₁-85₃ of the shell 30 are overmolded on the tendon guard 35. In some embodiments, also, the portion 744 of the tendon guard 35 comprises voids or holes creating the mechanical interlock holding the tendon guard 35 and the shell 30 together after the tendon guard 35 is

overmolded on the shell 30, as shown in Figures 177B and 177C.

In this embodiment, the portion 744 is a lower portion affixed to the shell 30 by overmolding of the at least one of the subshells 85₁-85₃ and the tendon guard 35
5 also comprises an upper portion free of overmolding.

In this embodiment, the tendon guard 35 comprises a material 734 that is different from the materials M₁-M_L of the shell 30 of the skate boot 22 at the overmold. The material 734 may be more flexible (i.e., less stiff) to increase comfort of the skate boot
10 22 and to increase durability. For instance, in some embodiments, a ratio of a modulus of elasticity of the material 734 over a modulus of elasticity of a given one of the materials M₁-M_L of the shell 30 of the skate boot 22 may be no more than 0.9, in some embodiments no more than 0.7, in some embodiments no more than 0.5, in some embodiments even less.

The material 734 of the tendon guard 35 may be implemented in any suitable way. In this embodiment, the material 734 may be a polymeric material. For example, in this embodiment, the material 734 is a polyester elastomer including is a thermoplastic resin. Any other suitable polymer may be used in other embodiments (e.g., polypropylene,
20 ethylene-vinyl acetate (EVA), nylon, polyurethane (PU), 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 some embodiments, as shown in Figures 177D and 177E, the material 734 of the tendon guard 35 may comprise one or more layers 736 of fabric to enhance overmolding, such as by creating a relief on a surface of the portion 744 of the tendon guard 35. In some embodiments, the layer 736 may be a woven layer, while in other embodiments, the layer 736 may be a non-woven layer. For instance, the fabric of
30 the layer of fabric 736 may comprise nylon, cotton, polyester, glass fibers, carbon fibers and/or any suitable material.

As another example, as shown in Figure 178, in some embodiments, the shell 30 may comprise pads 760₁-760_P disposed at the ankle portion of the skate boot 22 and/or at any suitable portion of the skate boot 22 (e.g., at the medial side portion, at the lateral
5 side portion, at the heel portion, etc.) to customize the inner shape of the skate boot 22 receiving the foot 11 of the user, to enhance comfort and fit, and/or for other purposes.

The shell 30 may comprise any suitable number (e.g., one, two or more) of pads 760₁-760_P spaced from one another. In some embodiments, the pads 760₁-760_P may be
10 disposed between the shell 30 and the liner 36 of the skate boot 22. In some cases, the pads 760₁-760_P and the liner 36 may be integrated into the skate boot 22 during molding of the skate boot 22. For instance, during molding, the liner 36 may be applied over the last and the pads 760₁-760_P may be affixed to the liner 36 before the molding of the shell 30 to impart a customized shape to the molded shell 30. In some cases, also, the pads
15 760₁-760_P and the liner 36 may be integrated into the skate boot 22 after molding of the shell 30. For instance, the shell 30 of the skate boot 22 may be molded without the liner 36. The pads 760₁-760_P may then be affixed to the inner surface of the shell 30 by any suitable means, such as by being adhesively bonded to and/or being stitched to the shell 30. Optionally, the liner 36 may be affixed to the inner surface of the shell
20 30 and to the pads 760₁-760_P by any suitable means, such as by being adhesively bonded to and/or being stitched to the shell 30 and/or the pads 760₁-760_P.

In other embodiments, the pads 760₁-760_P may be disposed between other elements of the skate boot 22, such as between adjacent ones of the subshells 85₁-85_I (e.g., between
25 the intermediate subshell 85₂ and the external subshell 85₃ of the skate boot 22). For instance, after molding of some but not all of the subshells 85₁-85_I, the pads 760₁-760_P may be affixed to the molded subshells 85₁-85_I, and molding of remaining ones of the subshells 85₁-85_I may be achieved subsequently.

30 In this embodiment, the pads 760₁-760_P are shaped, manufactured and located based on information about a shape of the user's foot 11 to customize the skate boot 22 for the

shape of the user's foot 11. For instance, information about a shape of a user's foot 11 may be measured manually or provided by an imaging system such as described in U.S. Patent Application No. 62/692,057, which is incorporated herein.

- 5 The pads 760₁-760_P may comprise lateral and medial ankle pads 760₁, 760₂ disposed between the liner 36 and the ankle portion 64 of the skate boot 22.

The pads 760₁-760_P may comprise any suitable material. For instance, a material of the pads 760₁-760_P may be soft enough (e.g., so that it can deform and does not
10 prevent the foot 11 of the user from entering the cavity of the skate boot 22 and does not cause excessive pressure in use). In some embodiments, the material of the pads 760₁-760_P may be softer or less stiff than a foam or another material of an underlying one of the subshells 85₁-85_I of the skate boot 22. For instance, the material of the pads 760₁-760_P may comprise foam.

15

The pads 760₁-760_P may have any suitable shape. For instance, a thickness of the pads 760₁-760_P may be greater than a thickness of a given one of the subshells 85₁-85_I such that the pads 760₁-760_P have a significant impact on the inner shape of the skate boot 22 and/or on the cavity of the skate boot 22. For example, in some
20 embodiments, a ratio of the thickness of a given one of the pads 760₁-760_P over the thickness of the internal subshell 85₁ at the location of the given one of the pads 760₁-760_P may be at least 1.1, in some embodiments at least 1.5, in some embodiments at least 2, in some embodiments at least 3, in some embodiments even more. In some embodiments, also, the thickness of the pads 760₁-760_P may vary in order to conform
25 to the shape of the user's foot 11.

In some embodiments, as shown in Figures 179 and 180, the skate boot 22 may comprise a heel-locking member 756 projecting forwardly above a rearwardly-projecting part of the heel HL of the foot 11 to keep the heel HL of the user in place in
30 the skate boot 22. The heel-locking member 756 creates a protuberance 766 in the cavity receiving the foot 11 of the user above the heel HL and helps keeping the foot

11 of the user tightly into place.

In this example, the heel-locking member 756 comprises a heel-locking pad 760_h. In some embodiments, the heel-locking pad 760_h may have a dimension in a heightwise
5 direction of the skate boot 22 that is sufficiently low to create a sort of cup to keep the heel HL of the user in place in the skate boot 22, while the ankle pads 760₁, 760₂ may have a dimension in the heightwise direction of the skate boot 22 that is sufficiently great to provide padding to the ankle of the user. For instance, in this embodiment, the dimension of the heel-locking pad 760_h in the heightwise direction of the skate boot
10 22 may be less than the dimension of the lateral ankle pad 760₁ in the heightwise direction of the skate boot 22 and less than the dimension of the medial ankle pad 760₂ in the heightwise direction of the skate boot 22.

The heel-locking pad 760_h may be integrally made with the lateral and medial ankle
15 pad 760₁, 760₂, such that the heel-locking pad 760_h and the ankle pads 760₁, 760₂ constitute a single continuous padding member. In this embodiment, the heel locking pad 760_h comprising a medial portion 762, a lateral portion 766 and a bridge portion 764 linking the portions 762 and 766 to one another and configured to form the protuberance above the heel HL of the user.

20

In other embodiments, the heel-locking pad 760_h, the lateral ankle pad 760₁ and the medial ankle pad 760₂ are separate from one another.

A material of the heel-locking pad 760_h may be soft enough (e.g., so that it can deform
25 and does not prevent the foot 11 of the user from entering the cavity of the skate boot 22 and does not cause excessive pressure in use). In some embodiments, the material of the heel-locking pad 760_h may be softer or less stiff than a foam or other material of an underlying one of the subshells 85₁-85_i of the skate boot 22. For instance, the material of the heel-locking pad 760_h may comprise foam.

30

In other embodiments, the heel locking padding may have other configurations, e.g.,

the heel locking pad 760_h may be devoid of any one of the portions 762 and 766, and the heel locking padding may comprise more than one heel locking pad.

As another example, in some embodiments, instead of being injection molded in the molding apparatus 150 as discussed above, one or more of the subshells 85₁-85_L of the shell 30 of the skate boot 22 may be formed differently in the molding apparatus. For instance, one or more of the subshells 85₁-85_L of the shell 30 of the skate boot 22 may be molded in a mold of the molding apparatus 150 using pellets (e.g., beads) of polymeric material (e.g., polypropylene, polyethylene, etc.) that are expanded and cured in the mold to create foam. In order to form a subshell 85_i, the beads may be combined with a blowing agent and/or comprise two or more constituents of a given polymeric material M_x which chemically react when combined to polymerize and optionally release heat. In some cases, to initiate and/or to maintain an expansion and/or polymerization reaction, heat, such as by steaming, electromagnetic radiation and/or acoustic radiation, may be applied to the beads to make them foam. After expansion and/or polymerization, the subshell 85_i is formed and has a shape generally corresponding to the shape of the mold. In this example, the mold cavity is filled with a pre-determined quantity of beads and the mold may be closed prior to polymerisation, such that there is substantially no flow. In other examples, the beads may be injected into the mold through a mold injection gate, prior to or during polymerization of the beads.

As another example, in some embodiments, as shown in Figures 181 to 186, the skate boot 22 may comprise zones 810₁-810_z comprising different materials M_{i1}-M_{im} which have different characteristics (e.g., stiffness, density, etc.) and thus imparting different characteristics to these zones 810₁-810_z of the skate boot 22.

For instance, in some embodiments, as shown in Figures 173 to 183, a subshell 85_j may only cover a given zone 810_j of the skate boot 22. This may be achieved, for instance, by using a female mold that prevents material M_j of the subshell 85_j from flowing to the zones that are not covered by the subshell 85_i during manufacturing of

the skate 10.

In some embodiments, as shown in Figures 184 to 186, a subshell 85_i may comprise different materials M₁-M_m covering different zones 810₁-810_z of the skate boot 22. In
5 this example, the different materials M₁-M_m of the subshell 85_i are disposed adjacent to one another in a direction of extent of the subshell 85_i that is normal to a thicknesswise direction of the subshell 85_i. For example, the subshell 85_i may comprise the materials M_i, M_j covering the zones 810_i, 810_j of the subshell 85_i. This may be achieved, for instance, by subsequently injecting predetermined volumes of materials M_i, M_j in the
10 mold cavity, such the first injected material M_i gets pushed by the subsequently injected material M_j to the zone 810_i of the subshell 85_i while the material M_j remains in the zone 810_j of the subshell 85_i, as shown in Figure 187. In other embodiments, this may be achieved by injecting the materials M_i, M_j simultaneously in the zones 810_i, 810_j of the subshell 85_i using different input channels 814_i, 814_j located towards the respective
15 zones 810_i, 810_j of the subshell 85_i, as shown in Figure 188.

The materials M_i, M_j covering the zones 810_i, 810_j may provide characteristics (e.g., stiffness, weight, etc.) to the skate boot 22 by having properties (e.g., rigidity, density, color, etc.) varying more or less amongst the materials M_i, M_j. For instance, in some
20 embodiments, a ratio of a density of the material M_i over a density of the material M_j may be less than 0.25, in some embodiments between 0.25 and 0.5, in some embodiments between 0.5 and 0.75, in some embodiments between 0.75 and 1, in some embodiments between 1 and 2, in some embodiments between 2 and 4, in some embodiments even more. Similarly, in some embodiments, a ratio of a modulus of elasticity of the material
25 M_i over a modulus of elasticity of the material M_j may be less than 0.25, in some embodiments between 0.25 and 0.5, in some embodiments between 0.5 and 0.75, in some embodiments between 0.75 and 1, in some embodiments between 1 and 2, in some embodiments between 2 and 4, in some embodiments even more.

30 The materials M_i, M_j may be any suitable materials. For instance, in some embodiments, the materials M_i, M_j are polymeric materials. More particularly, in some embodiments,

the materials M_i , M_j are foams. In some embodiments, the materials M_i , M_j may be composite materials, resins, plastics, and so on. In some embodiments, also, the materials M_i , M_j may be different kind of materials (e.g. a foam and a plastic material).

- 5 As another example, in some embodiments, one or more of the subshells 85₁-85₃ may be formed differently than by molding by flowing. For instance, the one or more of the subshells 85₁-85₃ may be thermoformed. For example, one or more of the subshells 85₁-85₃ may be formed using a sheet of material that is heated and molded over (e.g., pressed onto) a last. The one or more of the subshells 85₁-85₃ may be affixed to
- 10 underlying ones and/or overlying ones of the subshells 85₁-85₃ by any suitable means, such as may mechanical interlock, by fastening, etc. As another example, one or more of the subshells 85₁-85₃ may be formed using a sheet of material that is heated and molded over an underlying one of the subshells 85₁-85₃ that is already formed.
- 15 In some embodiments, the thermoformed subshell 85_i may cover an entirety of the surface of the shell 30. In this case, the thermoformed subshell 85_i substantially covers every portion of the user's foot 11 that is covered by the shell 30. In other embodiments, the thermoformed subshell 85_i may cover a portion of the skate boot 22; that is, the thermoformed subshell 85_i covers some, but not all, portions of the user's foot 11 that
- 20 are covered by the shell 30. For instance, the thermoformed subshell 85_i may comprise a toe cap that is thermoformed and incorporated in the shell 30 while the remainder of the shell 30 is molded by flowing.

The thermoformed subshell 85_i may be provided at any stage of the manufacturing

25 process of the skate boot 22. For instance, in some embodiments, the thermoformed subshell 85_i is provided and attached to the last 152 (e.g., by fastening) before the internal subshell 85₁ is produced. In some embodiments, the thermoformed subshell 85_i is provided and attached to the remainder of the shell 30 after the remainder of the shell 30 is produced (e.g., by a molding by flowing process) by any suitable means, such as

30 by being stitched or fastened to an underlying subshell 85_y. In some embodiments, the thermoformed subshell 85_i is provided after some, but not all, of the subshells 85₁-85_L

are produced (e.g., by a molding by flowing process). In this example, the thermoformed subshell 85_i may be attached to (e.g., by being stitched to, by being fastened to) an underlying one of the subshells 85₁-85_L already molded.

- 5 For instance, in some embodiments, the thermoformed subshell 85_i may be the insole 40, as shown in Figures 66 to 68.

As another example, in some embodiments, as shown in Figure 189 one or more of the subshells 85₁-85₃ may be thermoformable, as described in U.S. Patent Application
10 No. 14/867,962, which is incorporated herein. For instance, one or more of the polymeric materials M₁-M_N of the shell 30 may be thermoformable such that, prior to use, the skate boot 22 may be heated to a first temperature T₁, the user may wear the heated skate boot 22 in a relatively tight manner such that the user's foot 11 compresses and impart its shape to the skate boot 22 and the polymeric materials M₁-M_N of the shell 30.
15 This may allow, notably, a more customizable fit.

In this embodiment, the thermoformable material M_T might preserve physical properties such as rigidity after the thermoformable material M_T is thermoformed to conform to the user's foot 11. For instance, after the thermoformable material M_T is thermoformed to
20 conform to the user's foot 11, the thermoformable material M_T may have a modulus of elasticity and a yield strength. The thermoformable material M_T may thus deform when subject to a load and may regain its shape imparted by the thermoforming process to conform to the user's foot 11 after load is removed.

25 In some embodiments, the thermoformable material M_T may be a shape-memory material. That is, after the thermoformable material M_T is thermoformed, the thermoformable material M_T may be heated to a temperature T₂ to expand and regain an original shape, i.e., the shape of the thermoformable material M_T before the thermoforming process having imparted the shape of the user's foot 11 to the skate boot
30 22 and to the material M_T.

In some embodiments, after the thermoformable material M_T is heated to a temperature T_2 to expand and regain an original shape, the thermoformable material M_T may again be thermoformed such that the user's foot 11 compresses and impart its shape to the skate boot 22 and the polymeric materials M_1 - M_N of the shell 30.

5

The temperature T_2 may be equal or greater (i.e. hotter) than the temperature T_1 . That is, in some embodiments, the temperature T_2 may be approximately equal to the temperature T_1 . In some embodiments, the temperature T_2 may be at least 50°C warmer than the temperature T_1 , in some embodiments at least 100°C warmer, in some
10 embodiments at least 200°C, in some embodiments even more.

The temperature T_1 may be low enough to ensure that the user's foot 11 compressing the skate boot 22 during thermoforming does not get burnt. For example, in some embodiments, the temperature T_1 may be no more than 100°C, in some embodiments
15 no more than 80°C, in some embodiments no more than 60°C, in some embodiments even less.

The thermoformable material M_T may be of any nature. For instance, in this embodiment, the thermoformable material M_T comprises a polymeric material. More
20 specifically, in this embodiment, the thermoformable material M_T comprises a foam material.

In this embodiment, the thermoformable subshell comprising the thermoformable material M_T is the internal subshell 85₁. In some embodiments, the pads 760₁-760_p may
25 comprise the thermoformable material M_T .

As another example, in some embodiments, the skate boot 22 may be made using any other manufacturing processes, including conventional ones (e.g., using a conventional lasting machine, thermoforming, etc.), while including one or more
30 features discussed herein, such as, for example, the heel-locking member 756, the graphic elements 121 on the toe cap 32, an overmolded connection for the tendon

guard 35, etc.

For instance, in some embodiments, as shown in Figure 190, the skate boot 22 is made using a standard toe cap 32 which is not integrally made with the shell 30 of the skate boot 22. In this embodiment, the skate boot 22 comprises one or more design elements 121 which may be disposed over various portions of the shell 30 and/or over various other portions of the skate boot 22, for instance over the medial side portion 68 of the shell 30, over the lateral side portion 66 of the shell 30, over a top portion of the shell 30, and so on, and may also be disposed over the toe cap 32, over the tongue 34, over the tendon guard 35, over the liner 36, over the footbed 38, over the insole 40, over the lace members 44₁, 44₂, over the eyelets 46₁-46_E, and so on. For instance, the design elements 121 may be disposed at least on a side of the toe cap 32. In this example, the design elements 121 are disposed on a medial side, on a lateral side and on a top side of the toe cap 32.

The design elements 121 may cover at least a substantial part (i.e., a substantial part or an entirety) of a surface area of the toe cap 32 that is externally visible (i.e., visible from outside of the skate boot 22). For instance, in some embodiments, the design elements 121 covers at least a quarter (i.e., 25%), in some embodiments at least a third (i.e., 33%), in some embodiments at least a majority (i.e., at least 50%), in some embodiments at least 75%, and in some embodiments an entirety of the toe cap 32.

Some of the design elements 121 may also be continuous with other design elements 121 of adjacent portions of the skate boot 22. That is, there may be a continuity of the design element 121 between the toe cap 32 of the skate boot and a given one of the medial side portion 68 of the shell 30 and the lateral side portion 66 of the shell 30, thus providing an impression that the design elements 121 extend from a given one of the toe cap 32, the medial side portion 68 and the lateral side portion 66 to another one of the toe cap 32, the medial side portion 68 and the lateral side portion 66. In this embodiment, there is continuity of design elements 121 between the toe cap 32 of the skate boot 30, the medial side portion 68 of the shell 30 and the lateral side portion 66 of the shell 30.

In this embodiment, an external clear layer may be applied over the design elements 121 such that the design elements 121 are visible through the clear layer and such that the clear layer protects the design elements 121 from flying pucks, sticks, etc.

5

The design elements 121 may include a design pattern, a printed image, and so on. In this embodiment, the design element is a graphic element which includes one or many different colors.

- 10 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 is a dry surface (e.g., a polymeric, concrete, wooden, or turf playing surface or any other
- 15 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 wheel holder holding 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). The wheel holder may be constructed using principles discussed herein in respect of the blade holder 24.
- 20 Moreover, in other embodiments, the skate 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
- 25 any other suitable type of footwear. For example, as shown in Figure 192, 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
- 30 with an attachment mechanism 800 of the ski 802. In another example, as shown in Figure 193, 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. In another example, as shown in Figure 194, the footwear 10 may be a snowboard boot comprising a shell 1030 which can be constructed in the manner described above with respect to the shell of the skate. In another example, as shown in Figure 195, the footwear 10 may be a sport cleat comprising a shell 1130 which can be constructed in the manner described above with respect to the shell of the skate. In another example, as shown in Figure 196, the footwear 10 may be a hunting boot comprising a shell 1230 which can be constructed in the manner described above with respect to the shell of the skate.

In some embodiments, any feature of any embodiment described herein may be 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 embodiments may be free of, may lack and/or may function without any element that is not specifically disclosed herein.

In describing the embodiments, specific terminology has been resorted to for the sake of description but this 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 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 purposes of describing, but should not be limiting. Various modifications will become apparent to those skilled in the art.

CLAIMS

1. A method of making a skate boot for a skate, the skate boot being configured to receive a foot of a user, the method comprising:
 - 5 - providing a molding apparatus comprising a plurality of ports for receiving constituents that are different;
 - determining a desired property of a material of a body of the skate boot;
 - injecting respective ones of the constituents to produce the material of the body of the skate boot; and
 - 10 - controlling proportions of the respective ones of the constituents to impart the desired property to the material of the body of the skate boot.
2. The method of claim 1, wherein the constituents include at least three constituents.
- 15 3. The method of claim 2, wherein the respective ones of the constituents include a first one of the constituents, a second one of the constituents, and a third one of the constituents.
- 20 4. The method of any one of claims 1 and 2, wherein a given one of the constituents is not injected to produce the material of the body of the skate boot.
5. The method of any one of claims 1 to 4, wherein the material of the body of the skate boot is a polyurethane.
- 25 6. The method of claim 5, wherein the polyurethane of the body of the skate boot is a polyurethane foam.
7. The method of any one of claims 5 and 6, wherein the constituents include an isocyanate, a first polyol, and a second polyol different from the first polyol.
- 30

8. The method of claim 7, wherein the respective ones of the constituents include the isocyanate, the first polyol, and the second polyol.
9. The method of claim 8, wherein the proportion of the first polyol is different from the proportion of the second polyol.
10. The method of claim 7, wherein the respective ones of the constituents include the isocyanate and the first polyol but not the second polyol.
11. The method of any one of claims 1 to 10, wherein the desired property of the material of the body of the skate boot is stiffness of the material of the body of the skate boot.
12. The method of claim 11, wherein the stiffness of the material of the body of the skate boot is a modulus of elasticity of the material of the body of the skate boot.
13. The method of any one of claims 1 to 12, wherein: the material of the body of the skate boot is a first material of the body of the skate boot forming at least part of a first layer of the body of the skate boot; the respective ones of the constituents are first respective ones of the constituents; and the method comprises injecting second respective ones of the constituents to produce a second material of the body of the skate boot that forms at least part of a second layer of the body of the skate boot.
14. The method of claim 13, wherein the first layer of the body of the skate boot is disposed outwardly of the second layer of the body of the skate boot.
15. The method of claim 14, wherein the first layer of the body of the skate boot is an outermost layer of the body of the skate boot.

16. The method of claim 15, wherein the outermost layer of the body of the skate boot is clear.

5 17. The method of claim 13, wherein the first layer of the body of the skate boot is disposed inwardly of the second layer of the body of the skate boot.

18. The method of any one of claims 13 to 17, comprising:

- determining a desired property of the second material of the body of the skate boot; and
- 10 - controlling proportions of the second respective ones of the constituents to impart the desired property to the second material of the body of the skate boot.

15 19. The method of claim 18, wherein the desired property of the second material of the body of the skate boot is different from the desired property of the first material of the body of the skate boot.

20 20. The method of claim any one of claims 13 to 19, wherein the second respective ones of the constituents are different from the first respective ones of the constituents.

25 21. The method of any one of claims 13 to 20, wherein: the first material of the body of the skate boot is a first polyurethane; and the second material of the body of the skate boot is a second polyurethane different from the first polyurethane.

30 22. The method of any one of claims 1 to 21, wherein: the body of the skate boot comprises a medial side portion configured to face a medial side of the user's foot, a lateral side portion configured to face a lateral side of the user's foot, a heel portion configured to receive a heel of the user's foot, and an ankle portion configured to receive an ankle of the user that are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of

the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body of the skate boot.

23. The method of claim 22, wherein: the body of the skate boot comprises a sole portion configured to face a plantar surface of the user's foot; the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the sole portion of the body of the skate boot are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the sole portion of the body of the skate boot.
24. The method of any one of claims 22 and 23, wherein: the body of the skate boot comprises a toe portion configured to receive toes of the user's foot; the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the toe portion of the body of the skate boot are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the toe portion of the body of the skate boot.
25. The method of any one of claims 1 to 24, wherein: the skate is an ice skate comprising a blade; and the material of the body of the skate boot is also a material of a body of a blade holder extending downwardly from the skate boot and configured to hold the blade.
26. A method of making a skate boot for a skate, the skate boot being configured to receive a foot of a user, the method comprising:
- providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol;
 - determining a desired property of a polyurethane of a body of the skate boot;
 - injecting the isocyanate, the first polyol, and the second polyol to produce the polyurethane of the body of the skate boot; and

- controlling proportions of the isocyanate, the first polyol, and the second polyol to impart the desired property to the polyurethane of the body of the skate boot.

- 5 27. A method of making skate boots for skates, the method comprising:
- providing a molding apparatus comprising a plurality of ports for receiving constituents that are different;
 - for each skate boot, injecting respective ones of the constituents to produce a material of a body of the skate boot;
- 10 wherein proportions of the respective ones of the constituents injected to produce the material of the body of a first one of the skate boots differ from proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the skate boots.
- 15 28. The method of claim 27, wherein the constituents include at least three constituents.
29. The method of any one of claims 27 and 28, wherein the respective ones of the constituents include a first one of the constituents, a second one of the constituents, and a third one of the constituents.
- 20 30. The method of any one of claims 27 to 29, wherein a given one of the constituents is not injected to produce the material of the body of the skate boot.
- 25 31. The method of any one of claims 27 to 30, wherein: the material of the body of the first one of the skate boots is a polyurethane; and the material of the body of the second one of the skate boots is a polyurethane.
- 30 32. The method of claim 31, wherein: the polyurethane of the body of the first one of the skate boots is a polyurethane foam; and the polyurethane of the body of the second one of the skate boots is a polyurethane foam.

33. The method of any one of claims 31 and 32, wherein the constituents include an isocyanate, a first polyol, and a second polyol different from the first polyol.

5 34. The method of claim 33, wherein the respective ones of the constituents include the isocyanate, the first polyol, and the second polyol.

35. The method of claim 34, wherein the proportion of the first polyol injected to produce the material of the body of the first one of the skate boots is different
10 from the proportion of the first polyol injected to produce the material of the second one of the skate boots.

36. The method of claim 35, wherein the proportion of the second polyol injected to produce the material of the body of the first one of the skate boots is different
15 from the proportion of the first polyol injected to produce the material of the second one of the skate boots.

37. The method of claim 33, wherein: the respective ones of the constituents injected to produce the material of the first one of the skate boots include the
20 isocyanate, the first polyol, and the second polyol; and the respective ones of the constituents injected to produce the material of the second one of the skate boots include the isocyanate and the first polyol but not the second polyol.

38. The method of any one of claims 27 to 37, wherein a desired property of the
25 material of the body of the first one of the skate boots is different from a desired property of the material of the body of the second one of the skate boots.

39. The method of claim 38, wherein the desired property of the material of the body of the first one of the skate boots is stiffness of the material of the body of the
30 first one of the skate boots; and the desired property of the material of the body

of the second one of the skate boots is stiffness of the material of the body of the second one of the skate boots.

40. The method of claim 39, wherein: the stiffness of the material of the body of the first one of the skate boots is a modulus of elasticity of the material of the body of the first one of the skate boots; and the stiffness of the material of the body of the second one of the skate boots is a modulus of elasticity of the material of the body of the second one of the skate boots.

41. The method of any one of claims 27 to 40, wherein: the material of the body of the skate boot is a first material of the body of the skate boot forming at least part of a first layer of the body of the skate boot; the respective ones of the constituents are first respective ones of the constituents; and the method comprises, for each skate boot, injecting second respective ones of the constituents to produce a second material of the body of the skate boot forming at least part of a second layer of the body of the skate boot.

42. The method of claim 41, wherein the second respective ones of the constituents are different from the first respective ones of the constituents.

43. The method of any one of claims 41 and 42, wherein the first layer of the body of the skate boot is disposed outwardly of the second layer of the body of the skate boot.

44. The method of claim 43, wherein the first layer of the body of the skate boot is an outermost layer of the body of the skate boot.

45. The method of claim 44, wherein the outermost layer of the body of the skate boot is clear.

46. The method of any one of claims 41 and 42, wherein the first layer of the body of the skate boot is disposed inwardly of the second layer of the body of the skate boot.

5 47. The method of any one of claims 41 to 46, wherein: the first material of the body of the skate boot is a first polyurethane; and the second material of the body of the skate boot is a second polyurethane different from the first polyurethane.

48. The method of any one of claims 27 to 47, wherein: the body of the skate boot
10 comprises a medial side portion configured to face a medial side of the user's foot, a lateral side portion configured to face a lateral side of the user's foot, a heel portion configured to receive a heel of the user's foot, and an ankle portion configured to receive an ankle of the user that are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of
15 the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body of the skate boot.

49. The method of claim 48, wherein: the body of the skate boot comprises a sole
20 portion configured to face a plantar surface of the user's foot; the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the sole portion of the body of the skate boot are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the sole portion of the body of the skate boot.

25

50. The method of any one of claims 48 and 49, wherein: the body of the skate boot
comprises a toe portion configured to receive toes of the user's foot; the medial
side portion, the lateral side portion, the heel portion, the ankle portion, and the
toe portion of the body of the skate boot are molded integrally together; and the
30 material of the body of the skate boot constitutes at least part of each of the

medial side portion, the lateral side portion, the heel portion, the ankle portion, and the toe portion of the body of the skate boot.

51. The method of any one of claims 27 to 50, wherein: the skates are ice skates
5 each comprising a blade; and the material of the body of the skate boot is also a material of a body of a blade holder extending downwardly from the skate boot and configured to hold the blade.

52. A method of making skate boots for skates, the method comprising:

- 10 - providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol;
- for each skate boot, injecting the isocyanate, the first polyol, and the second polyol to produce a polyurethane of a body of the skate boot;

wherein proportions of the isocyanate, the first polyol, and the second polyol
15 injected to produce the polyurethane of the body of a first one of the skate boots differ from proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the skate boots.

20 53. A plurality of skate boots for skates, each of the skate boots comprising a body including a material produced by injecting respective ones of a plurality of constituents, wherein proportions of the respective ones of the constituents injected to produce the material of the body of a first one of the skate boots differ from proportions of the respective ones of the constituents injected to produce
25 the material of the body of a second one of the skate boots.

54. The plurality of skate boots of claim 53, wherein the constituents include at least three constituents.

55. The plurality of skate boots of claim 54, wherein the respective ones of the constituents include a first one of the constituents, a second one of the constituents, and a third one of the constituents.

5 56. The plurality of skate boots of any one of claims 53 and 54, wherein a given one of the constituents is not injected to produce the material of the body of the first one of the skate boots and the given one of the constituents is injected to produce the material of the body of the second one of the skate boots.

10 57. The plurality of skate boots of any one of claims 53 to 56, wherein the material of the body of each of the skate boots is a polyurethane.

58. The plurality of skate boots of claim 57, wherein the polyurethane of the body of each of the skate boots is a polyurethane foam.

15

59. The plurality of skate boots of any one of claims 57 and 58, wherein the constituents include an isocyanate, a first polyol, and a second polyol different from the first polyol.

20 60. The plurality of skate boots of claim 59, wherein the respective ones of the constituents include the isocyanate, the first polyol, and the second polyol.

61. The plurality of skate boots of claim 60, wherein the proportion of the first polyol injected to produce the material of the body of the first one of the skate boots is
25 different from the proportion of the second polyol injected to produce the material of the body of the first one of the skate boots.

62. The plurality of skate boots of claim 59, wherein the respective ones of the constituents include the isocyanate and the first polyol but not the second polyol.

30

63. The plurality of skate boots of claims 53 to 62, wherein a stiffness of the material of the body of the first one of the skate boots differs from a stiffness of the material of the body of the second one of the skate boots.

5 64. The plurality of skate boots of claim 63, wherein, for each of the skate boots, the stiffness of the material of the body of the skate boot is a modulus of elasticity of the material of the body of the skate boot.

65. The plurality of skate boots of claims 53 to 64, wherein, for each of the skate
10 boots: the material of the body of the skate boot is a first material of the body of the skate boot forming at least part of a first layer of the body of the skate boot; the respective ones of the constituents are first respective ones of the constituents; and the body of the skate boot comprises a second material produced by injecting second respective ones of the constituents, the second
15 material forming at least part of a second layer of the body of the skate boot.

66. The plurality of skate boots of claim 65, wherein, for each of the skate boots, the first layer of the body of the skate boot is disposed outwardly of the second layer of the body of the skate boot.

20

67. The plurality of skate boots of claim 66, wherein, for each of the skate boots, the first layer of the body of the skate boot is an outermost layer of the body of the skate boot.

25 68. The plurality of skate boots of claim 67, wherein, for each of the skate boots, the outermost layer of the body of the skate boot is clear.

69. The plurality of skate boots of claim 65, wherein, for each of the skate boots, the first layer of the body of the skate boot is disposed inwardly of the second layer
30 of the body of the skate boot.

70. The plurality of skate boots of any one of claims 65 to 69, wherein, for each of the skate boots, the second material is produced by injecting second respective ones of the constituents at controlled proportions to impart a pre-determined desired property to the second material.

5

71. The plurality of skate boots of claim 70, wherein, for each of the skate boots, the desired property of the second material of the body of the skate boot is different from the desired property of the first material of the body of the skate boot.

10 72. The plurality of skate boots of any one of claims 65 to 71, wherein, for at least a given one of the skate boots, the second respective ones of the constituents are different from the first respective ones of the constituents.

15 73. The plurality of skate boots of any one of claims 53 to 72, wherein, for each of the skate boots: the first material of the body of the skate boot is a first polyurethane; and the second material of the body of the skate boot is a second polyurethane different from the first polyurethane.

20 74. The plurality of skate boots of any one of claims 53 to 73, wherein, for each of the skate boots: the body of the skate boot comprises a medial side portion configured to face a medial side of the user's foot, a lateral side portion configured to face a lateral side of the user's foot, a heel portion configured to receive a heel of the user's foot, and an ankle portion configured to receive an ankle of the user that are molded integrally together; and the material of the
25 body of the skate boot constitutes at least part of each of the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body of the skate boot.

30 75. The plurality of skate boots of claim 74, wherein, for each of the skate boots: the body of the skate boot comprises a sole portion configured to face a plantar surface of the user's foot; the medial side portion, the lateral side portion, the

heel portion, the ankle portion, and the sole portion of the body of the skate boot are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the sole portion of the body of the skate boot.

76. The plurality of skate boots of any one of claims 74 and 75, wherein, for each of the skate boots: the body of the skate boot comprises a toe portion configured to receive toes of the user's foot; the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the toe portion of the body of the skate boot are molded integrally together; and the material of the body of the skate boot constitutes at least part of each of the medial side portion, the lateral side portion, the heel portion, the ankle portion, and the toe portion of the body of the skate boot.

77. The plurality of skate boots of any one of claims 53 to 76, wherein, for each of the skate boots: the skate is an ice skate comprising a blade; and the material of the body of the skate boot is also a material of a body of a blade holder extending downwardly from the skate boot and configured to hold the blade.

78. A plurality of skate boots for skates, each of the skate boots comprising a body including a polyurethane produced by injecting an isocyanate, a first polyol, and a second polyol, wherein proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the skate boots differ from proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the skate boots.

79. A method of making an article of footwear, the article of footwear being configured to receive a foot of a user, the method comprising:

- providing a molding apparatus comprising a plurality of ports for receiving constituents that are different;
- determining a desired property of a material of a body of the article of footwear;
- 5 - injecting respective ones of the constituents to produce the material of the body of the article of footwear; and
- controlling proportions of the respective ones of the constituents to impart the desired property to the material of the body of the article of footwear.

10 80. A method of making an article of footwear, the article of footwear being configured to receive a foot of a user, the method comprising:

- providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol;
- determining a desired property of a polyurethane of a body of the article of footwear;
- 15 - injecting the isocyanate, the first polyol, and the second polyol to produce the polyurethane of the body of the article of footwear; and
- controlling proportions of the isocyanate, the first polyol, and the second polyol to impart the desired property to the polyurethane of the body of the article of footwear.

81. A method of making articles of footwear, the method comprising:

- providing a molding apparatus comprising a plurality of ports for receiving constituents that are different;

25 - for each article of footwear, injecting respective ones of the constituents to produce a material of a body of the article of footwear;

wherein proportions of the respective ones of the constituents injected to produce the material of the body of a first one of the articles of footwear differ from proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the articles of footwear.

30

82. A method of making articles of footwear, the method comprising:

- providing a molding apparatus comprising a plurality of ports for receiving an isocyanate, a first polyol, and a second polyol different from the first polyol;
- for each article of footwear, injecting the isocyanate, the first polyol, and the

5 second polyol to produce a polyurethane of a body of the article of footwear; wherein proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the articles of footwear differ from proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a second one

10 of the articles of footwear.

83. A plurality of articles of footwear, each of the articles of footwear comprising a body including a material produced by injecting respective ones of a plurality of constituents, wherein proportions of the respective ones of the constituents

15 injected to produce the material of the body of a first one of the articles of footwear differ from proportions of the respective ones of the constituents injected to produce the material of the body of a second one of the articles of footwear.

20 84. A plurality of articles of footwear, each of the articles of footwear comprising a body including a polyurethane produced by injecting an isocyanate, a first polyol, and a second polyol, wherein proportions of the isocyanate, the first polyol, and the second polyol injected to produce the polyurethane of the body of a first one of the articles of footwear differ from proportions of the isocyanate, the first

25 polyol, and the second polyol injected to produce the polyurethane of the body of a second one of the articles of footwear.

85. A skate for skating on ice, the skate comprising:

- a skate boot configured to receive a foot of a user, the skate boot comprising
- 30 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; and

- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising an integrally-formed portion formed integrally with the body of the skate boot, the blade holder comprising a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder.

86. The skate of claim 85, wherein the core of the blade holder is affixed to the integrally-formed portion of the blade holder by overmolding.

87. The skate of any one of claims 85 and 86, wherein the integrally-formed portion of the blade holder is overmolded onto the core of the blade holder.

88. The skate of any one of claims 85 to 87, wherein the blade holder comprises a blade-retaining base configured to retain the blade and a support extending upwardly from the blade-retaining base towards the skate boot to interconnect the blade holder and the skate boot; and the core of the blade holder constitutes at least a substantial part of the blade-retaining base.

89. The skate of claim 88, wherein the support of the blade holder comprises a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot.

90. The skate of claim 89, wherein the blade-retaining base comprises a bridge interconnecting the front pillar and the rear pillar.

91. The skate of any one of claims 89 and 90, wherein the core of the blade holder comprises a pillar-forming member extending upwardly from the blade-retaining

base and constituting at least part of a given one of the front pillar and the rear pillar.

92. The skate of claim 91, wherein the core of the blade holder comprises a cavity
5 defined at least partly by the pillar-forming member.

93. The skate of claim 92, wherein the pillar-forming member comprises a reinforcement.

10 94. The skate of claim 93, wherein: the core of the blade holder is affixed to the integrally-formed portion of the blade holder by overmolding; and the reinforcement of the pillar-forming member is configured to maintain a shape of the pillar-forming member during overmolding.

15 95. The skate of any one of claims 93 and 94, wherein the pillar-forming member comprises a wall and the reinforcement of the pillar-forming member comprises a reinforcing projection projecting from the wall of the pillar-forming member.

20 96. The skate of claim 95, wherein the reinforcing projection of the pillar-forming member comprises a reinforcing rib.

97. The skate of any one of claims 93 and 94, wherein the reinforcement of the pillar-forming member comprises a plurality of reinforcing elements.

25 98. The skate of claim 97, wherein respective ones of the reinforcing elements of the pillar-forming member are spaced from one another.

99. The skate of any one of claims 97 and 98, wherein intersecting ones of the reinforcing elements of the pillar-forming member intersect one another.

30

100. The skate of any one of claims 97 to 99, wherein the pillar-forming member comprises a wall and the reinforcing elements of the pillar-forming member comprise reinforcing projections projecting from the wall of the pillar-forming member.

5

101. The skate of claim 100, wherein the reinforcing projections of the pillar-forming member comprise reinforcing ribs.

102. The skate of any one of claims 93 to 101, wherein the reinforcement of the
10 pillar-forming member comprises reinforcing fibers.

103. The skate of claim 102, wherein the reinforcing fibers of the pillar-forming member are carbon fibers.

15 104. The skate of any one of claims 92 to 103, wherein the core of the blade holder comprises a cap capping the cavity at least partly defined by the pillar-forming member.

105. The skate of claim 104, wherein the cap comprises a reinforcement.

20

106. The skate of claim 105, wherein: the core of the blade holder is affixed to the integrally-formed portion of the blade holder by overmolding; and the reinforcement of the cap is configured to maintain a shape of the cap during overmolding.

25

107. The skate of any one of claims 105 and 106, wherein the cap comprises a base and the reinforcement of the cap comprises a reinforcing projection projecting from the base of the cap.

30 108. The skate of claim 107, wherein the reinforcing projection of the cap comprises a reinforcing rib.

109. The skate of any one of claims 105 and 106, wherein the reinforcement of the cap comprises a plurality of reinforcing elements.

5 110. The skate of claim 109, wherein respective ones of the reinforcing elements of the cap are spaced from one another.

111. The skate of any one of claims 109 and 110, wherein intersecting ones of the reinforcing elements of the cap intersect one another.

10

112. The skate of any one of claims 109 to 111, wherein the cap comprises a base and the reinforcing elements of the cap comprise reinforcing projections projecting from the base of the cap.

15 113. The skate of claim 112, wherein the reinforcing projections of the cap comprise reinforcing ribs.

114. The skate of any one of claims 105 to 114, wherein the reinforcement of the cap comprises reinforcing fibers.

20

115. The skate of claim 114, wherein the reinforcing fibers of the cap are carbon fibers.

116. The skate of any one of claims 92 to 115, wherein: the blade holder
25 comprises a quick-connect system configured to attach the blade to and detach the blade from the blade holder; and at least part of the quick-connect system of the blade holder is disposed in the cavity defined at least partly by the pillar-forming member.

30 117. The skate of any one of claims 89 and 90, wherein the core of the blade holder comprises a front pillar-forming member extending upwardly from the

blade-retaining base and constituting at least part of the front pillar and a rear pillar-forming member extending upwardly from the blade-retaining base and constituting at least part of the rear pillar.

5 118. The skate of claim 117, wherein the core of the blade holder comprises a front cavity defined at least partly by the front pillar-forming member and a rear cavity defined at least partly by the rear pillar-forming member.

119. The skate of any one of claims 117 and 118, wherein the front pillar-forming member comprises a reinforcement and the rear pillar-forming member comprises a reinforcement.
10

120. The skate of claim 119, wherein: the core of the blade holder is affixed to the integrally-formed portion of the blade holder by overmolding; the reinforcement of the front pillar-forming member is configured to maintain a shape of the front pillar-forming member during overmolding; and the reinforcement of the rear pillar-forming member is configured to maintain a shape of the rear pillar-forming member during overmolding.
15

20 121. The skate of any one of claims 119 and 120, wherein: the front pillar-forming member comprises a wall and the reinforcement of the front pillar-forming member comprises a reinforcing projection projecting from the wall of the front pillar-forming member; and the rear pillar-forming member comprises a wall and the reinforcement of the rear pillar-forming member comprises a reinforcing projection projecting from the wall of the rear pillar-forming member.
25

122. The skate of claim 121, wherein: the reinforcing projection of the front pillar-forming member comprises a reinforcing rib; and the reinforcing projection of the rear pillar-forming member comprises a reinforcing rib.

30

123. The skate of any one of claims 119 and 120, wherein: the reinforcement of the front pillar-forming member comprises a plurality of reinforcing elements; and the reinforcement of the rear pillar-forming member comprises a plurality of reinforcing elements.

5

124. The skate of claim 123, wherein: respective ones of the reinforcing elements of the front pillar-forming member are spaced from one another; and respective ones of the reinforcing elements of the rear pillar-forming member are spaced from one another.

10

125. The skate of any one of claims 123 and 124, wherein: intersecting ones of the reinforcing elements of the front pillar-forming member intersect one another; and intersecting ones of the reinforcing elements of the rear pillar-forming member intersect one another.

15

126. The skate of any one of claims 123 to 125, wherein: the front pillar-forming member comprises a wall and the reinforcing elements of the front pillar-forming member comprise reinforcing projections projecting from the wall of the front pillar-forming member; and the rear pillar-forming member comprises a wall and the reinforcing elements of the rear pillar-forming member comprise reinforcing projections projecting from the wall of the rear pillar-forming member.

20

127. The skate of claim 126, wherein: the reinforcing projections of the front pillar-forming member comprise reinforcing ribs; and the reinforcing projections of the rear pillar-forming member comprise reinforcing ribs.

25

128. The skate of any one of claims 119 to 127, wherein: the reinforcement of the front pillar-forming member comprises reinforcing fibers; and the reinforcement of the rear pillar-forming member comprises reinforcing fibers.

30

129. The skate of claim 128, wherein: the reinforcing fibers of the front pillar-forming member are carbon fibers; and the reinforcing fibers of the rear pillar-forming member are carbon fibers.

5 130. The skate of any one of claims 118 to 129, wherein the core of the blade holder comprises a front cap capping the front cavity at least partly defined by the front pillar-forming member and a rear cap capping the rear cavity at least partly defined by the rear pillar-forming member.

10 131. The skate of claim 130, wherein the front cap comprises a reinforcement and the rear cap comprises a reinforcement.

132. The skate of claim 131, wherein: the core of the blade holder is affixed to the integrally-formed portion of the blade holder by overmolding; the reinforcement
15 of the front cap is configured to maintain a shape of the front cap during overmolding; and the reinforcement of the rear cap is configured to maintain a shape of the rear cap during overmolding.

133. The skate of any one of claims 131 and 132, wherein: the front cap comprises
20 a base and the reinforcement of the front cap comprises a reinforcing projection projecting from the base of the front cap; and the rear cap comprises a base and the reinforcement of the rear cap comprises a reinforcing projection projecting from the base of the rear cap.

25 134. The skate of claim 133, wherein: the reinforcing projection of the front cap comprises a reinforcing rib; and the reinforcing projection of the rear cap comprises a reinforcing rib.

135. The skate of any one of claims 131 and 132, wherein: the reinforcement of
30 the front cap comprises a plurality of reinforcing elements; and the reinforcement of the rear cap comprises a plurality of reinforcing elements.

136. The skate of claim 135, wherein: respective ones of the reinforcing elements of the front cap are spaced from one another; and respective ones of the reinforcing elements of the rear cap are spaced from one another.

5

137. The skate of any one of claims 135 and 136, wherein: intersecting ones of the reinforcing elements of the front cap intersect one another; and intersecting ones of the reinforcing elements of the rear cap intersect one another.

10 138. The skate of any one of claims 135 to 137, wherein: the front cap comprises a base and the reinforcing elements of the front cap comprise reinforcing projections projecting from the base of the front cap; and the rear cap comprises a base and the reinforcing elements of the rear cap comprise reinforcing projections projecting from the base of the rear cap.

15

139. The skate of claim 138, wherein: the reinforcing projections of the front cap comprise reinforcing ribs; and the reinforcing projections of the rear cap comprise reinforcing ribs.

20 140. The skate of any one of claims 119 to 139, wherein: the reinforcement of the front cap comprises reinforcing fibers; and the reinforcement of the rear cap comprises reinforcing fibers.

25 141. The skate of claim 140, wherein: the reinforcing fibers of the front cap are carbon fibers; and the reinforcing fibers of the rear cap are carbon fibers.

142. A skate for skating on ice, the skate comprising:
- a skate boot configured 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
30 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; and

- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising an integrally-formed portion formed integrally with the body of the skate boot, the blade holder comprising a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder;

wherein: the blade holder comprises a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot; the core of the blade holder comprises a pillar-forming member extending upwardly from the blade-retaining base and constituting at least part of a given one of the front pillar and the rear pillar; the core of the blade holder comprises a cavity defined at least partly by the pillar-forming member; and the pillar-forming member comprises a reinforcement.

143. A skate for skating on ice, the skate comprising:

- a skate boot configured 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; and
- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising an integrally-formed portion formed integrally with the body of the skate boot, the blade holder comprising a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder;

wherein: the blade holder comprises a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot; the core of the blade holder comprises a

pillar-forming member extending upwardly from the blade-retaining base and constituting at least part of a given one of the front pillar and the rear pillar; the core of the blade holder comprises a cavity defined at least partly by the pillar-forming member; the core of the blade holder comprises a cap capping the cavity at least partly defined by the pillar-forming member; the pillar-forming member comprises a reinforcement; and the cap comprises a reinforcement.

144. A skate for skating on ice, the skate comprising:

- a skate boot configured 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; and
- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot, a given one of the front pillar and the rear pillar extending downwardly from a respective one of a front sole part of the skate boot and a rear sole part of the skate boot, a width of the given one of the front pillar and the rear pillar being at least 80% of a width of the respective one of the front sole part of the skate boot and the rear sole part of the skate boot.

145. The skate of claim 144, wherein the width of the given one of the front pillar and the rear pillar is at least 90% of the width of the respective one of the front sole part of the skate boot and the rear sole part of the skate boot.

146. The skate of claim 144, wherein the width of the given one of the front pillar and the rear pillar is at least 95% of the width of the respective one of the front sole part of the skate boot and the rear sole part of the skate boot.

147. The skate of claim 144, wherein the width of the given one of the front pillar and the rear pillar is at least 100% of the width of the respective one of the front sole part of the skate boot and the rear sole part of the skate boot.

5

148. The skate of any one of claims 144 to 147, wherein the blade holder is configured to hold the blade such that the blade is unsupported by the blade holder between the front pillar and the rear pillar.

10 149. The skate of claim 148, wherein the blade holder is free of a bridge interconnecting the front pillar and the rear pillar.

150. The skate of any one of claims 144 to 149, wherein a modulus of elasticity of a material of the given one of the front pillar and the rear pillar is at least 300 MPa.

15

151. The skate of any one of claims 144 to 149, wherein a modulus of elasticity of a material of the given one of the front pillar and the rear pillar is at least 1000 GPa.

20

152. The skate of any one of claims 144 to 149, wherein a modulus of elasticity of a material of the given one of the front pillar and the rear pillar is at least 10 GPa.

25 153. The skate of any one of claims 144 to 152, wherein the blade holder comprises: an integrally-formed portion formed integrally with the body of the skate boot; and a core formed separately from the integrally-formed portion of the blade holder and the body of the skate boot and affixed to the integrally-formed portion of the blade holder.

30

154. The skate of claim 153, wherein the core of the blade holder is affixed to the integrally-formed portion of the blade holder by overmolding.

5 155. The skate of any one of claims 153 and 154, wherein the integrally-formed portion of the blade holder is overmolded onto the core of the blade holder.

156. The skate of any one of claims 153 to 155, wherein the core of the blade holder comprises a pillar-forming member extending upwardly from the blade-retaining base and constituting at least part of the given one of the front pillar
10 and the rear pillar.

157. The skate of claim 156, wherein the core of the blade holder comprises a cavity defined at least partly by the pillar-forming member.

15 158. The skate of claim 157, wherein the pillar-forming member comprises a reinforcement.

159. The skate of any one of claims 144 to 134, wherein: the given one of the front pillar and the rear pillar is the front pillar; the respective one of the front sole part
20 of the skate boot and the rear sole part of the skate boot is the front sole part of the skate boot; the rear pillar extends downwardly from the rear sole part of the skate boot; and a width of the rear pillar is at least 80% of a width of the rear sole part of the skate boot.

25 160. The skate of claim 159, wherein the width of the rear pillar is at least 90% of the width of the rear sole part of the skate boot.

161. The skate of claim 159, wherein the width of the rear pillar is at least 95% of the width of the rear sole part of the skate boot.

30

162. The skate of claim 159, wherein the width of the rear pillar is at least 100% of the width of the rear sole part of the skate boot.

163. A skate for skating on ice, the skate comprising:

- 5 - a skate boot configured 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; and
- 10 - a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot, a
- 15 given one of the front pillar and the rear pillar extending downwardly from a respective one of a front sole part of the skate boot and a rear sole part of the skate boot and being at least as wide as the respective one of the front sole part of the skate boot and the rear sole part of the skate boot.

20 164. A skate for skating on ice, the skate comprising:

- a skate boot configured 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
- 25 ankle of the user; and
- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that
- 30 extend upwardly from the blade-retaining base towards the skate boot, the

blade holder being configured to hold the blade such that the blade is unsupported by the blade holder between the front pillar and the rear pillar.

165. A skate for skating on ice, the skate comprising:

- 5 - a skate boot configured 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; and
- 10 - a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising a blade-retaining base configured to retain the blade and a support extending upwardly from the blade-retaining base towards the skate boot, the blade-retaining base comprising a blade-receiving slot extending from a front portion of the blade-
- 15 retaining base to a rear portion of the blade-retaining base and configured to receive the blade, the blade-receiving slot being wider in an intermediate portion of the blade-retaining base between the front portion of the blade-retaining base and the rear portion of the blade-retaining base than in the front portion of the blade-retaining base and in the rear portion of the blade-
- 20 retaining base.

166. The skate of claim 165, wherein a ratio of a width of the blade-receiving slot in the intermediate portion of the blade-retaining base over the width of the blade-receiving slot in a given one of the front portion of the blade-retaining base and

25 the rear portion of the blade-retaining base is at least 1.3.

167. The skate of claim 165, wherein a ratio of a width of the blade-receiving slot in the intermediate portion of the blade-retaining base over the width of the blade-receiving slot in a given one of the front portion of the blade-retaining base and

30 the rear portion of the blade-retaining base is at least 1.5.

168. The skate of claim 165, wherein a ratio of a width of the blade-receiving slot in the intermediate portion of the blade-retaining base over the width of the blade-receiving slot in a given one of the front portion of the blade-retaining base and the rear portion of the blade-retaining base is at least 2.

5

169. The skate of any one of claims 165 to 168, wherein a ratio of a width of the blade-receiving slot in the intermediate portion of the blade-retaining base over a narrowest dimension of the blade holder in a widthwise direction of the blade holder is at least 2.

10

170. The skate of any one of claims 165 to 168, wherein a ratio of a width of the blade-receiving slot in the intermediate portion of the blade-retaining base over a narrowest dimension of the blade holder in a widthwise direction of the blade holder is at least 5.

15

171. The skate of any one of claims 165 to 168, wherein a ratio of a width of the blade-receiving slot in the intermediate portion of the blade-retaining base over a narrowest dimension of the blade holder in a widthwise direction of the blade holder is at least 10.

20

172. The skate of any one of claims 165 to 171, wherein a width of the blade-receiving slot in the intermediate portion of the blade-retaining base is greater than 3 mm.

25

173. The skate of any one of claims 165 to 171, wherein a width of the blade-receiving slot in the intermediate portion of the blade-retaining base is at least 4 mm.

30

174. The skate of any one of claims 165 to 171, wherein a width of the blade-receiving slot in the intermediate portion of the blade-retaining base is at least 5 mm.

175. The skate of any one of claims 165 to 171, wherein a width of the blade-receiving slot in the intermediate portion of the blade-retaining base is at least 6 mm.

5

176. The skate of any one of claims 165 to 175, wherein the support comprises a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot.

10 177. The skate of claim 176, wherein the blade-receiving slot is wider between the front pillar and the rear pillar than beneath the front pillar and beneath the rear pillar.

15 178. The skate boot of any one of claims 165 to 177, wherein at least part of the blade holder is formed integrally with the body of the skate boot.

179. A skate for skating on ice, the skate comprising:

- a skate boot configured 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; and
- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, the blade holder comprising a blade-retaining base configured to retain the blade and a front pillar and a rear pillar that extend upwardly from the blade-retaining base towards the skate boot, the blade-retaining base comprising a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade, the blade-receiving slot being wider between the front pillar and the rear pillar than beneath the front pillar and beneath the rear pillar.

180. A blade holder for a skate for skating on ice, the skate comprising a skate boot configured 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, the blade holder being configured to be disposed below the skate boot and hold a blade for engaging the ice, the blade holder comprising"

- a blade-retaining base configured to retain the blade; and

- a front pillar and a rear pillar that extend upwardly from the blade-retaining base;

wherein: the blade-retaining base comprises a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade; and the blade-receiving slot is wider between the front pillar and the rear pillar than beneath the front pillar and beneath the rear pillar.

181. A blade holder for a skate for skating on ice, the skate comprising a skate boot configured 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, the blade holder being configured to be disposed below the skate boot and hold a blade for engaging the ice, the blade holder comprising"

- a blade-retaining base configured to retain the blade; and

- a support extending upwardly from the blade-retaining base;

wherein: the blade-retaining base comprises a blade-receiving slot extending from a front portion of the blade-retaining base to a rear portion of the blade-retaining base and configured to receive the blade; and the blade-receiving slot is wider in an intermediate portion of the blade-retaining base between the front portion of the blade-retaining base and the rear portion of the blade-retaining

base than in the front portion of the blade-retaining base and in the rear portion of the blade-retaining base.

182. A skate boot for a skate, the skate boot being configured to receive a foot of a user and 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 face an ankle of the user, the body of the skate boot comprising graphical ink implementing graphics and provided by a film, the graphical ink covering at least a majority of a surface area of an ink-providing side of the film providing the graphical ink.

183. The skate boot of claim 182, wherein the graphical ink covers at least 60% of the surface area of the ink-providing side of the film.

184. The skate boot of claim 182, wherein the graphical ink covers at least 80% of the surface area of the ink-providing side of the film.

185. The skate boot of claim 182, wherein the graphical ink covers substantially an entirety of the surface area of the ink-providing side of the film.

186. The skate boot of any one of claims 182 to 185, wherein the graphical ink is disposed at least in the medial side portion and the lateral side portion of the body of the skate boot.

187. The skate boot of any one of claims 182 to 185, wherein the graphical ink is disposed at least in the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the body of the skate boot.

188. The skate boot of any one of claims 182 to 187, wherein: the medial side portion, the lateral side portion, the heel portion, and the ankle portion of the skate boot are formed integrally with one another.

5 189. The skate boot of any one of claims 182 to 188, wherein the body of the skate boot includes a clear layer over the graphical ink.

190. The skate boot of any one of claims 182 to 188, wherein the body of the skate boot includes a plurality of layers formed integrally with one another by flowing in
10 a molding apparatus.

191. The skate boot of claim 190, wherein: the graphical ink is disposed between a first one of the layers and a second one of the layers of the body of the skate boot; and the first one of the layers of the body of the skate boot is clear.

15

192. The skate boot of any one of claims 182 to 191, comprising the film.

193. The skate boot of any one of claims 182 to 191, wherein the film is a removable film providing the graphical ink in the skate boot and removed from
20 the skate boot while the graphical ink remains in the skate boot.

194. A method of making a skate boot for a skate, the skate boot being configured to receive a foot of a user, the method comprising:

- 25 - forming a body of the skate boot 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 face an ankle of the user; and
- positioning a film including graphical ink to implement graphics on the body of the skate boot, the graphical ink covering at least a majority of a surface
30 area of an ink-providing side of the film providing the graphical ink.

195. The method of claim 194, comprising leaving the film in the body of the skate boot such that the film is part of the skate.

196. The method of claim 194, comprising removing the film from the skate boot while the graphical ink remains in the skate boot.

197. A skate boot for a skate, the skate boot being configured to receive a foot of a user and 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 face an ankle of the user, the body of the skate boot including:

- a plurality of layers formed integrally with one another by flowing in a molding apparatus;
- graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the skate boot, the graphical ink being solventless.

198. A skate boot for a skate, the skate boot being configured to receive a foot of a user and 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 face an ankle of the user, the body of the skate boot including:

- a plurality of layers formed integrally with one another by flowing in a molding apparatus;
- graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the skate boot, a surface energy of the graphical ink being less than 32 dynes/cm.

199. An article of footwear configured to receive a foot of a user, the article of footwear 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, and a heel portion to receive a heel of the user's foot, the body of the article of footwear including:

- a plurality of layers formed integrally with one another by flowing in a molding apparatus;

5 - graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the article of footwear, the graphical ink being solventless.

200. An article of footwear configured to receive a foot of a user, the article of footwear 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, and a heel portion to receive a heel of the user's foot, the body of the article of footwear including:

15 - a plurality of layers formed integrally with one another by flowing in a molding apparatus;

- graphical ink implementing graphics and disposed between a first one of the layers and a second one of the layers of the body of the article of footwear, a surface energy of the graphical ink being less than 32 dynes/cm.

20 201. A skate for skating on ice, the skate comprising:

- a skate boot configured 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; and
- a blade holder disposed below the skate boot and configured to hold a blade for engaging the ice, at least part of the blade holder being formed integrally with the body of the skate boot;

25 wherein the skate comprises a graphical element extending from the skate boot to the blade holder such that the skate boot comprises an upper portion of the graphical element and the blade holder comprises a lower portion of the

graphical element visually continuous with the upper portion of the graphical element.

202. The skate of claim 201, wherein: the blade holder comprises a blade-retaining
5 base configured to retain the blade and a front pillar and a rear pillar that extend
upwardly from the blade-retaining base towards the skate boot; and a given one
of the front pillar and the rear pillar comprises the lower portion of the graphical
element.

10 203. The skate of claim 201, wherein: the graphical element is a first graphical
element; the skate comprises a second graphical element extending from the
skate boot to the blade holder such that the skate boot comprises an upper
portion of the second graphical element and the blade holder comprises a lower
portion of the second graphical element visually continuous with the upper
15 portion of the second graphical element.

204. The skate of claim 203, wherein: the blade holder comprises a blade-retaining
base configured to retain the blade and a front pillar and a rear pillar that extend
20 upwardly from the blade-retaining base towards the skate boot; the front pillar
comprises the lower portion of the first graphical element; and the rear pillar
comprises the lower portion of the second graphical element.

205. The skate of any one of claims 201 to 204, wherein: the graphical element
25 exhibits a plurality of different colors; the upper portion of the graphical element
exhibits the different colors; and the lower portion of the second graphical
element exhibits the different colors.

206. A skate boot for a skate, the skate boot being configured to receive a foot of a
30 user and 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 face an ankle of the user, the body of the skate boot including a plurality of layers formed integrally with one another by flowing in a molding apparatus, wherein a given one of the layers comprises an opening that opens onto an adjacent one of the layers.

207. The skate boot of claim 206, wherein the given one of the layers is disposed outwardly of the adjacent one of the layers.

208. The skate boot of claim 206, wherein the given one of the layers is an outermost one of the layers.

209. The skate boot of any one of claims 206 to 208, wherein the given one of the layers is clear.

210. The skate boot of any one of claims 206 to 209, wherein the adjacent one of the layers comprises a graphical element visible through the opening of the given one of the layers.

211. The skate boot of any one of claims 206 to 210, wherein the opening of the given one of the layers is one of a plurality of openings of the given one of the layers that open onto the adjacent one of the layers.

212. An article of footwear configured to receive a foot of a user, the article of footwear 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 face an ankle of the user, the body of the article of footwear including a plurality of layers formed integrally with one another by flowing in a molding apparatus, wherein a given one of the layers comprises an opening that opens onto an adjacent one of the layers.

1/121

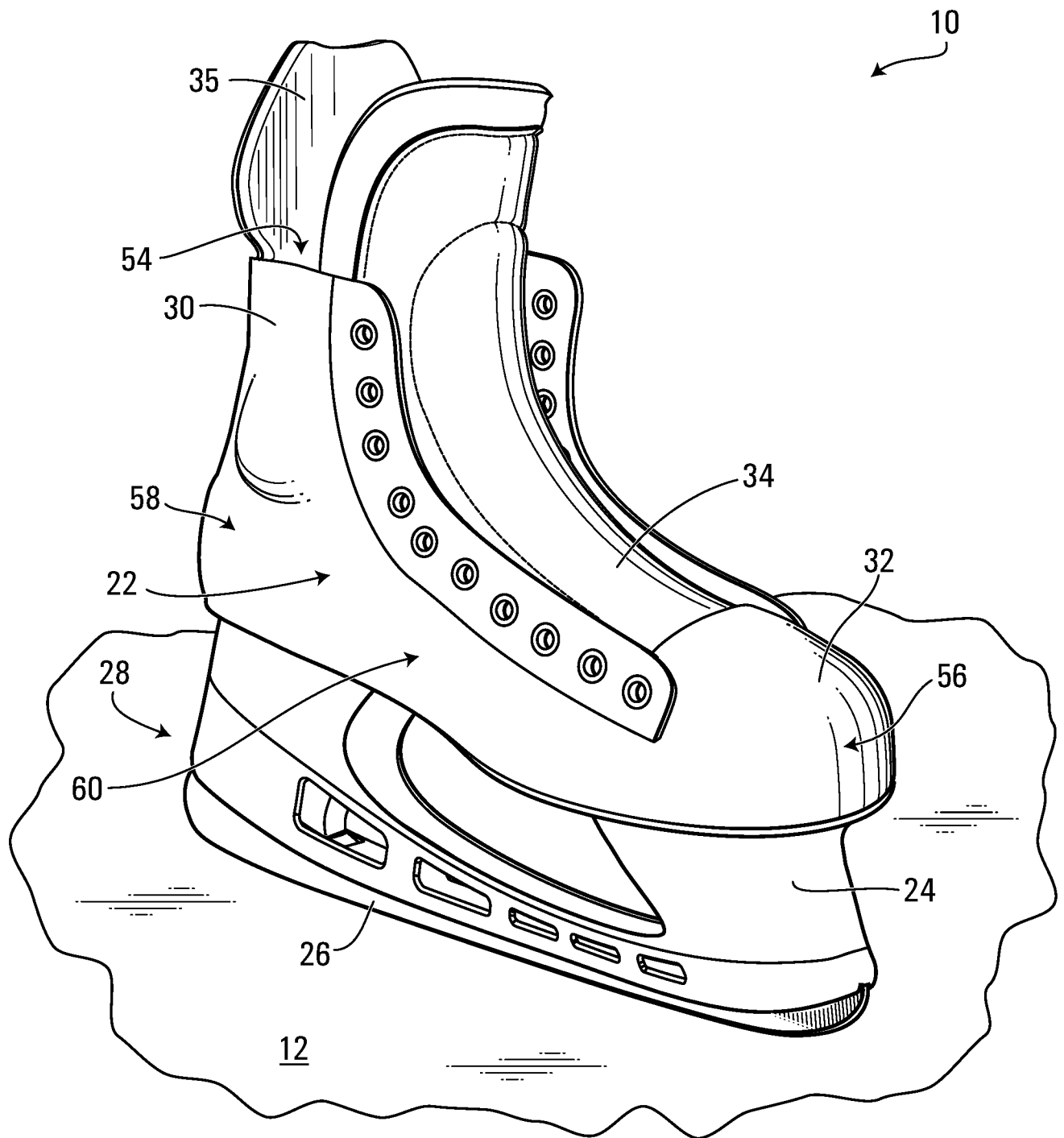


FIG. 1

2/121

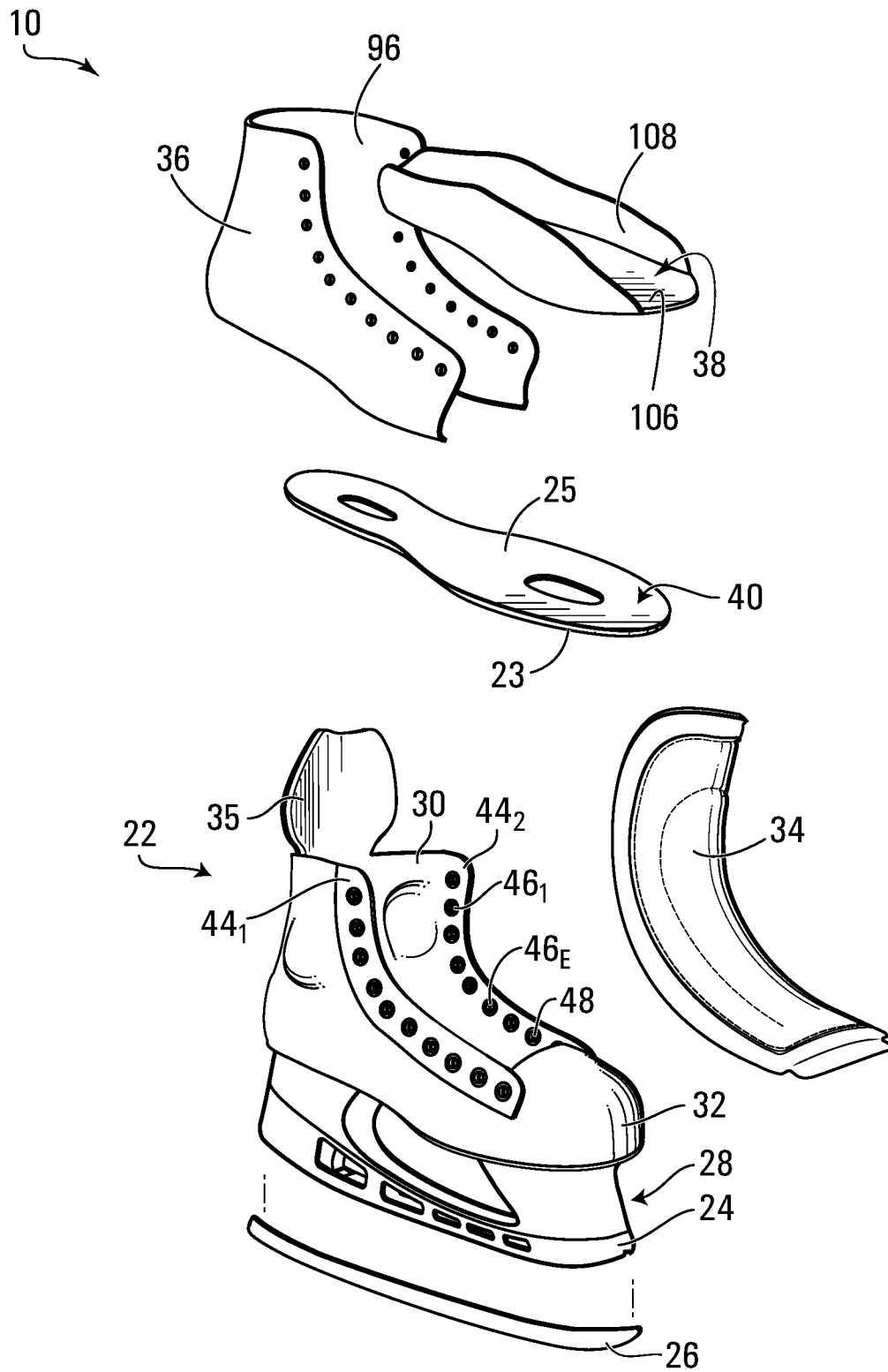
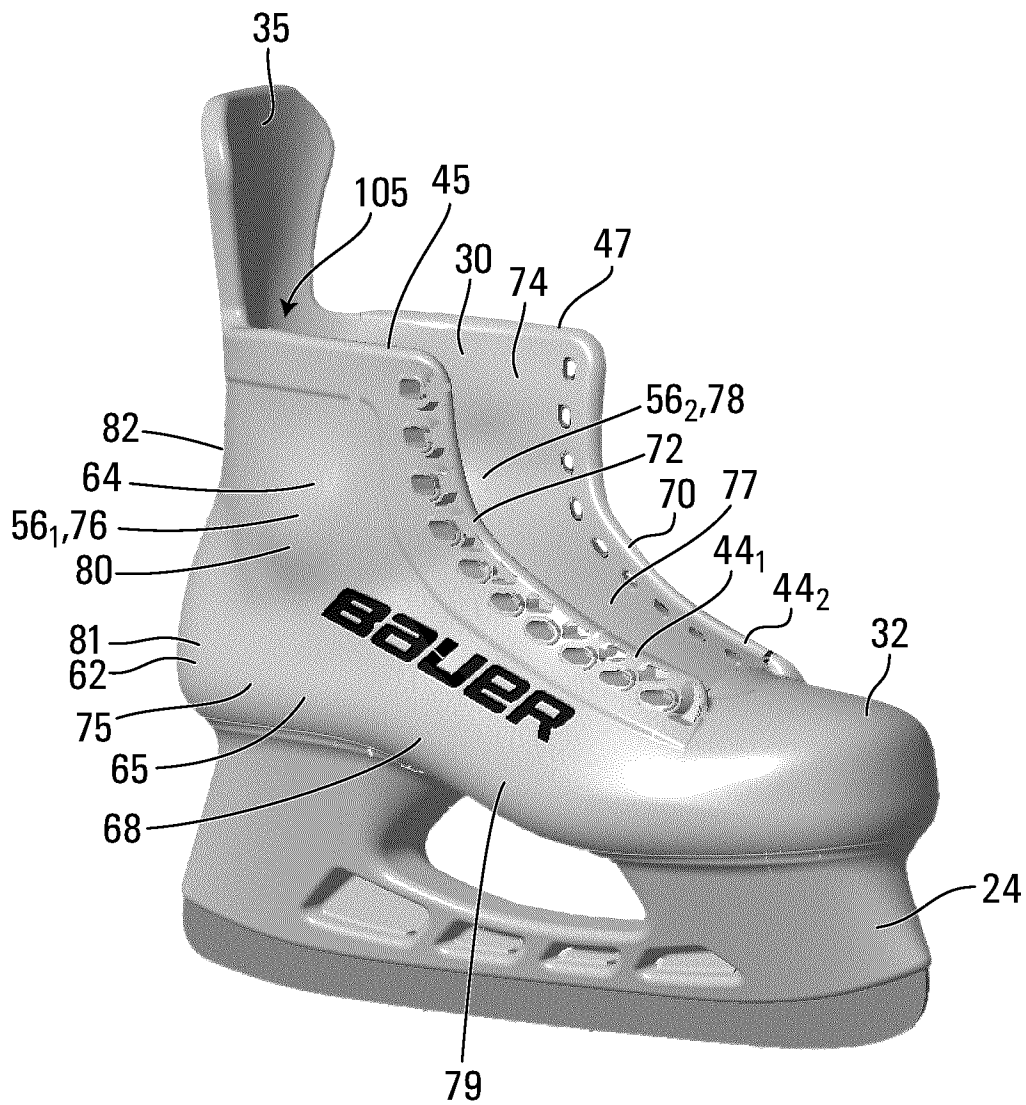
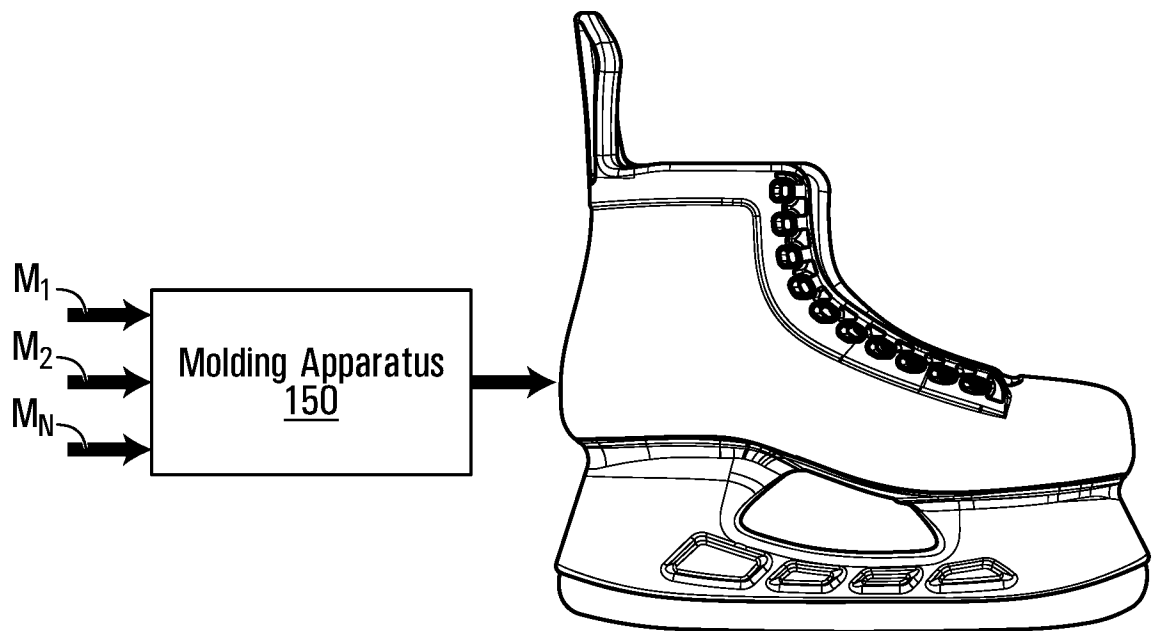


FIG. 2

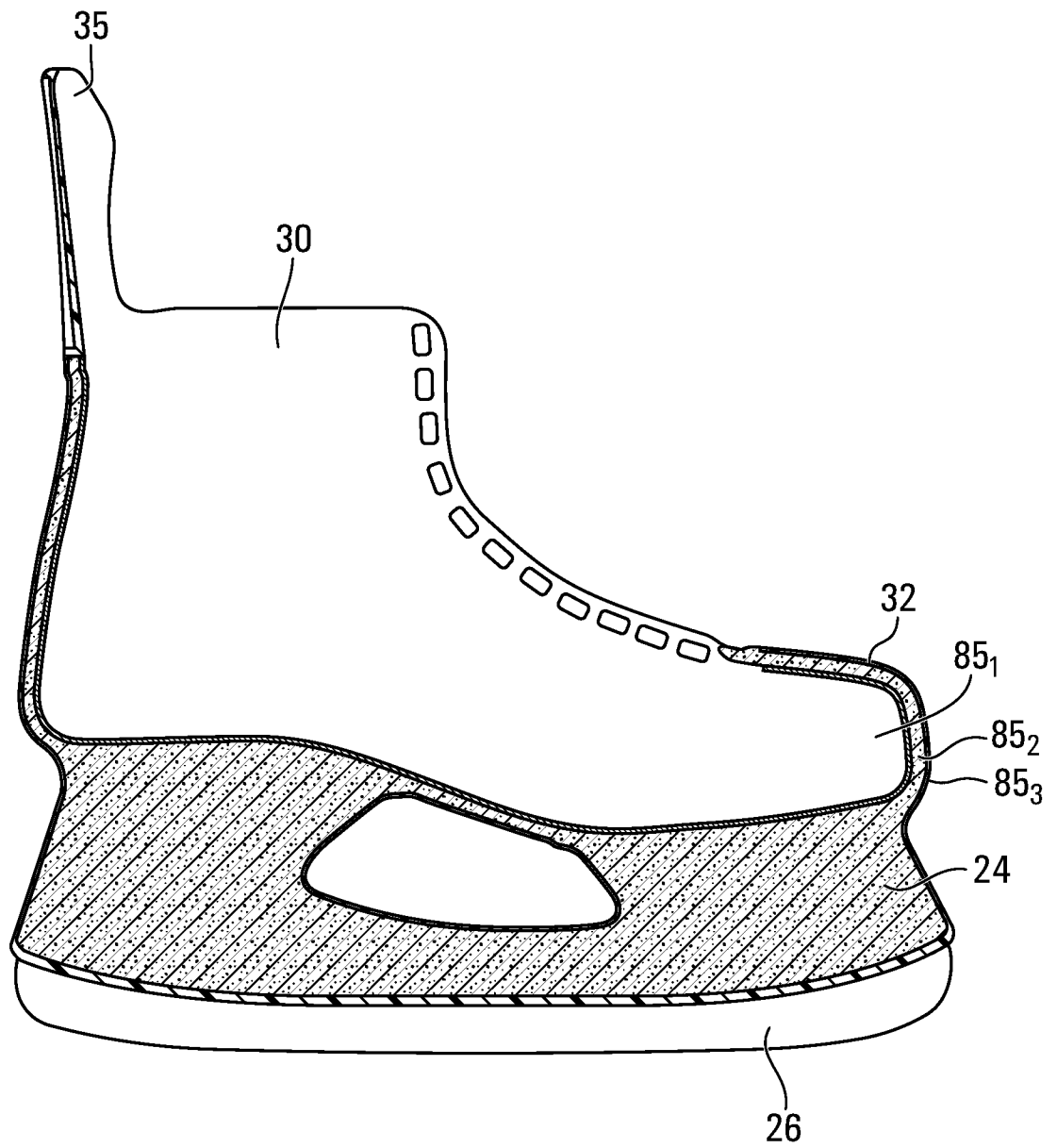
3/121

**FIG. 3**

4/121

**FIG. 4**

5/121

**FIG. 5**

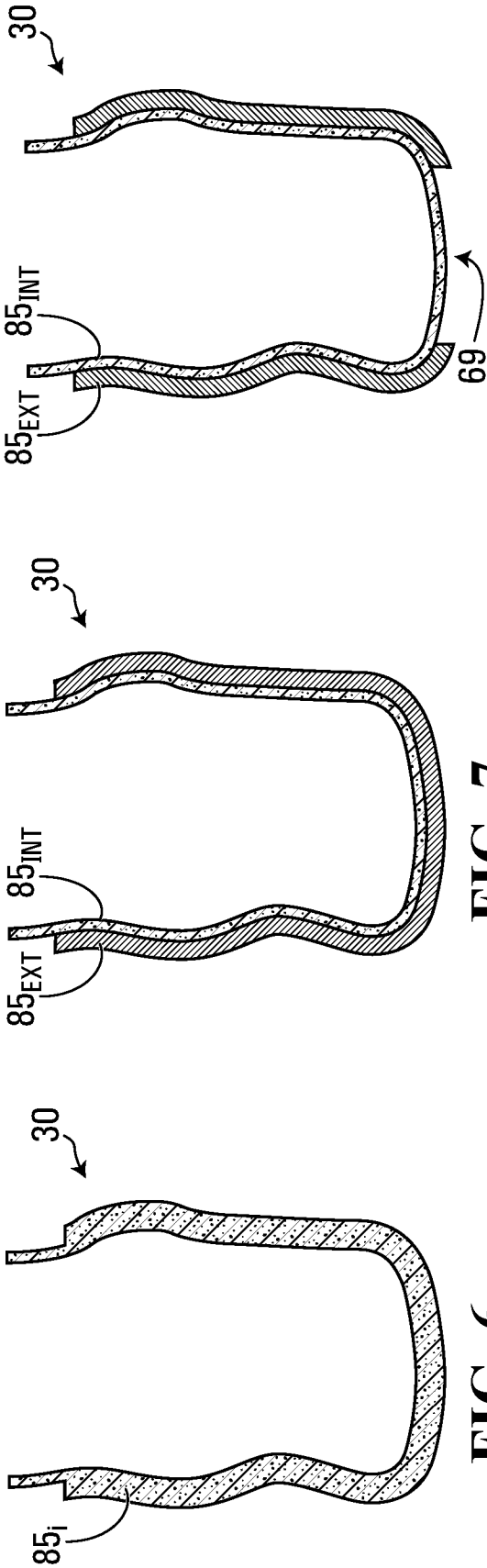


FIG. 8

FIG. 7

FIG. 6

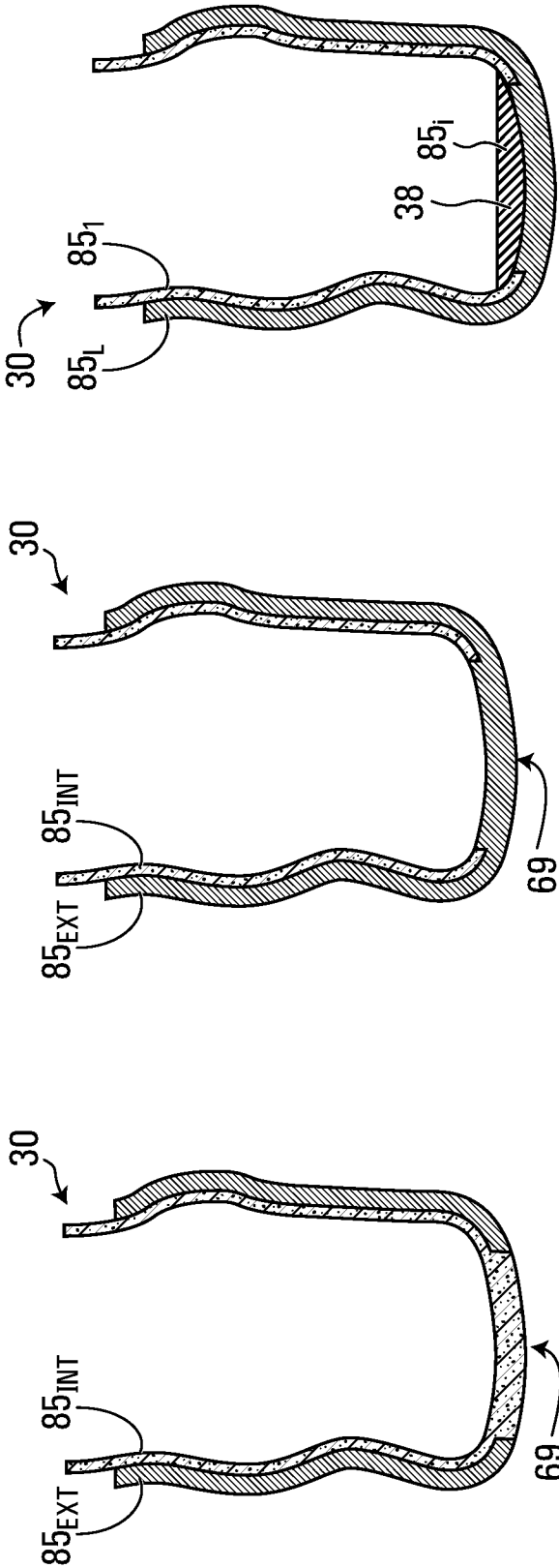


FIG. 11

FIG. 10

FIG. 9

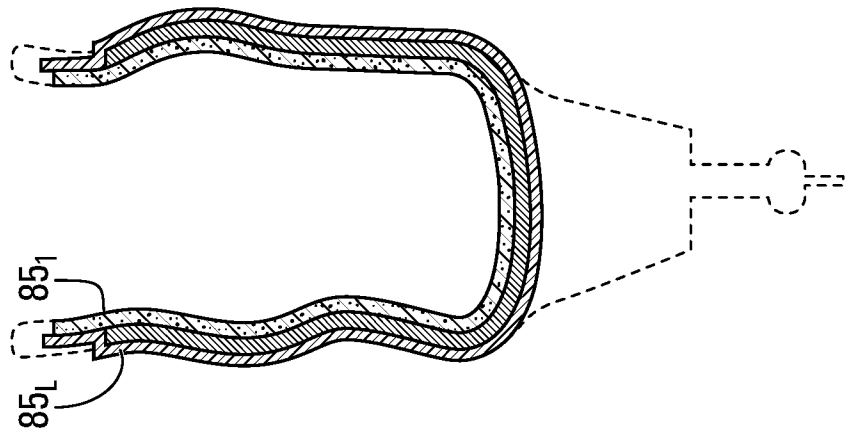


FIG. 14

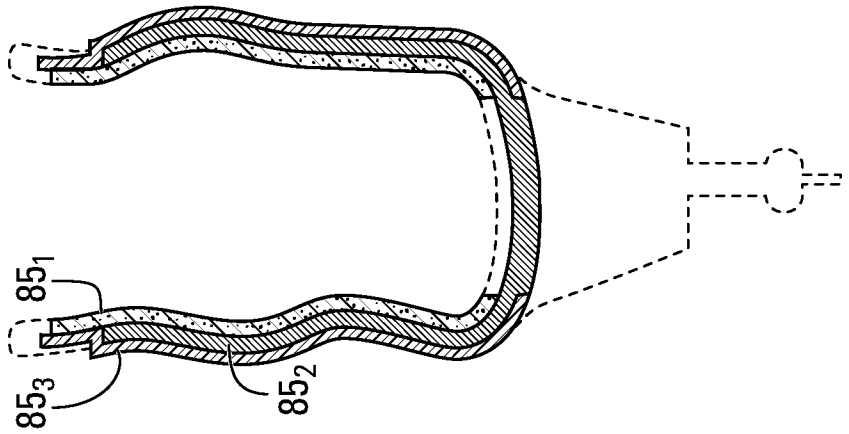


FIG. 13

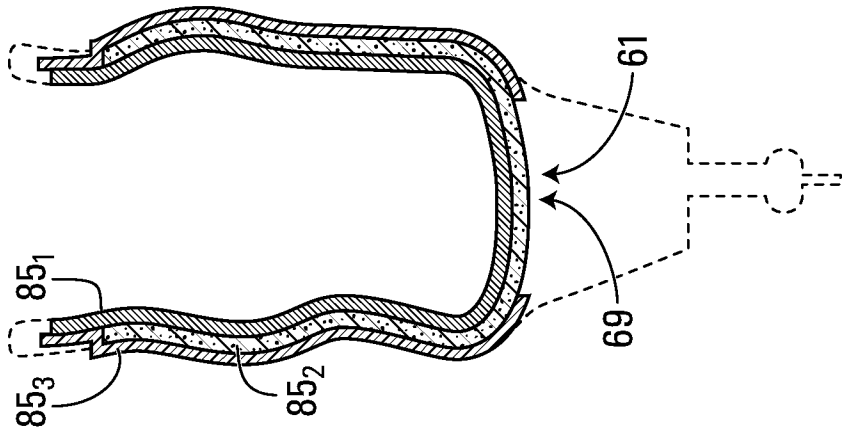


FIG. 12

8/121



FIG. 15

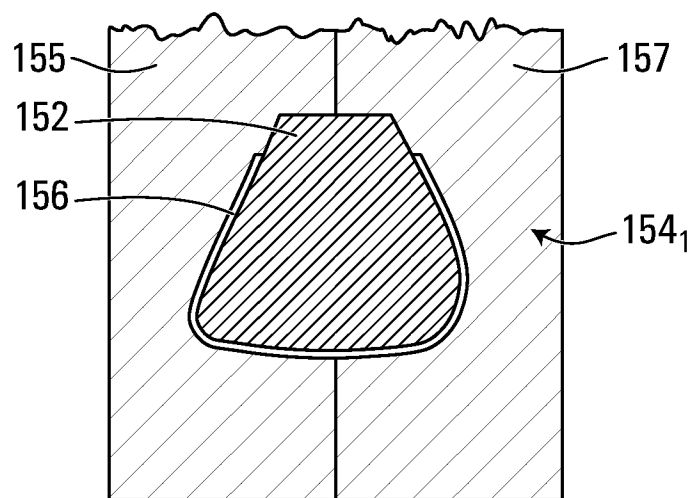


FIG. 16

9/121

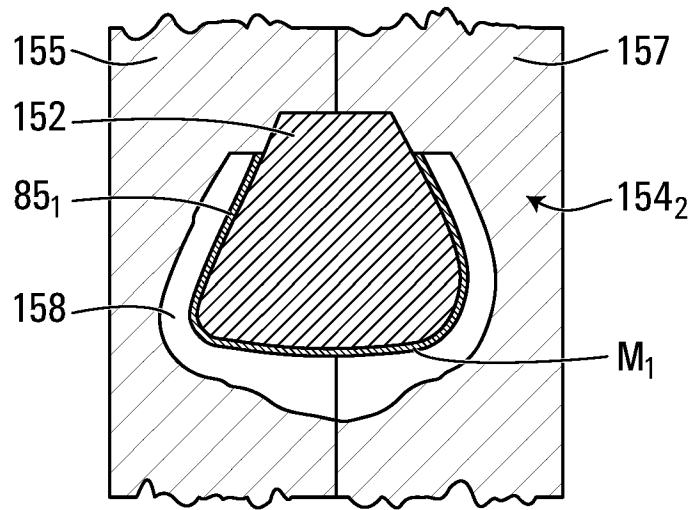


FIG. 17

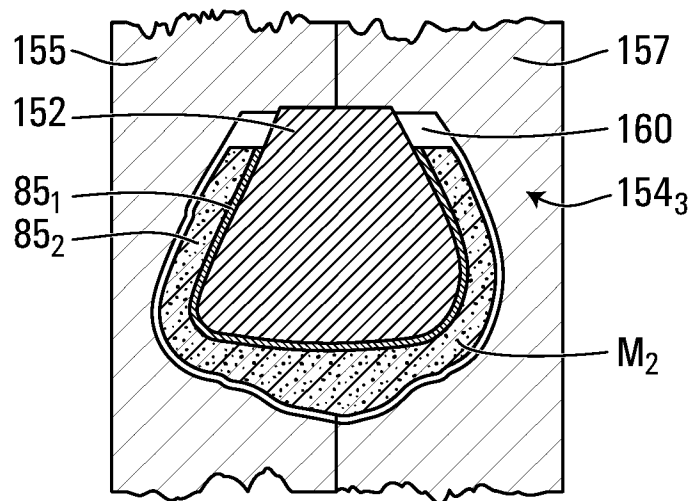


FIG. 18

10/121

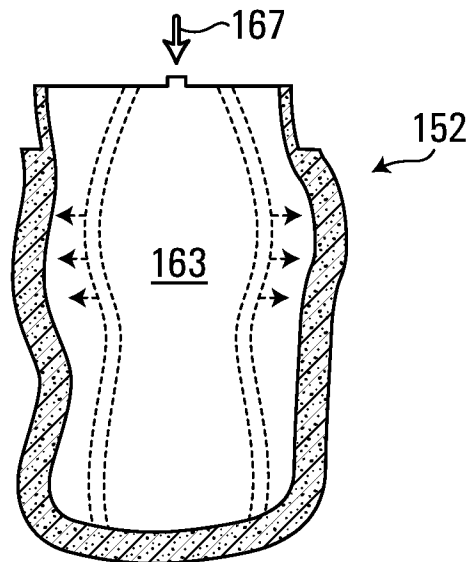


FIG. 19

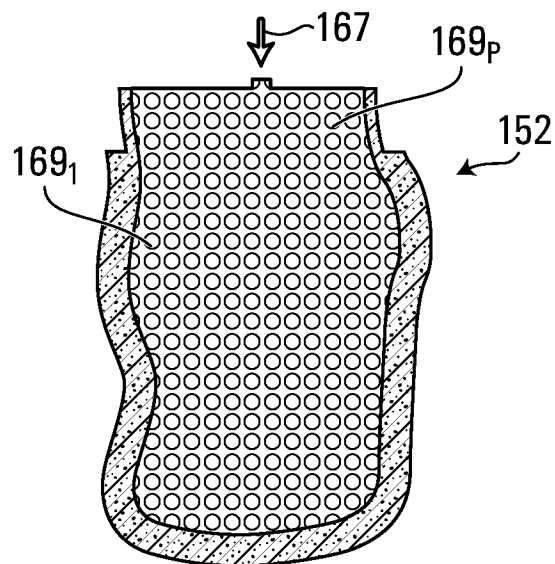


FIG. 20

11/121

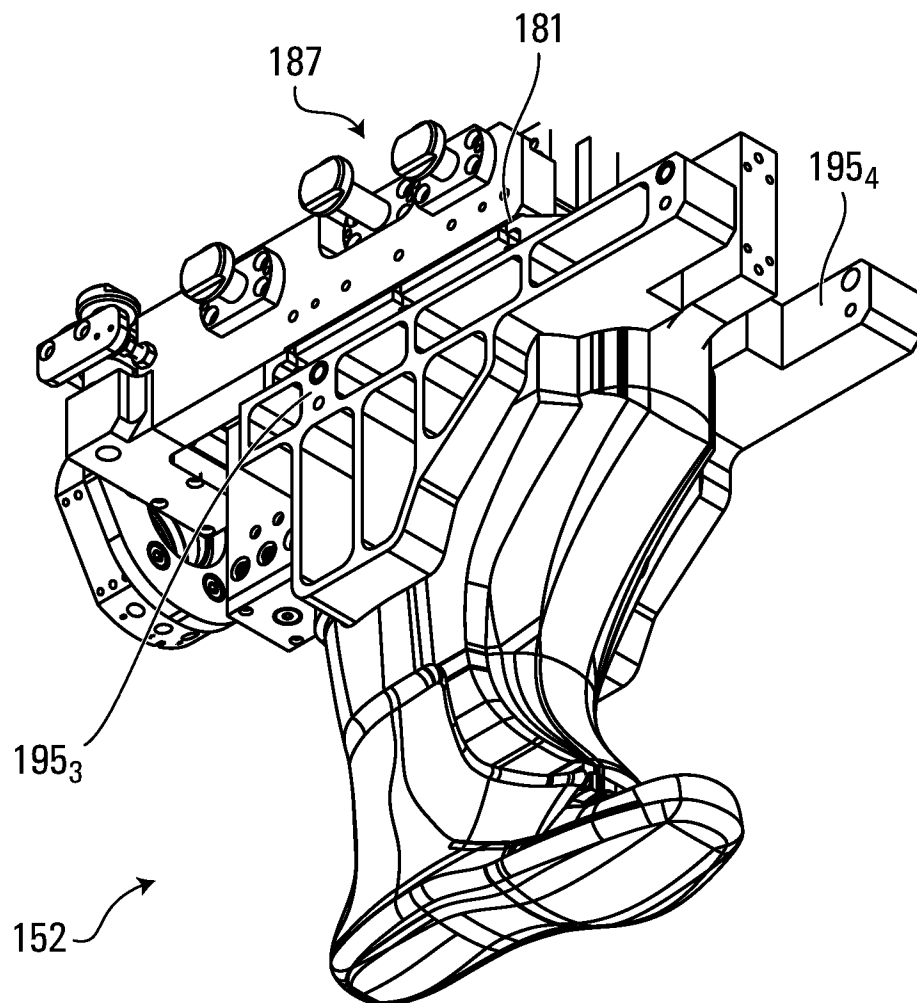


FIG. 21

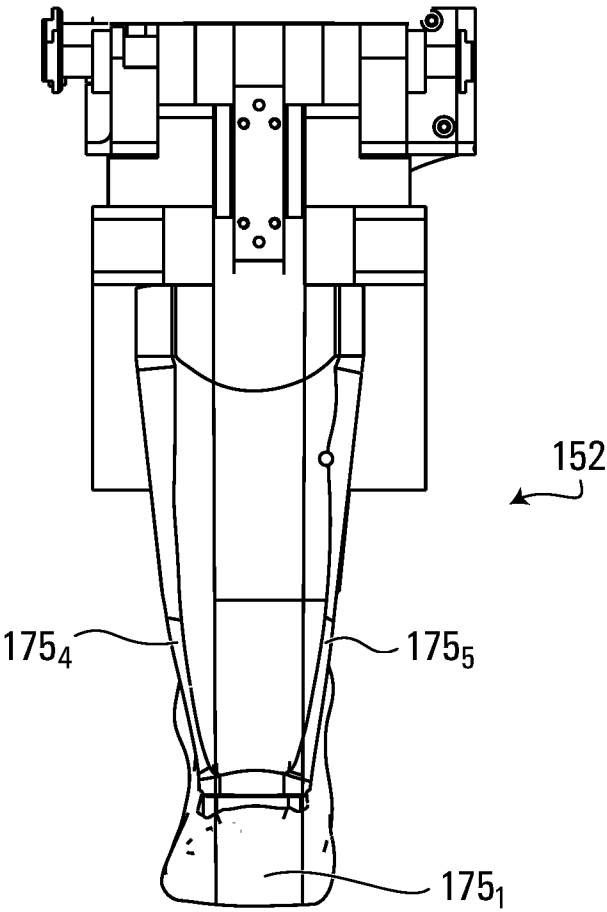


FIG. 22

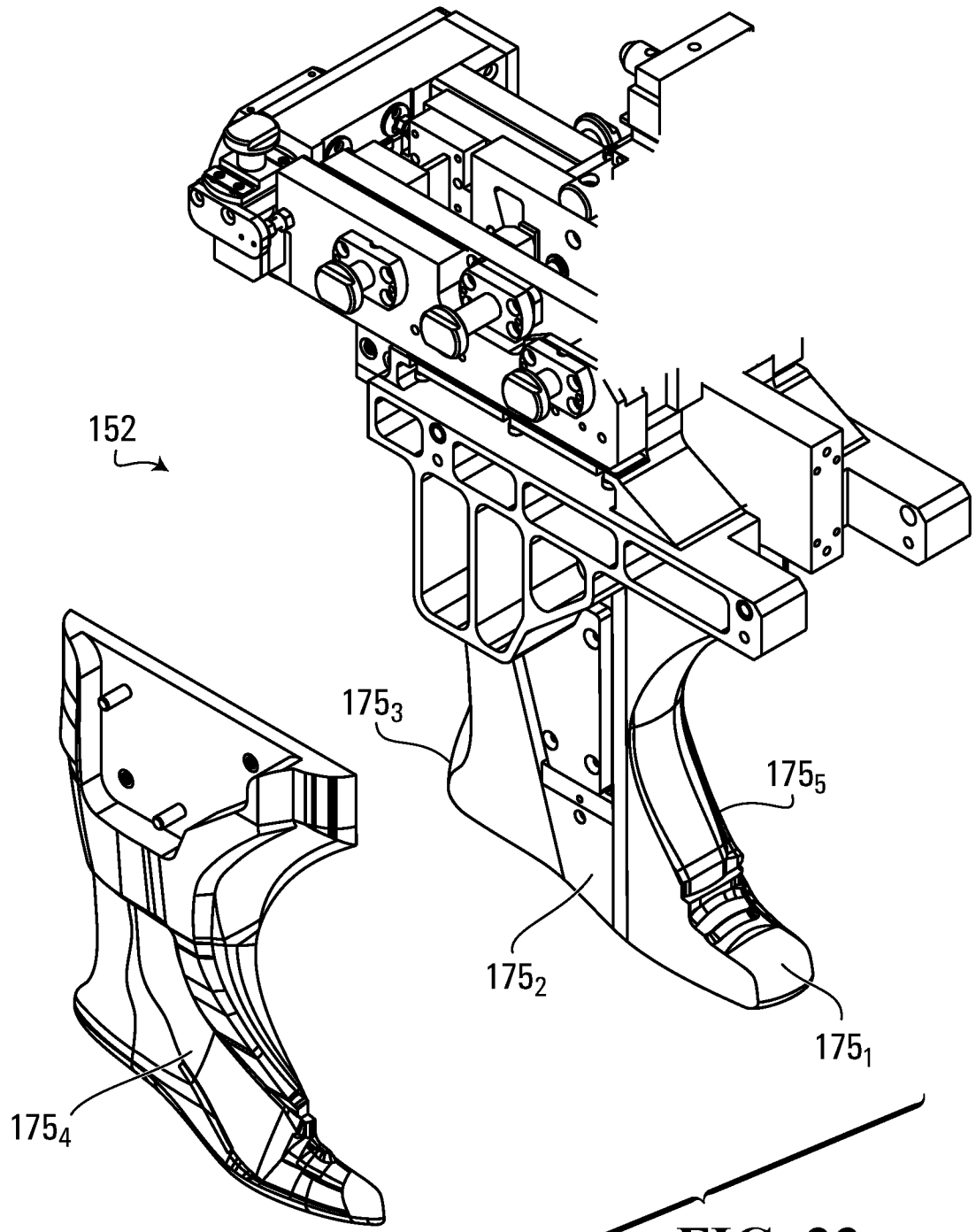


FIG. 23

14/121

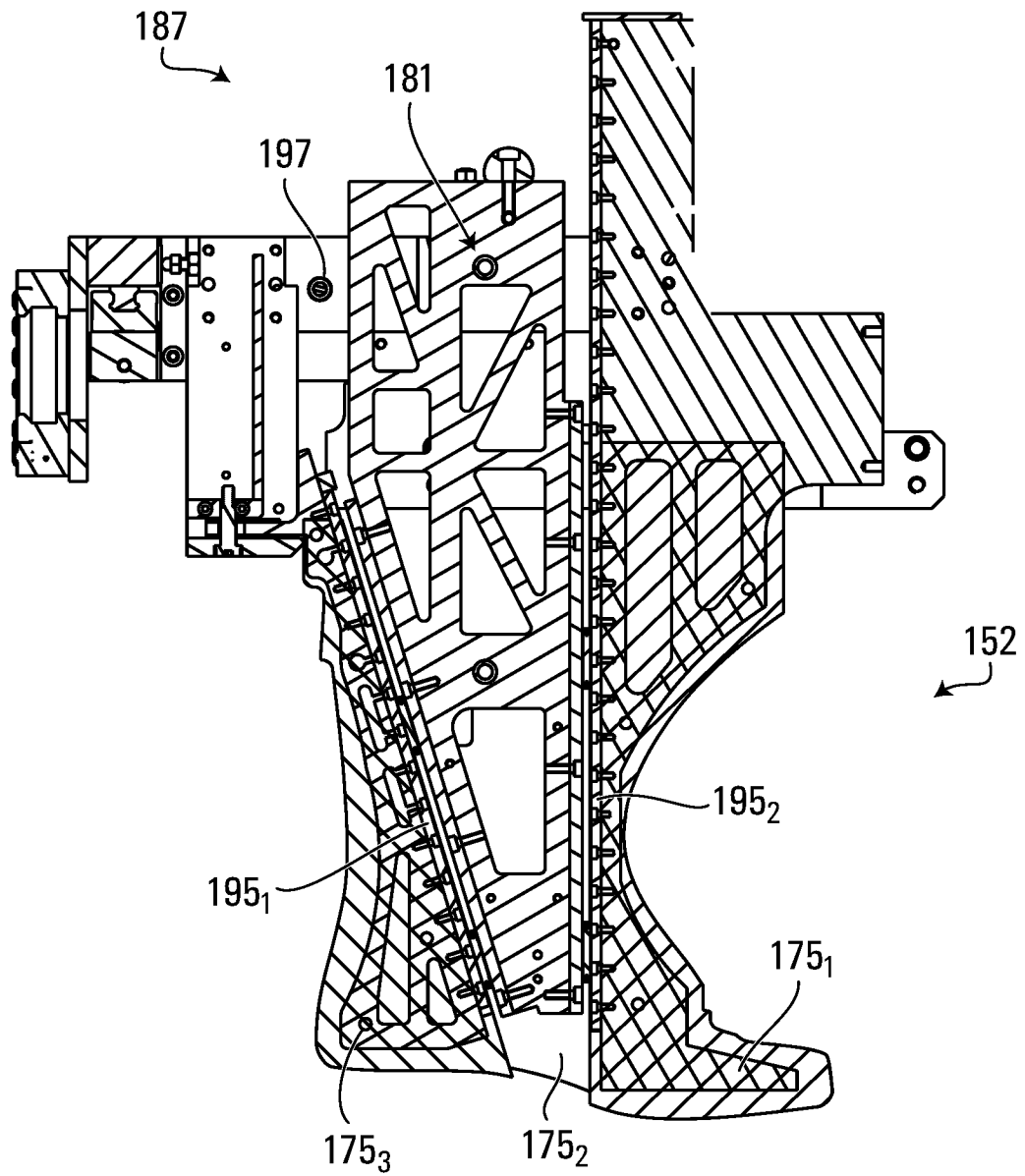


FIG. 24

15/121

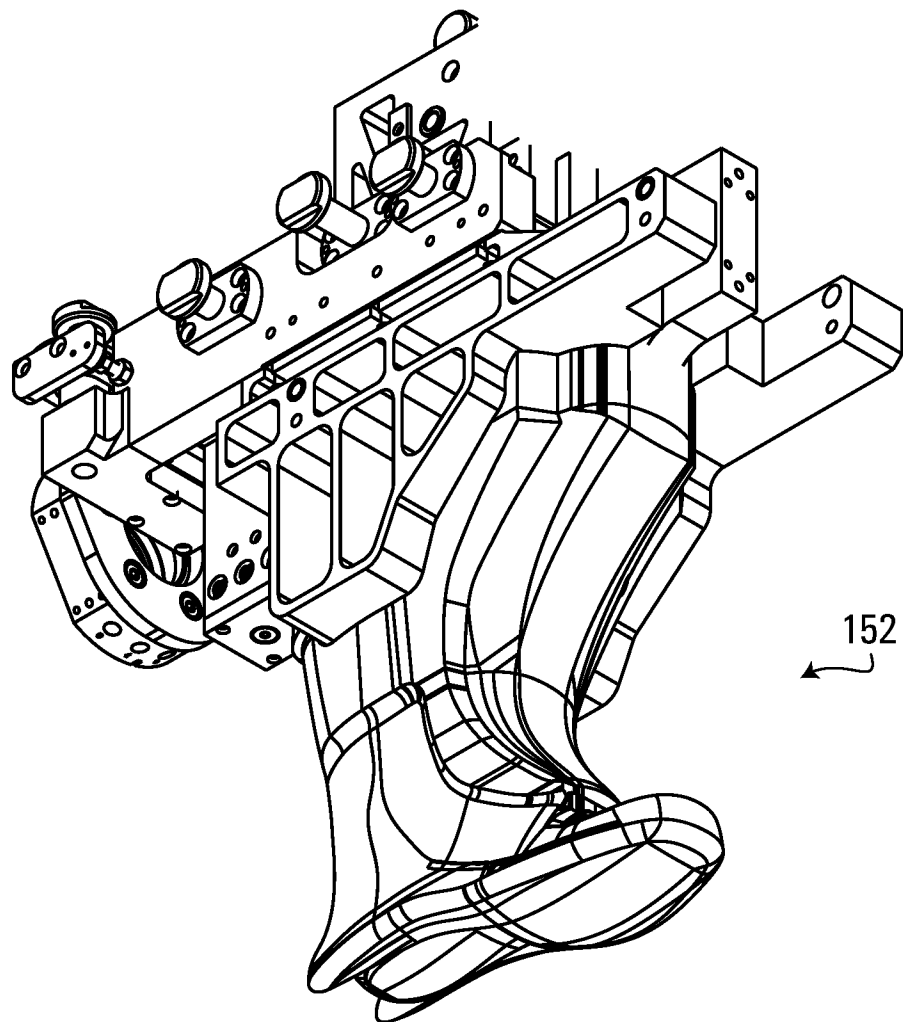


FIG. 25

16/121

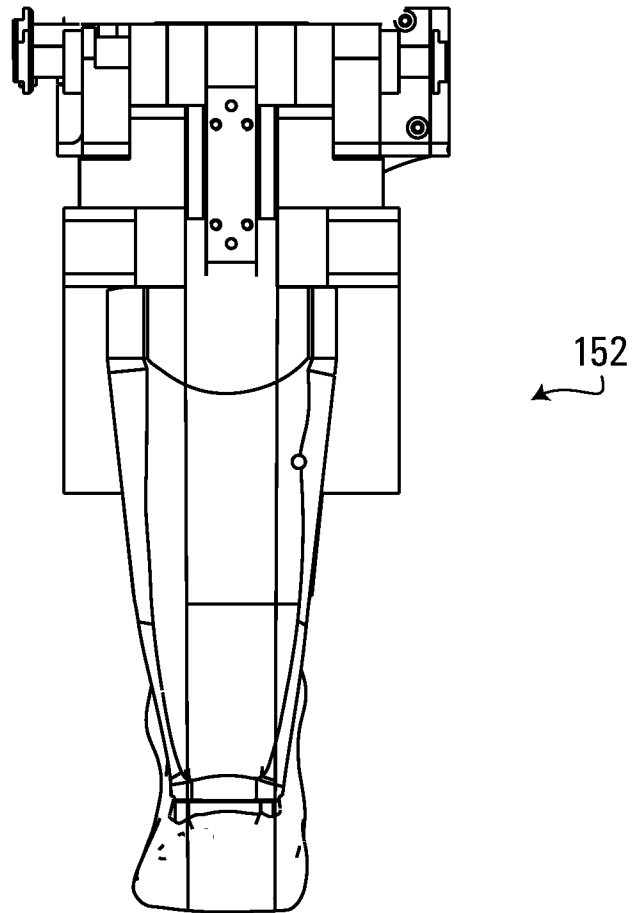


FIG. 26

17/121

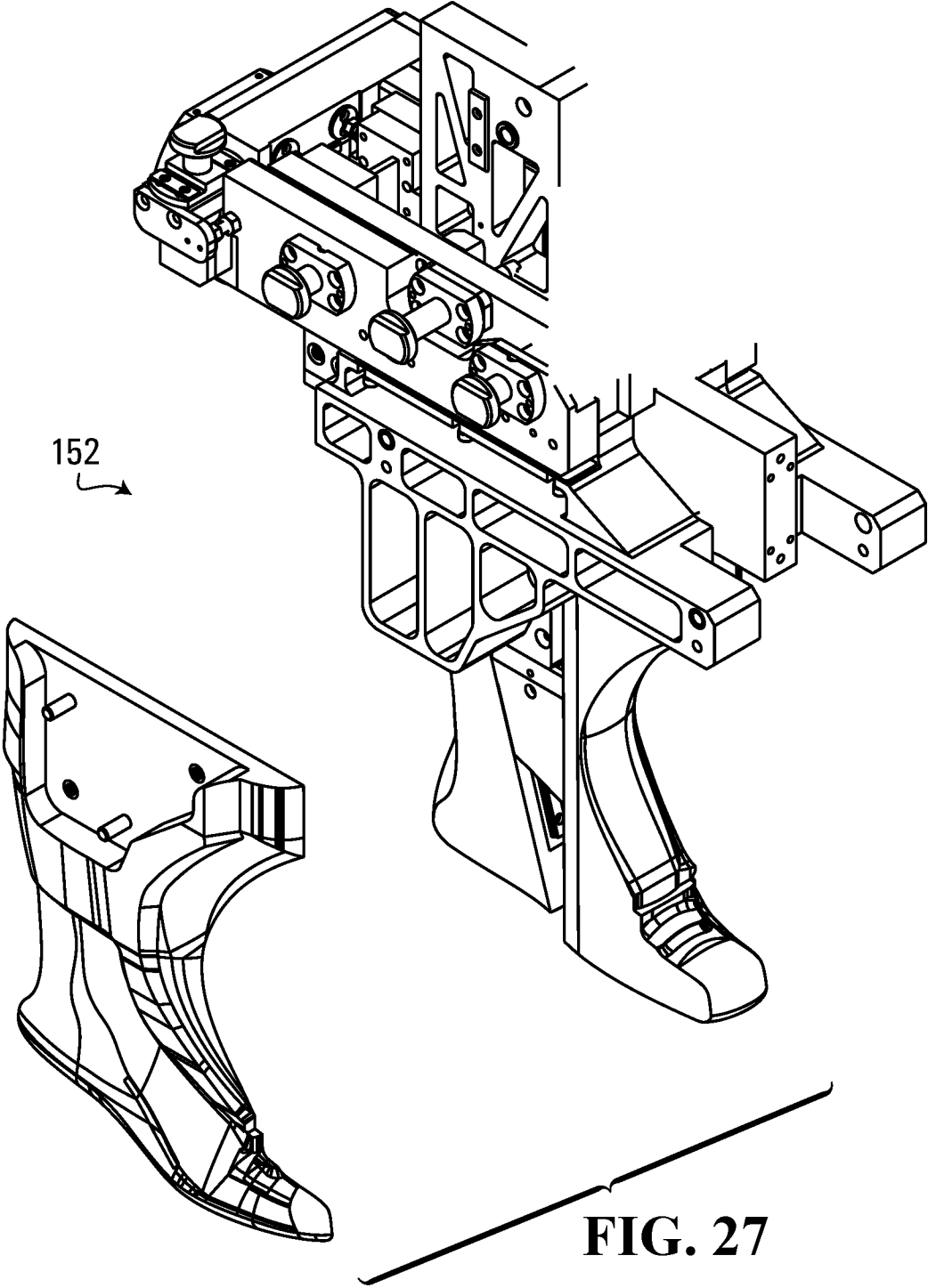


FIG. 27

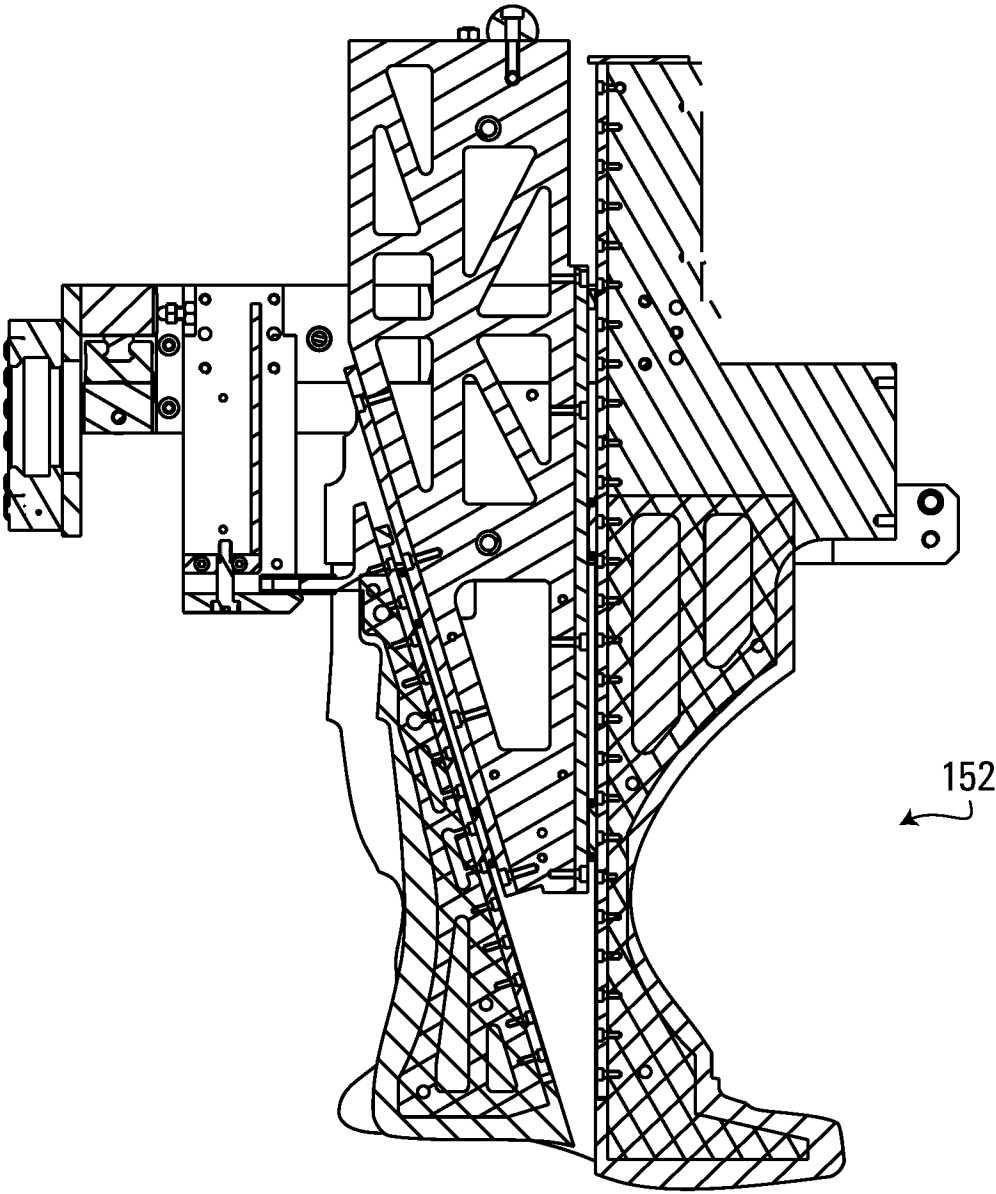


FIG. 28

19/121

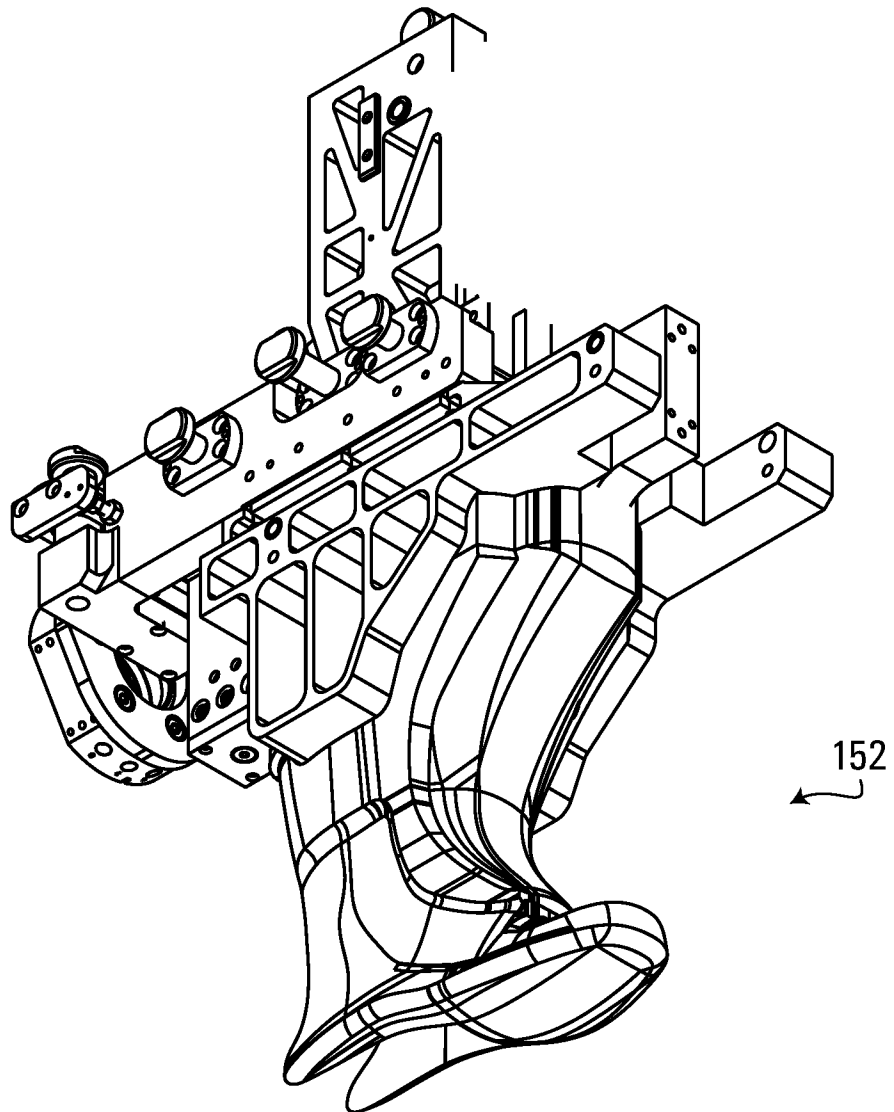


FIG. 29

20/121

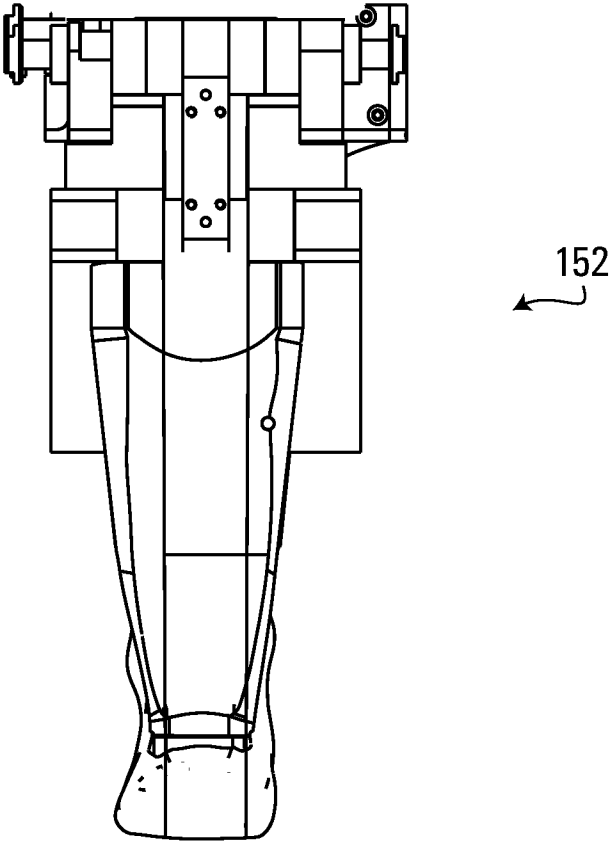
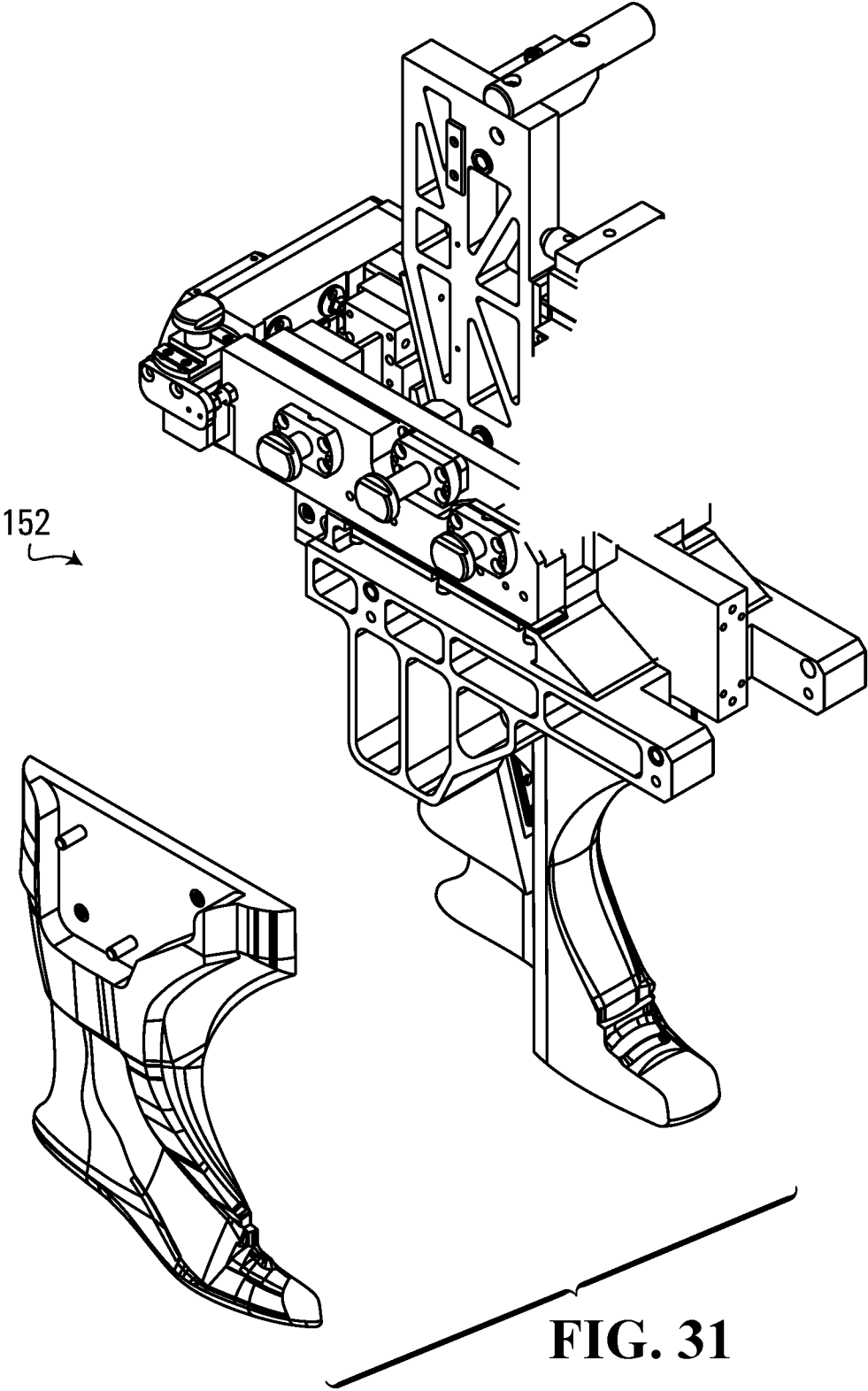


FIG. 30

21/121



22/121

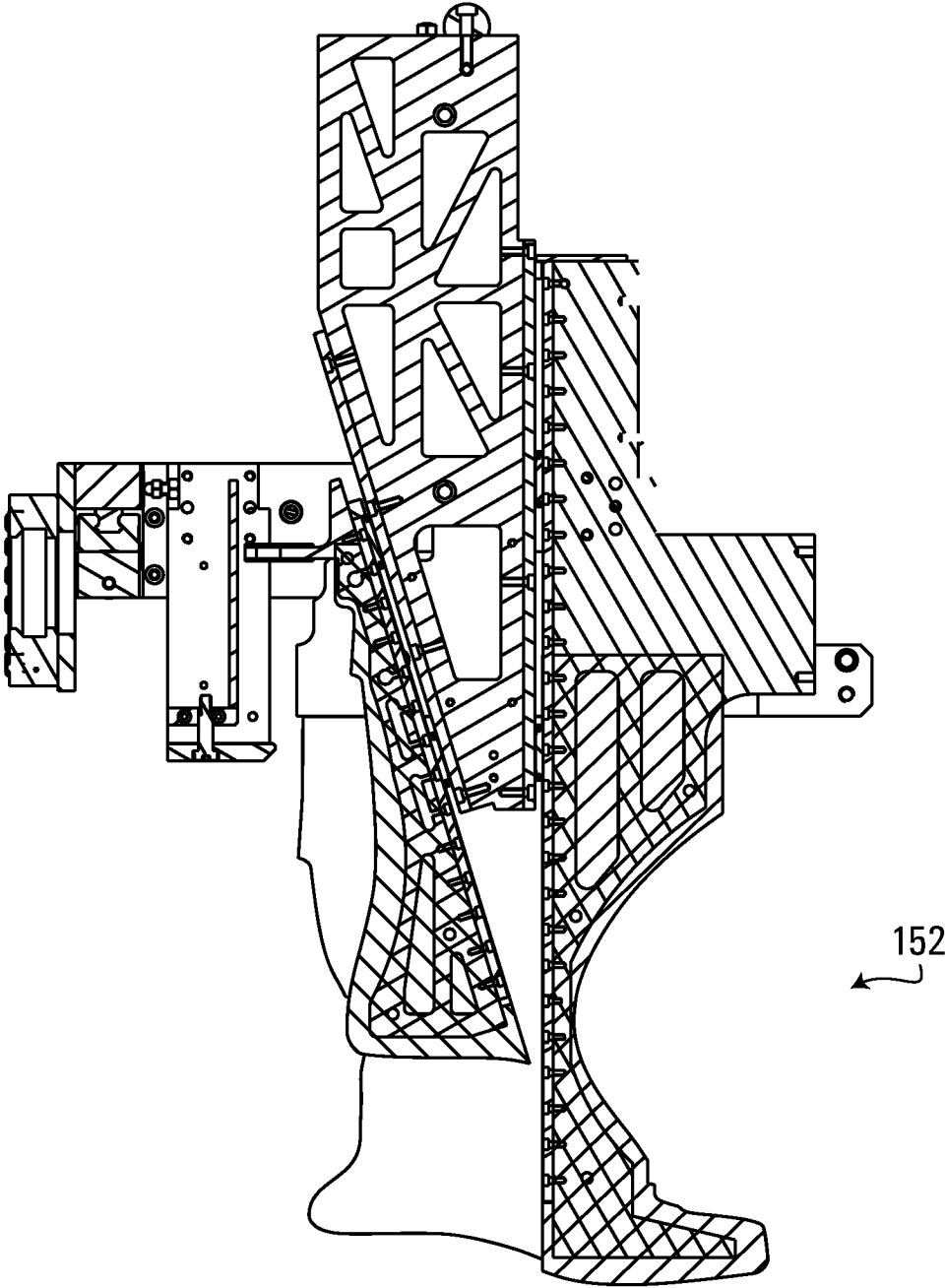


FIG. 32

23/121

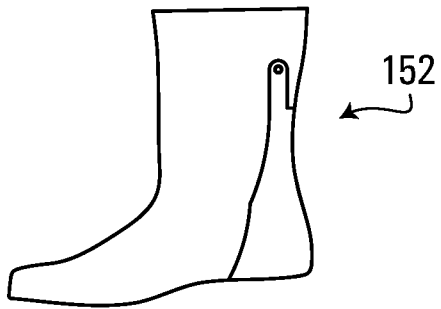


FIG. 33

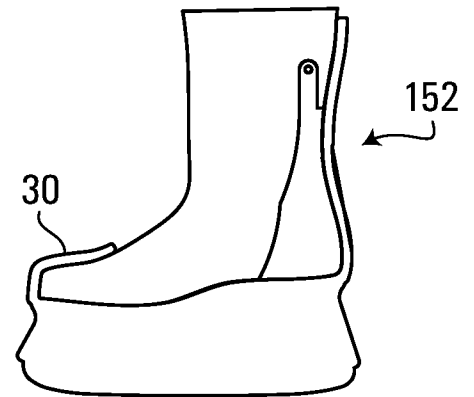


FIG. 34

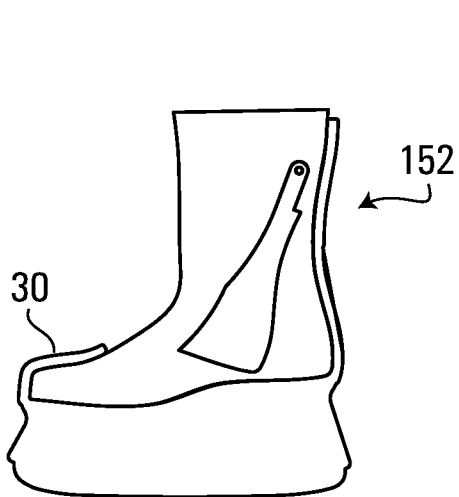


FIG. 35

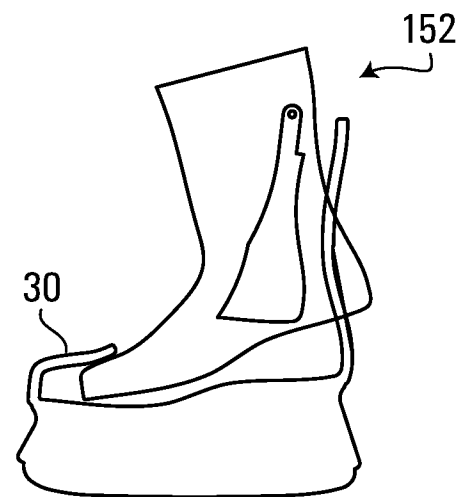


FIG. 36

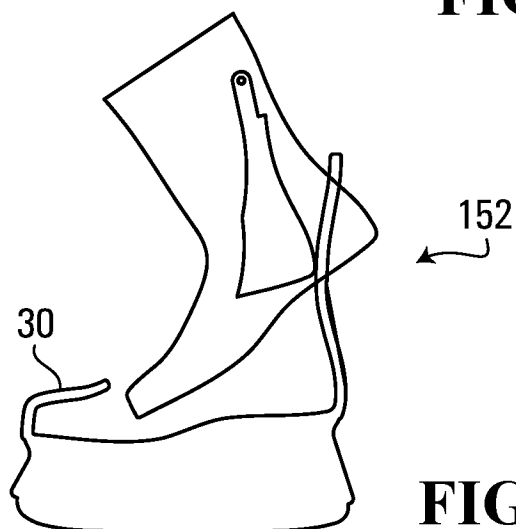


FIG. 37

24/121

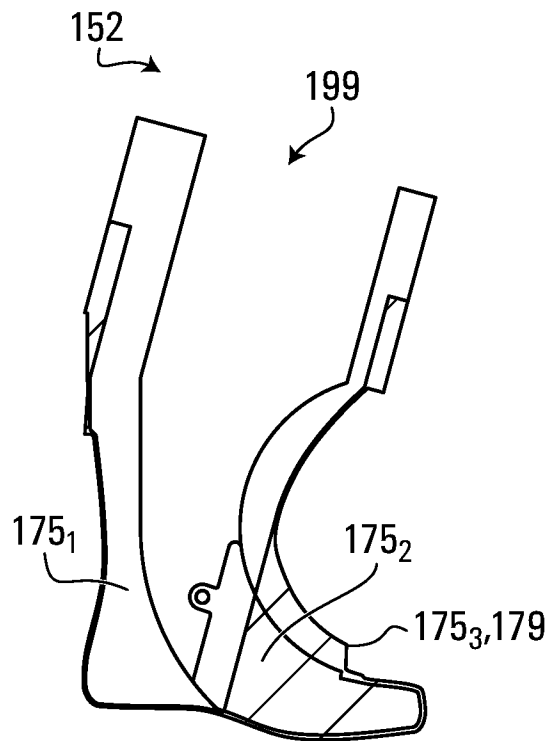


FIG. 38

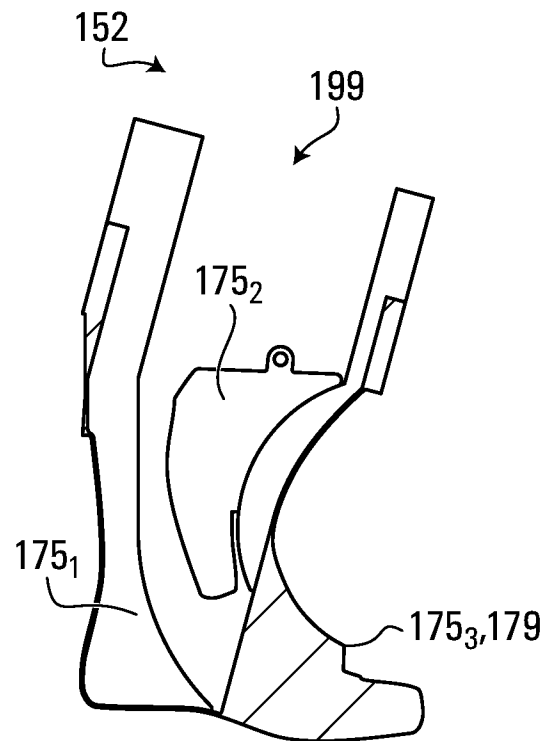


FIG. 39

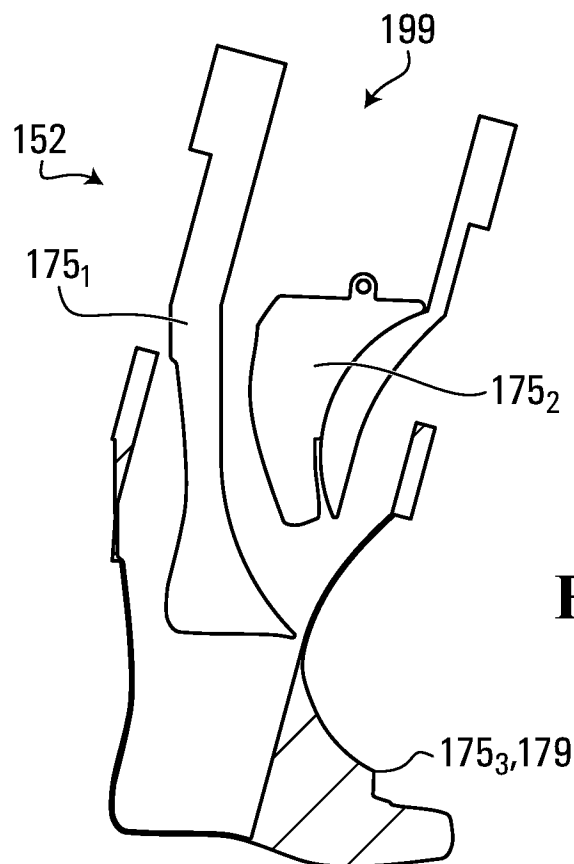


FIG. 40

25/121

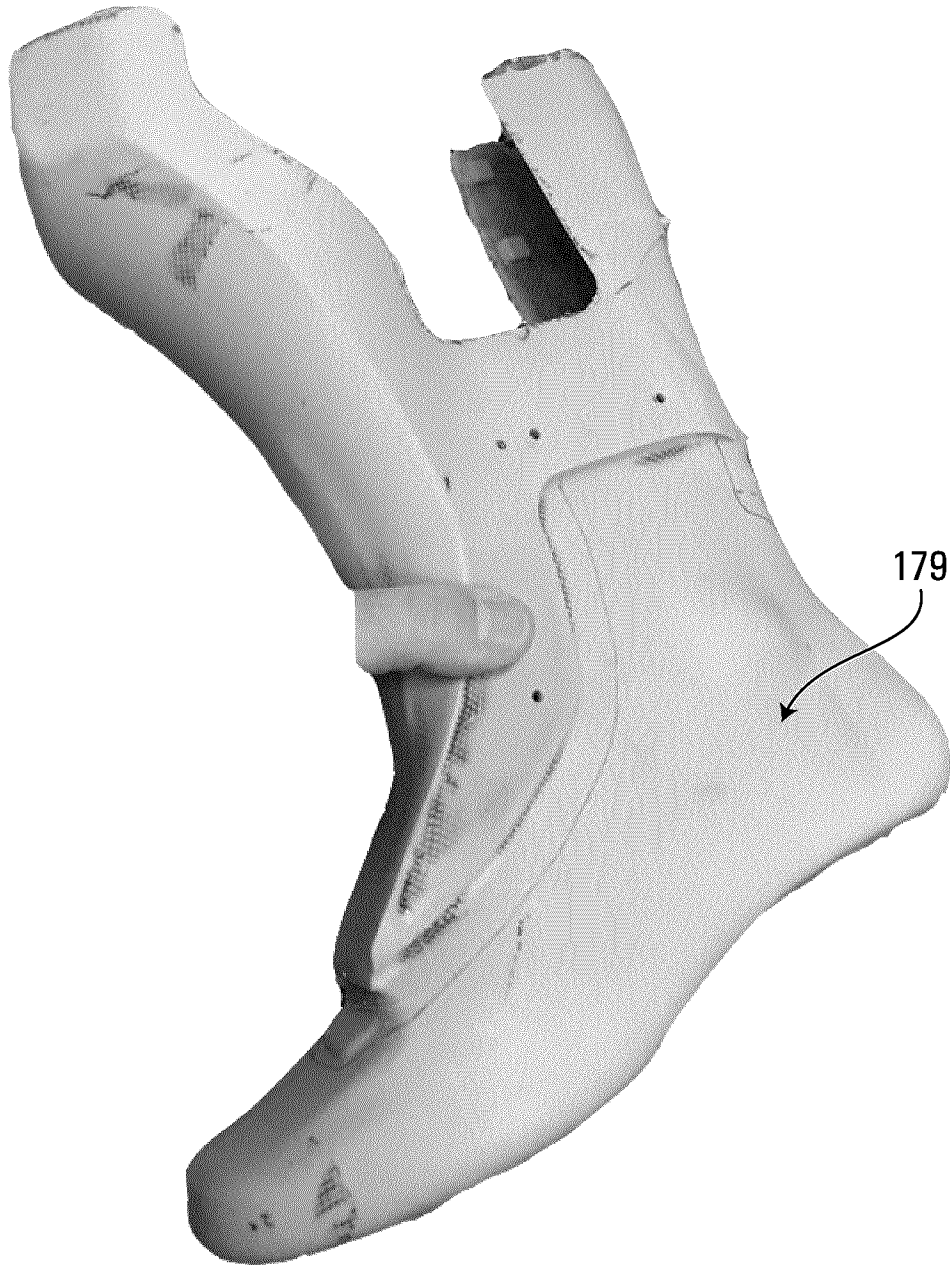


FIG. 41

26/121

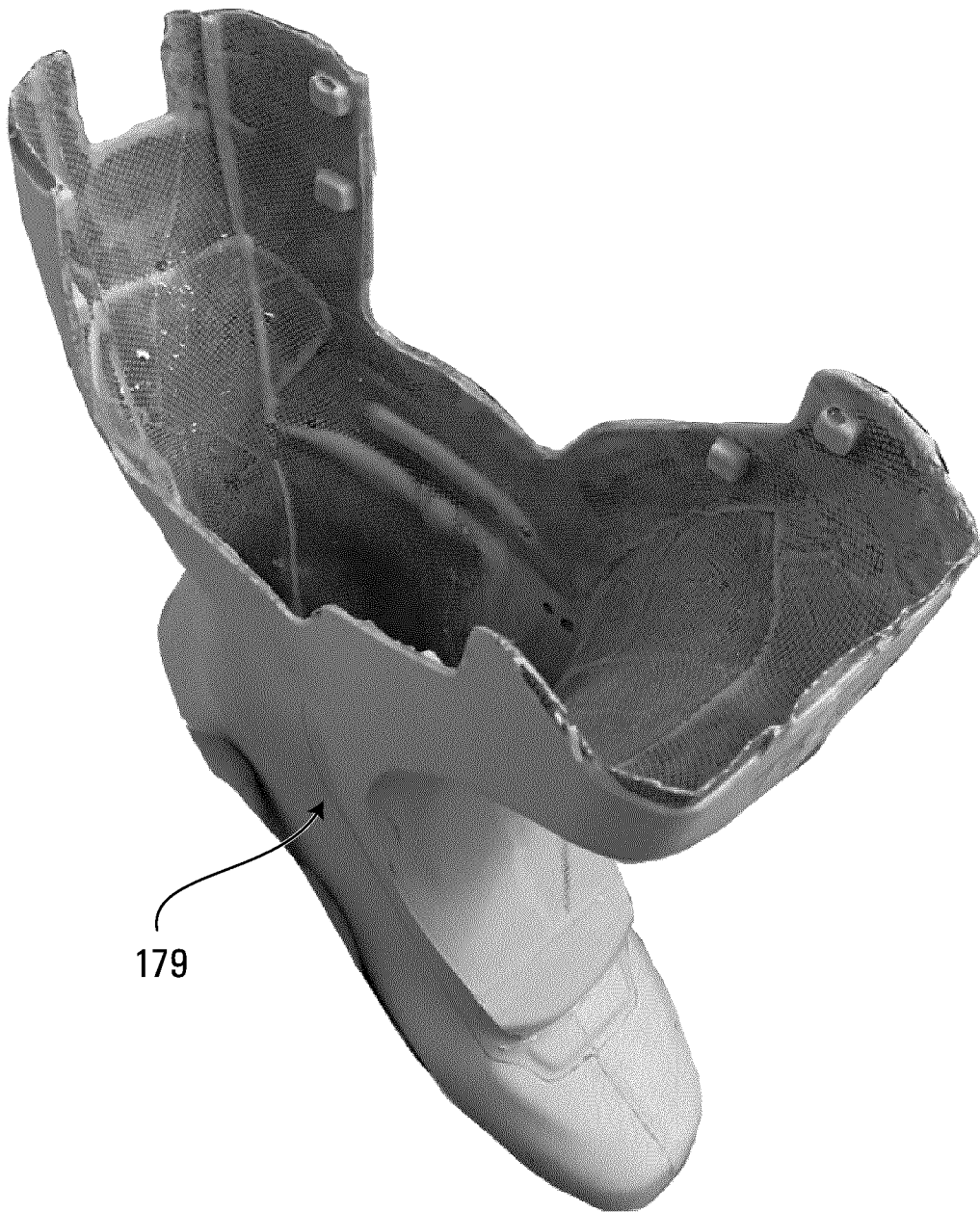


FIG. 42

27/121

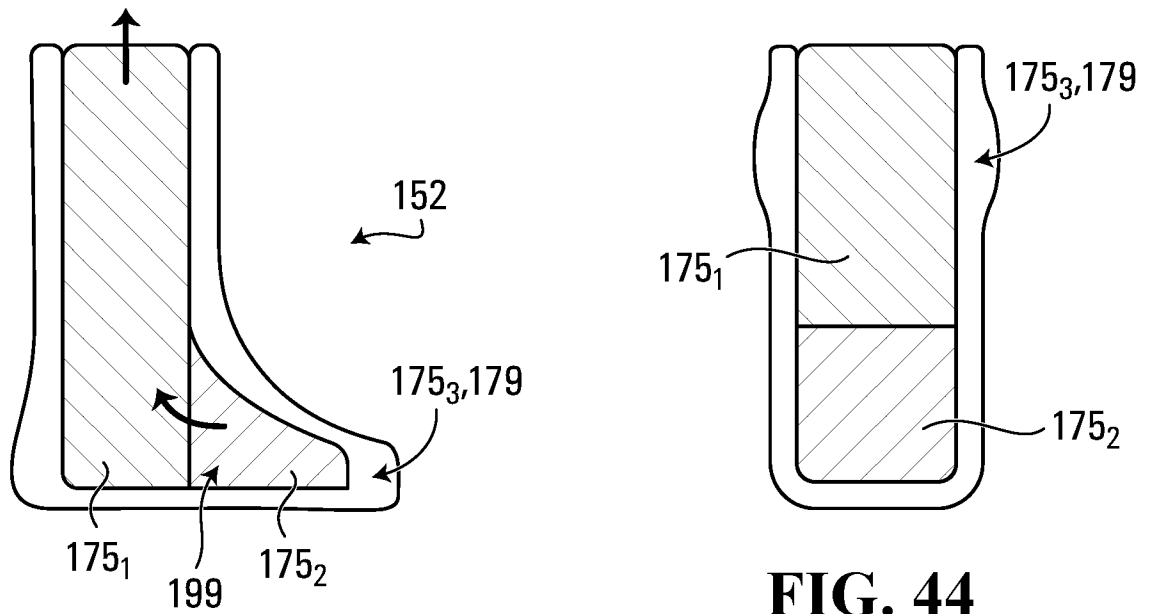


FIG. 43

FIG. 44

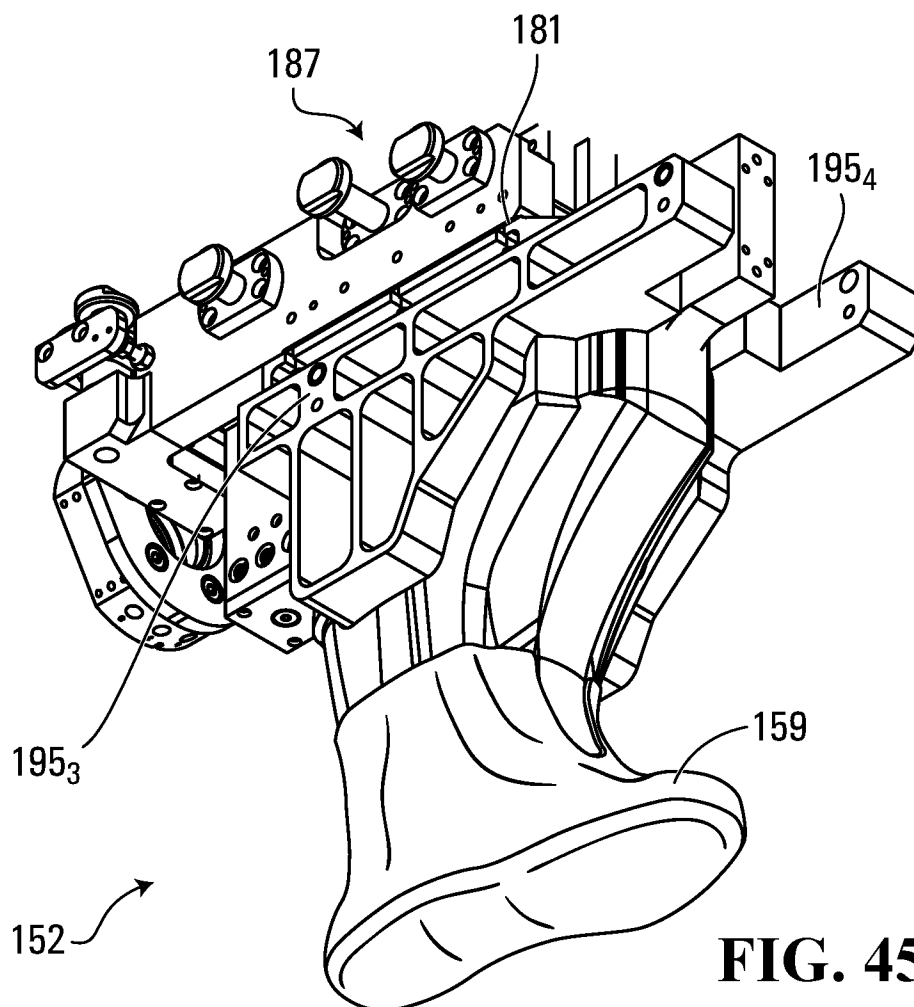


FIG. 45

28/121

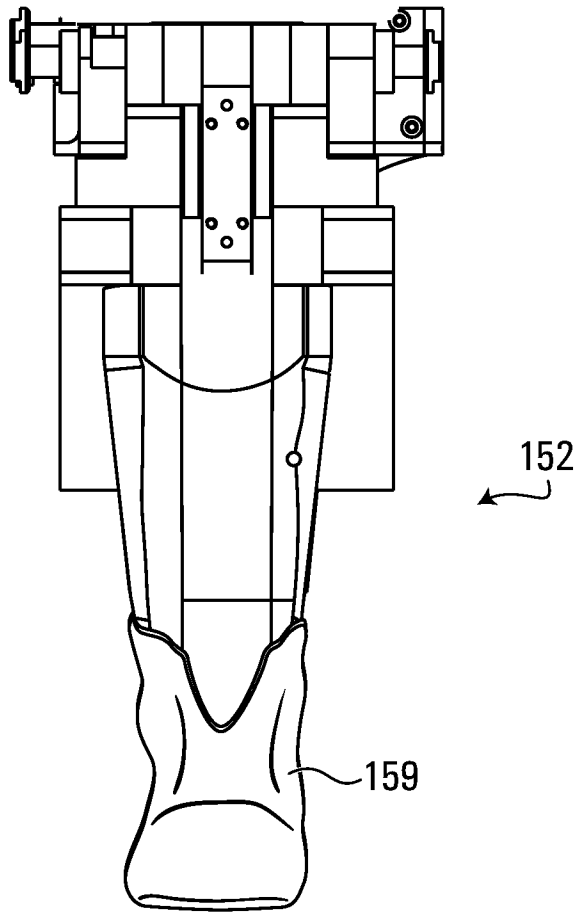


FIG. 46

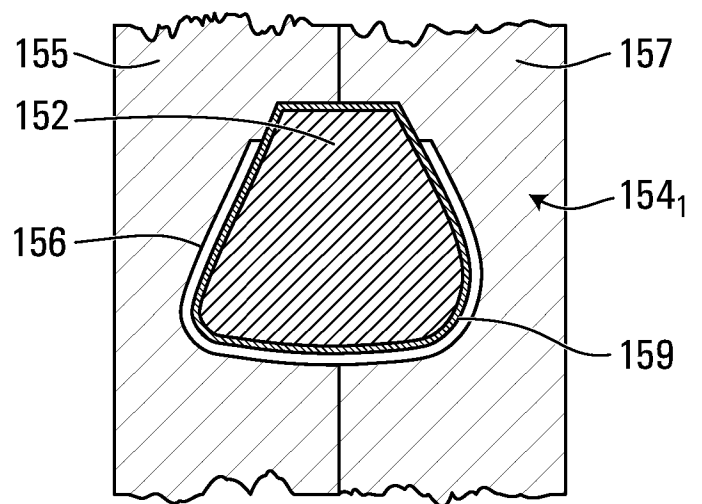


FIG. 47

29/121

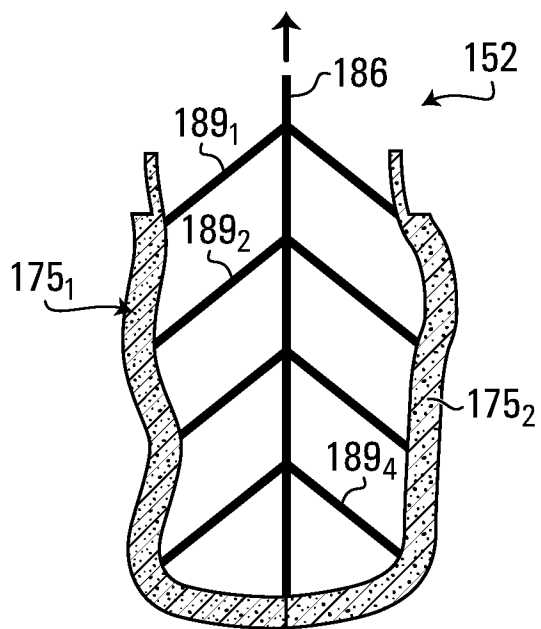


FIG. 48

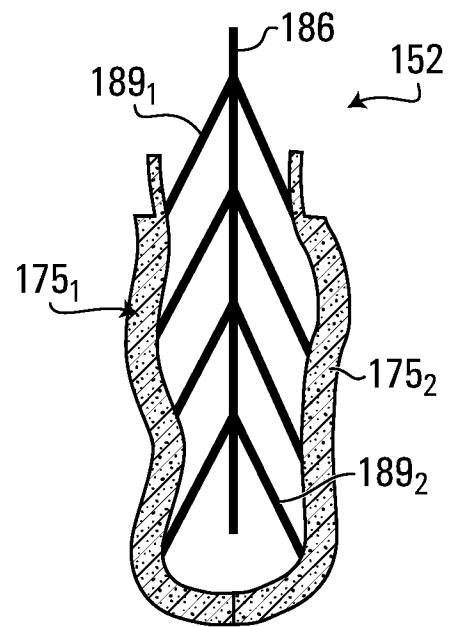


FIG. 49

30/121

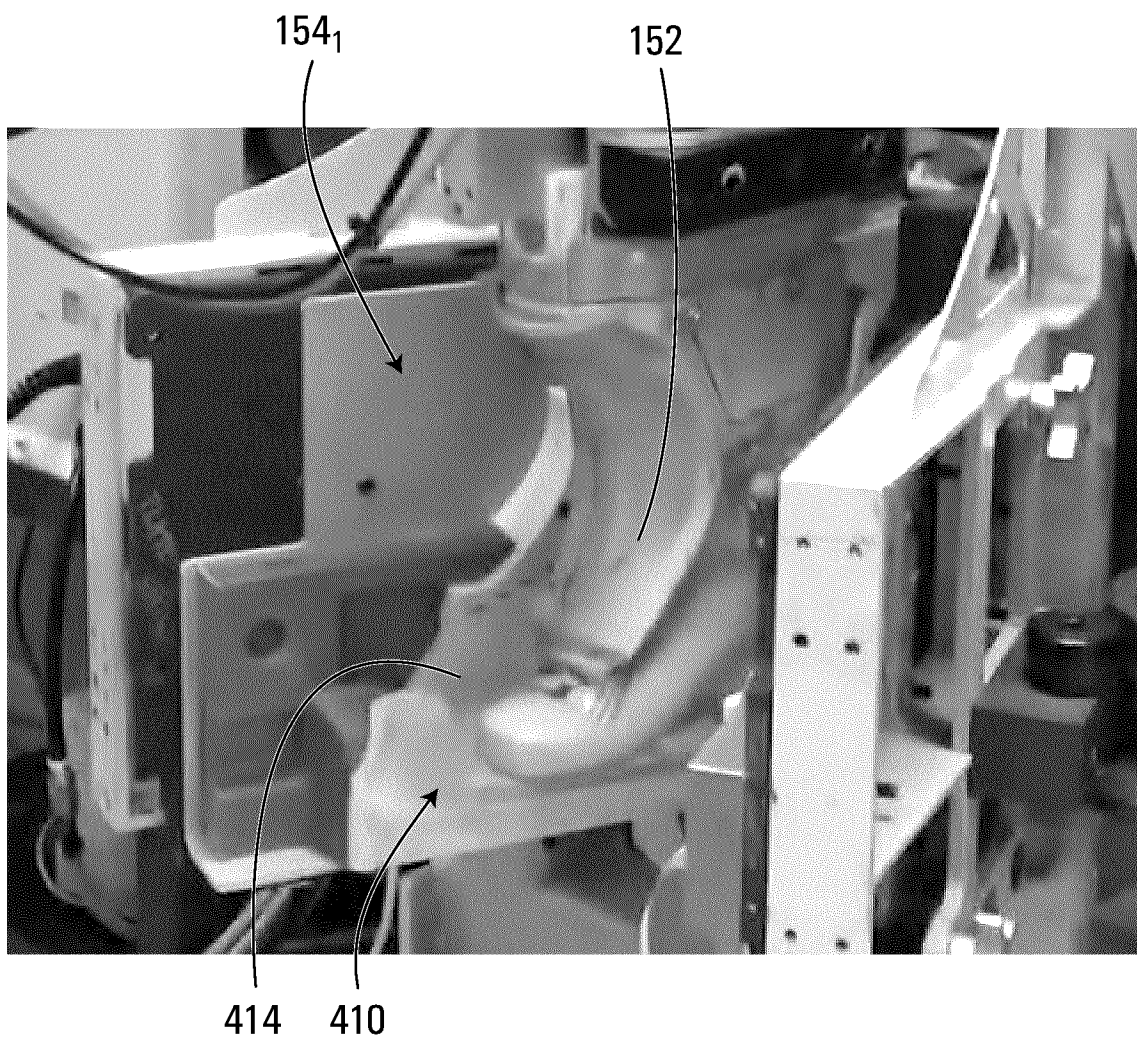


FIG. 50

31/121

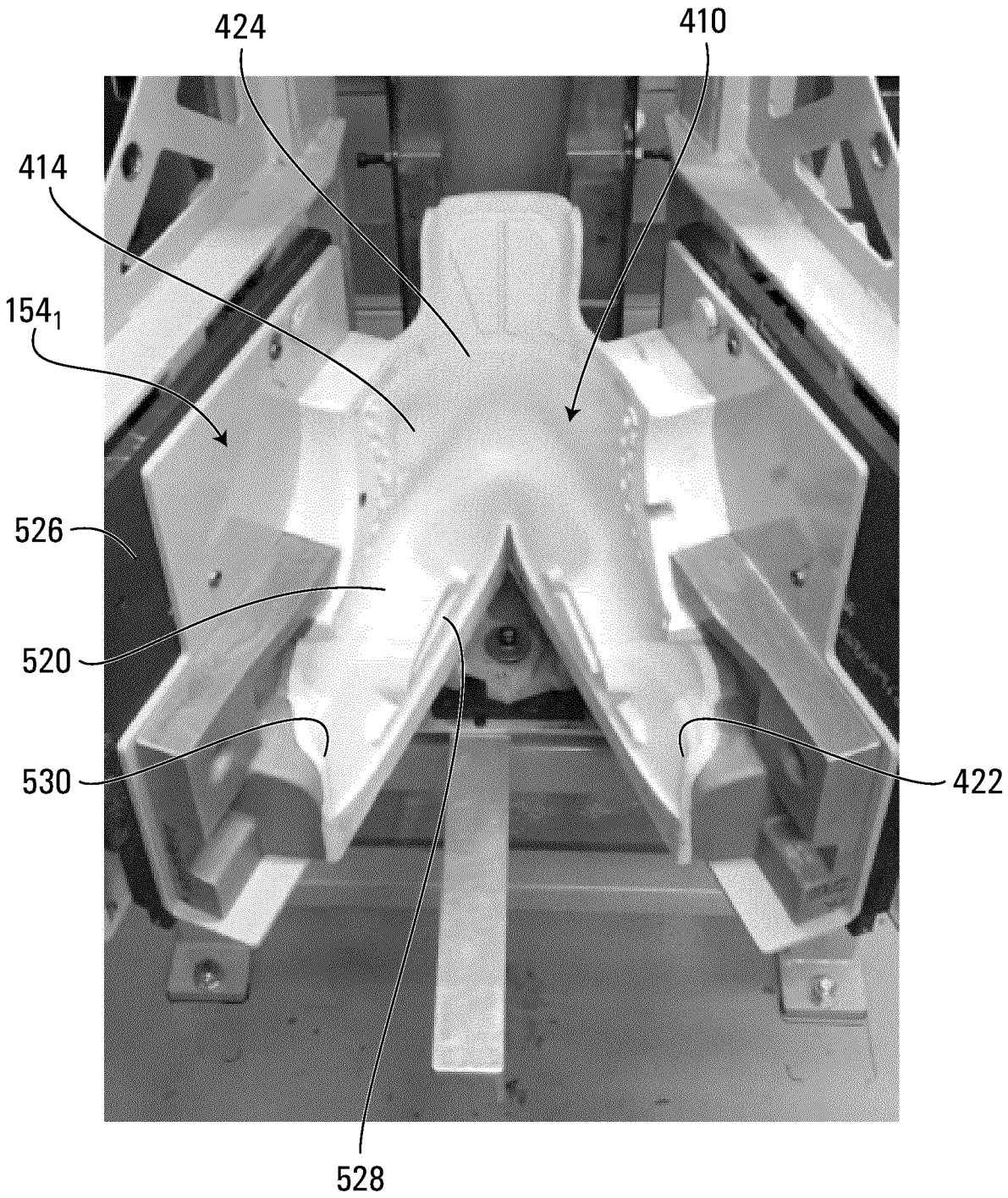


FIG. 51

32/121

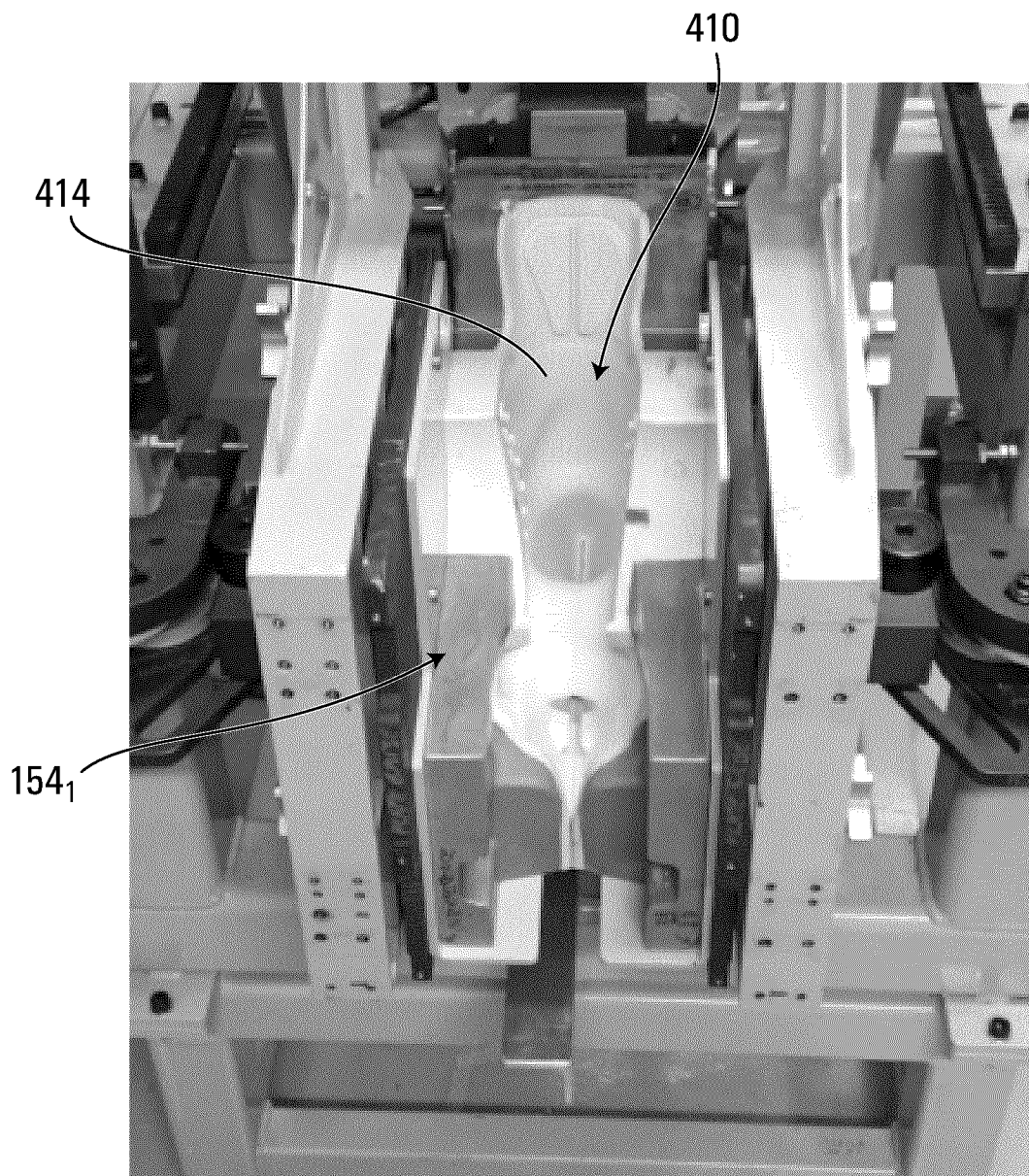
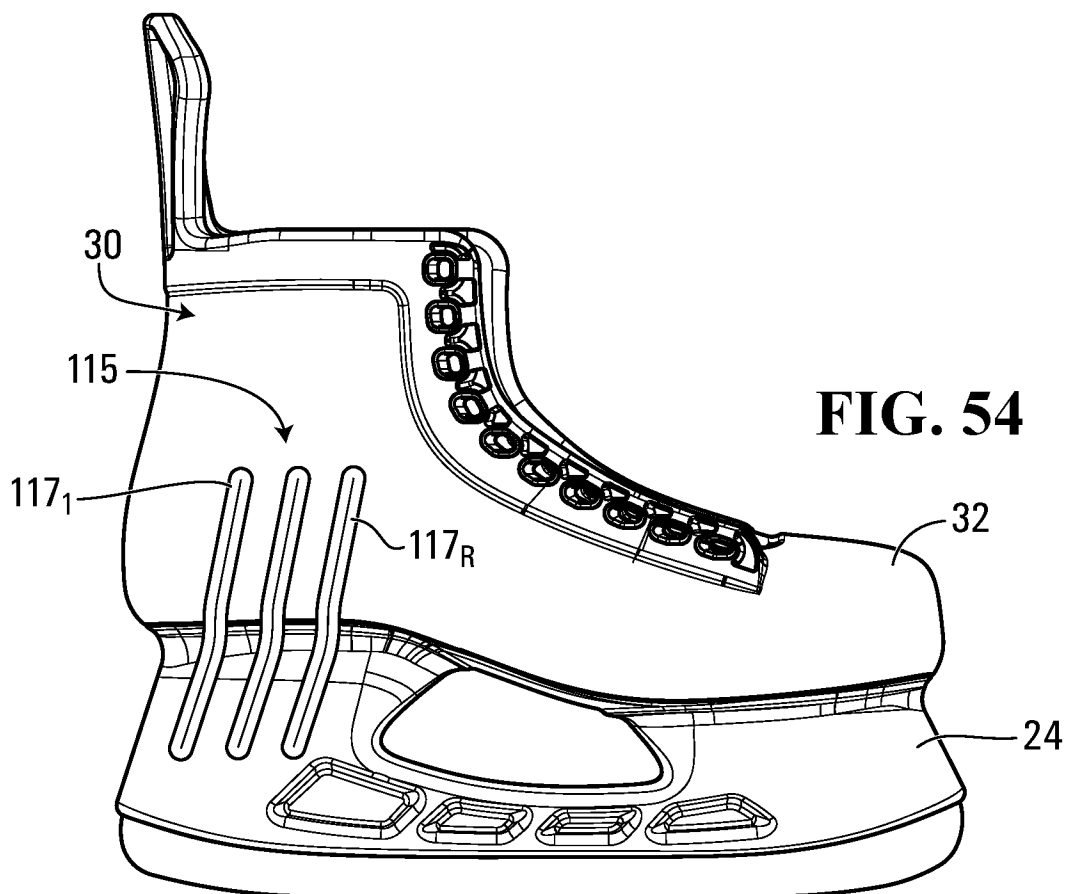
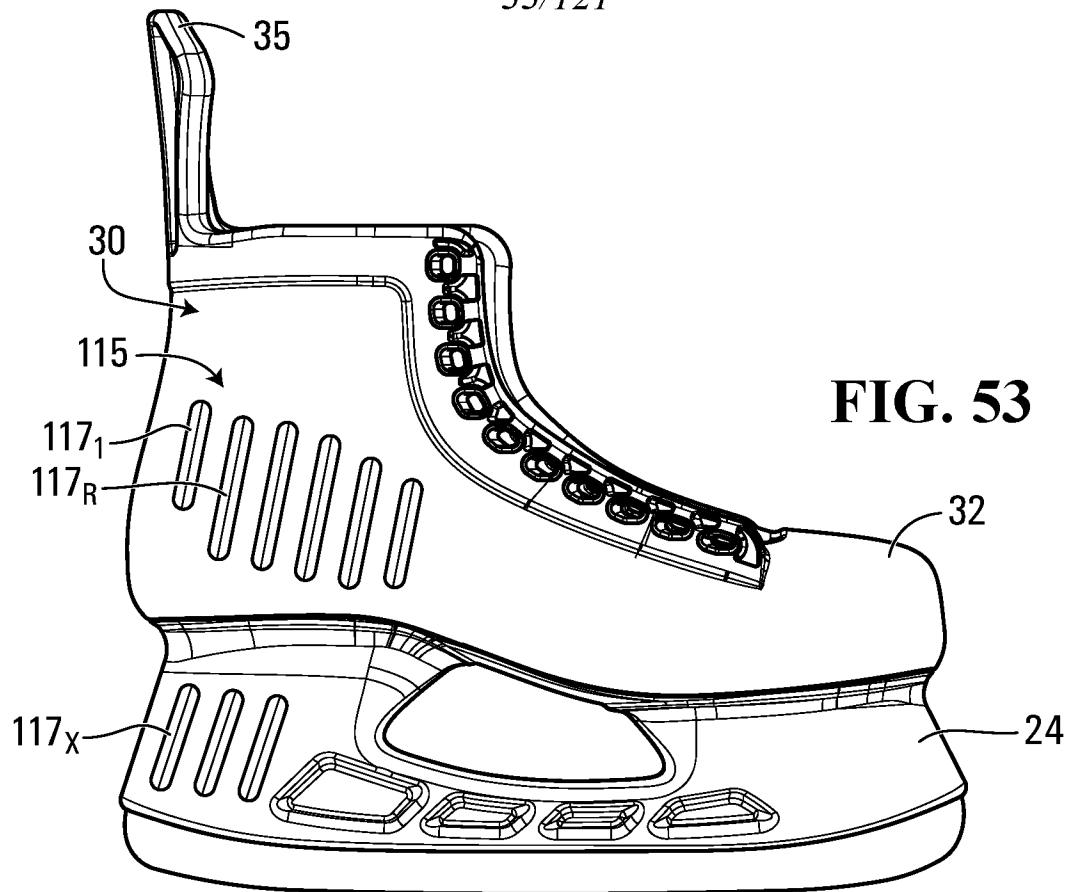


FIG. 52

33/121



34/121

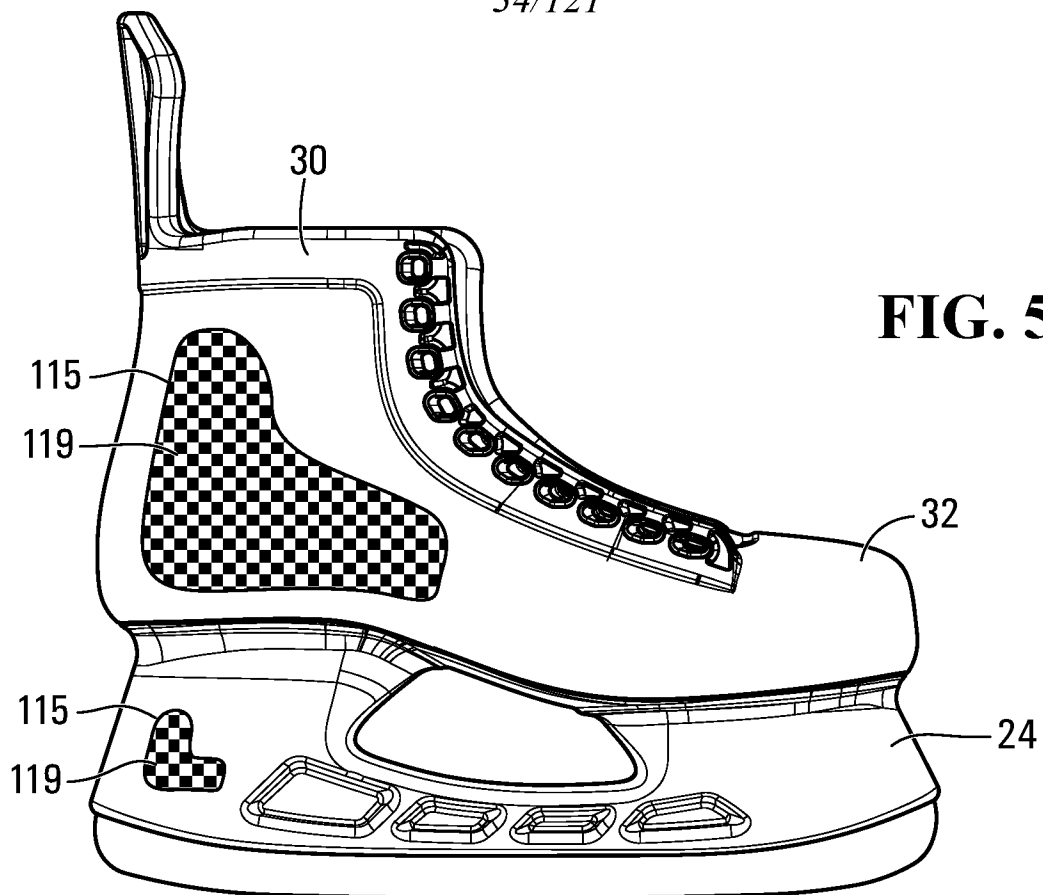


FIG. 55A

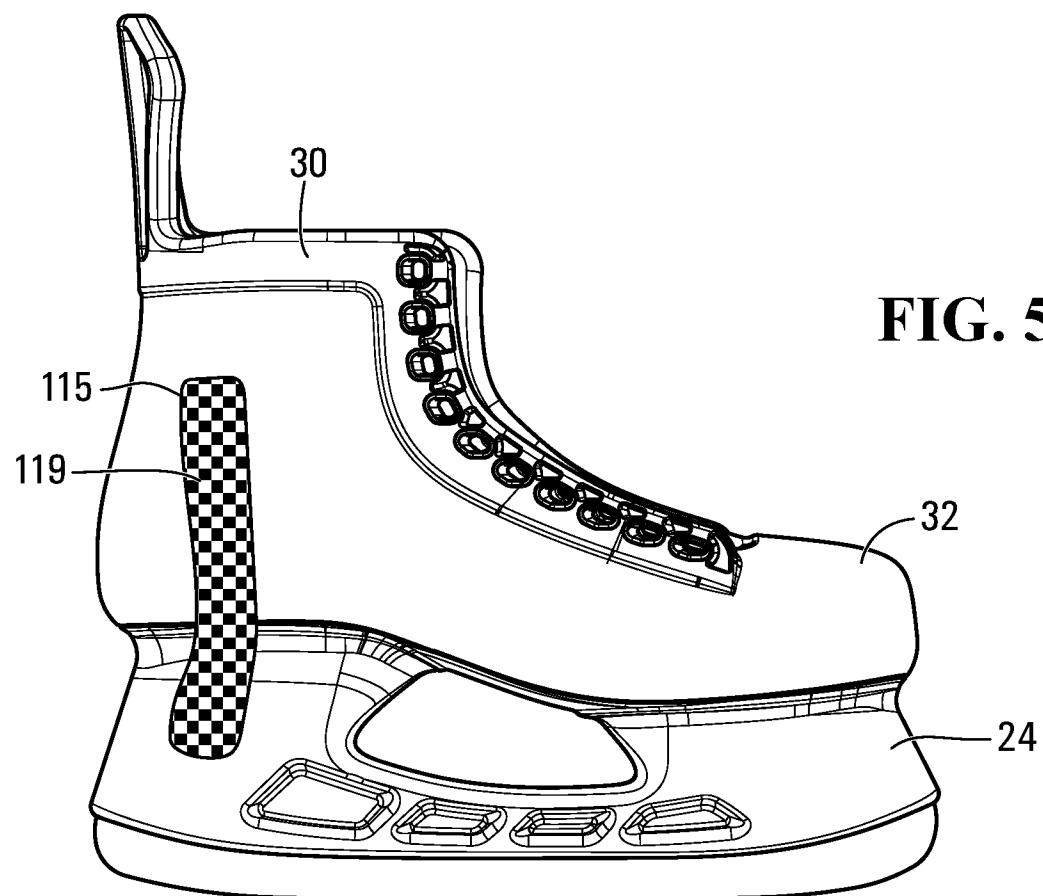
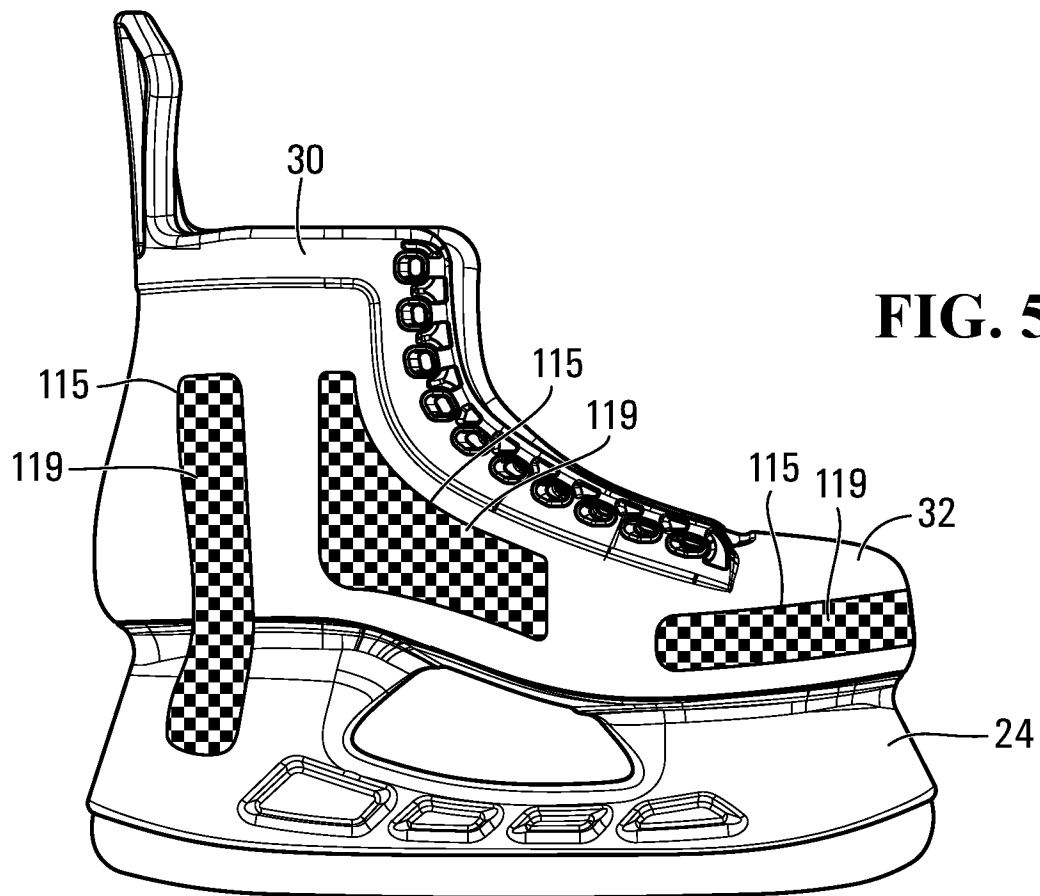


FIG. 55B

35/121



36/121

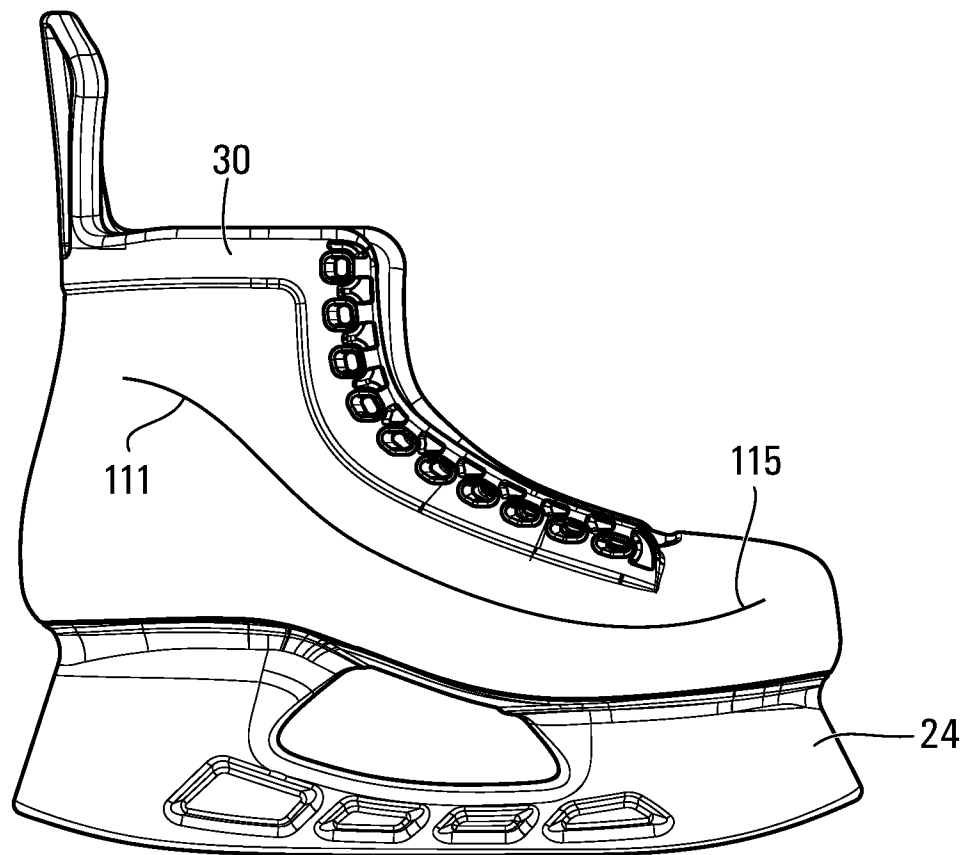


FIG. 57

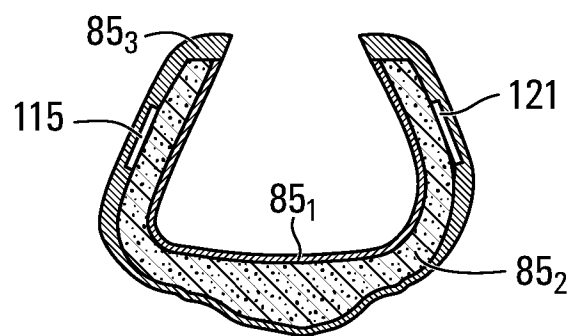


FIG. 58

37/121

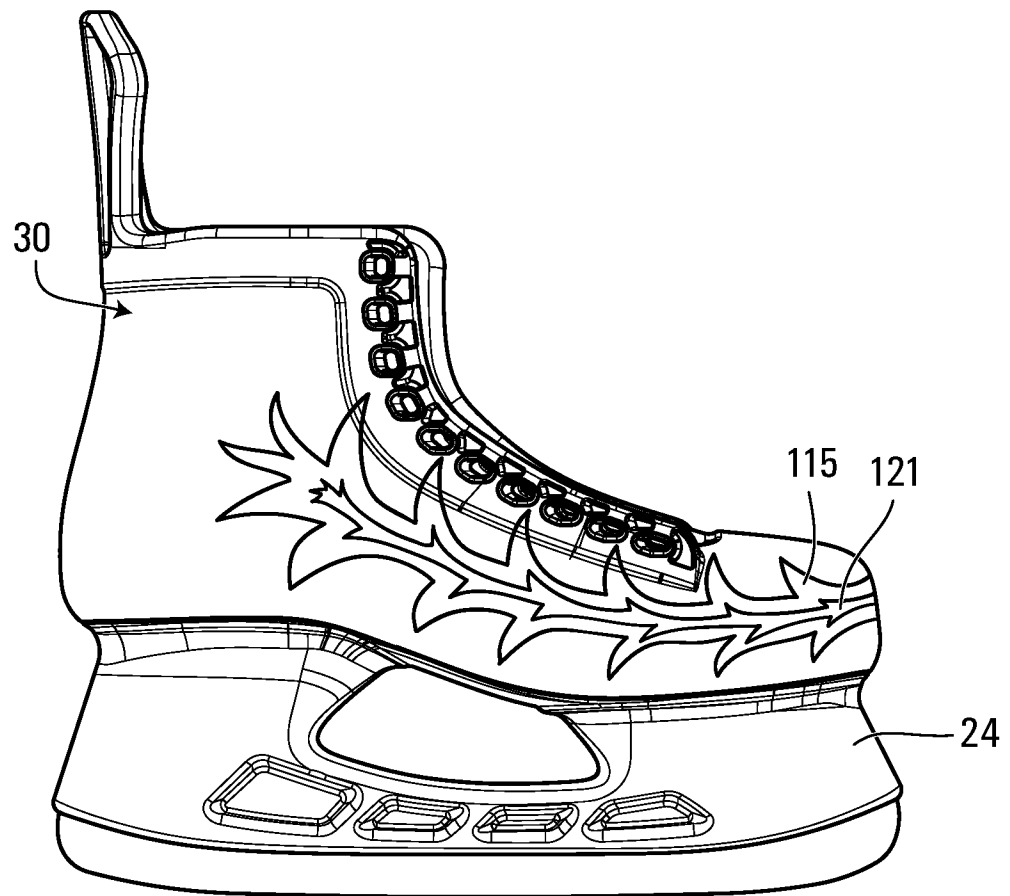


FIG. 59

38/121

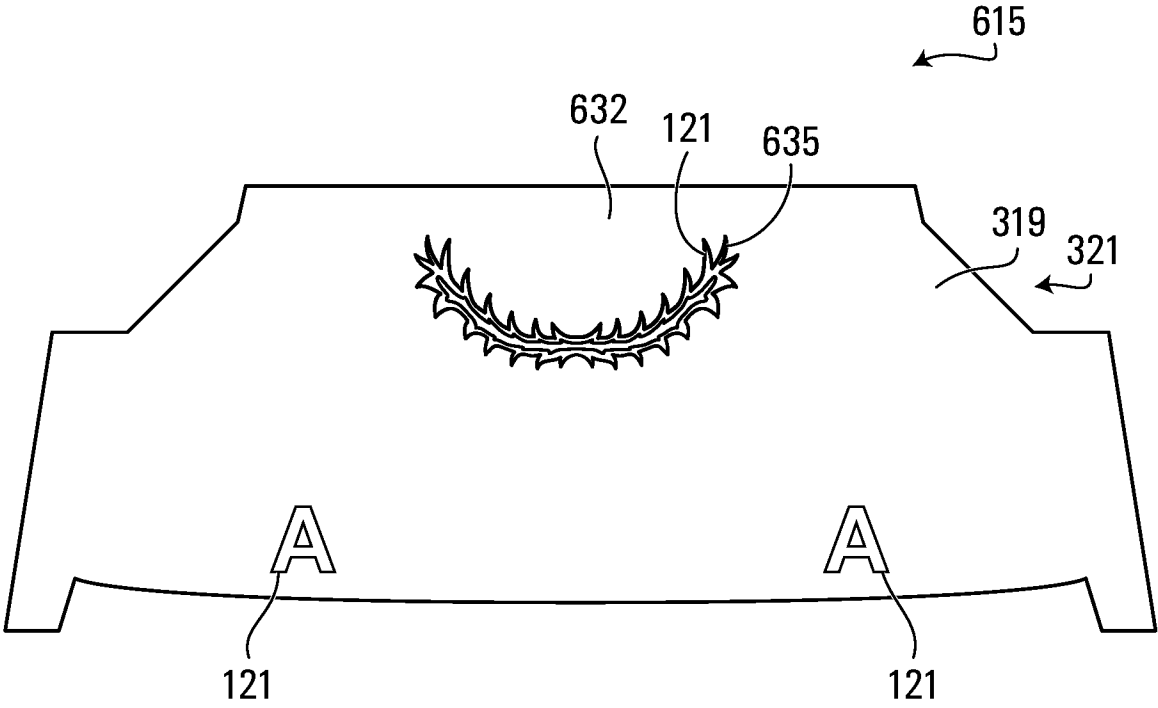


FIG. 60

39/121

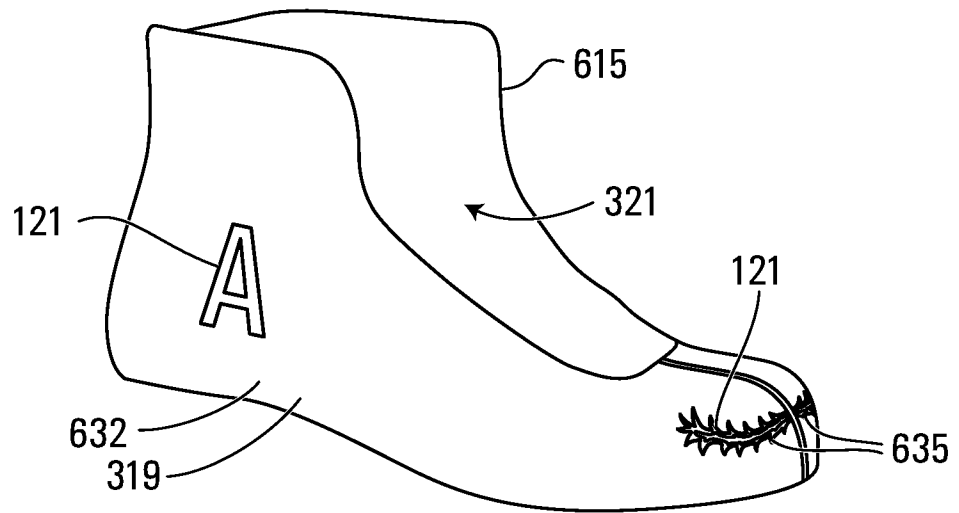


FIG. 61

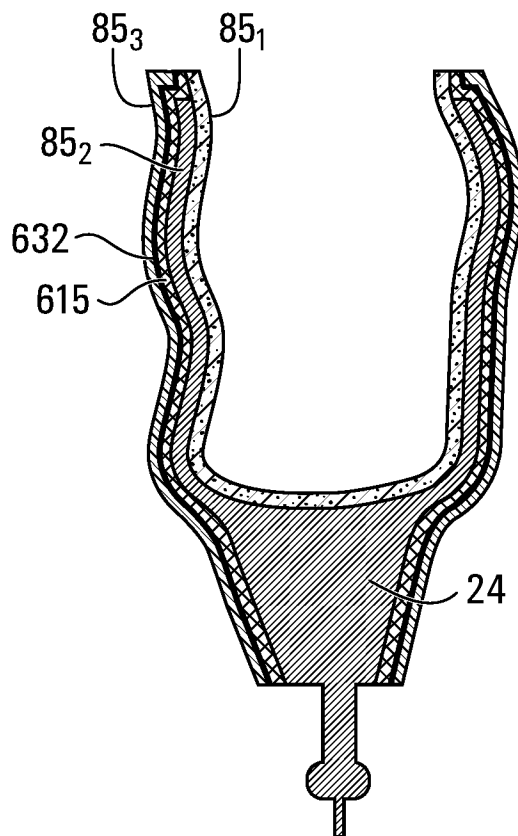


FIG. 62

40/121

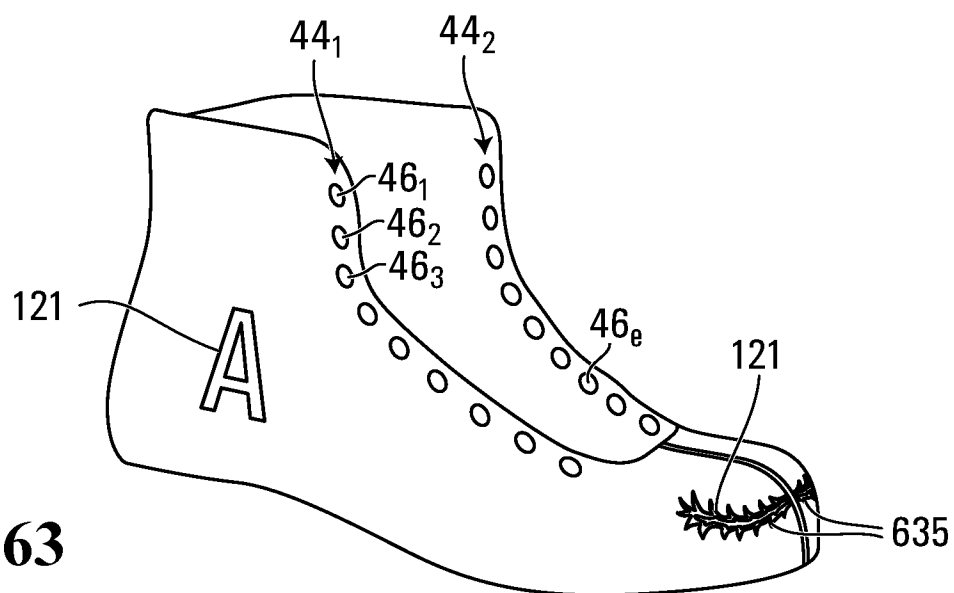


FIG. 63

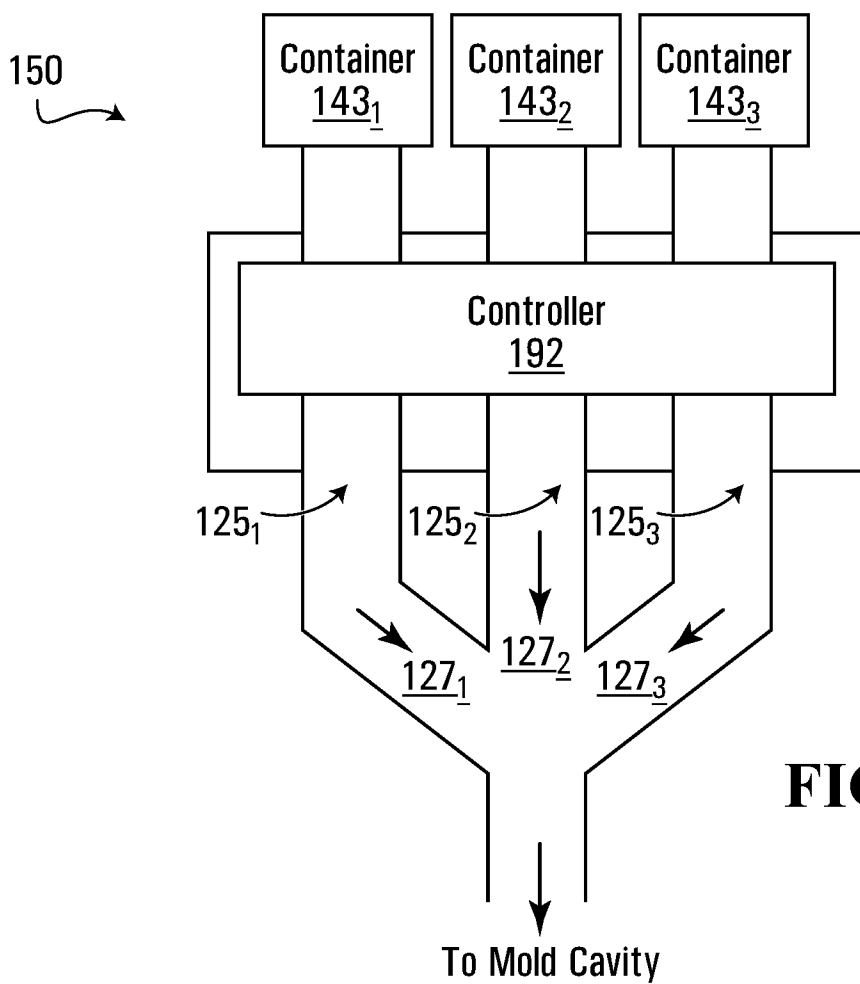


FIG. 64

41/121

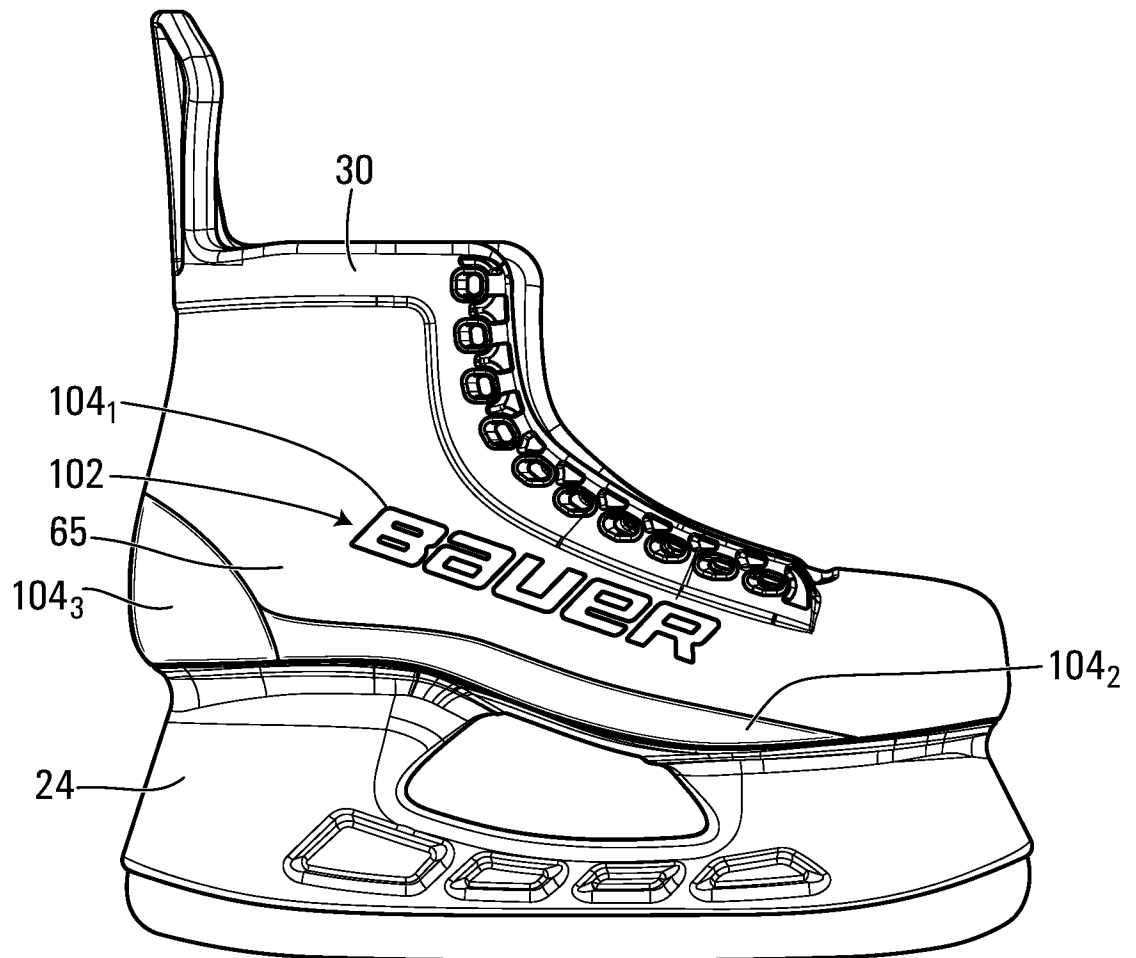


FIG. 65

42/121

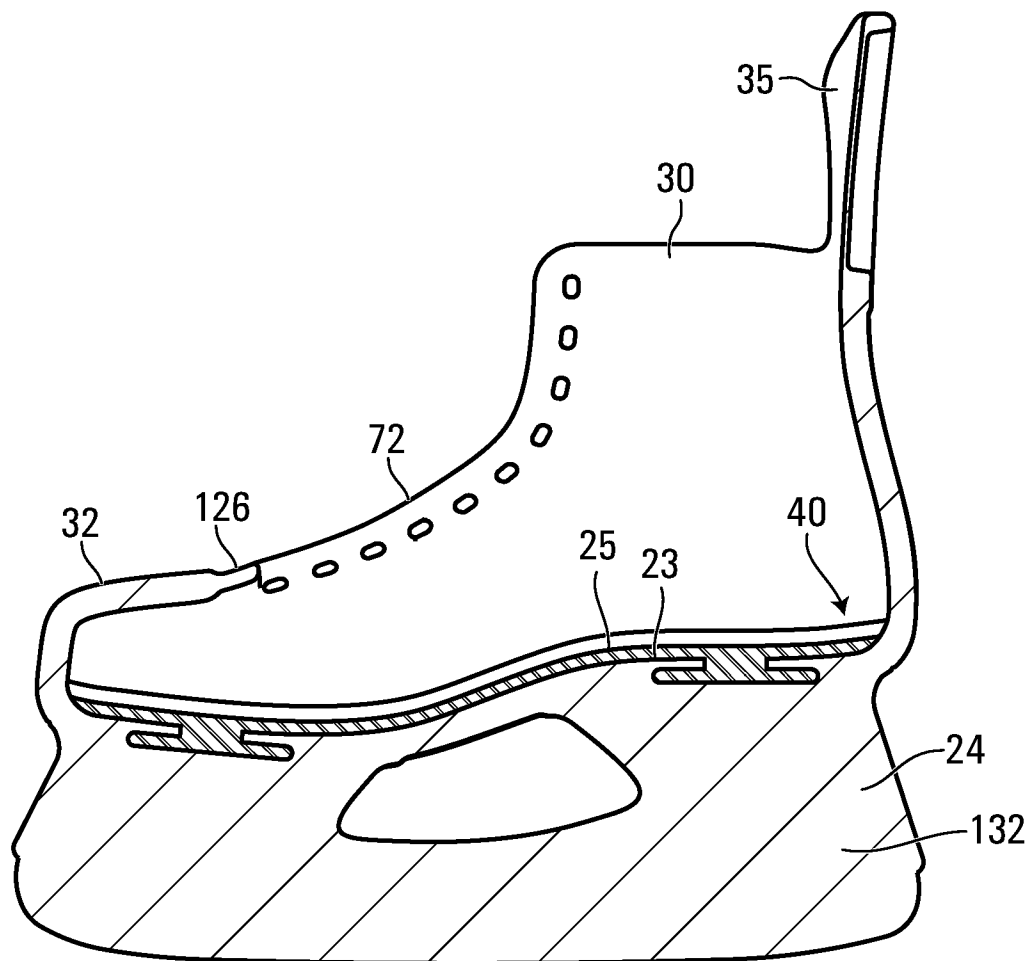


FIG. 66

43/121

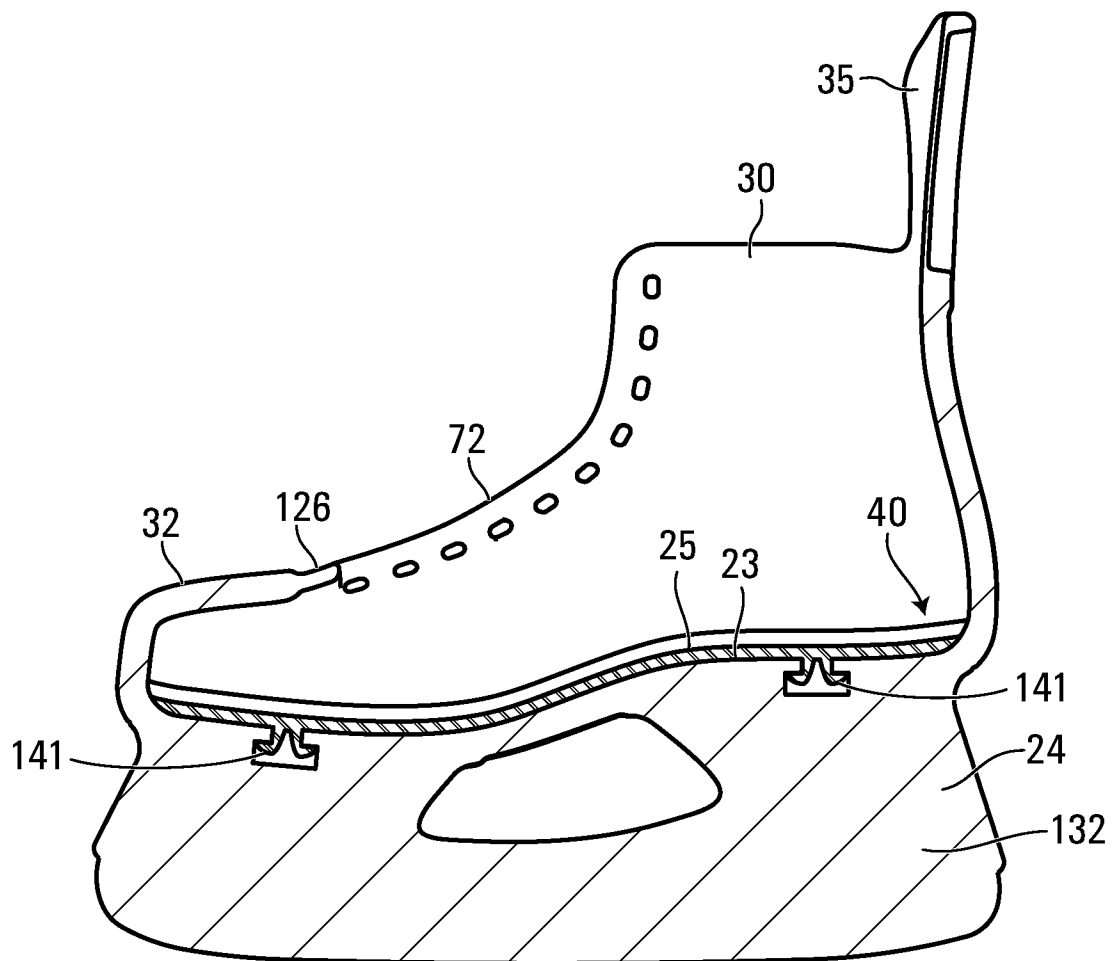


FIG. 67

44/121

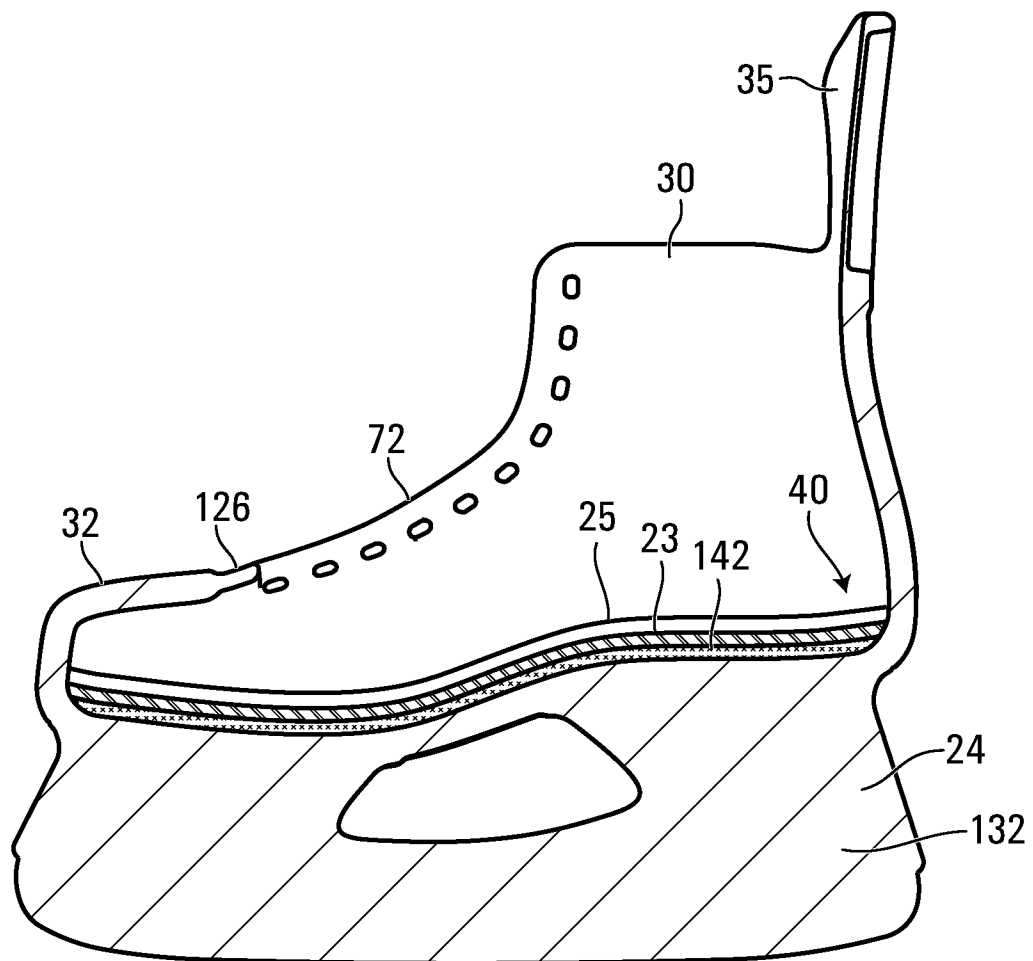


FIG. 68

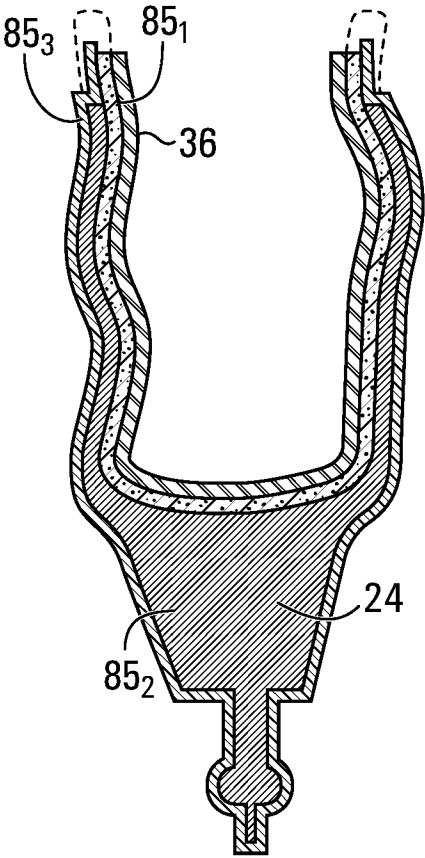


FIG. 69A

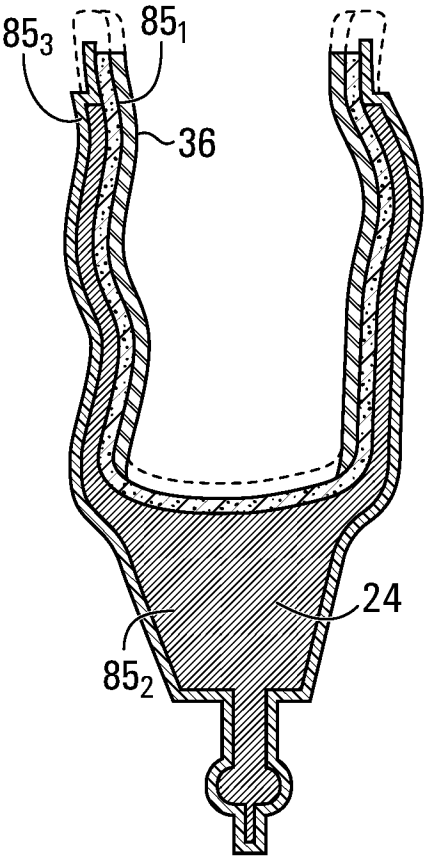


FIG. 69B

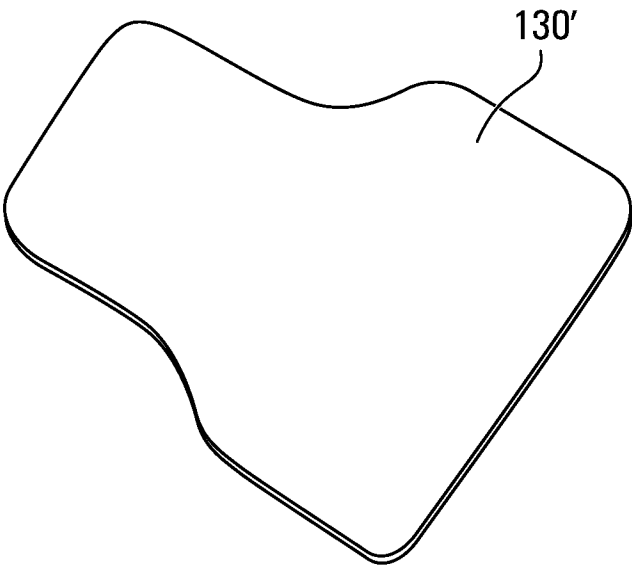


FIG. 70A

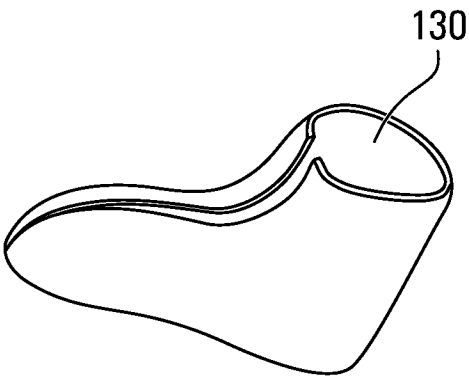


FIG. 70B

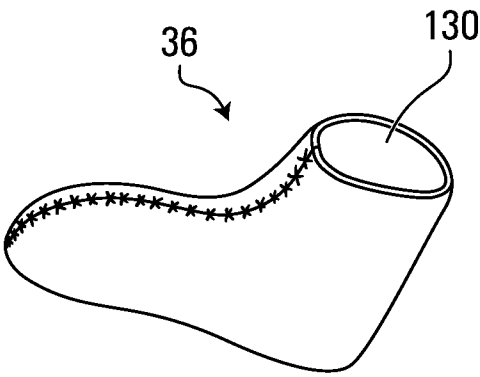


FIG. 71

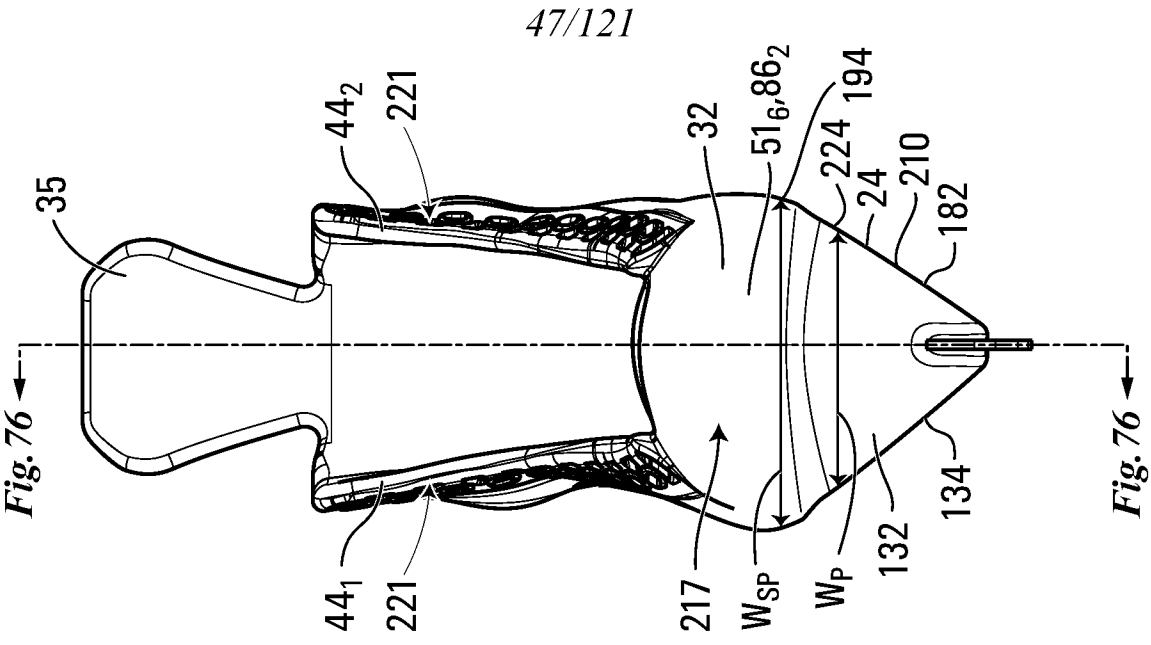


FIG. 73

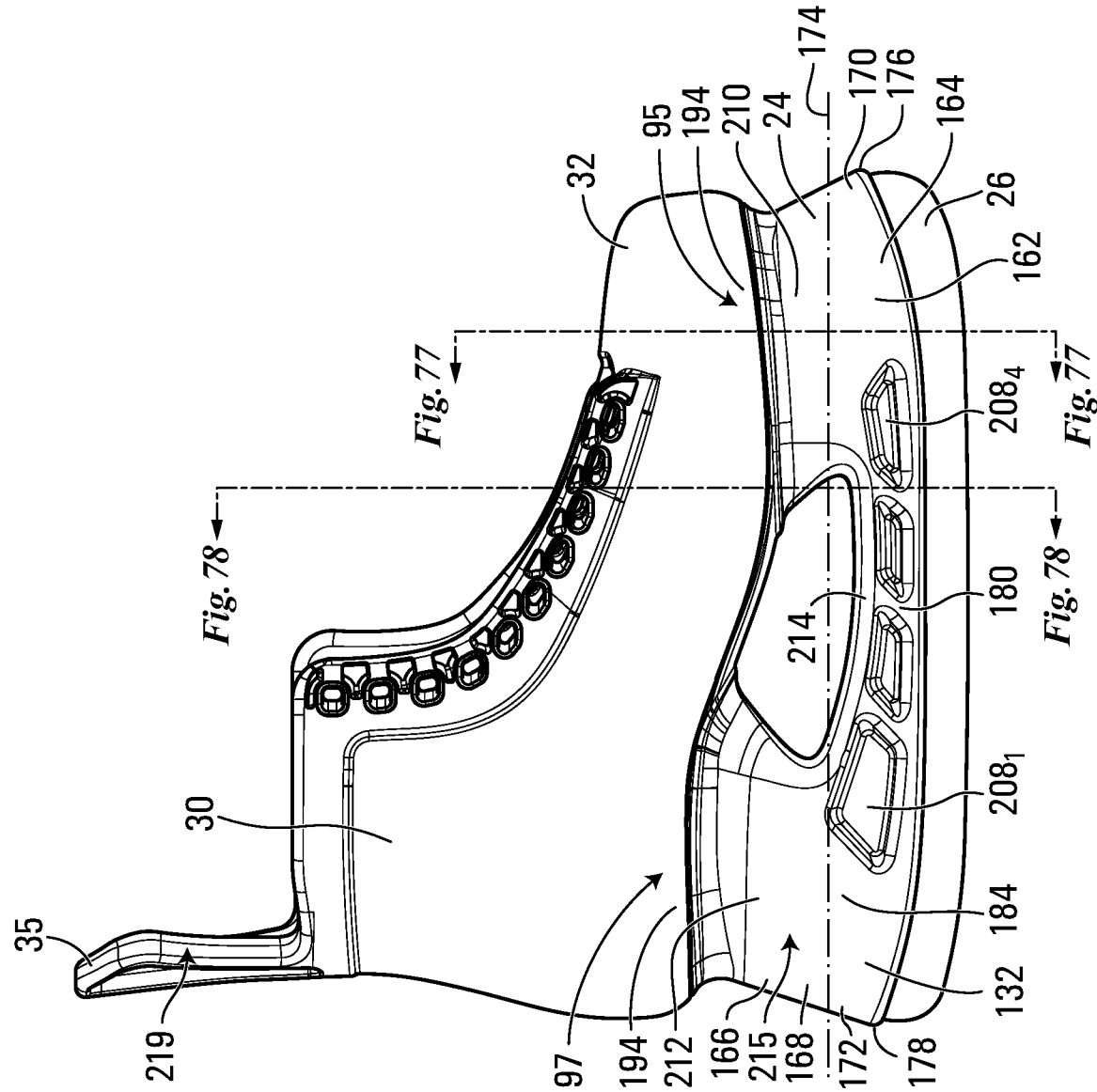


FIG. 72

48/121

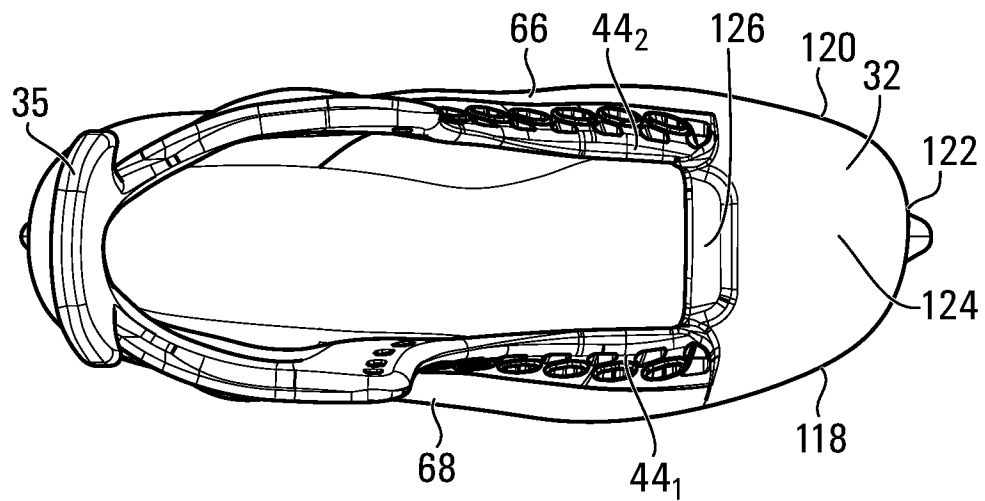


FIG. 74

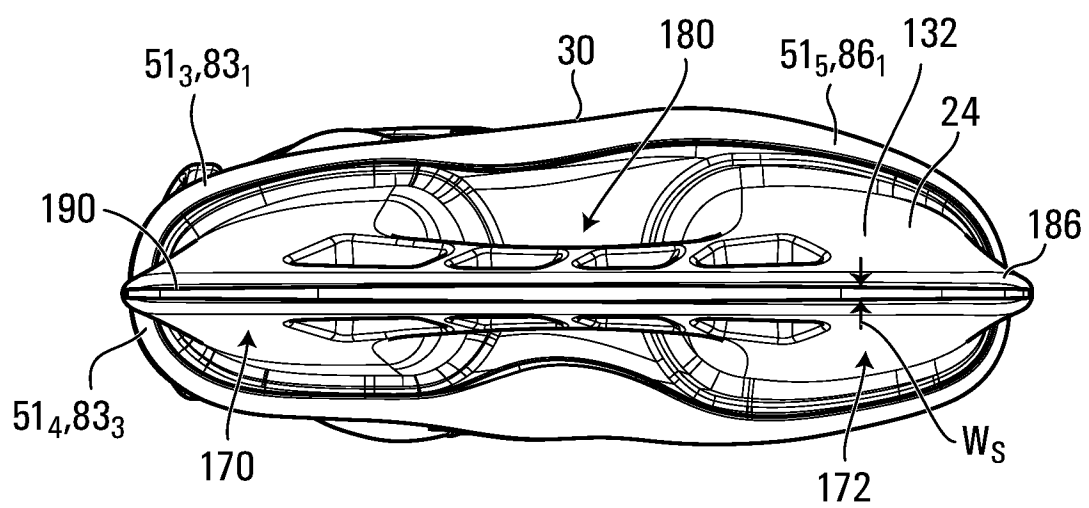


FIG. 75

49/121

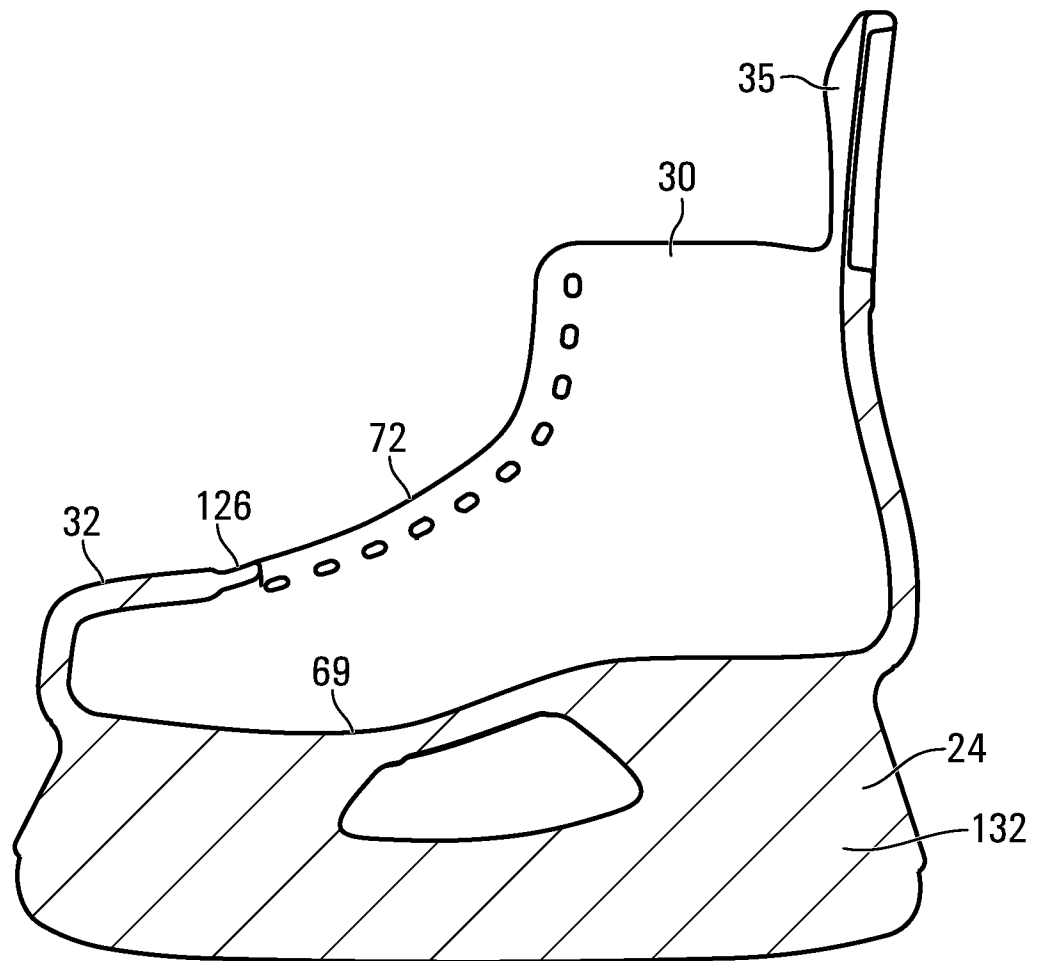


FIG. 76

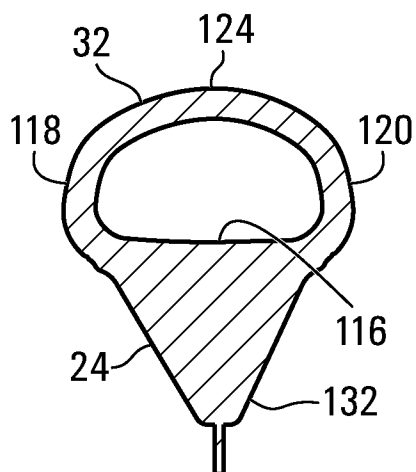


FIG. 77

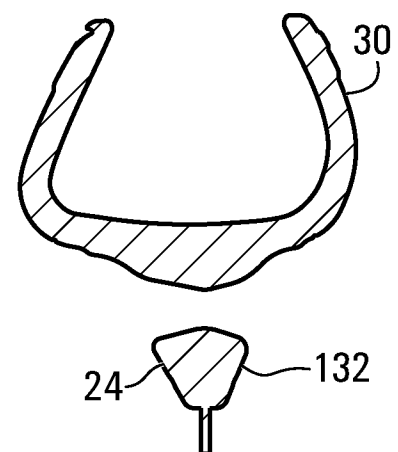


FIG. 78

50/121

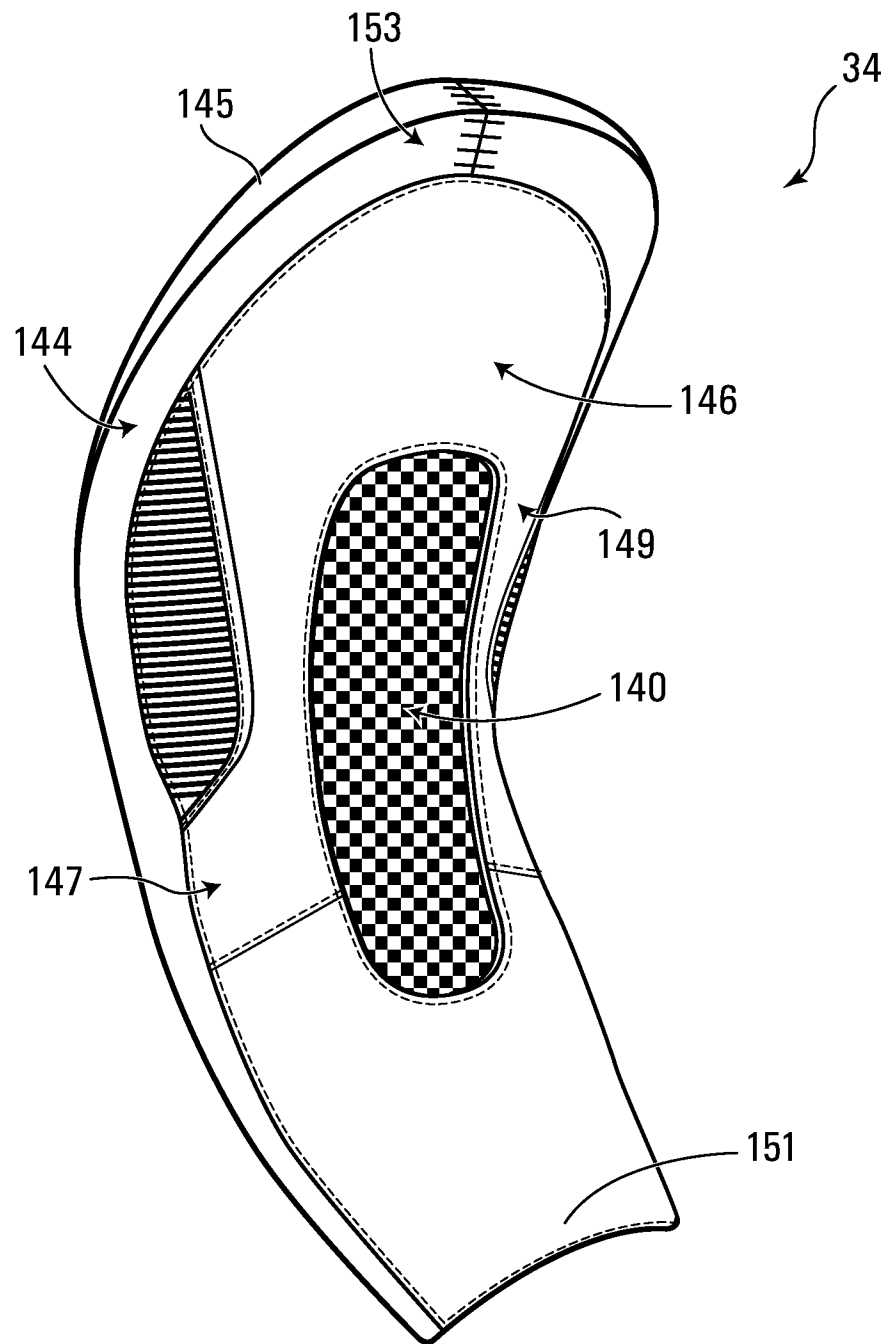


FIG. 79

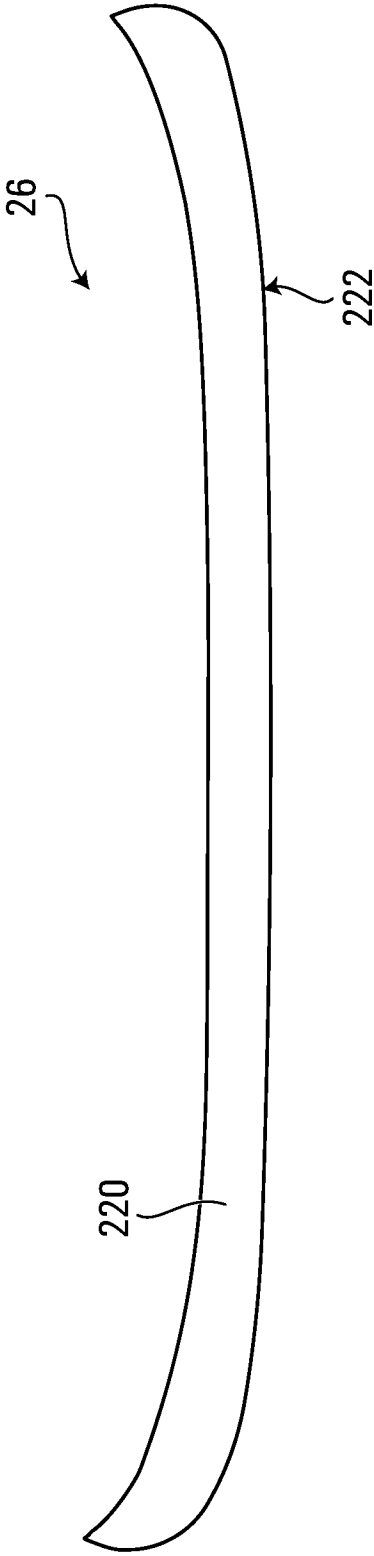


FIG. 80

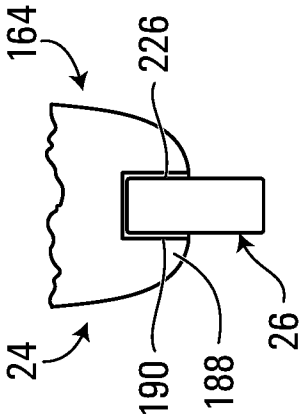


FIG. 81

52/121

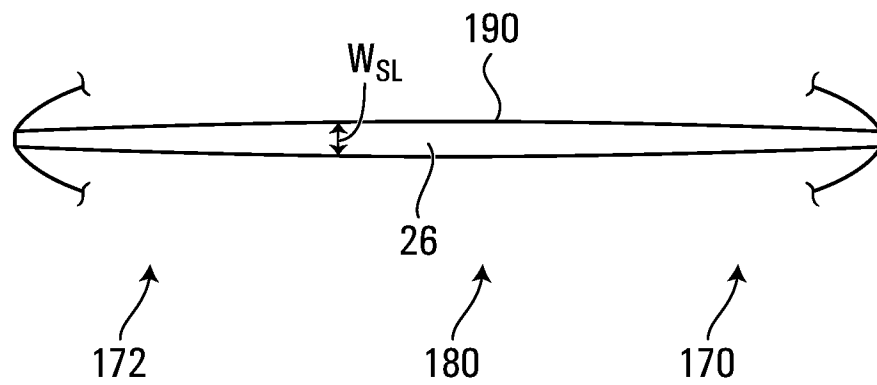


FIG. 82

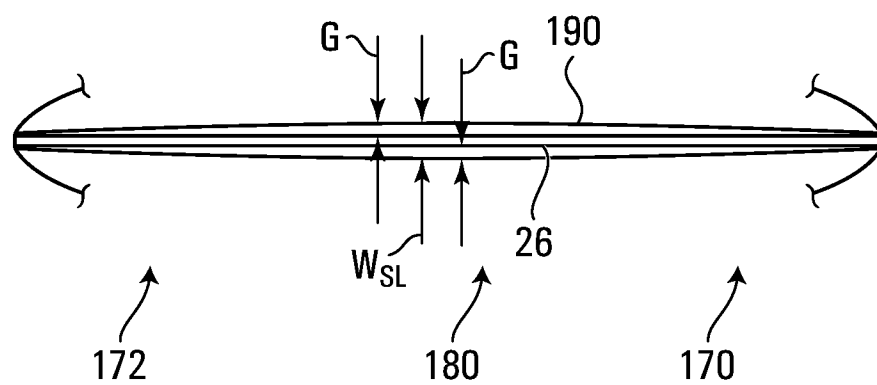
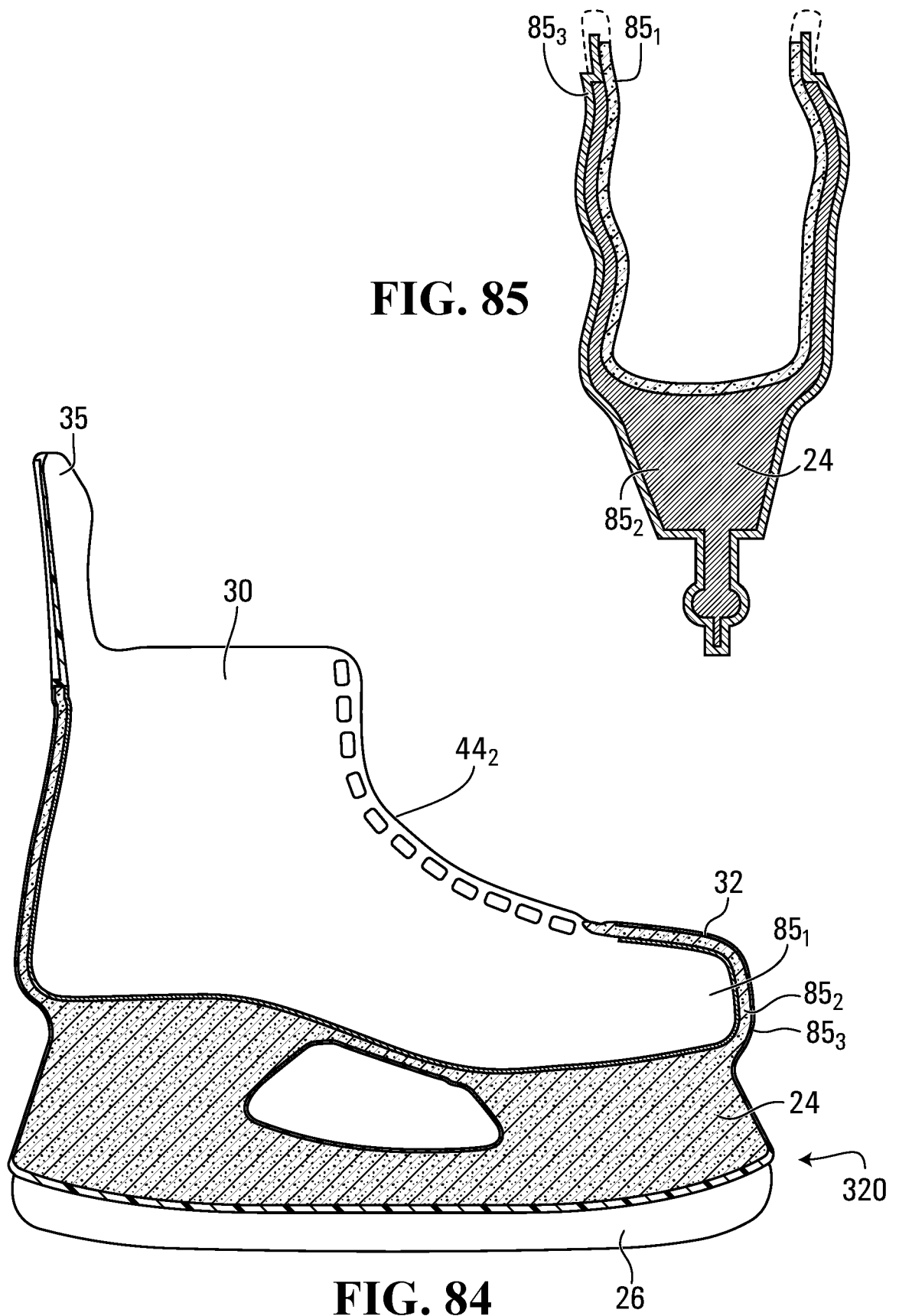


FIG. 83

53/121



54/121

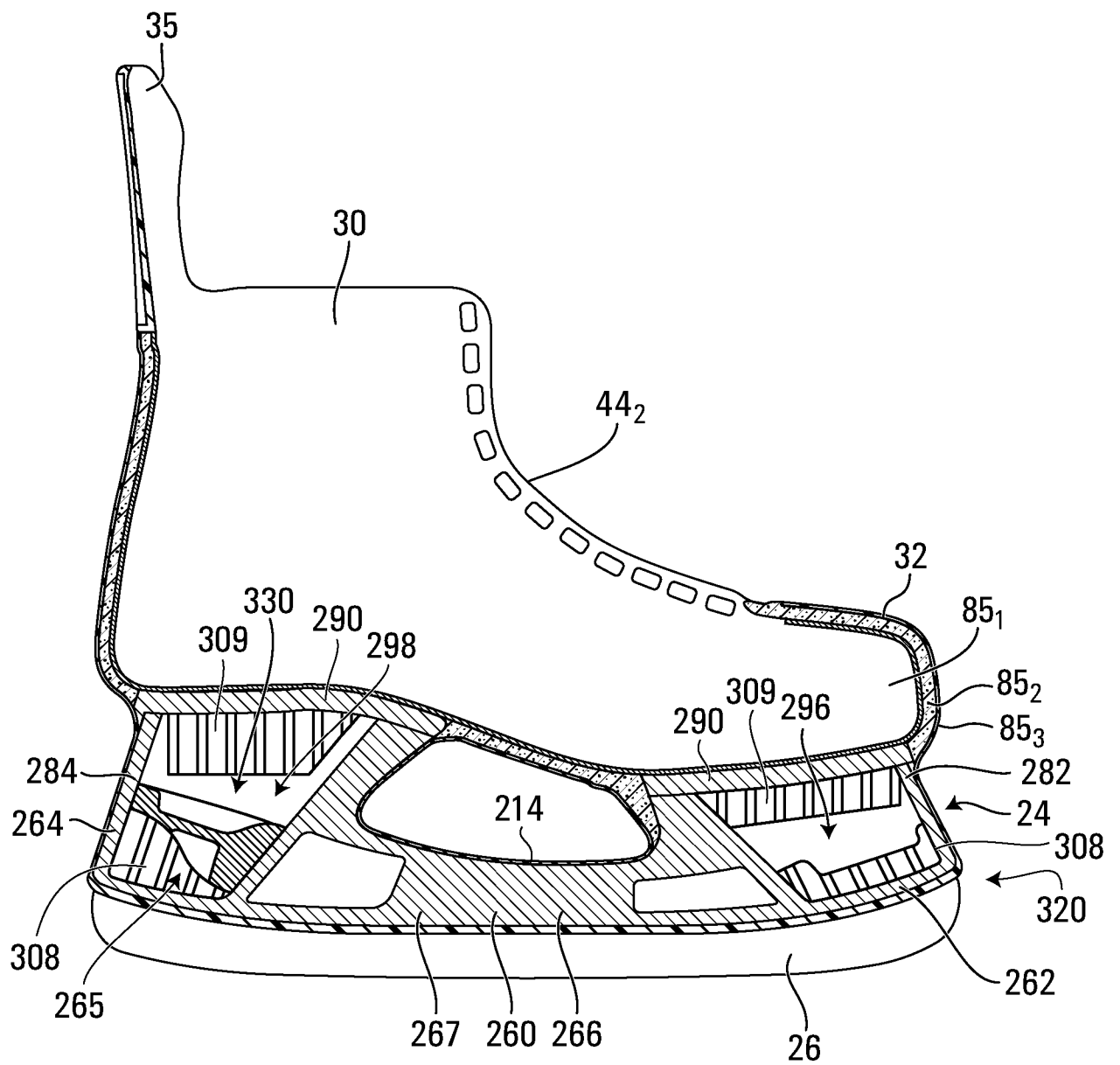
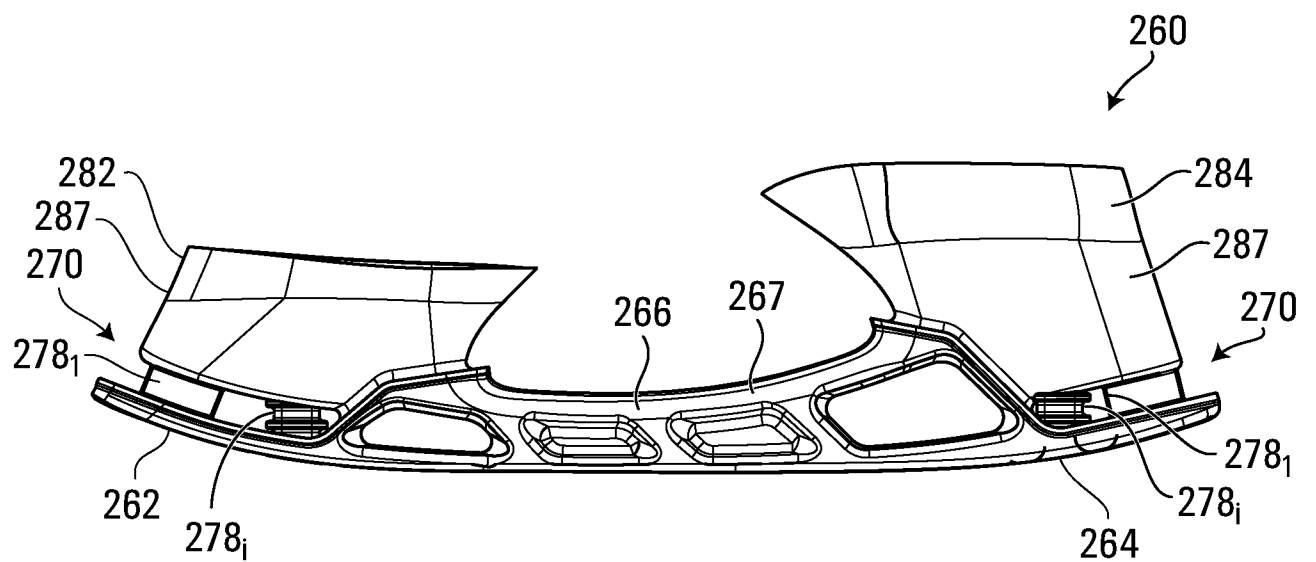
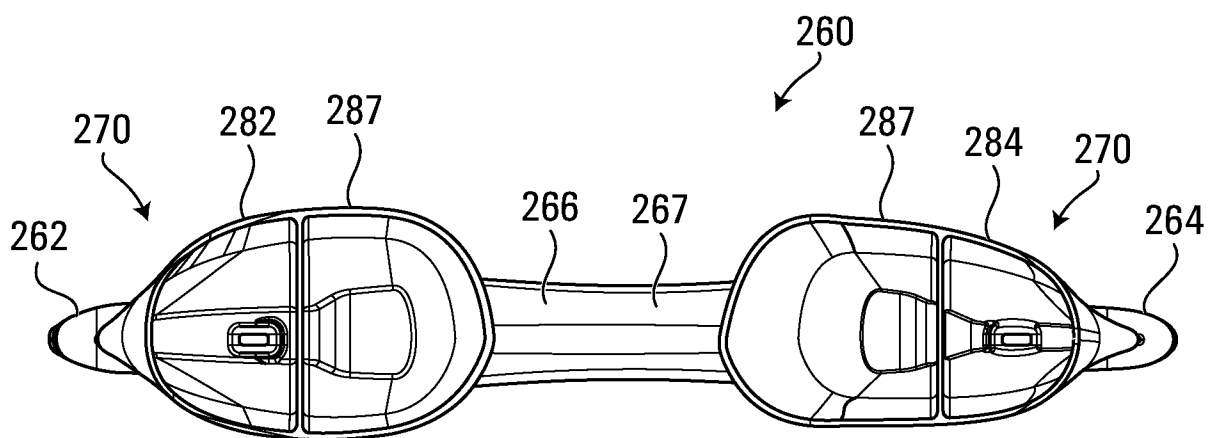
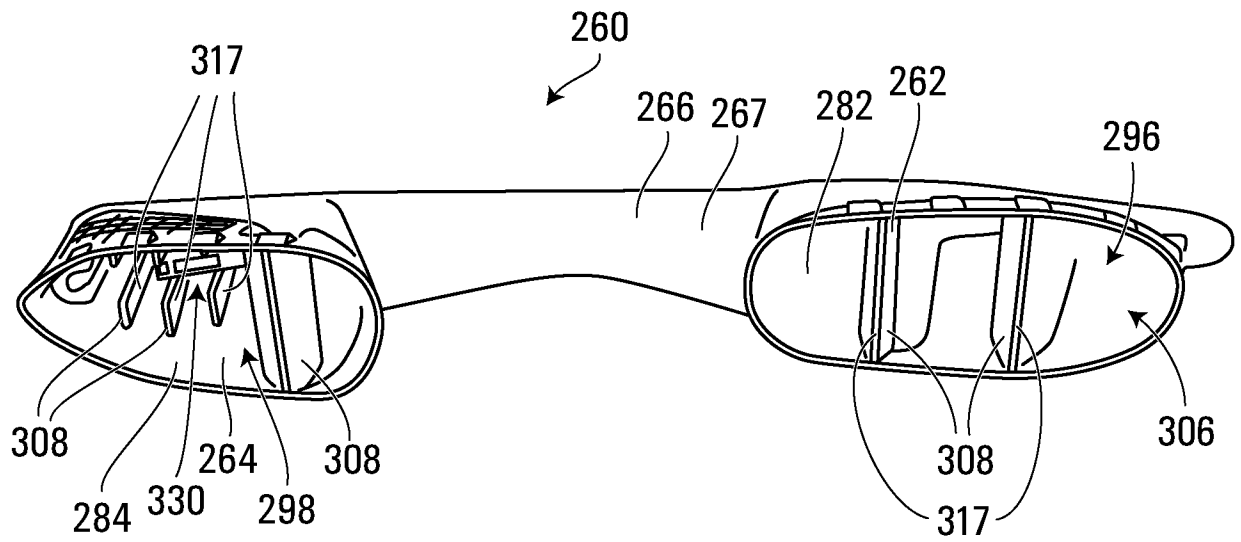


FIG. 86

55/121

**FIG. 87****FIG. 88**

56/121

**FIG. 89**

57/121

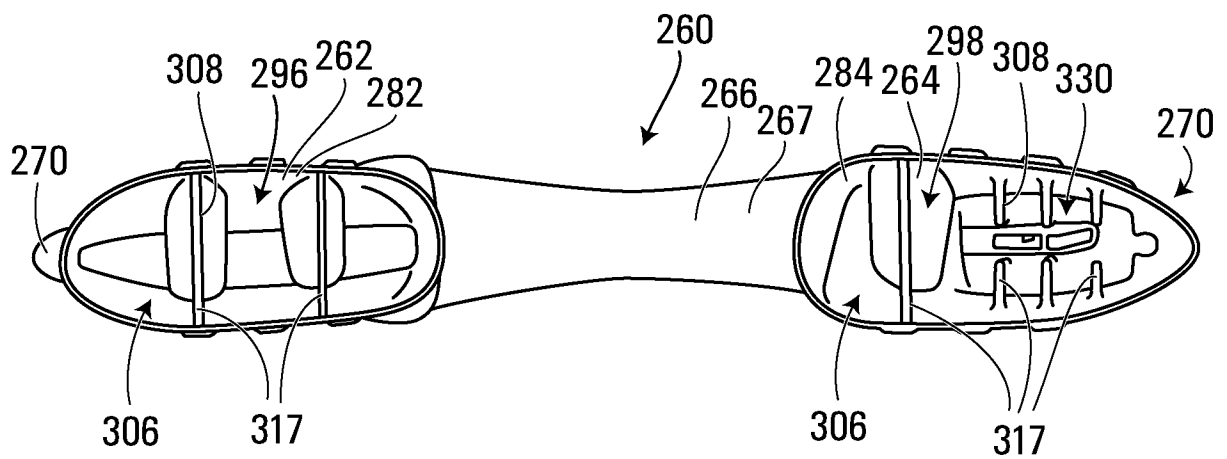


FIG. 90

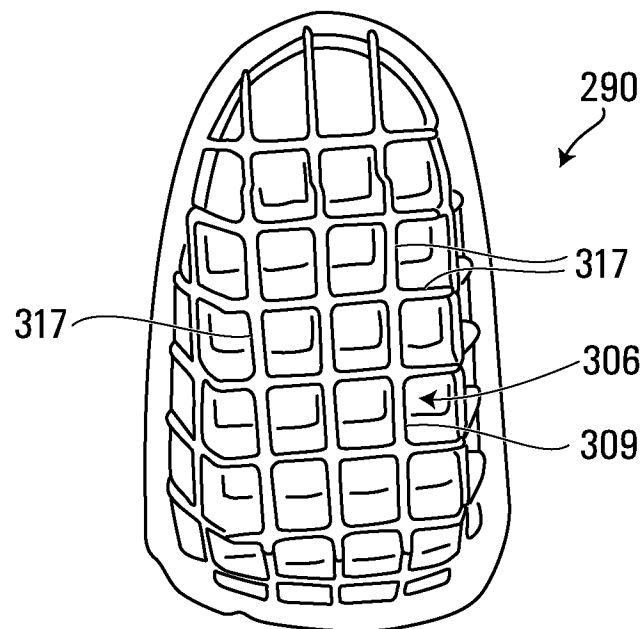


FIG. 91

58/121

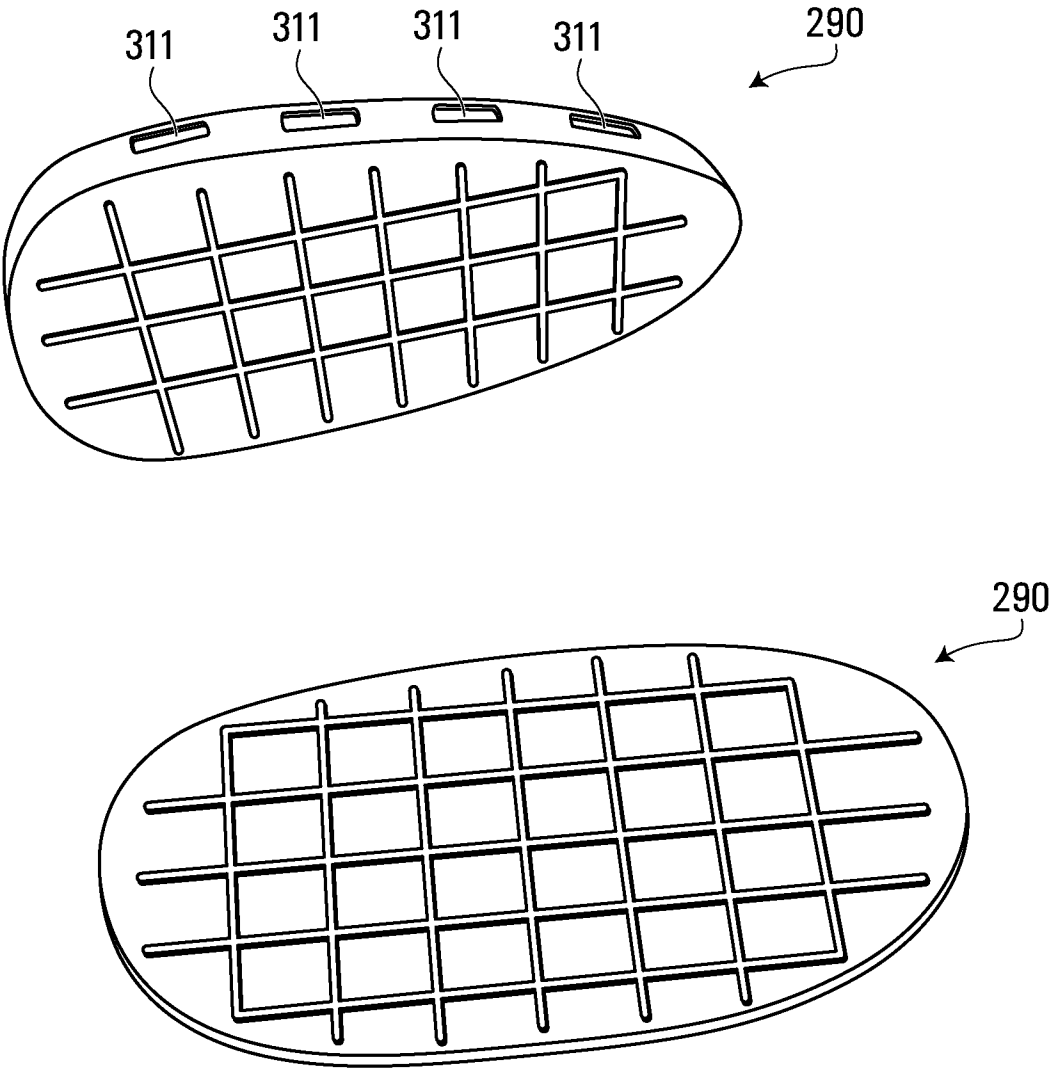


FIG. 92A

59/121

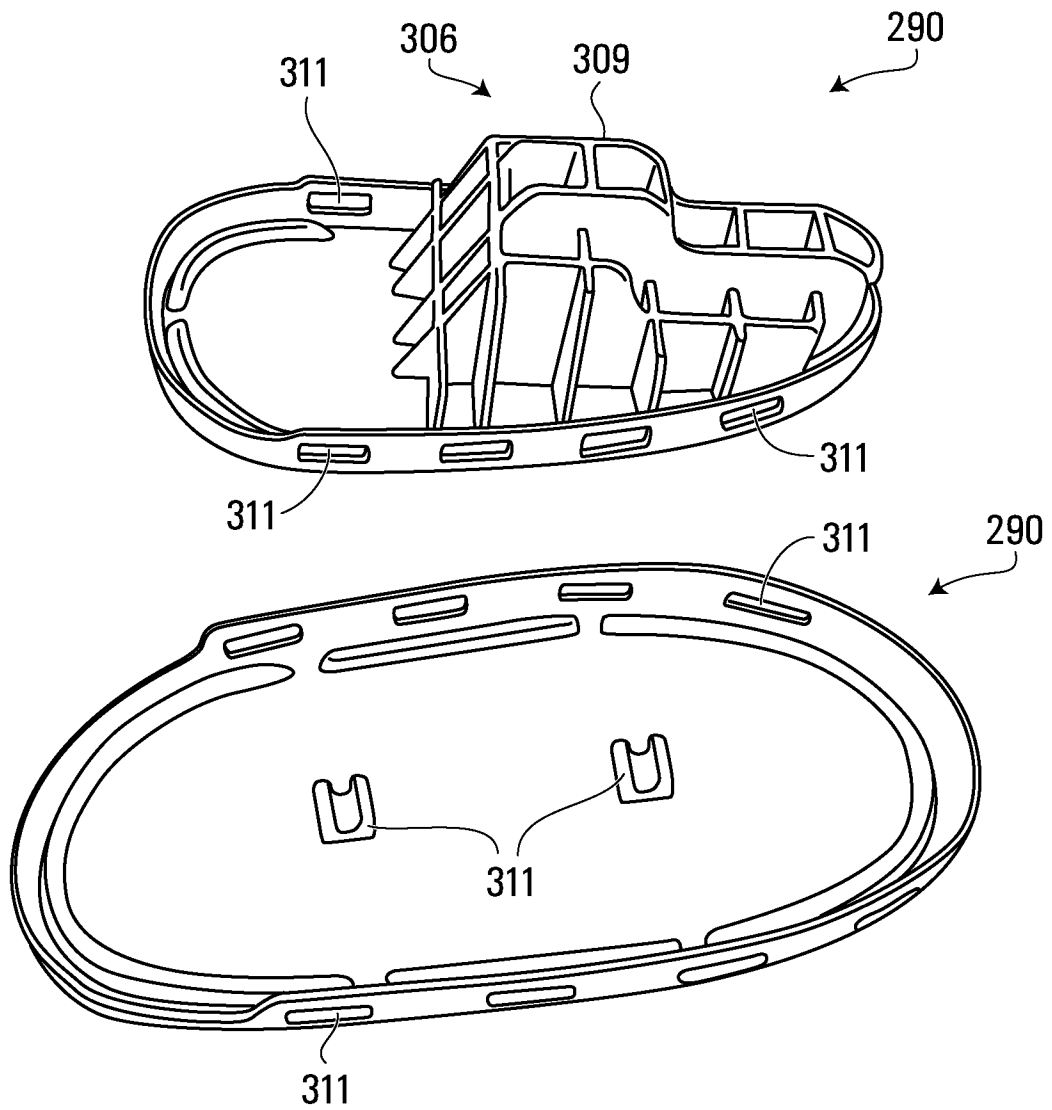
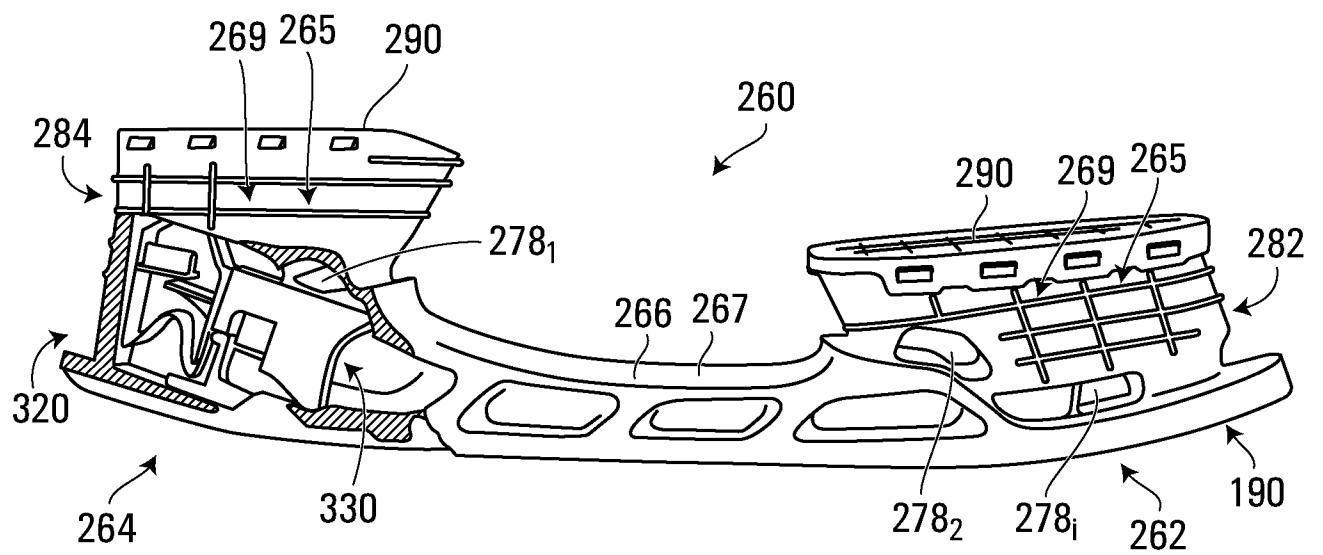


FIG. 92B

60/121

**FIG. 93**

61/121

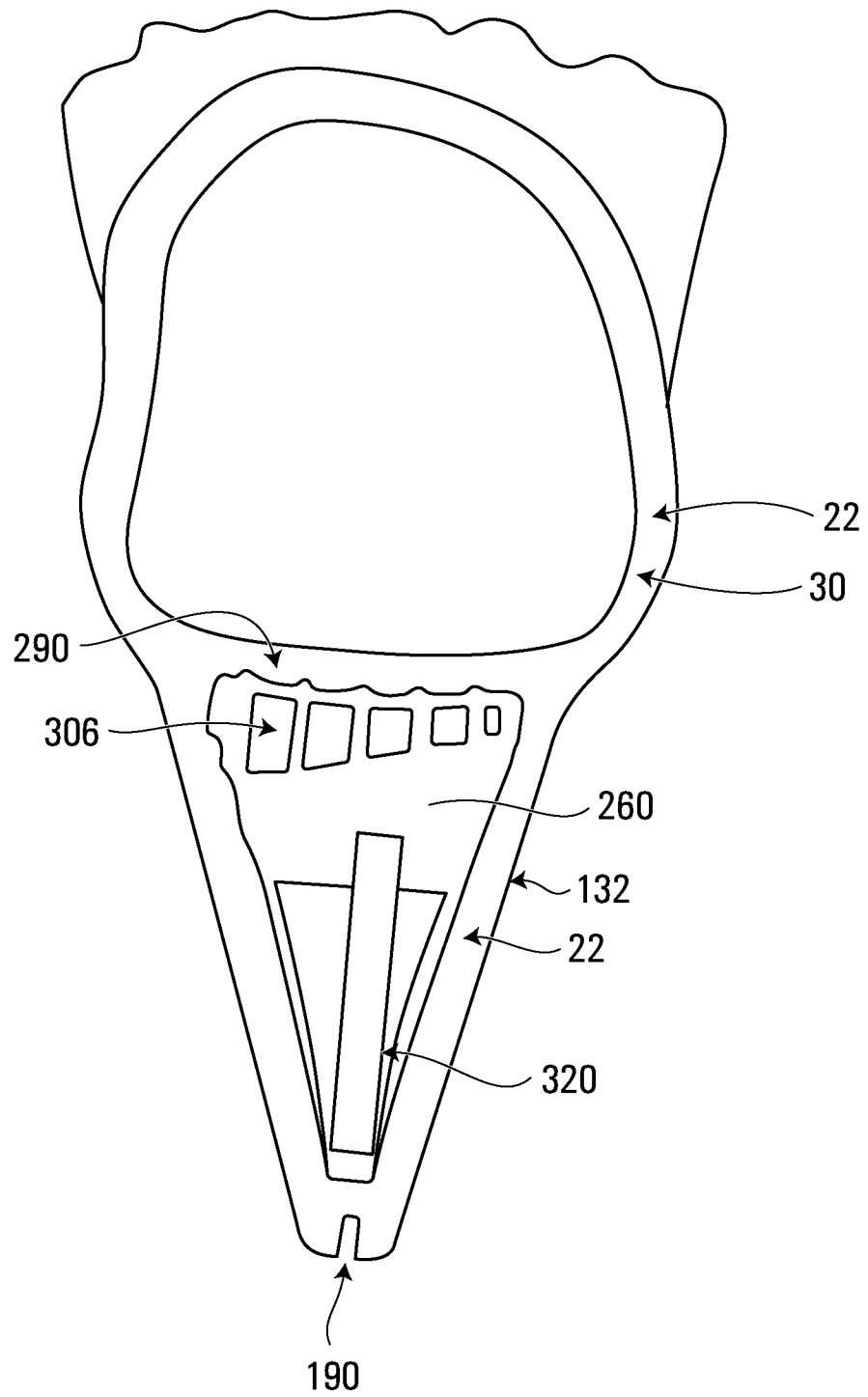


FIG. 94

62/121

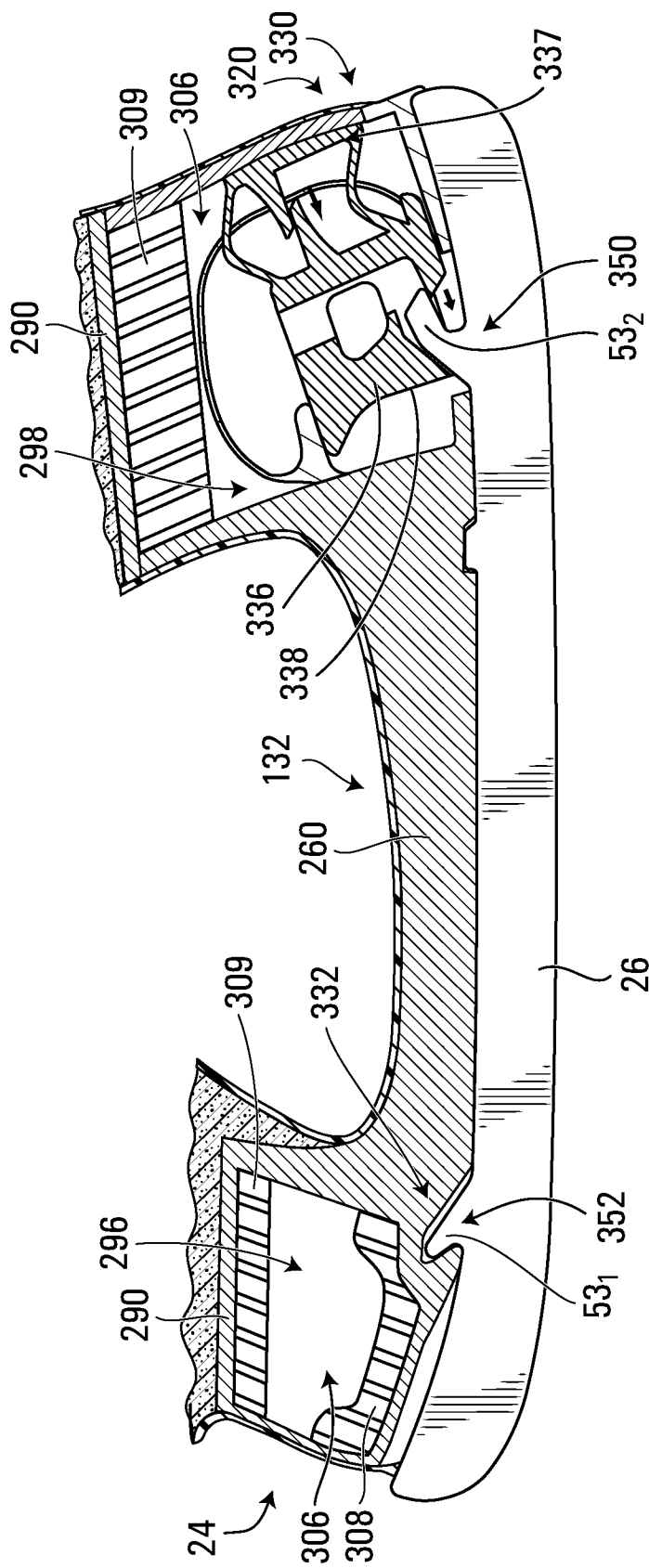


FIG. 95A

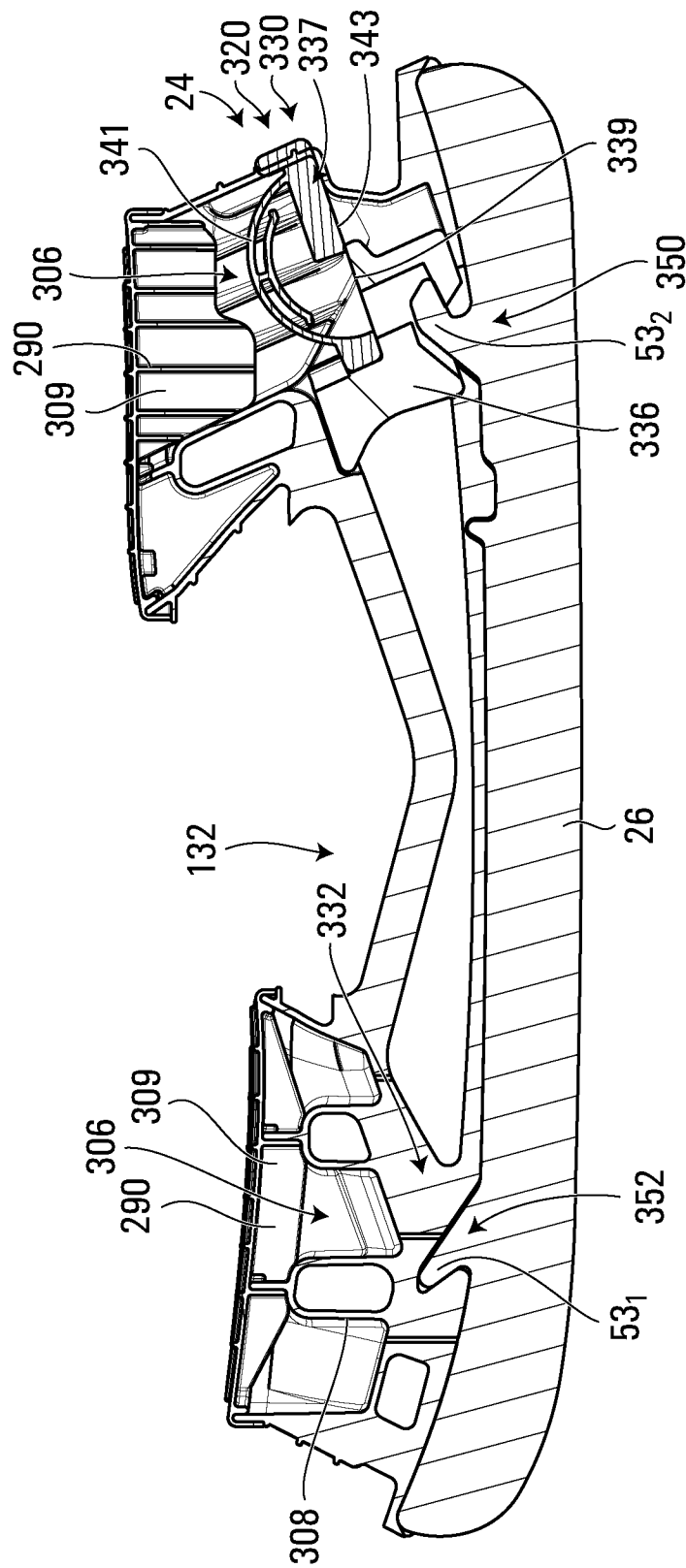


FIG. 95B

64/121

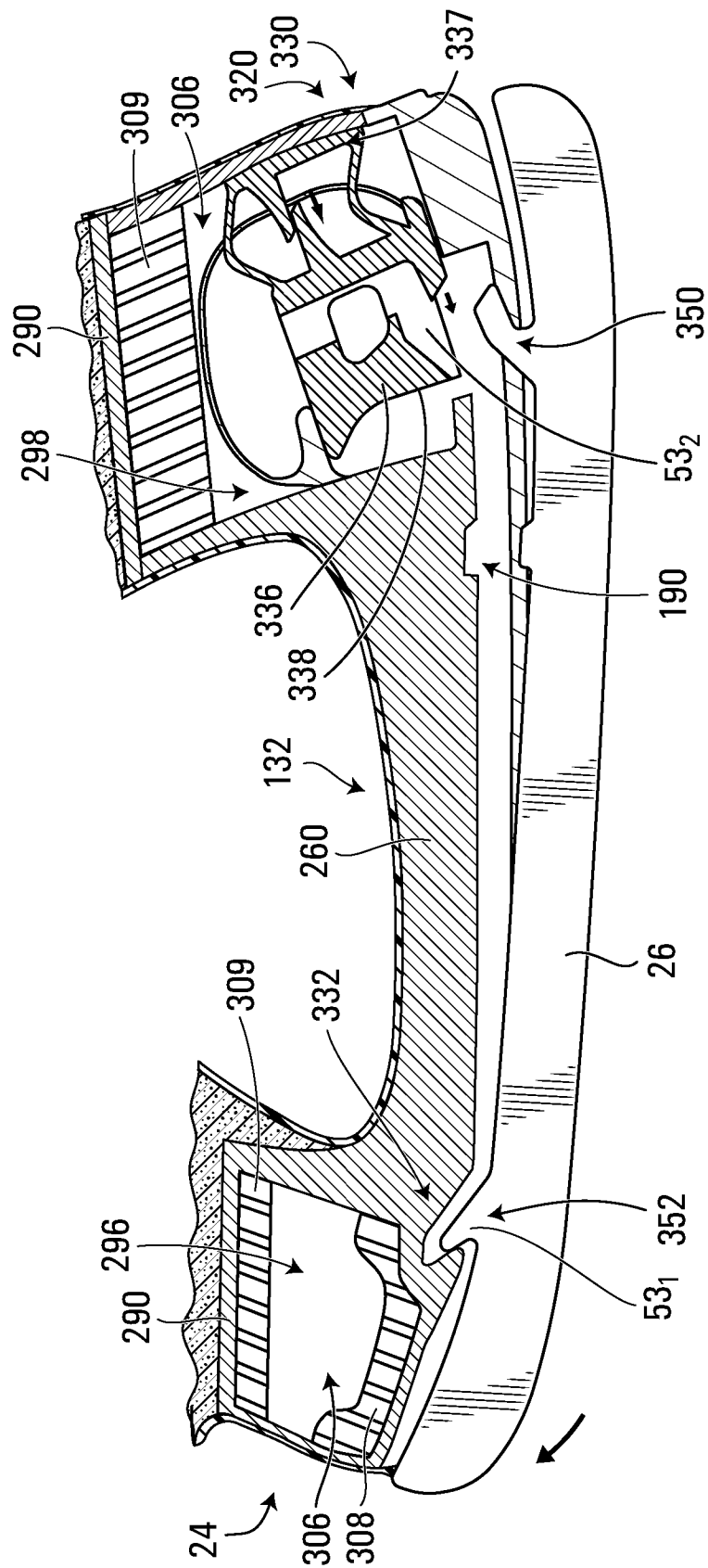


FIG. 96

65/121

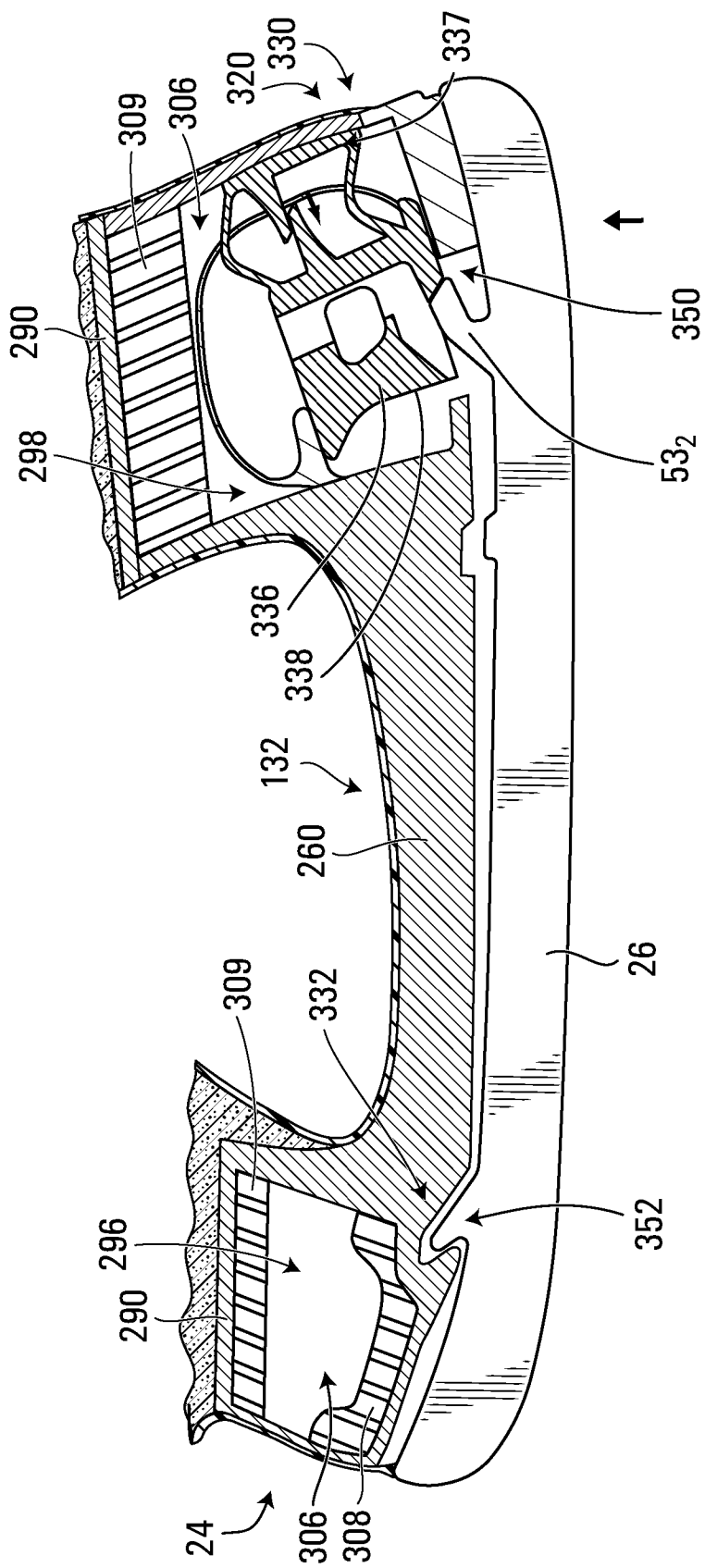


FIG. 97

66/121

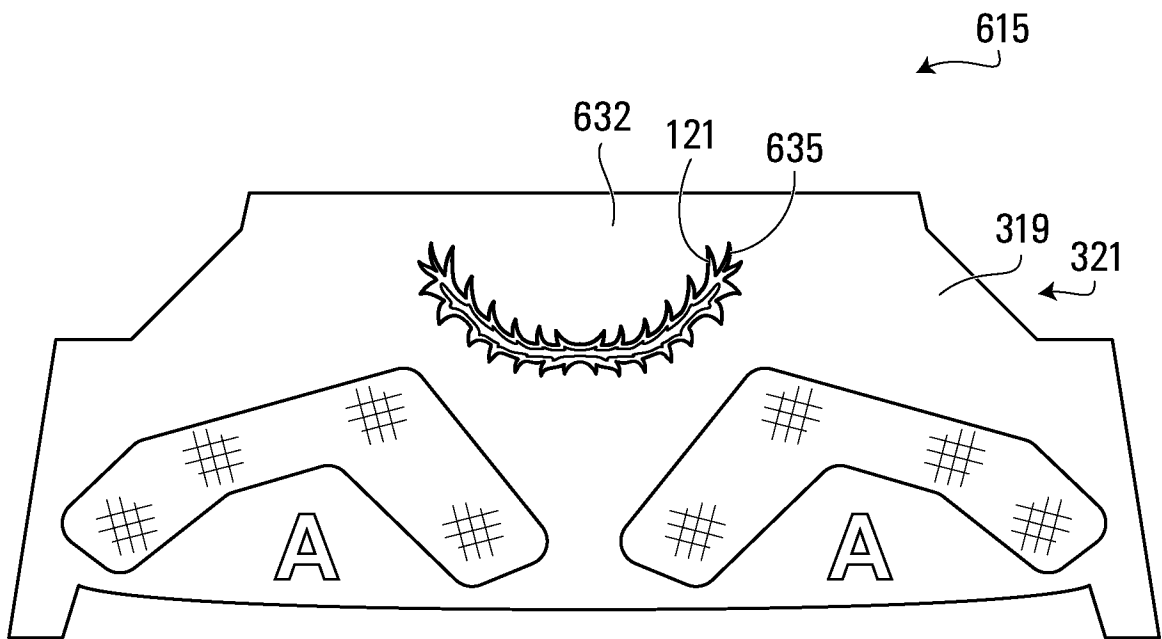


FIG. 98

67/121

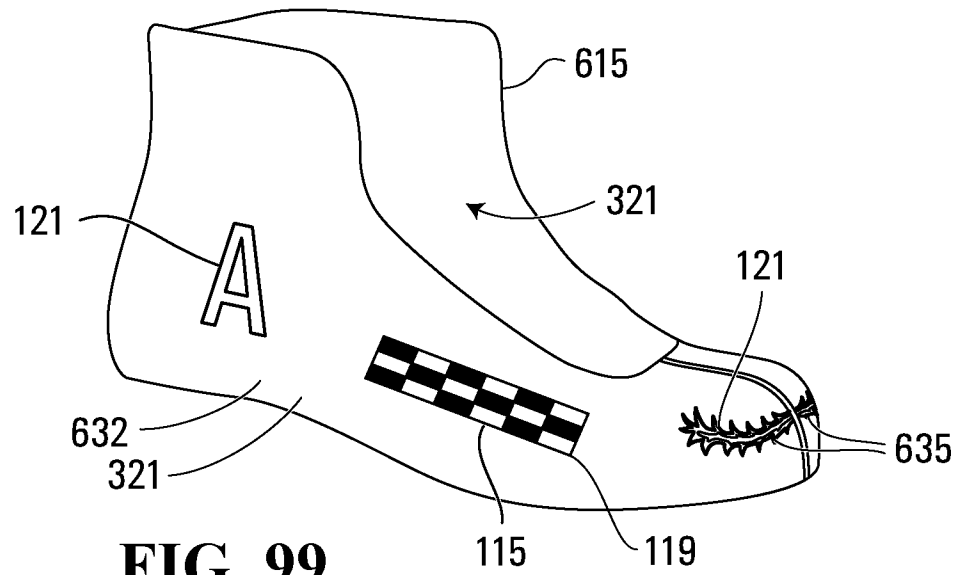


FIG. 99

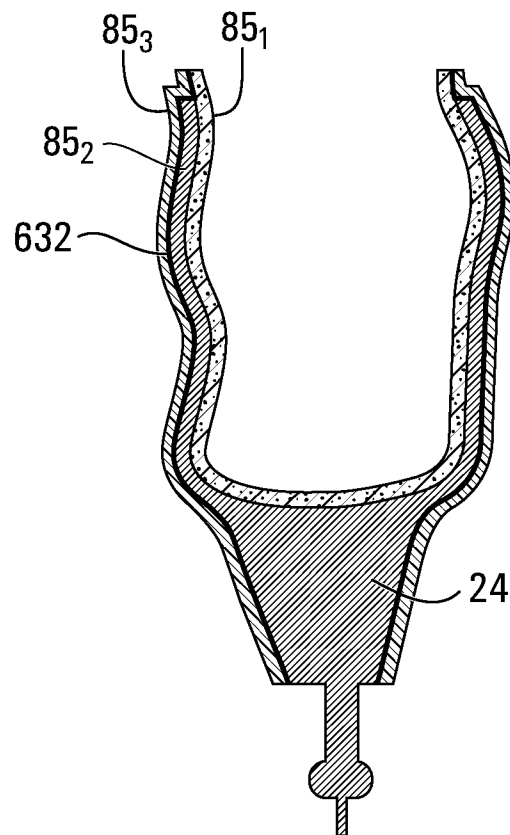
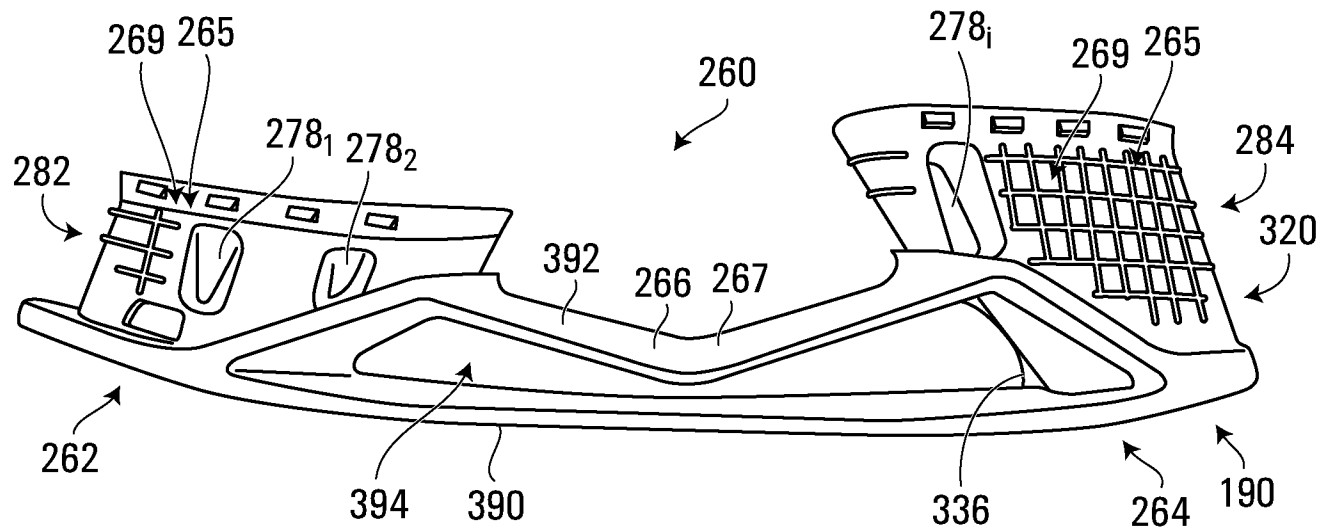


FIG. 100

68/121

**FIG. 101**

69/121

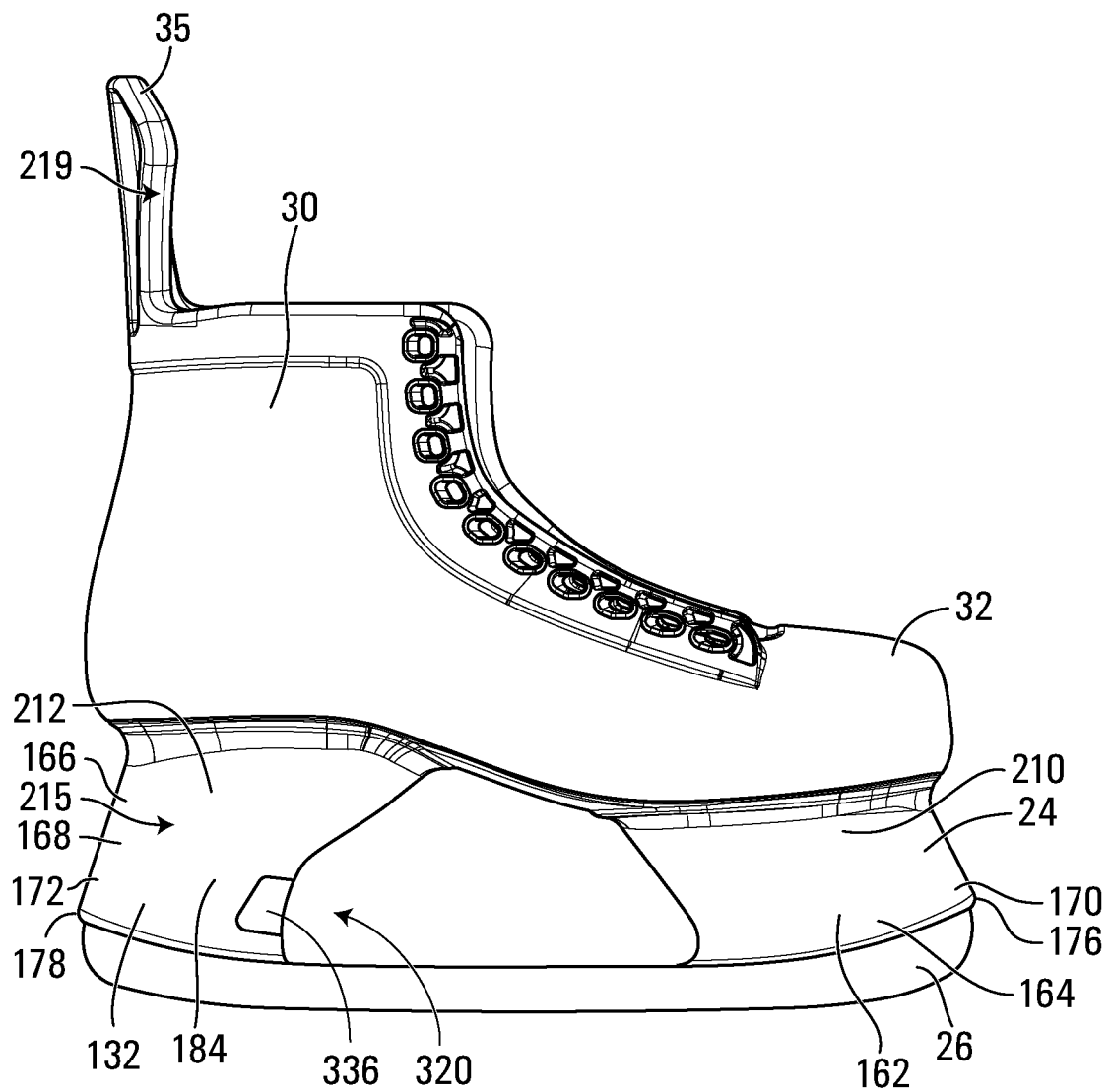


FIG. 102

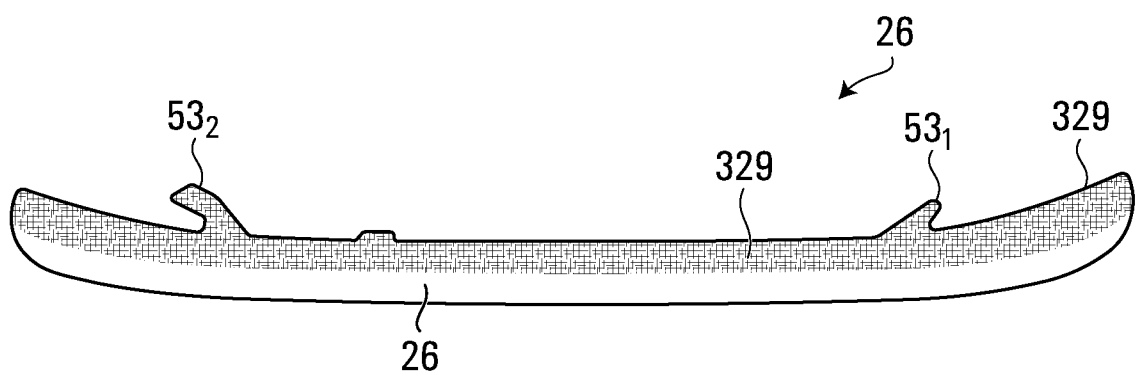


FIG. 103

70/121

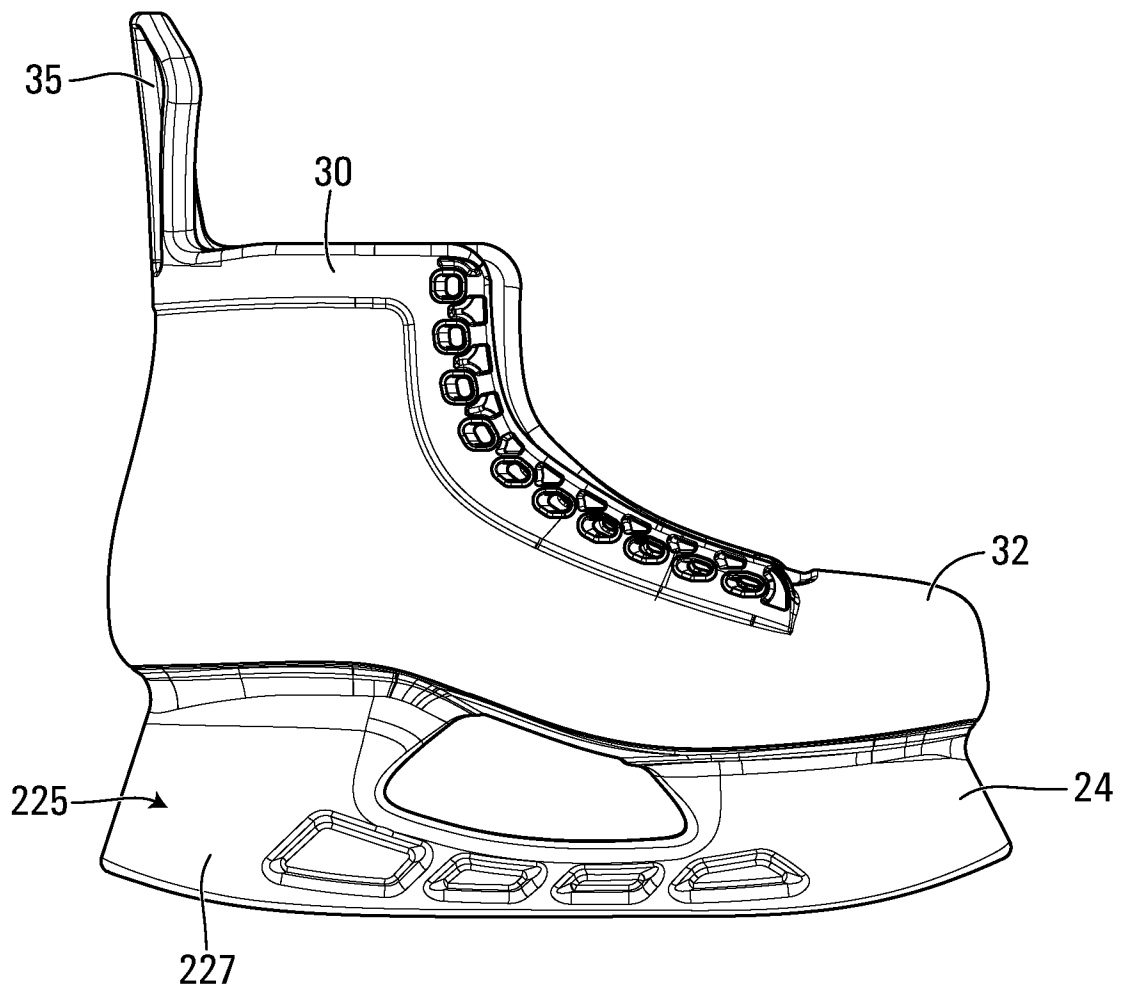


FIG. 104

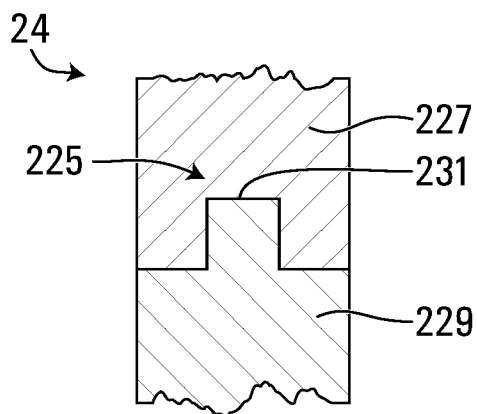


FIG. 105

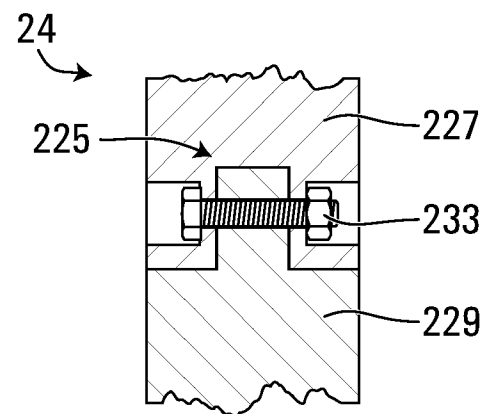


FIG. 106

71/121

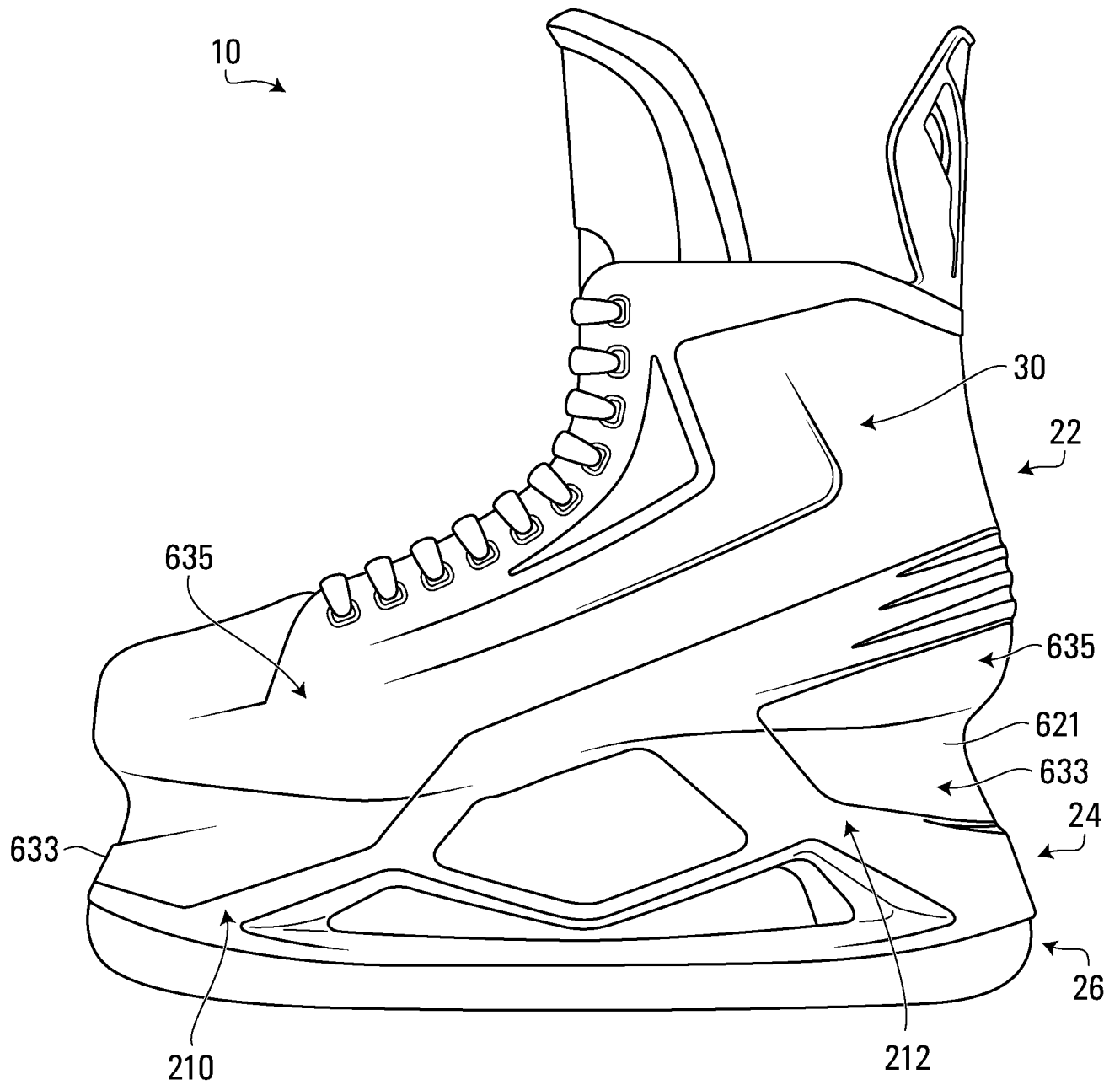


FIG. 107

72/121

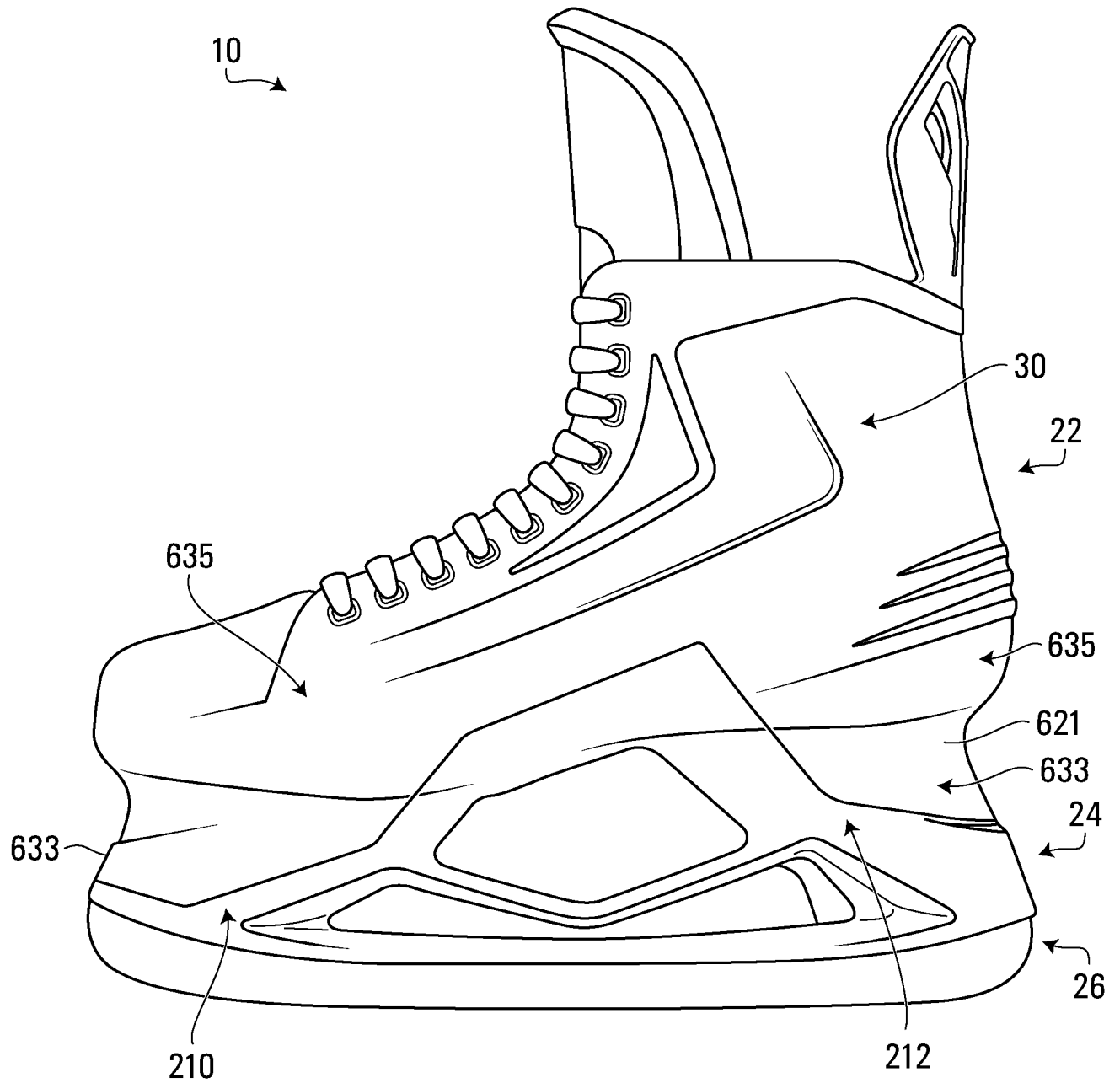


FIG. 108

73/121

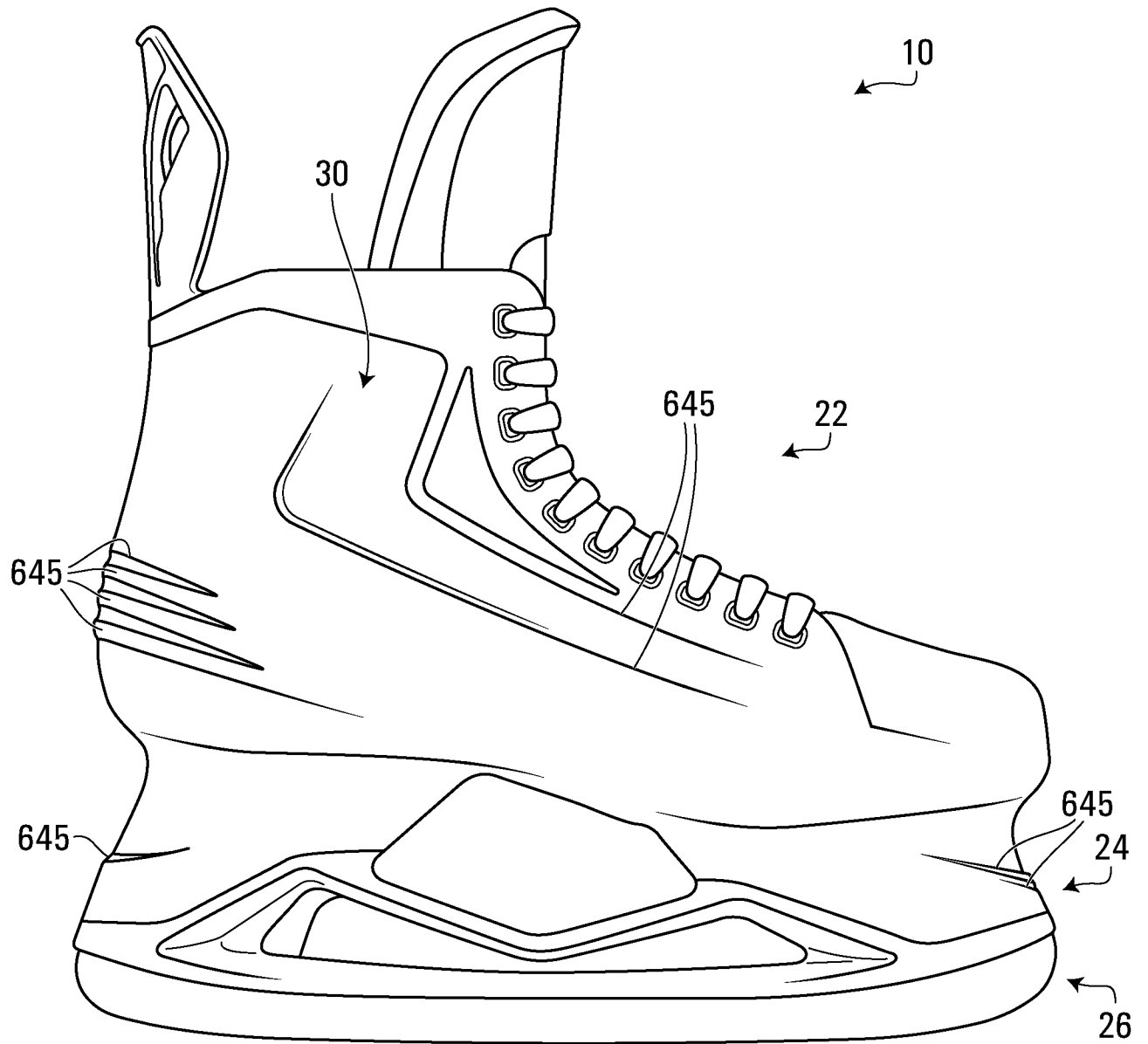


FIG. 109

74/121

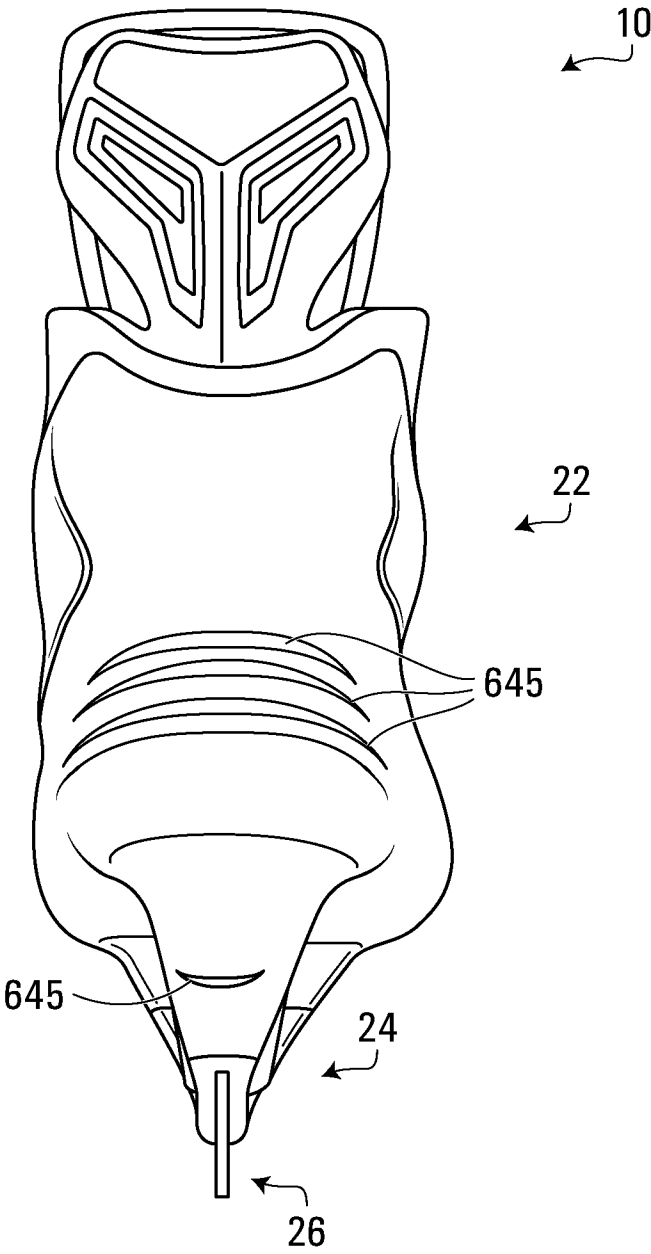


FIG. 110

75/121

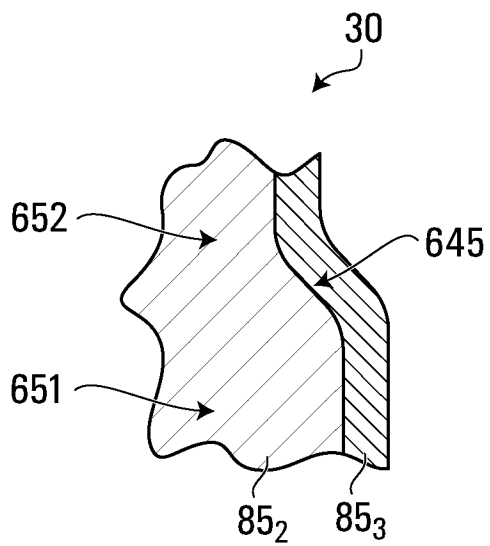


FIG. 111

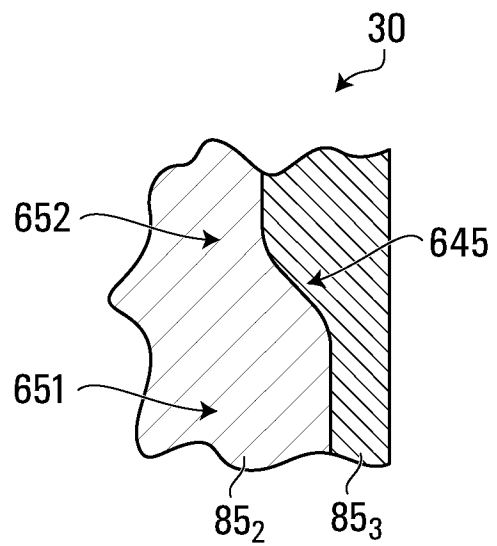


FIG. 112

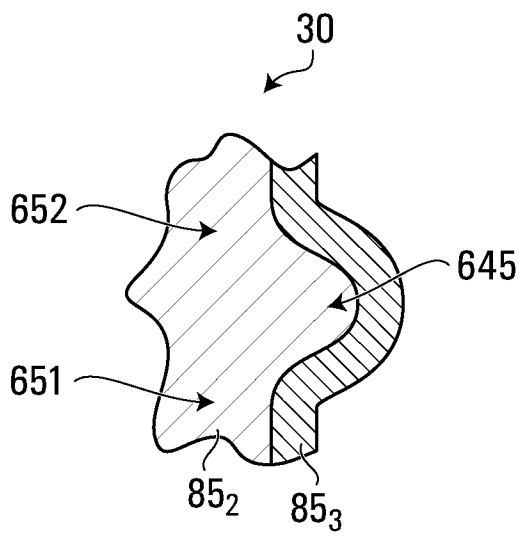


FIG. 113

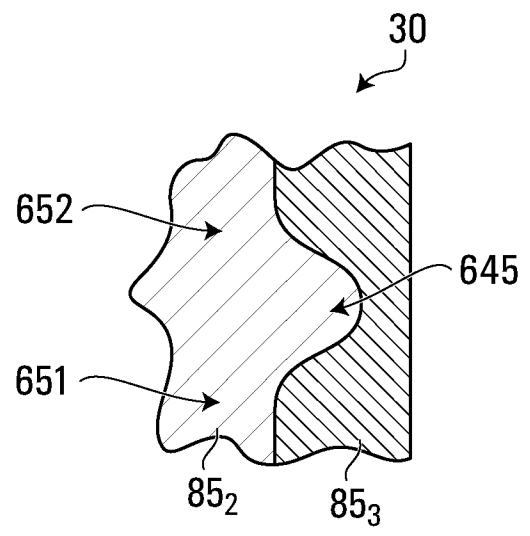


FIG. 114

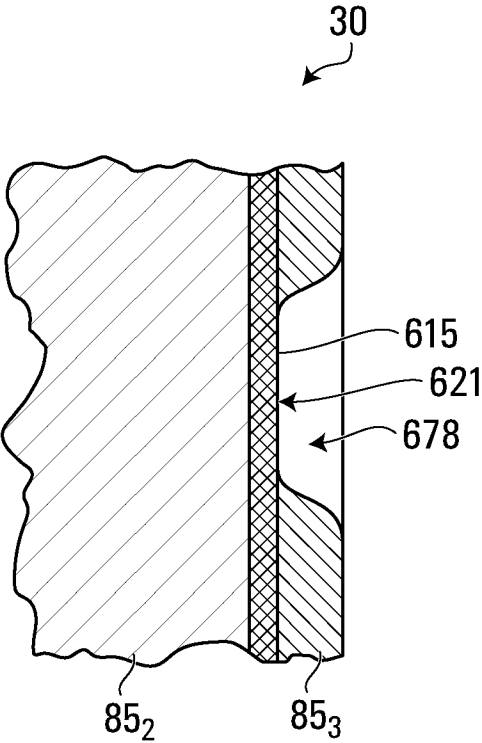


FIG. 115

77/121

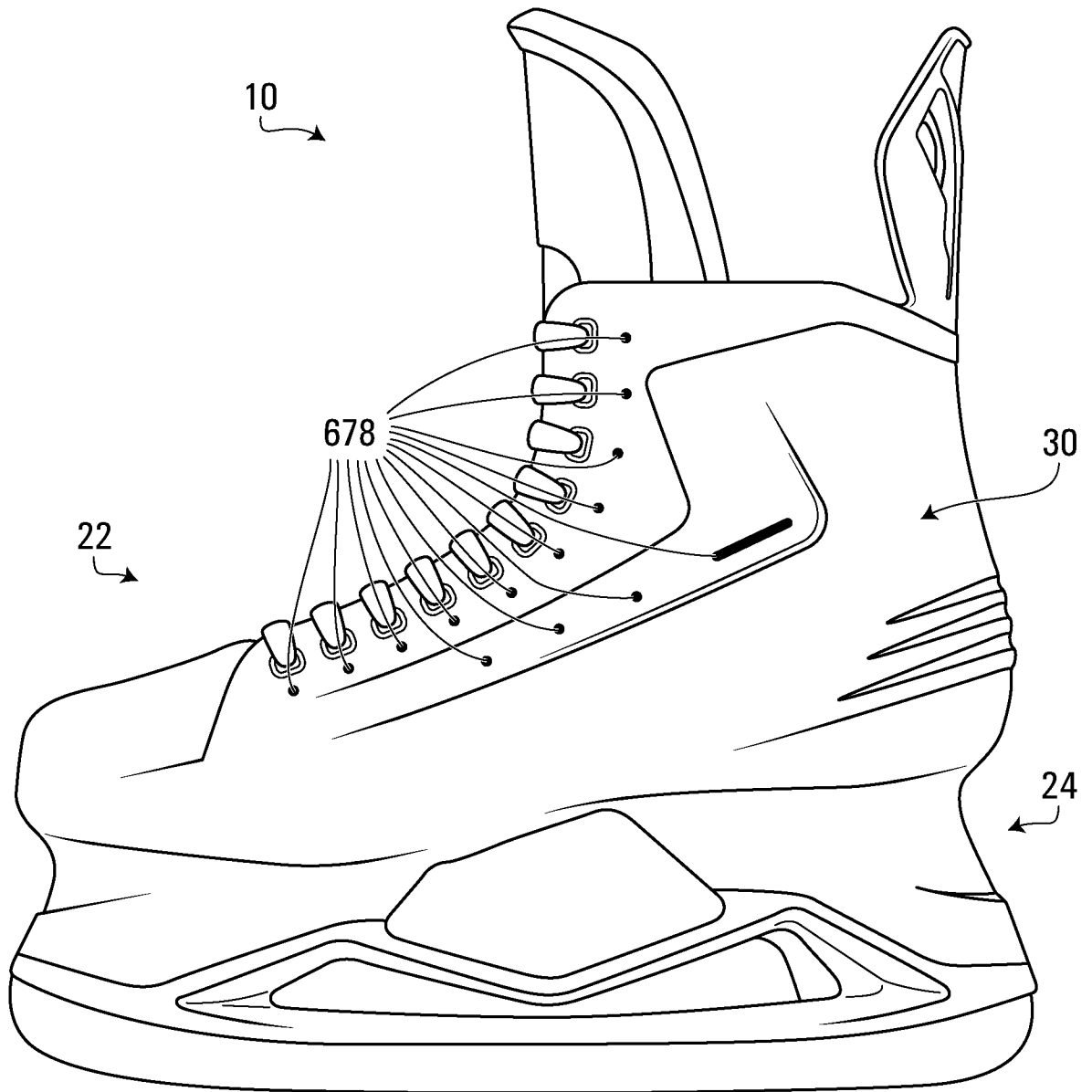


FIG. 116

78/121

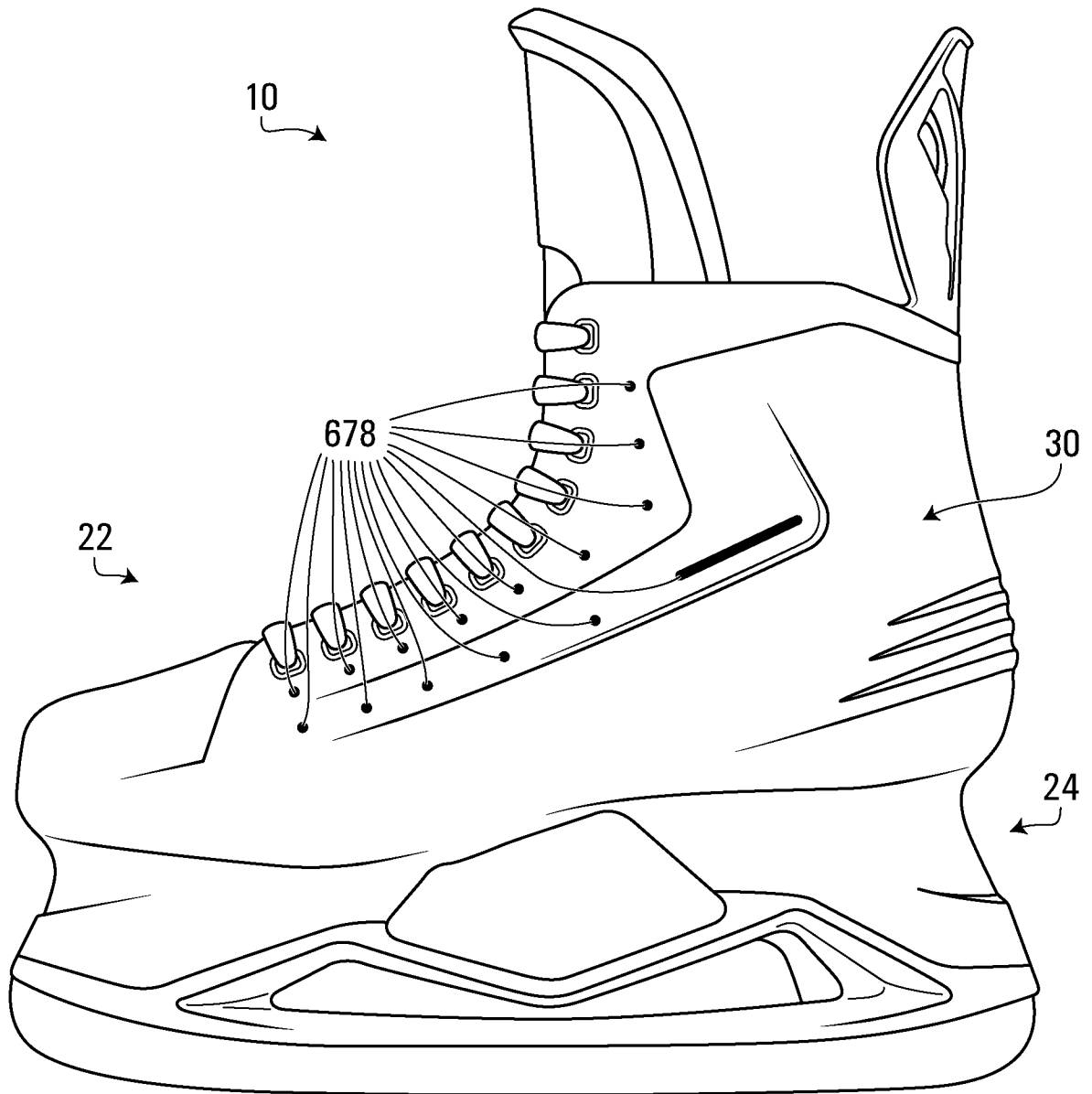


FIG. 117

79/121

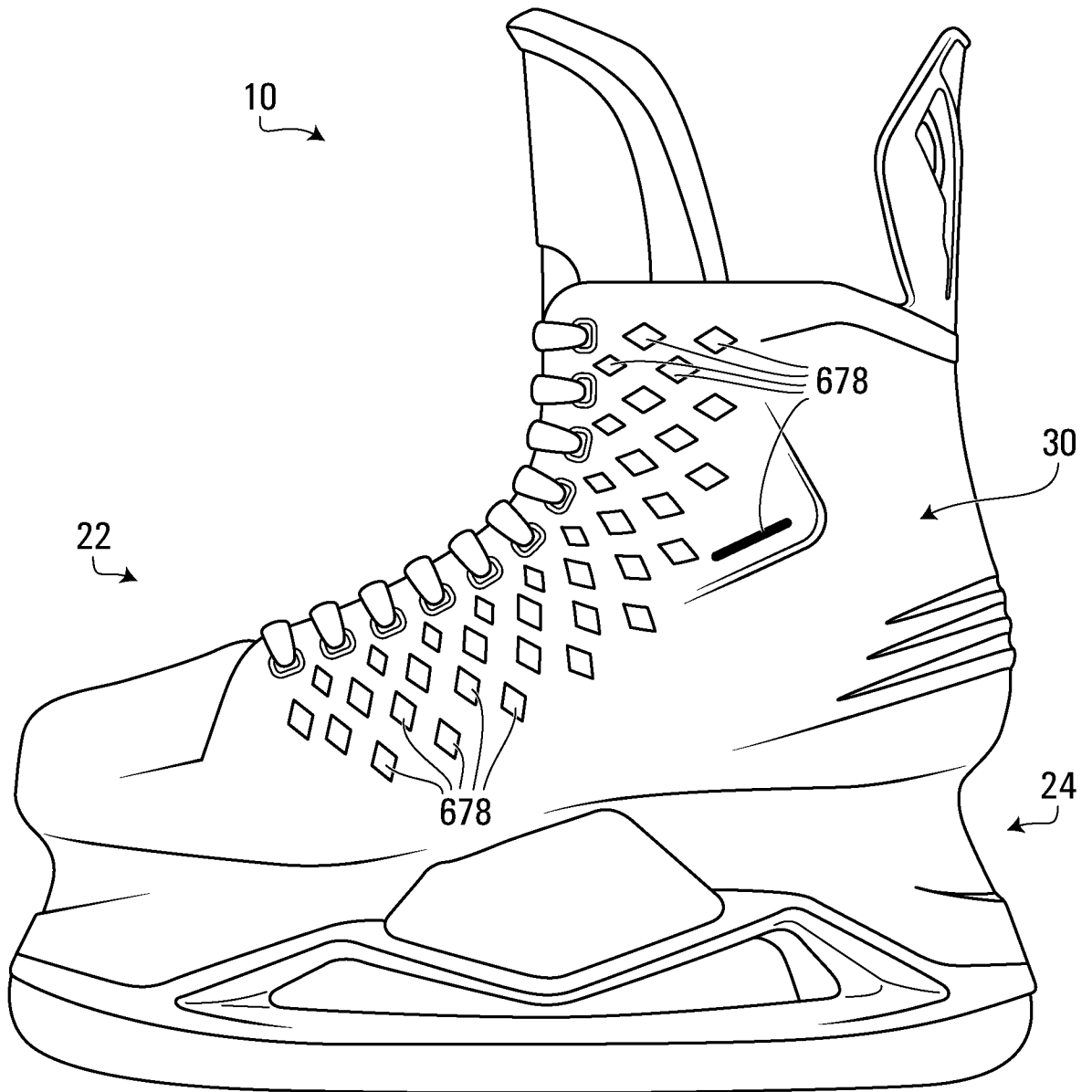


FIG. 118

80/121

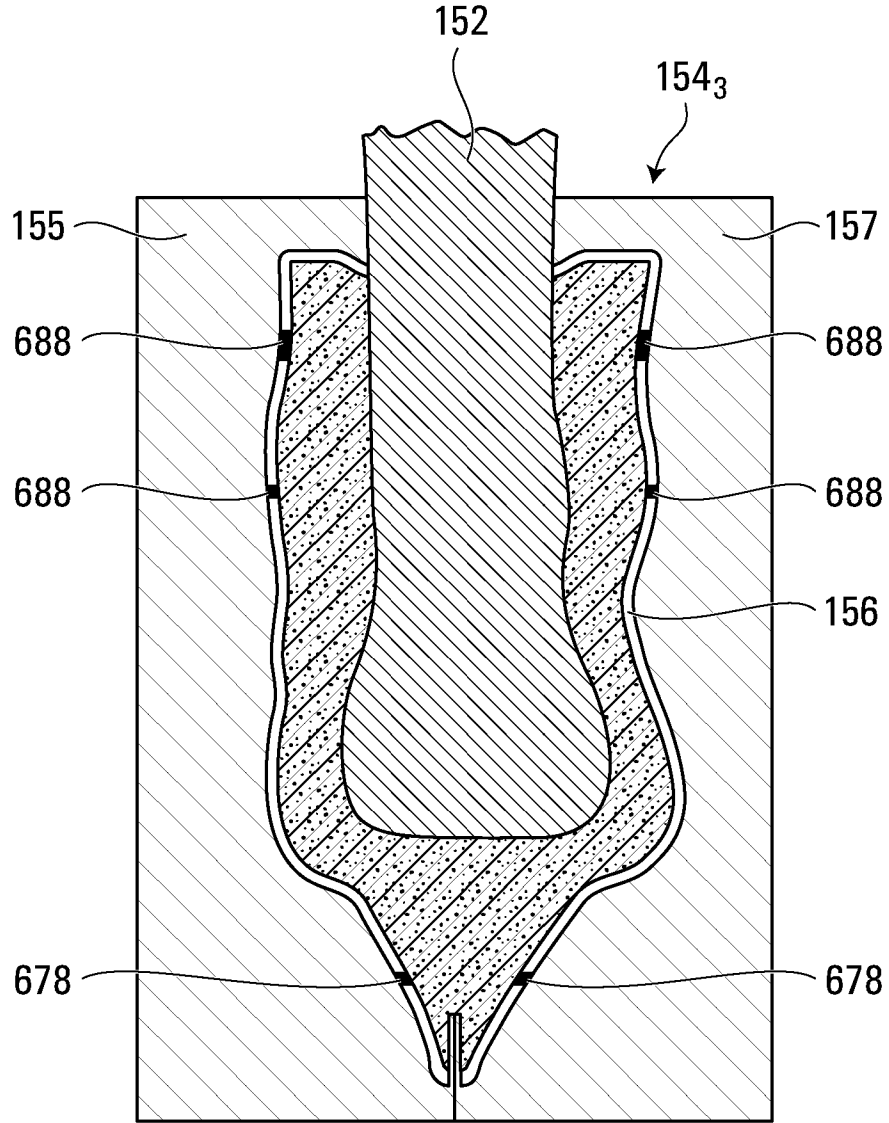


FIG. 119

81/121

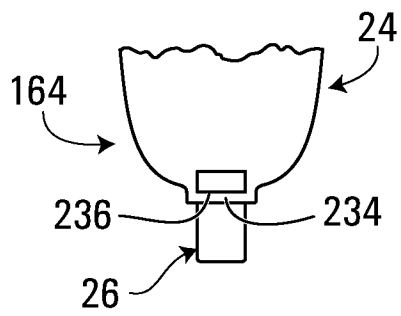


FIG. 120

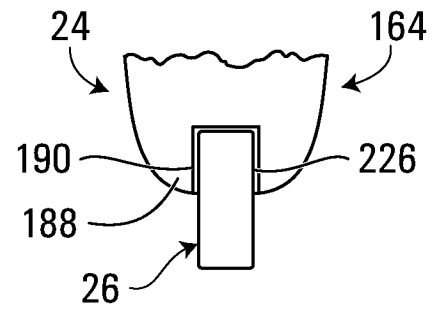


FIG. 121

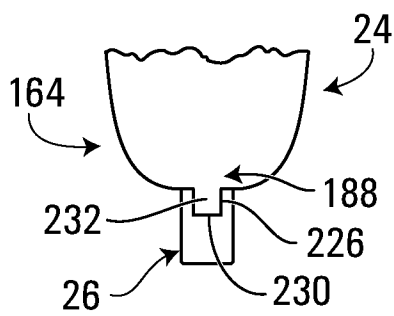


FIG. 122

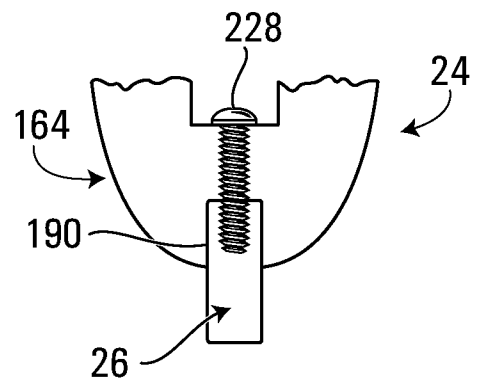


FIG. 123

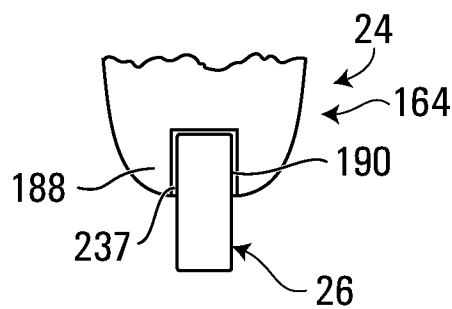


FIG. 124

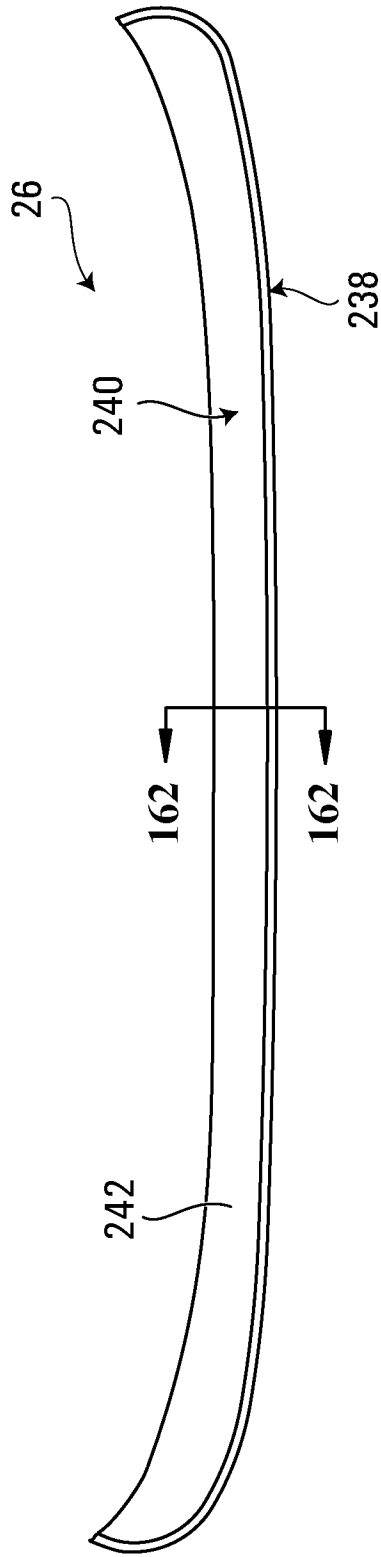


FIG. 125

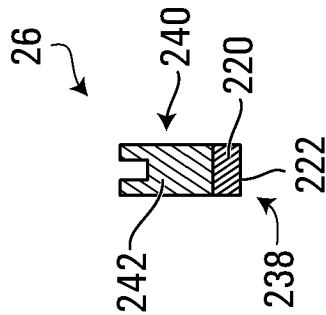


FIG. 126

83/121

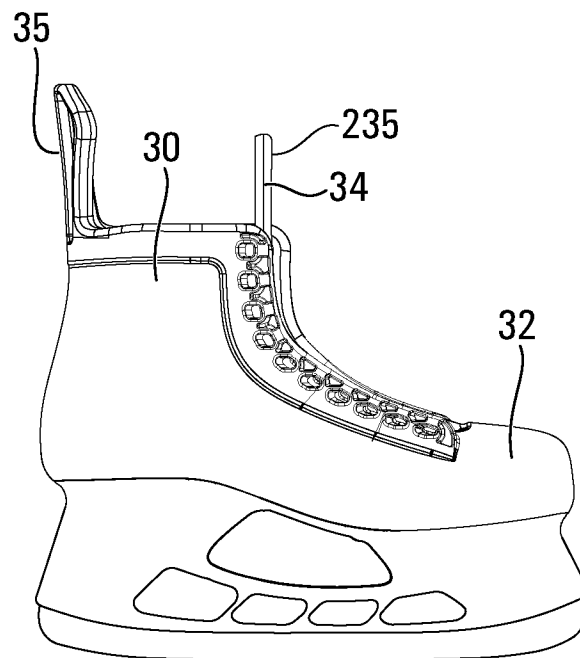


FIG. 127

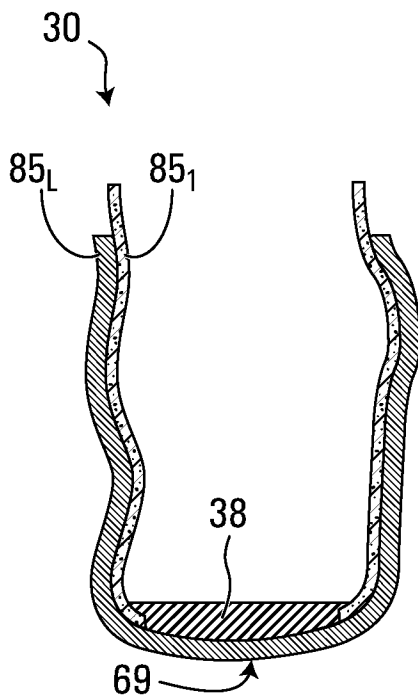


FIG. 128

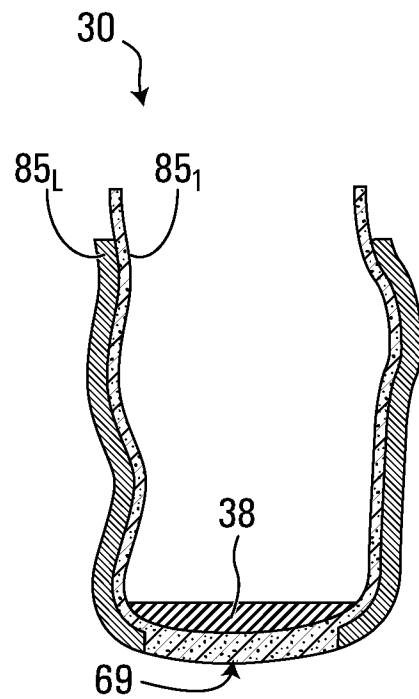


FIG. 129

84/121

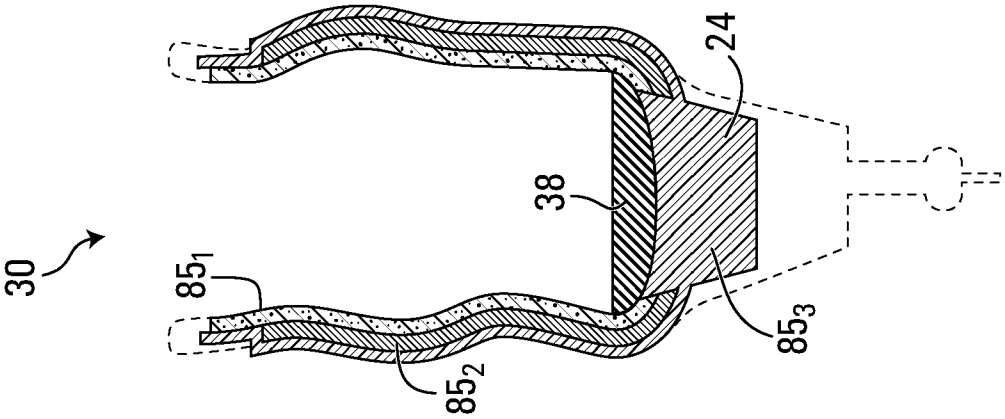


FIG. 130

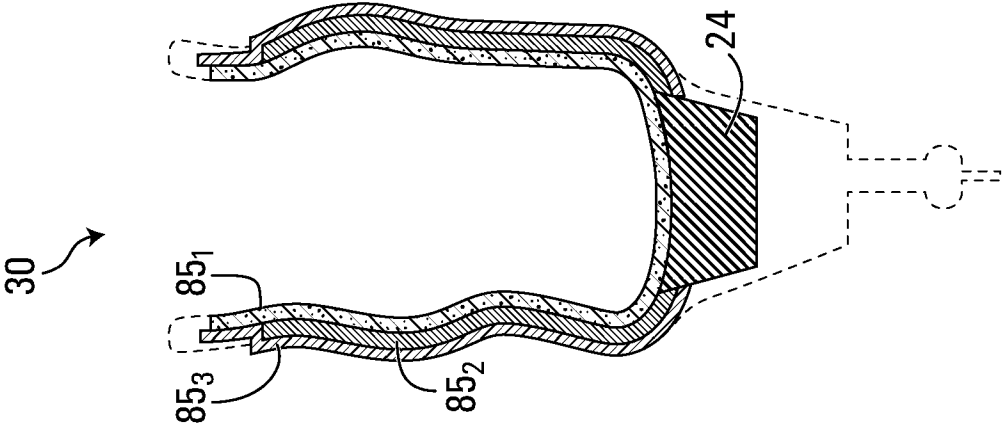


FIG. 131

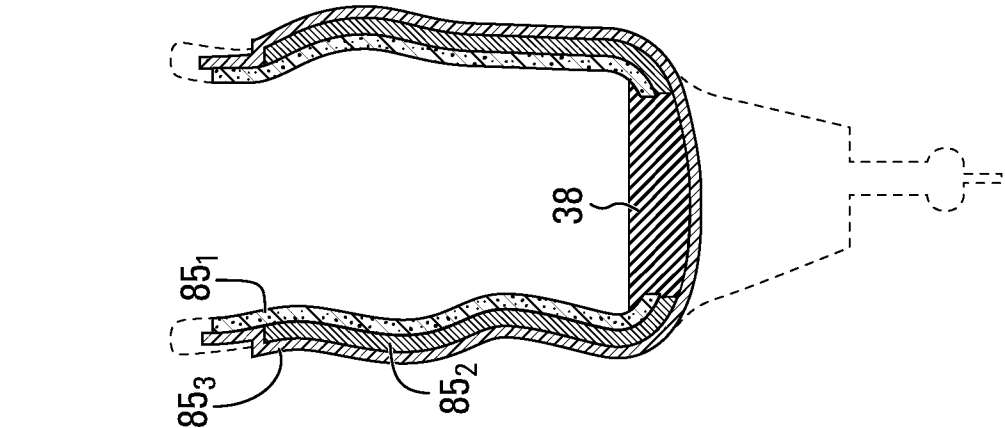


FIG. 132

30

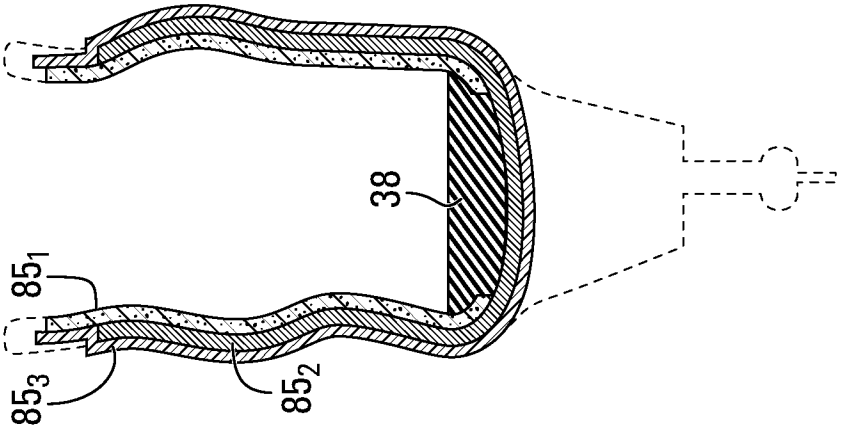


FIG. 133

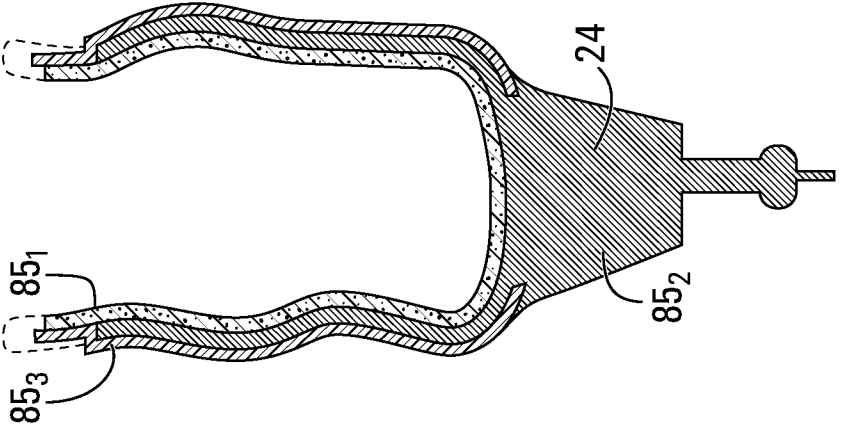


FIG. 134

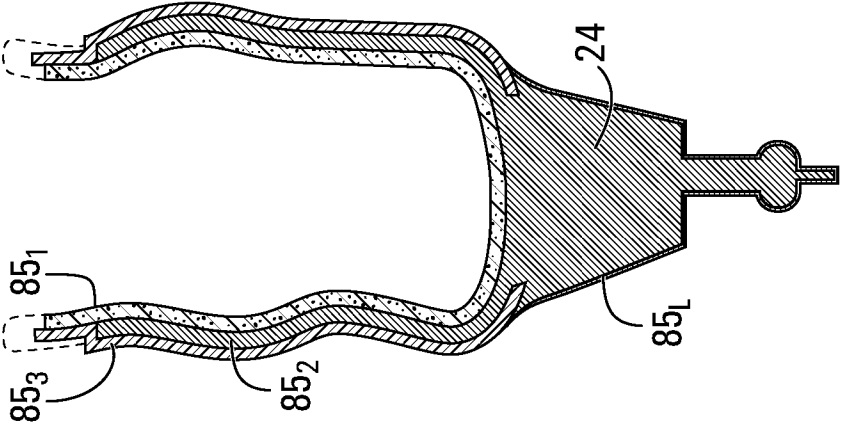


FIG. 135

85/121

86/121

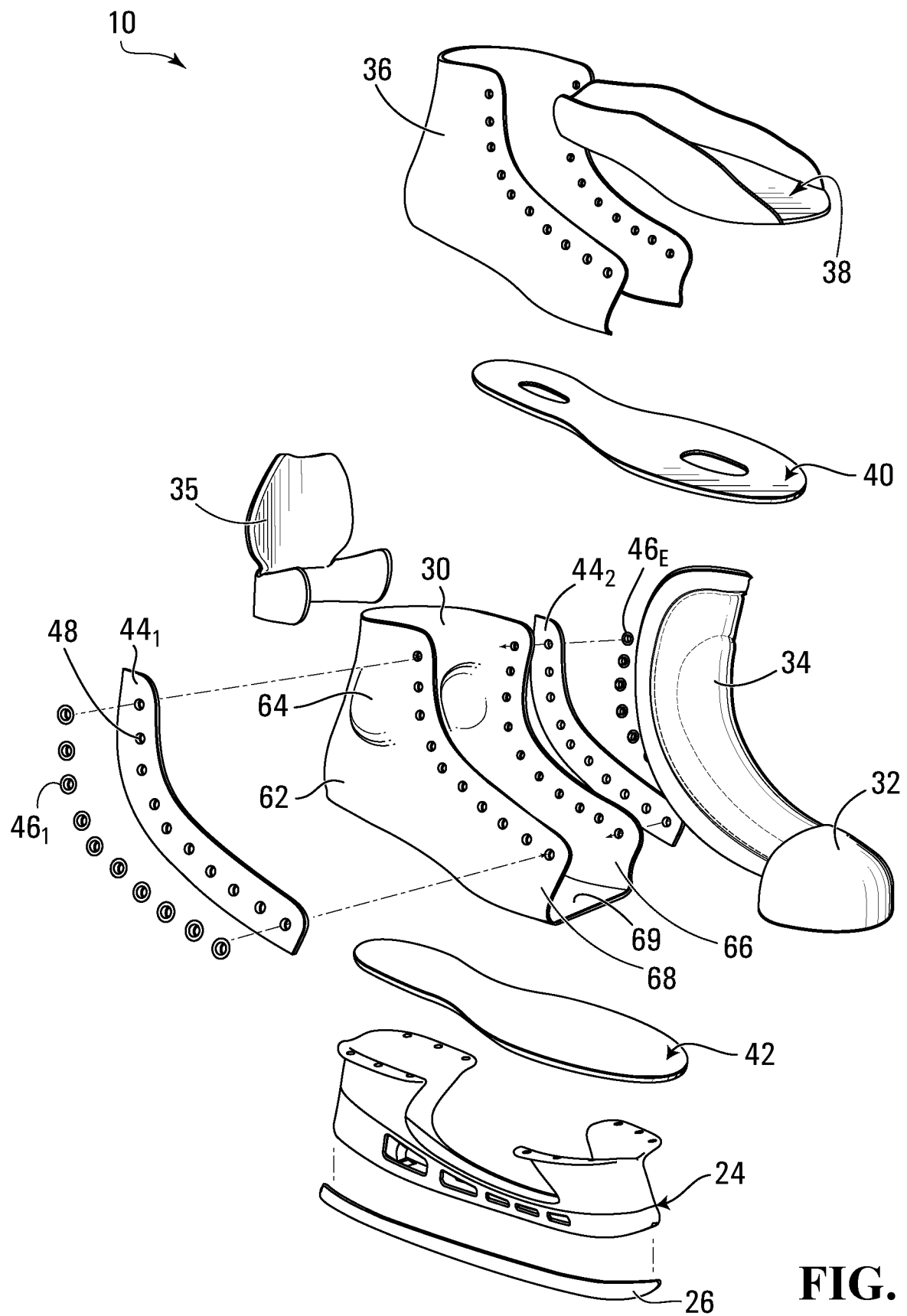
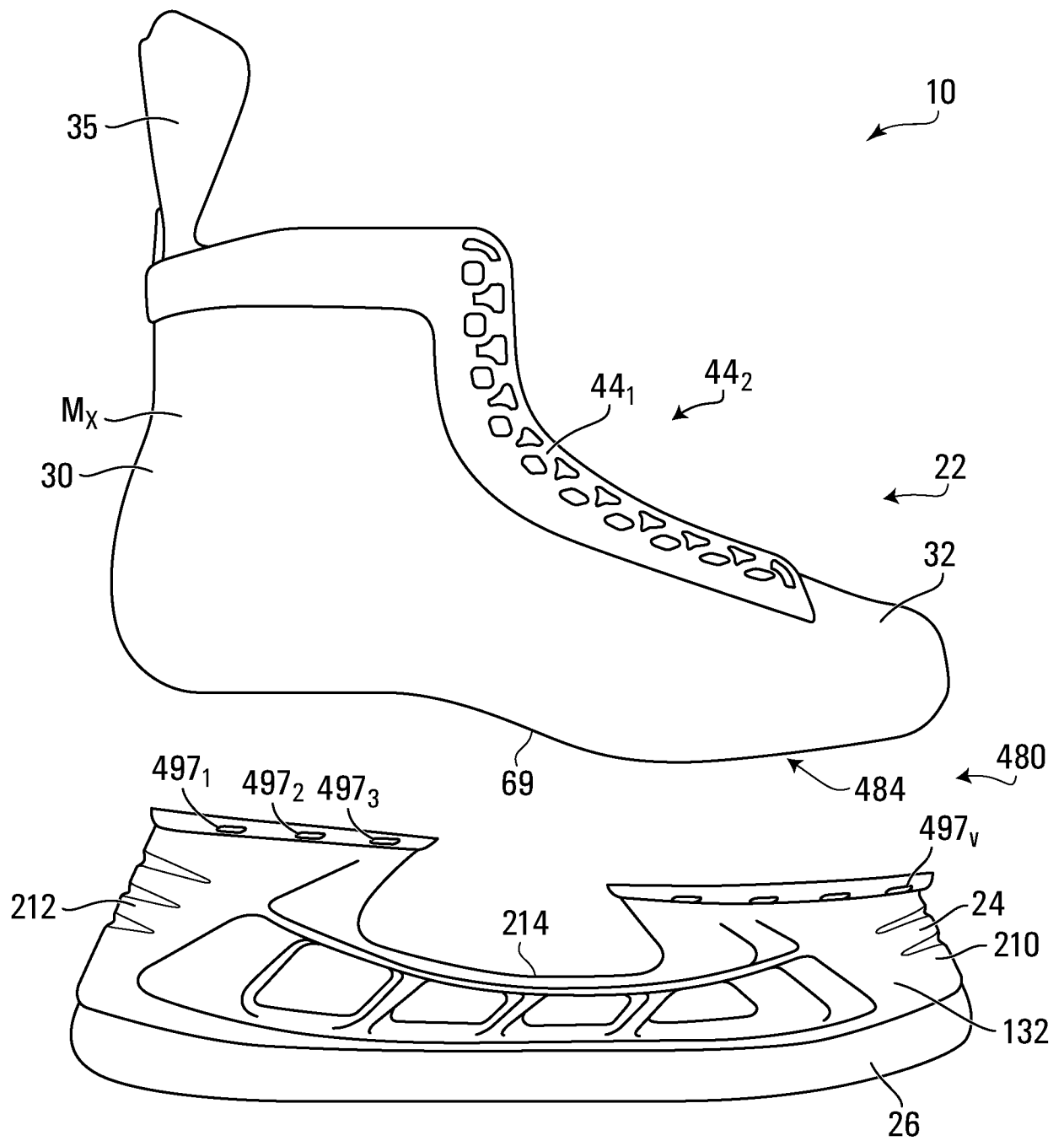


FIG. 136

87/121

**FIG. 137**

88/121

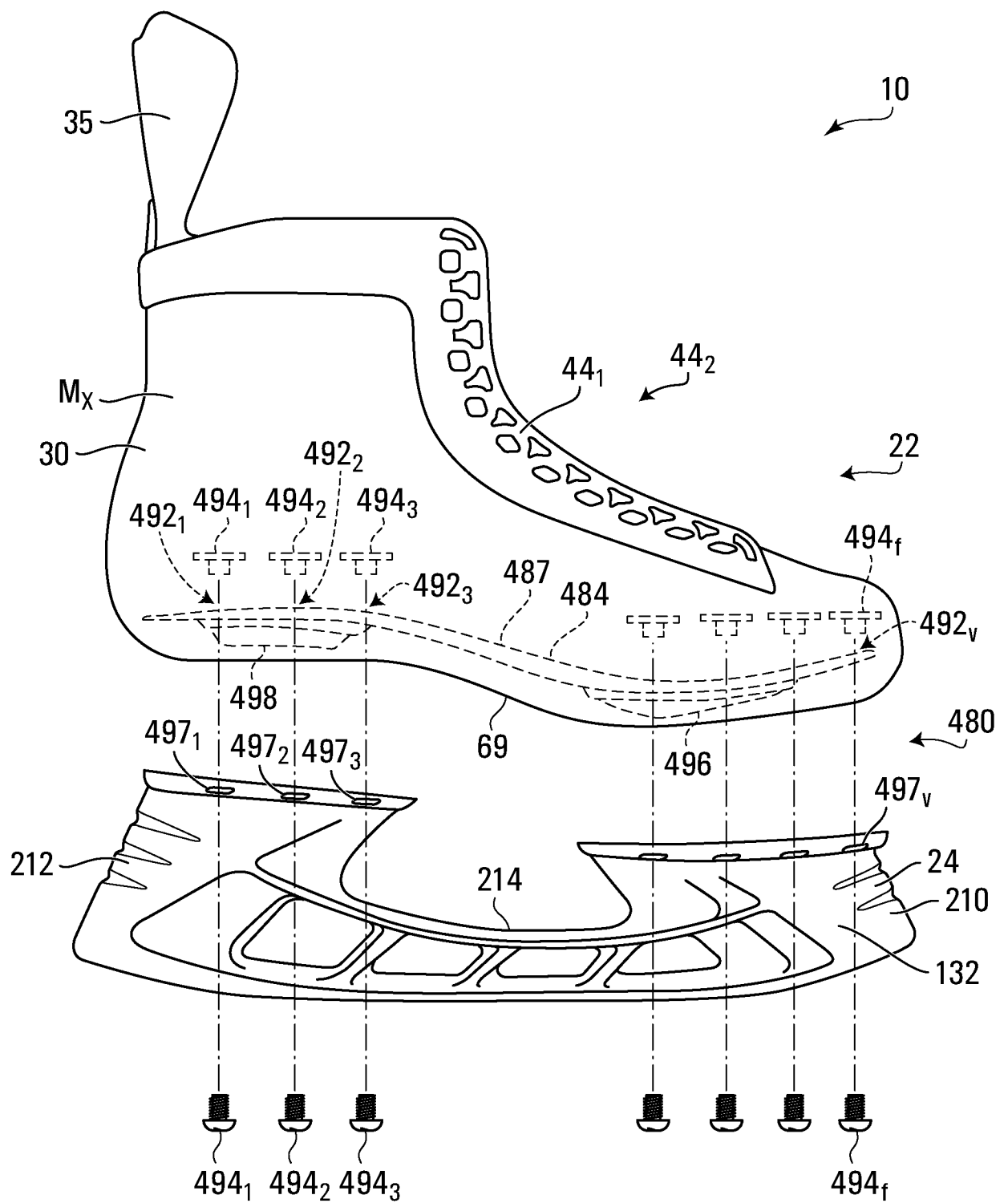


FIG. 138

89/121

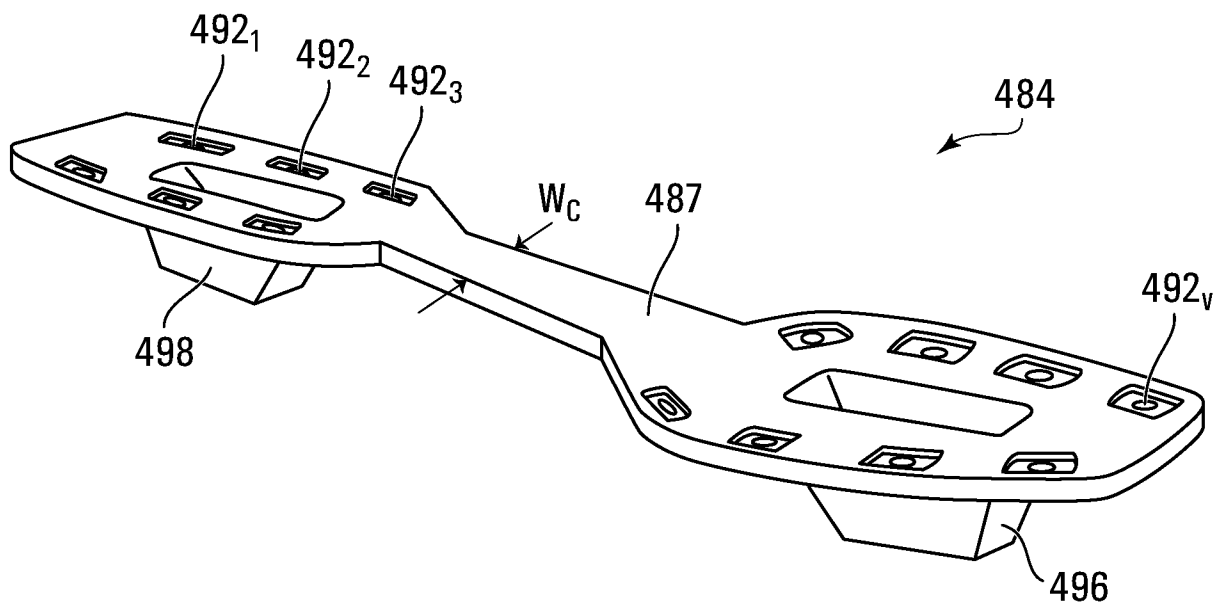


FIG. 139

90/121

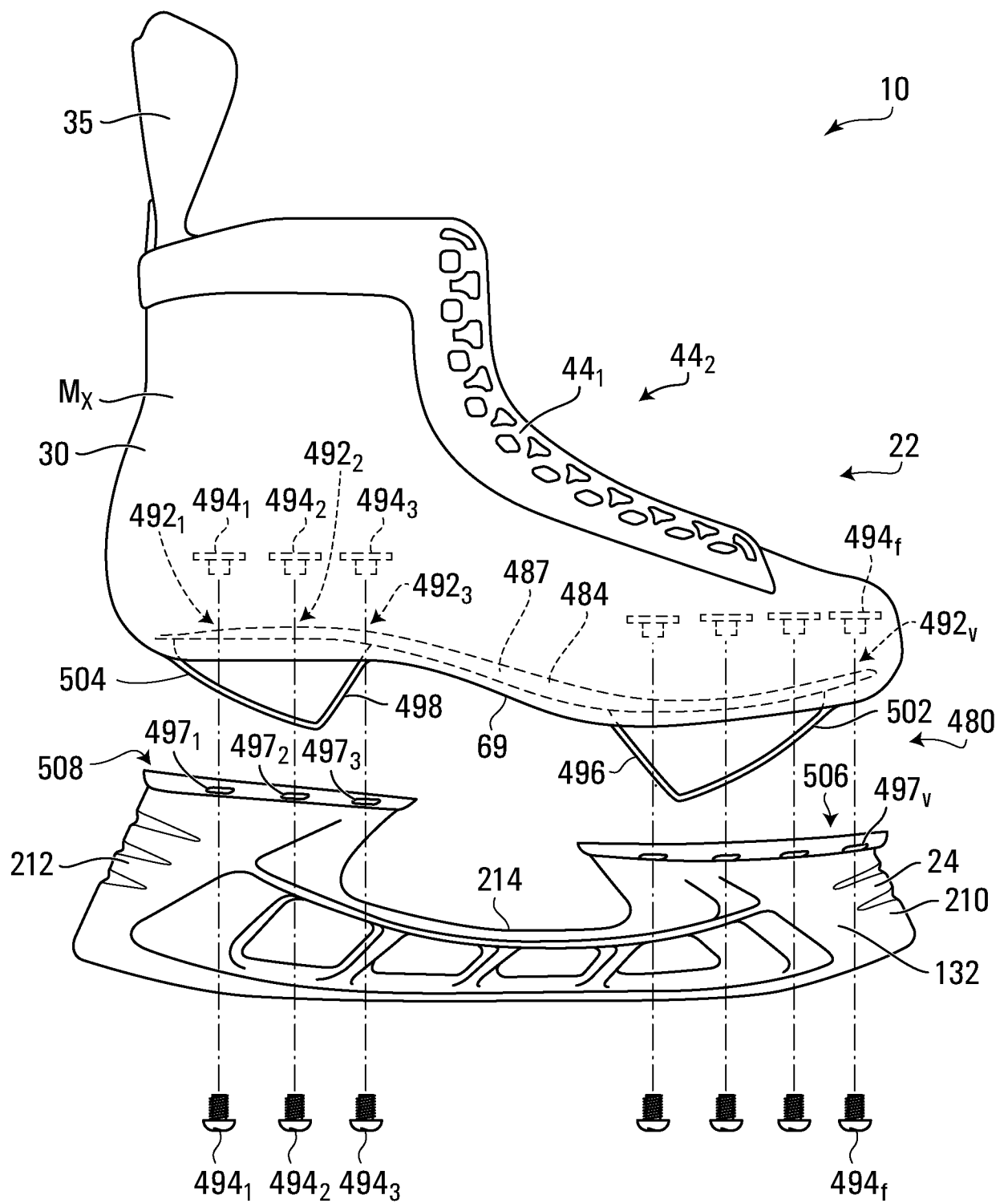


FIG. 140

91/121

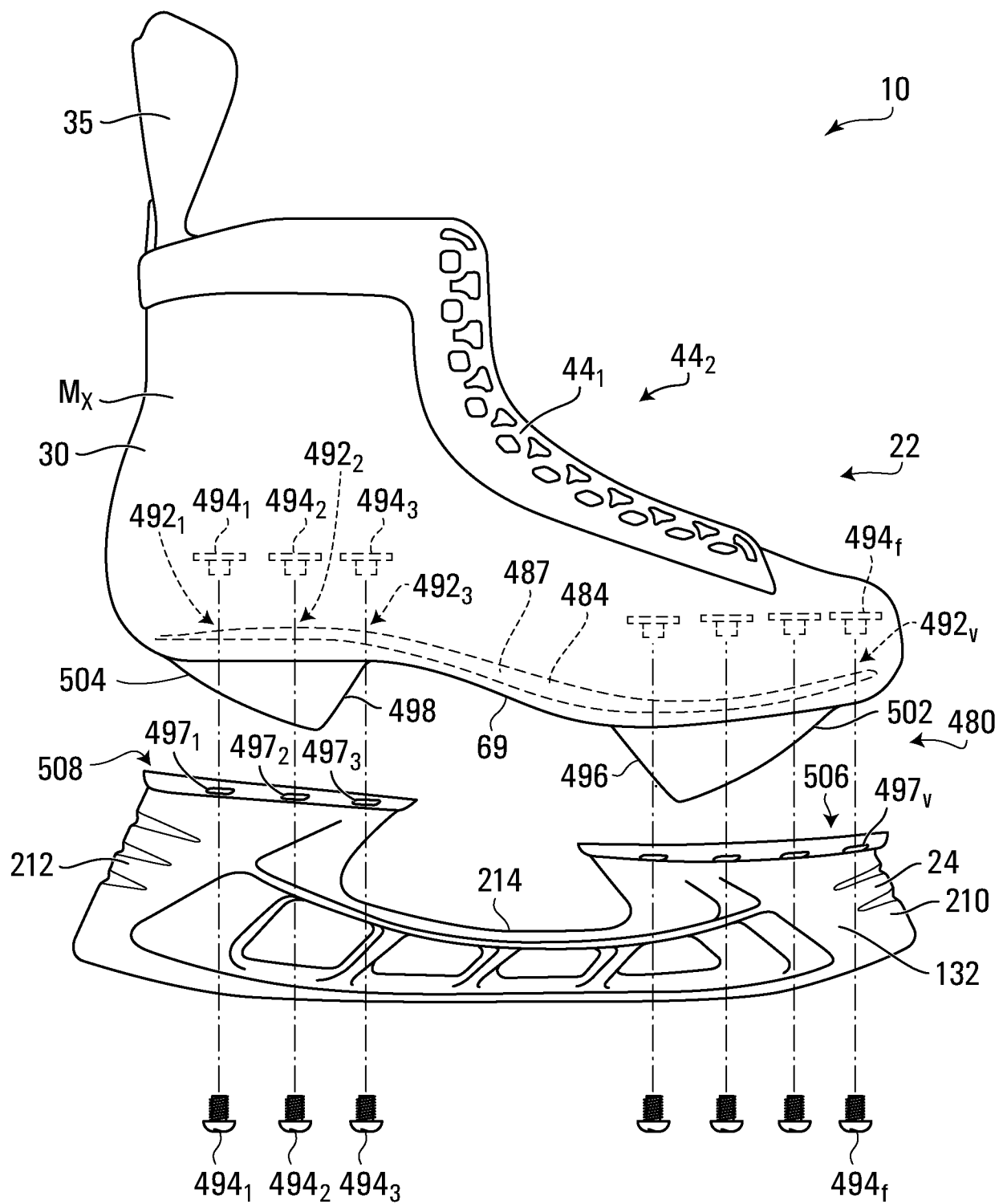


FIG. 141

92/121

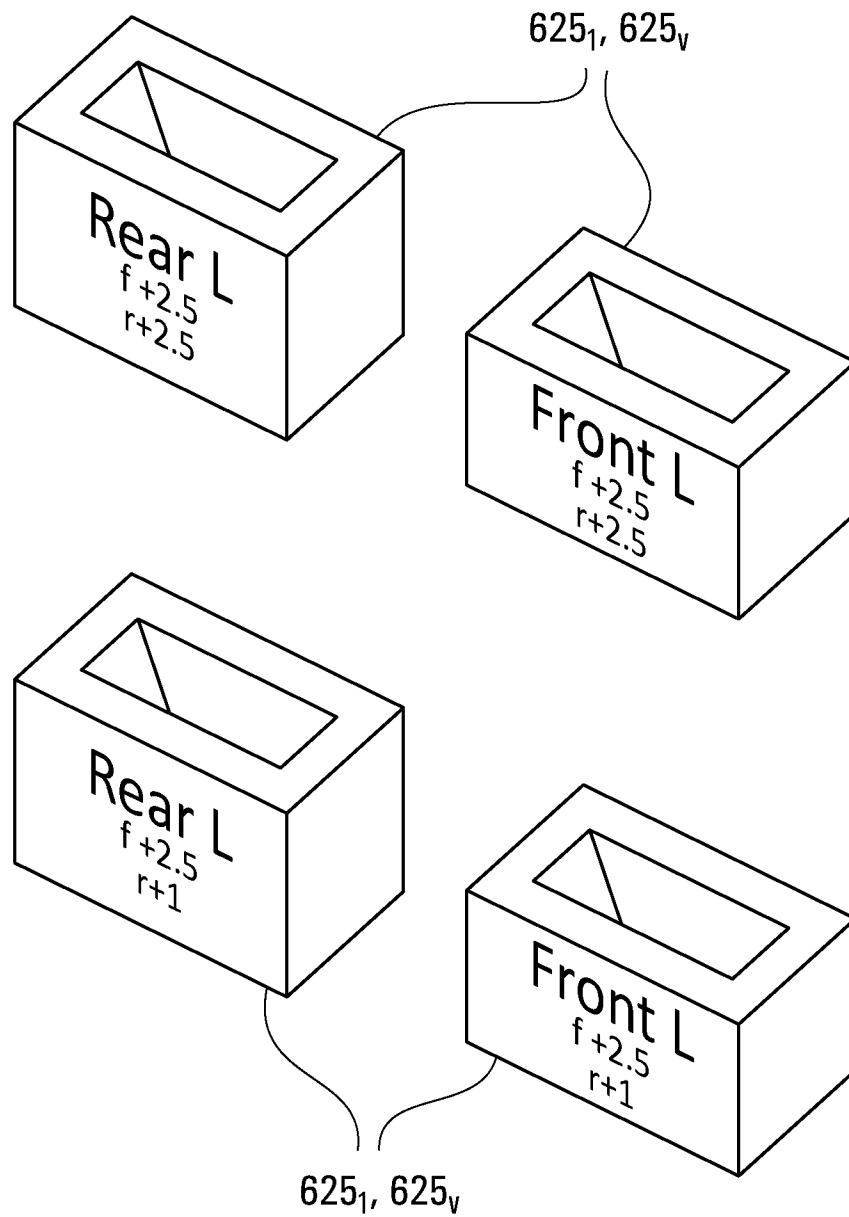


FIG. 142

93/121

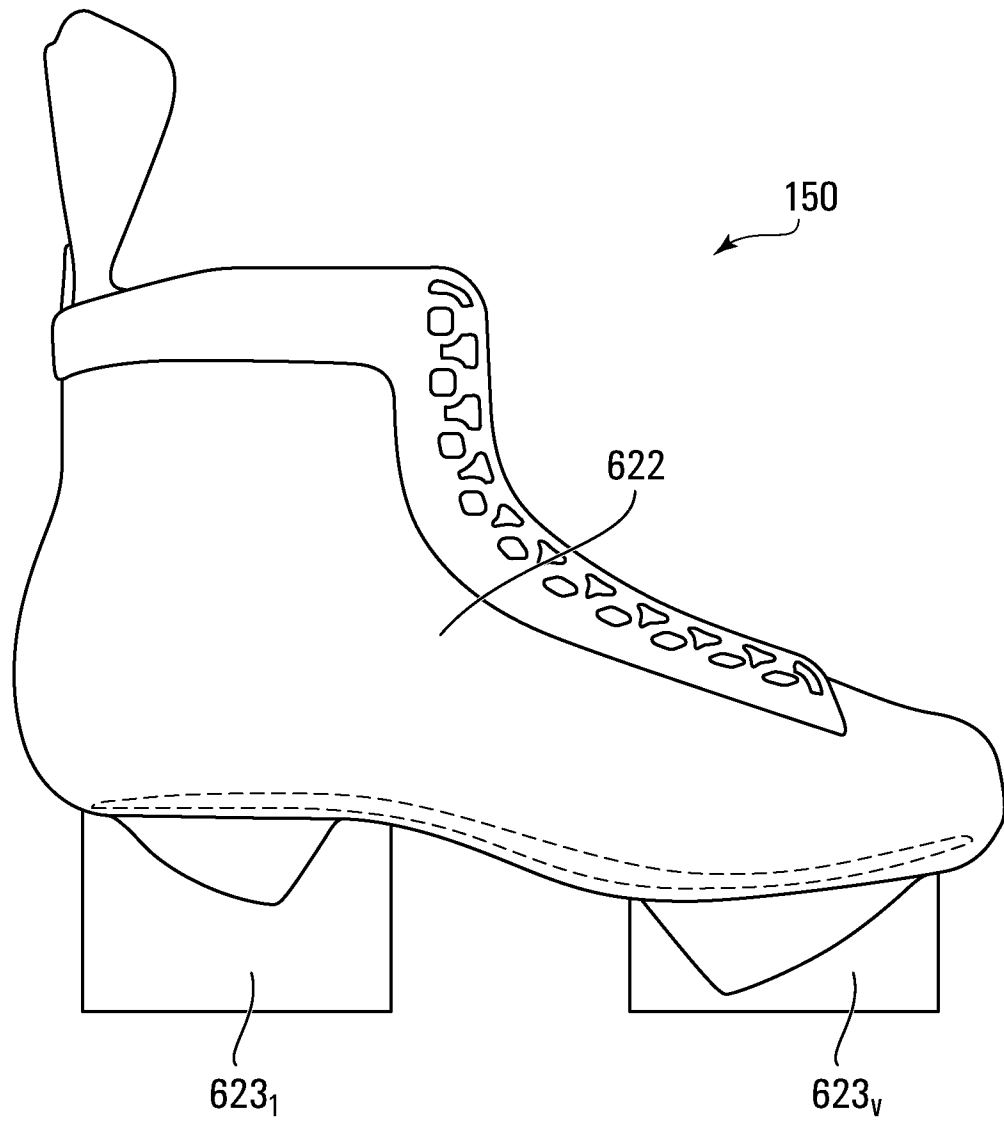


FIG. 143

94/121

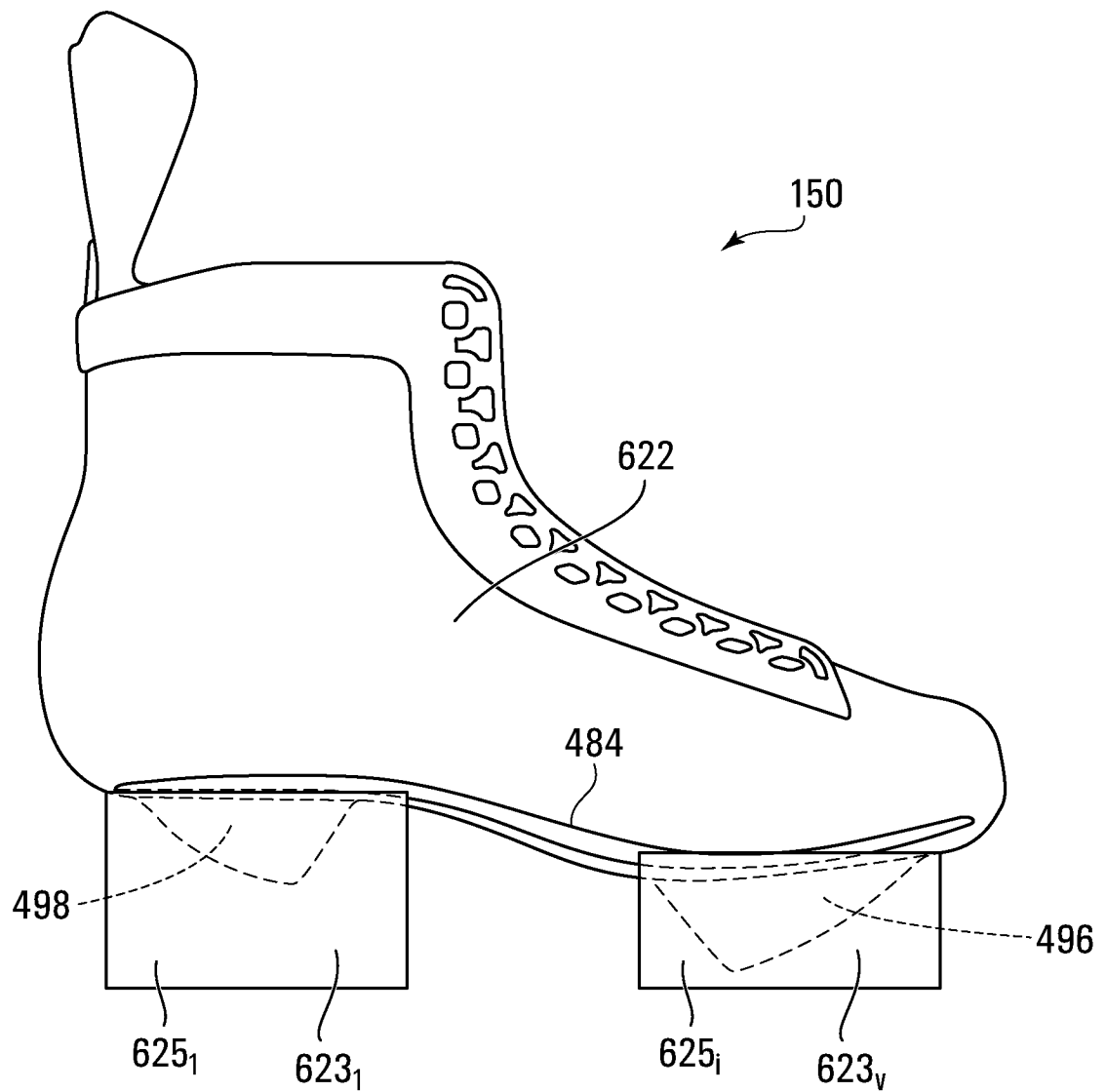


FIG. 144

95/121

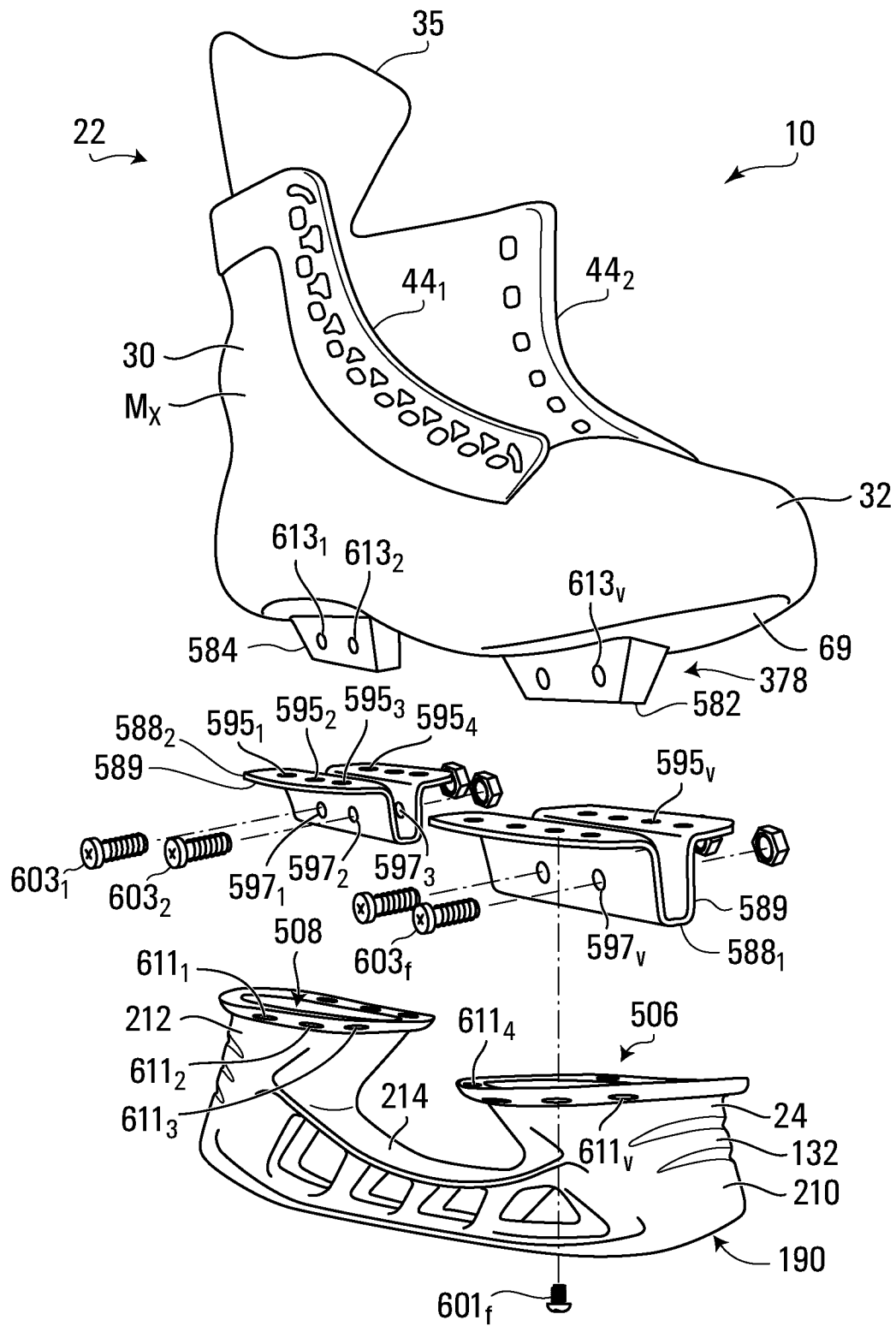


FIG. 145

96/121

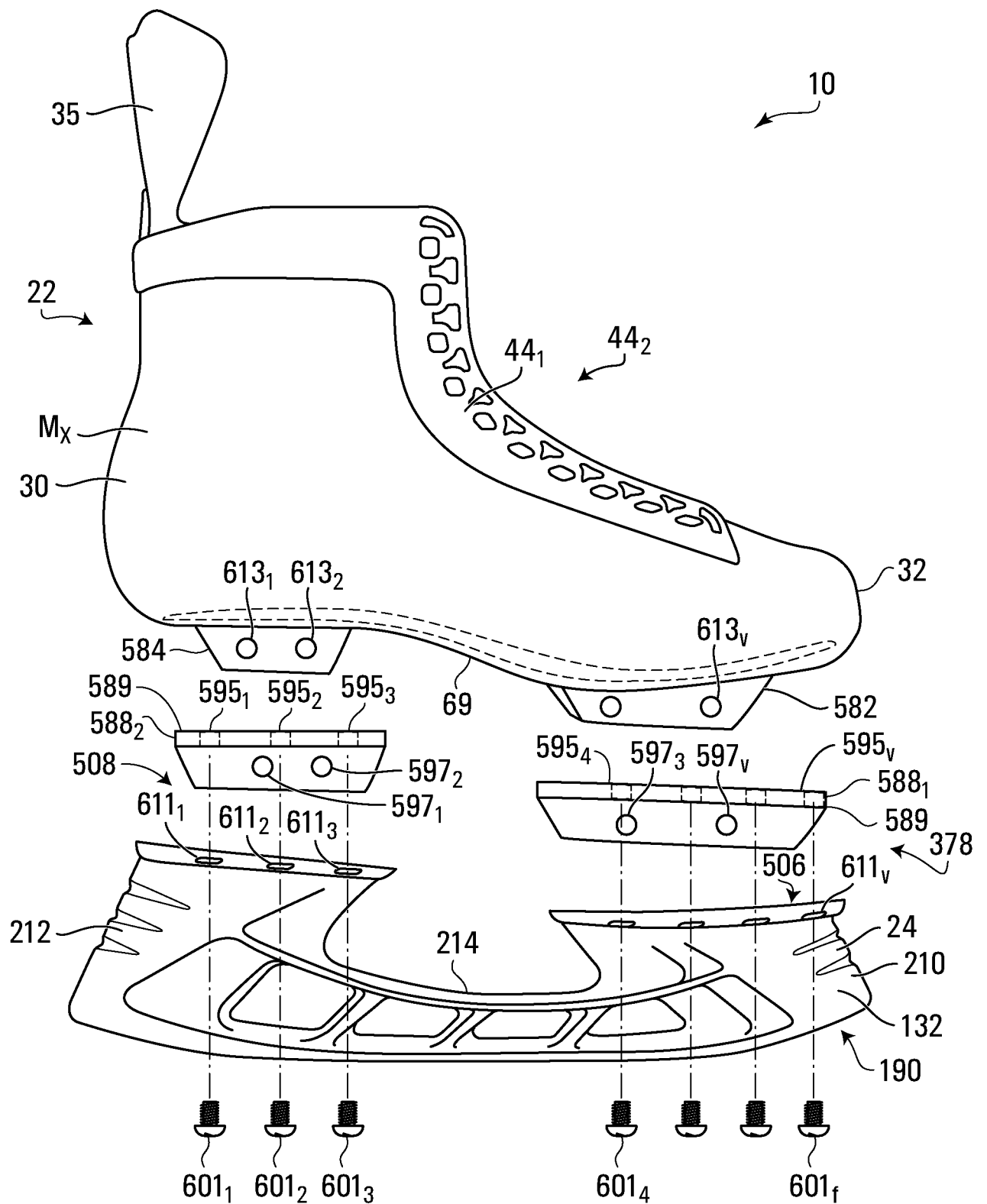
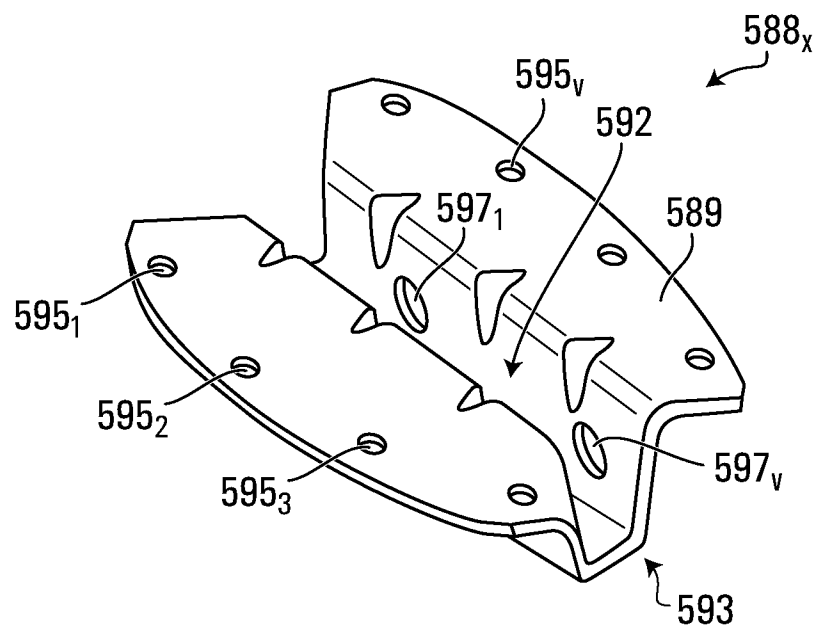


FIG. 146

97/121

**FIG. 147**

98/121

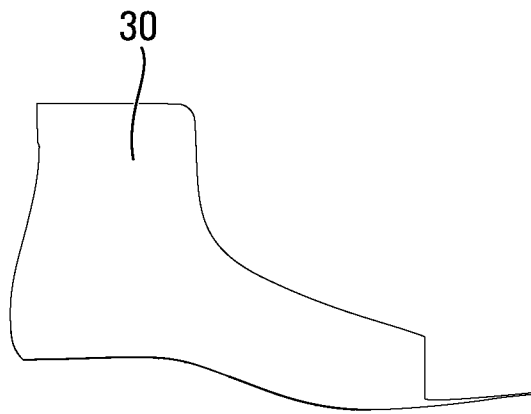


FIG. 148

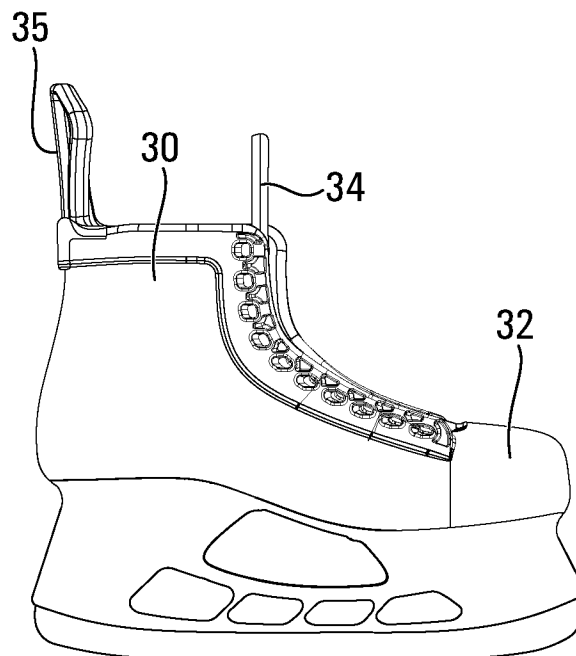


FIG. 149

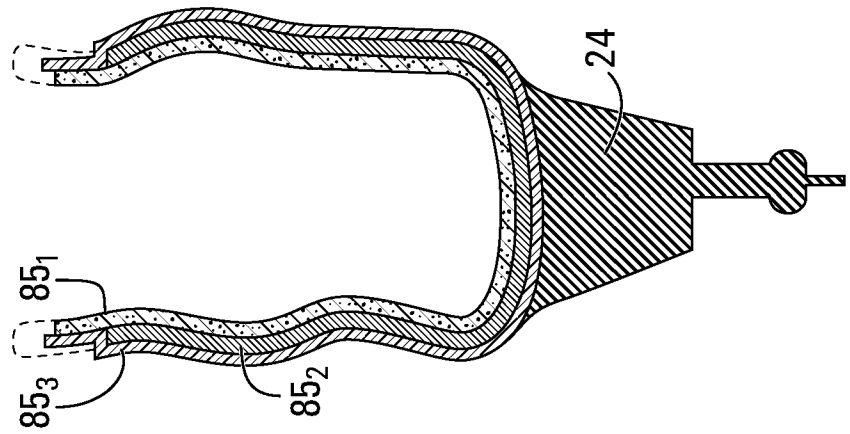


FIG. 152

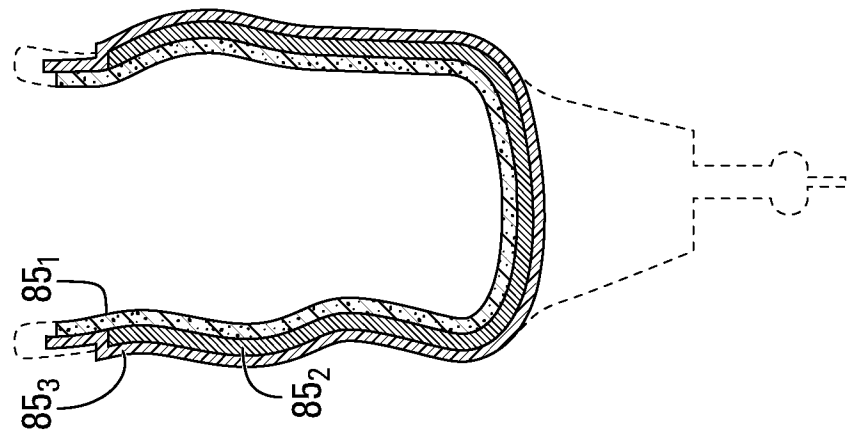


FIG. 151

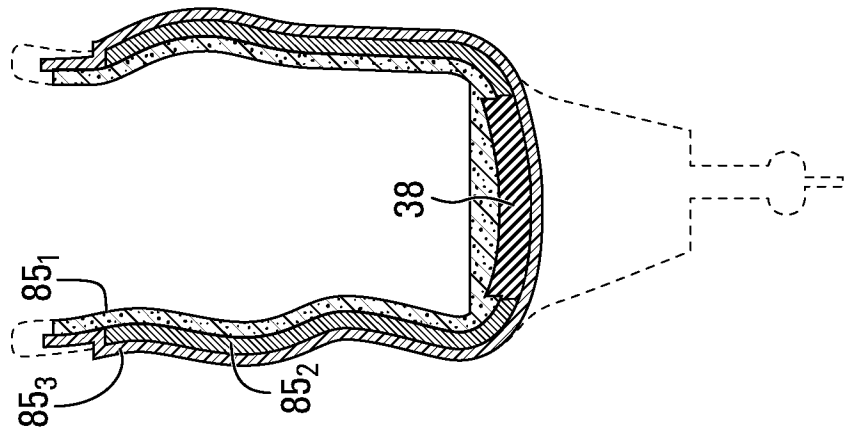
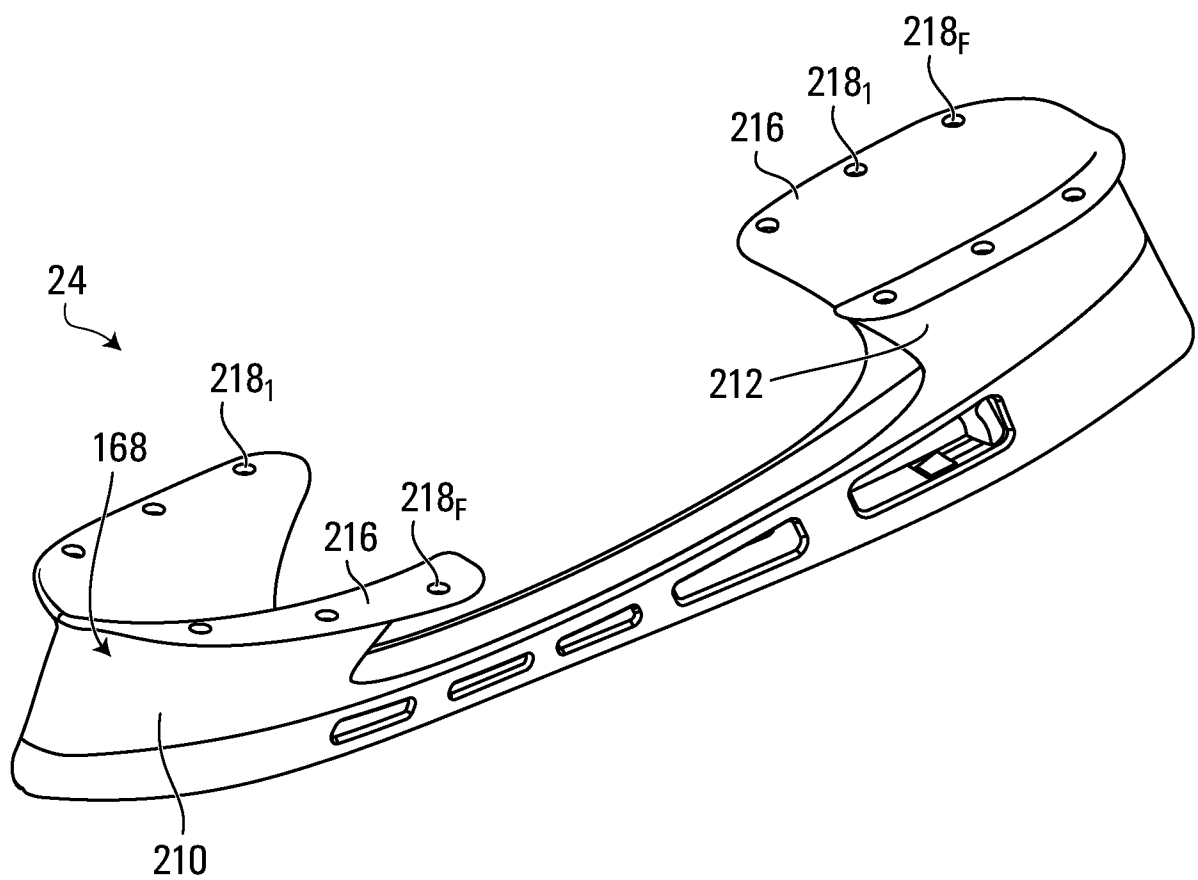


FIG. 150

100/121

**FIG. 153**

101/121

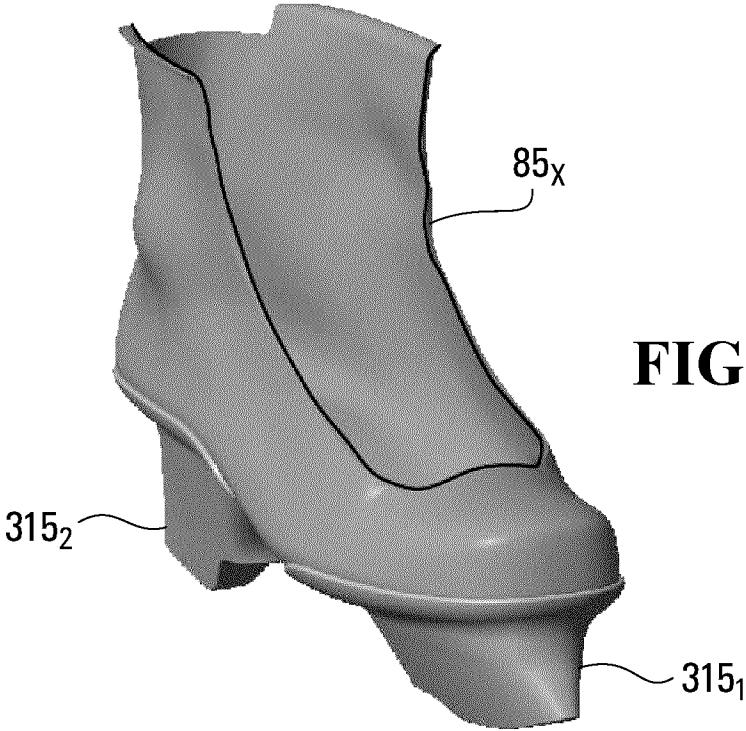


FIG. 155

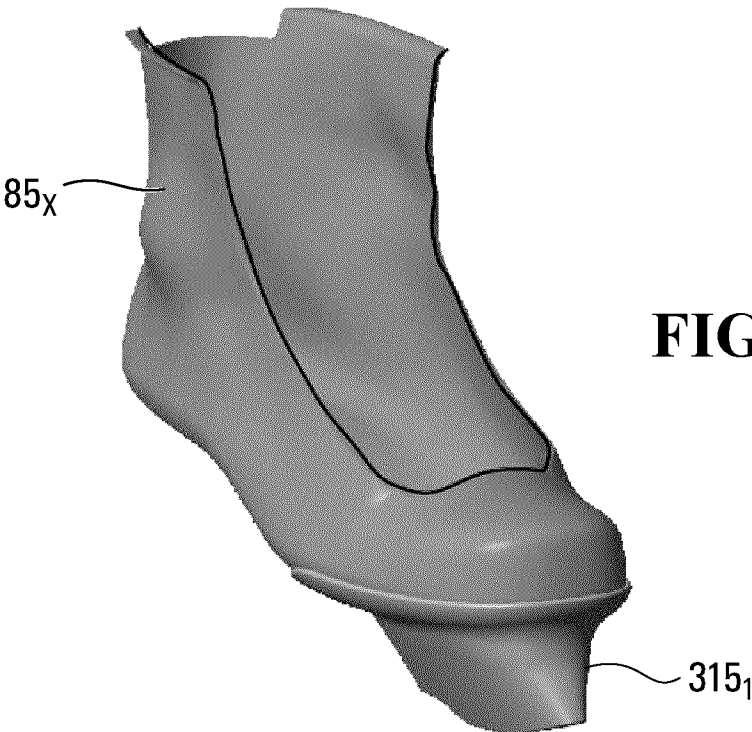


FIG. 154

102/121

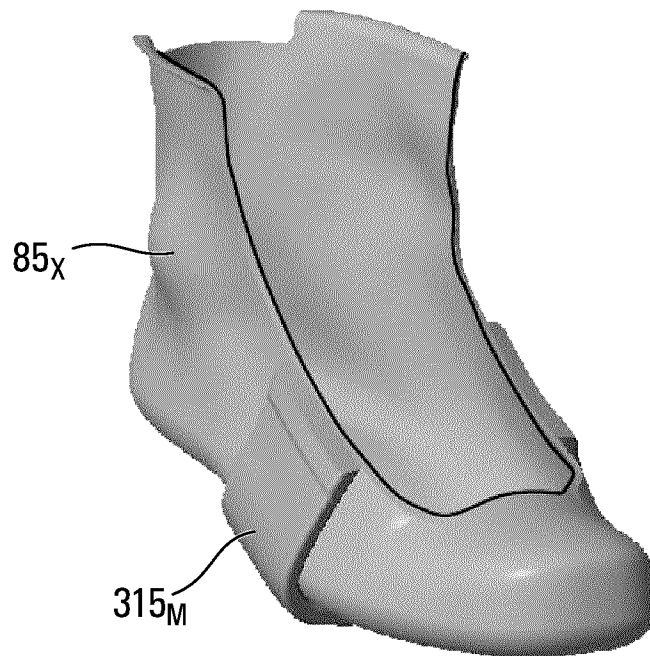


FIG. 156

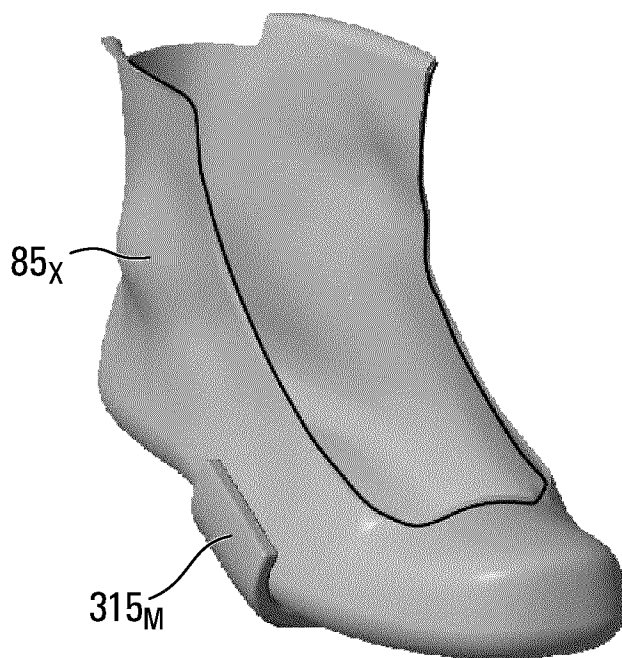


FIG. 157

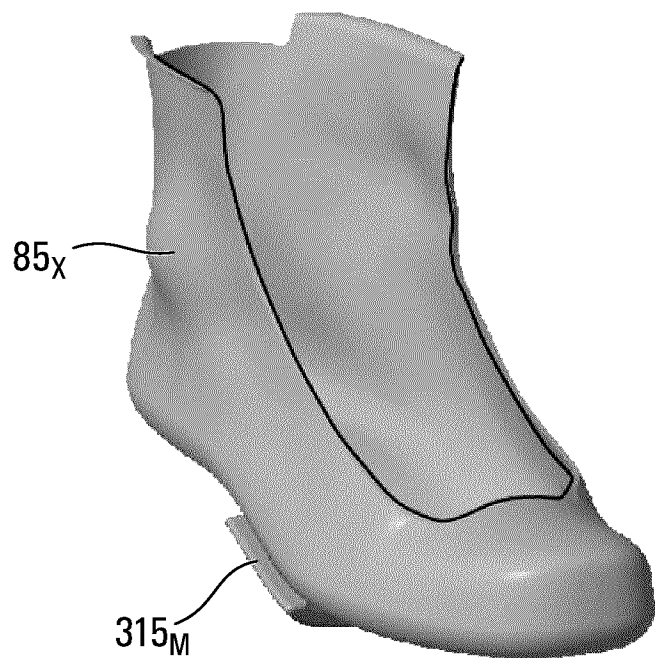


FIG. 158

103/121

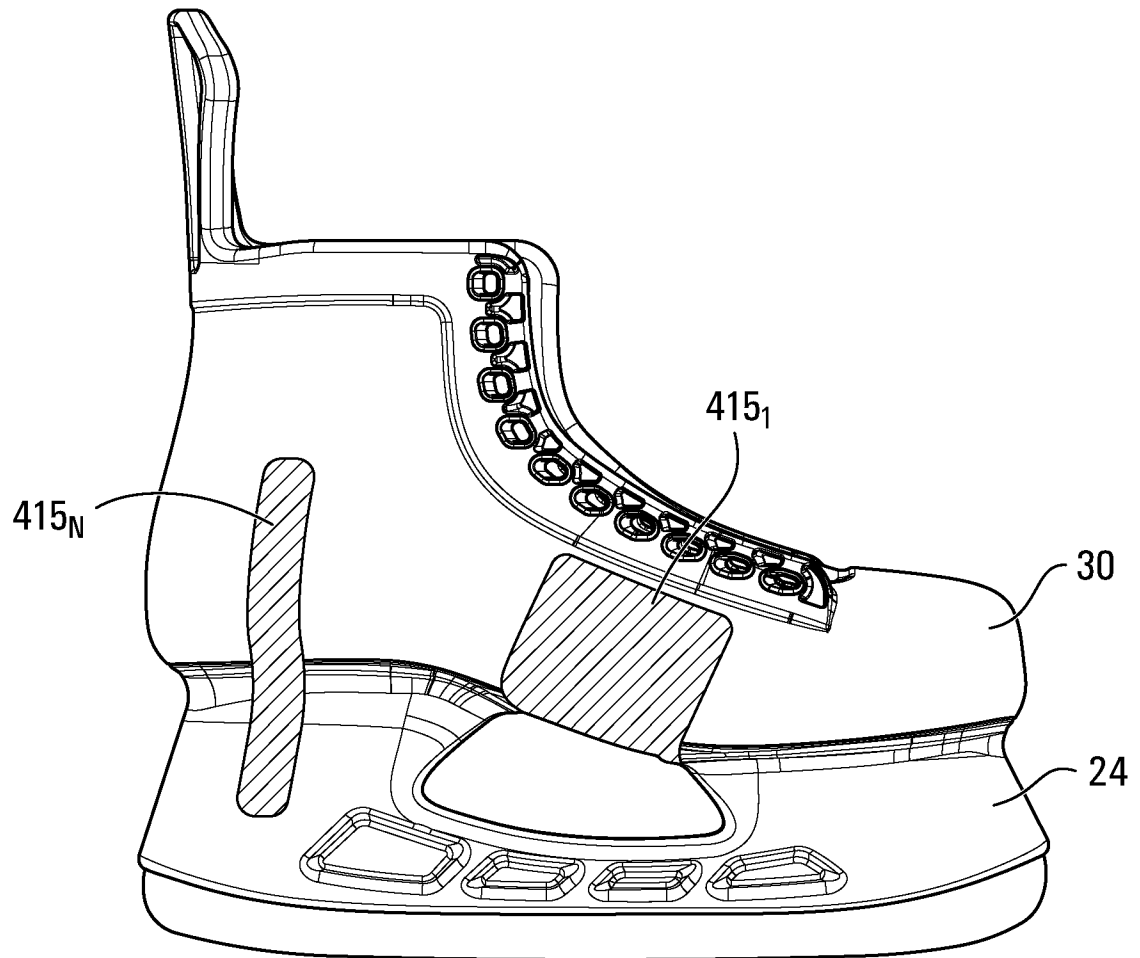


FIG. 159

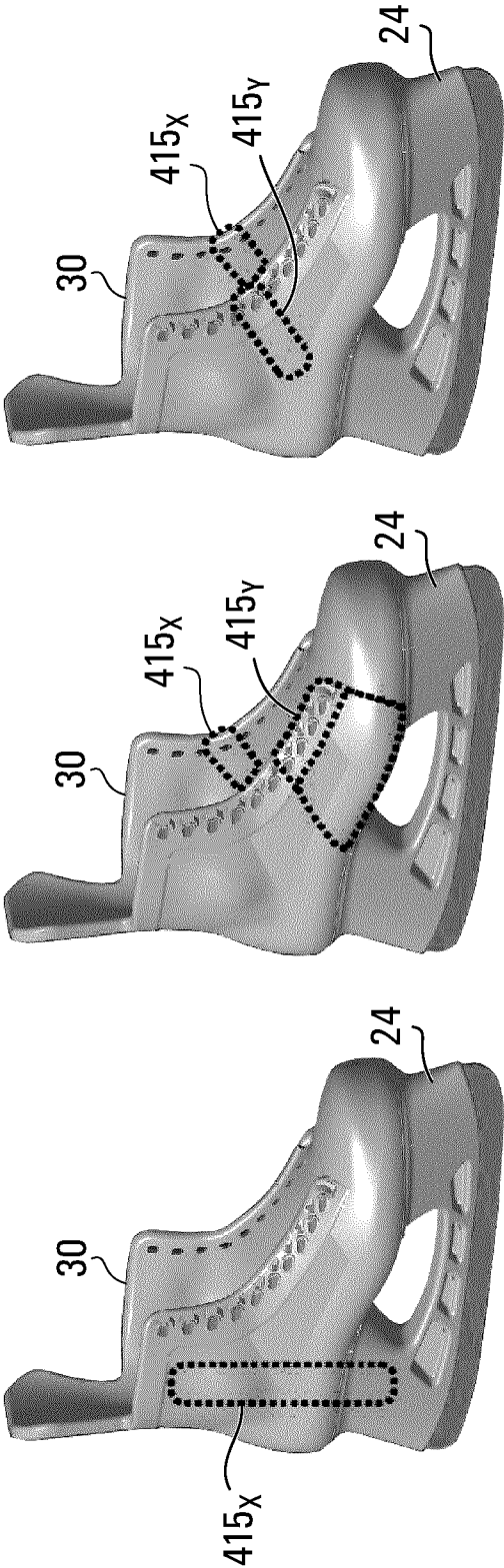


FIG. 160

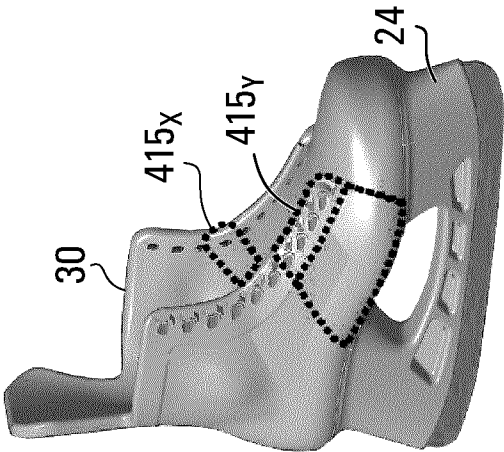


FIG. 161

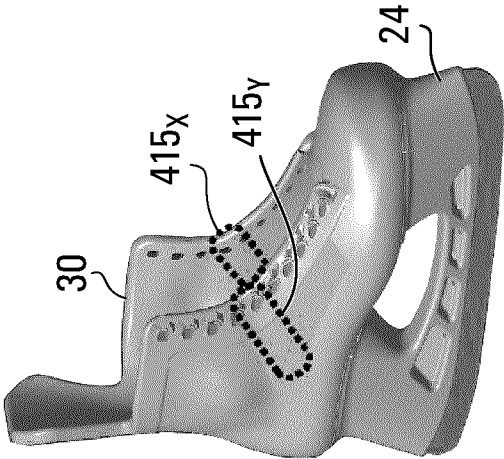


FIG. 162

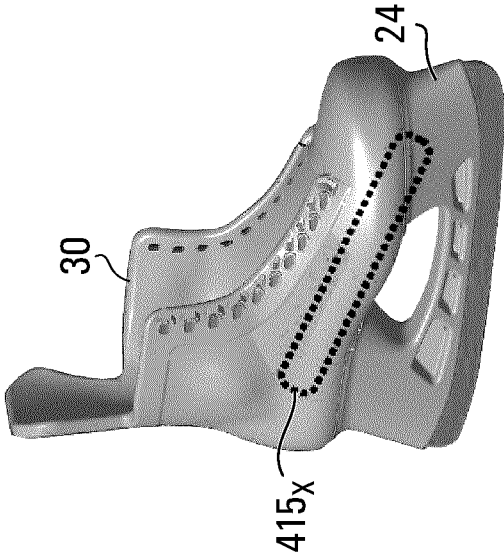


FIG. 163

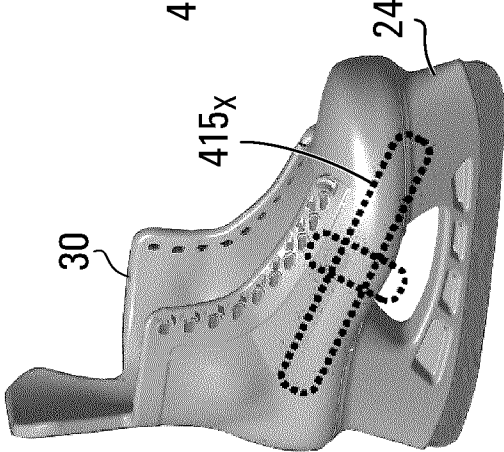


FIG. 164

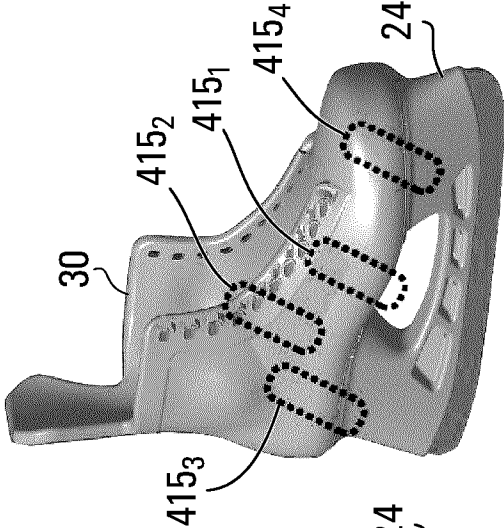


FIG. 165

105/121

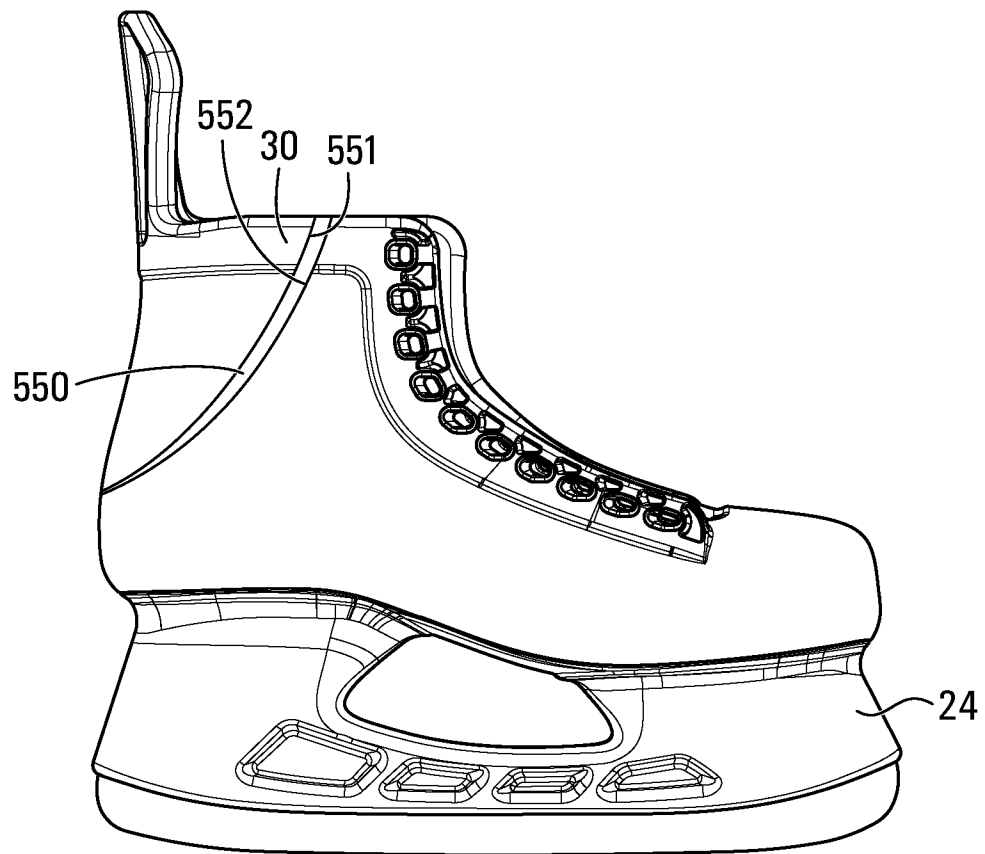


FIG. 166

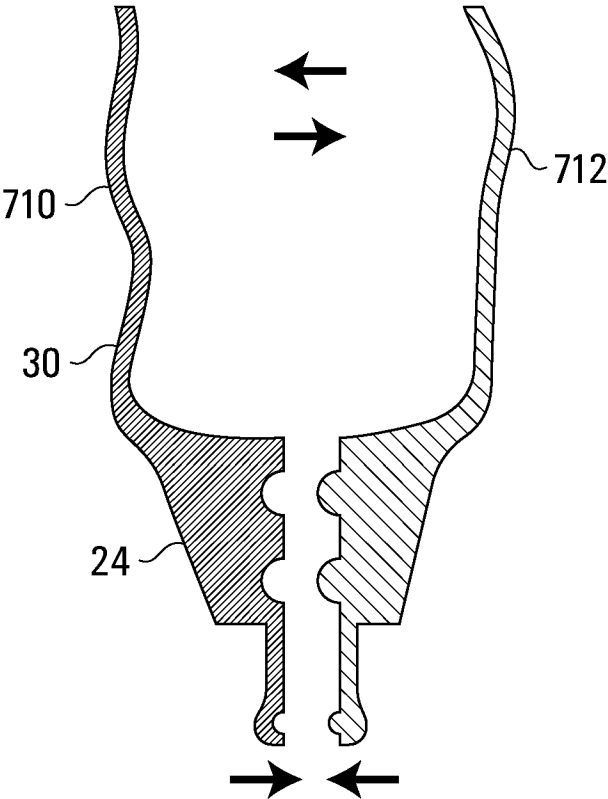


FIG. 167

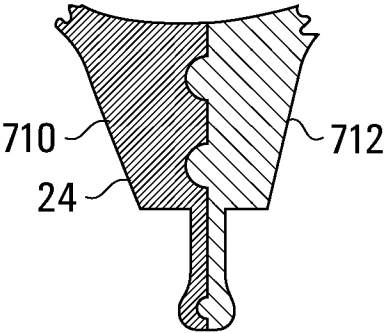


FIG. 168

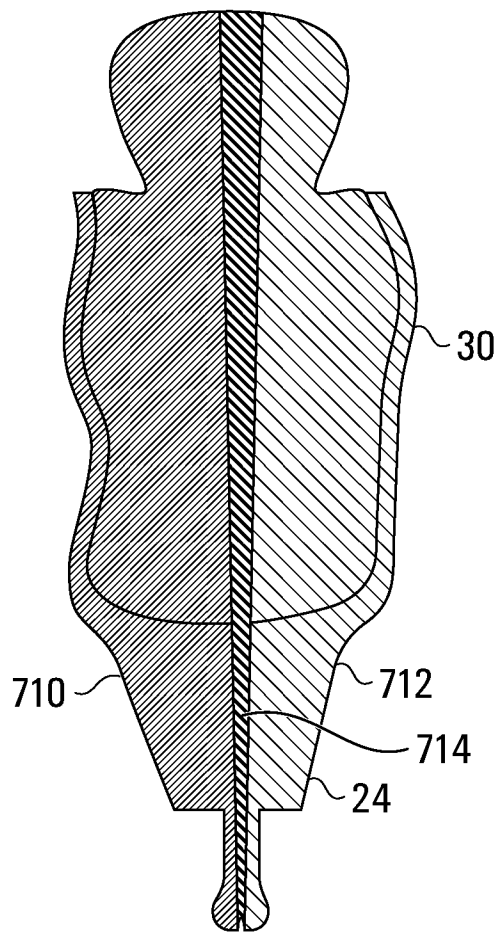


FIG. 169

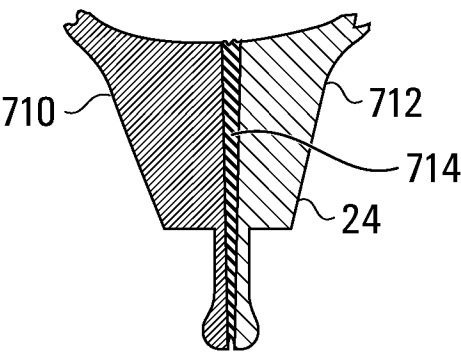


FIG. 170

108/121

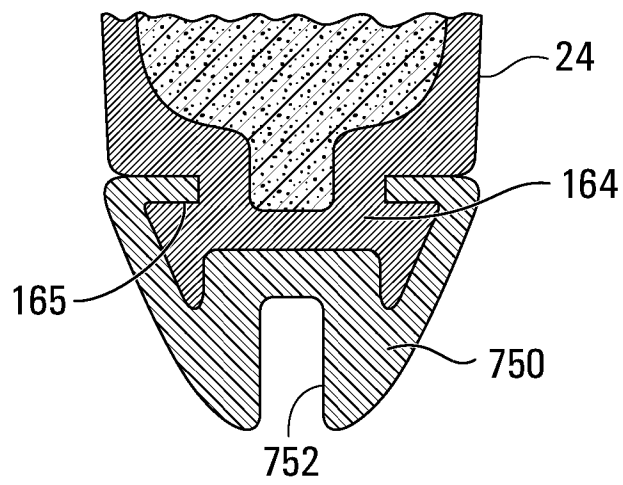


FIG. 171

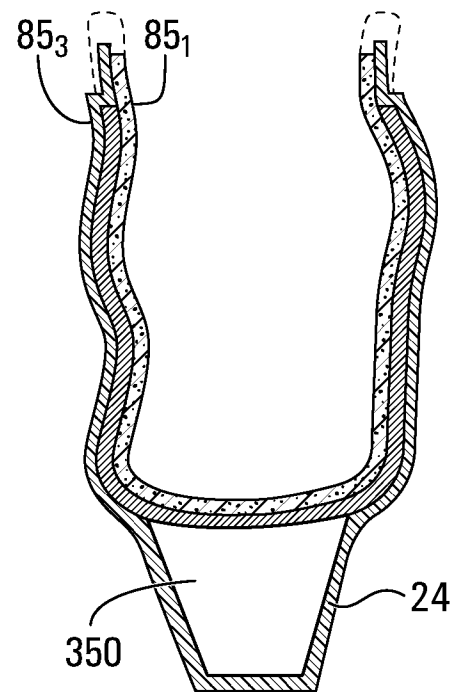
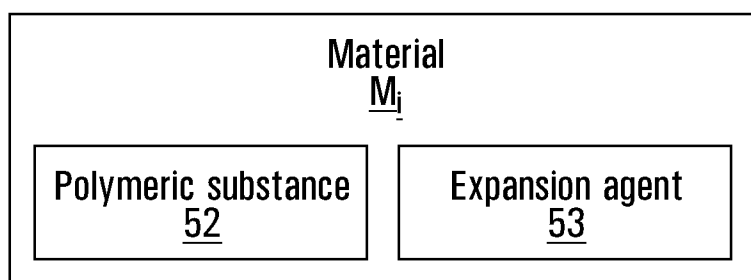
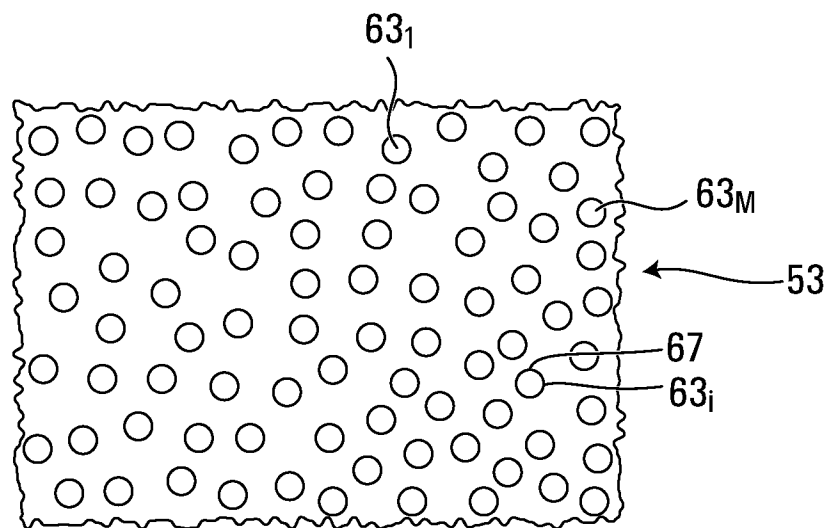


FIG. 172

109/121

**FIG. 173****FIG. 174**

110/121

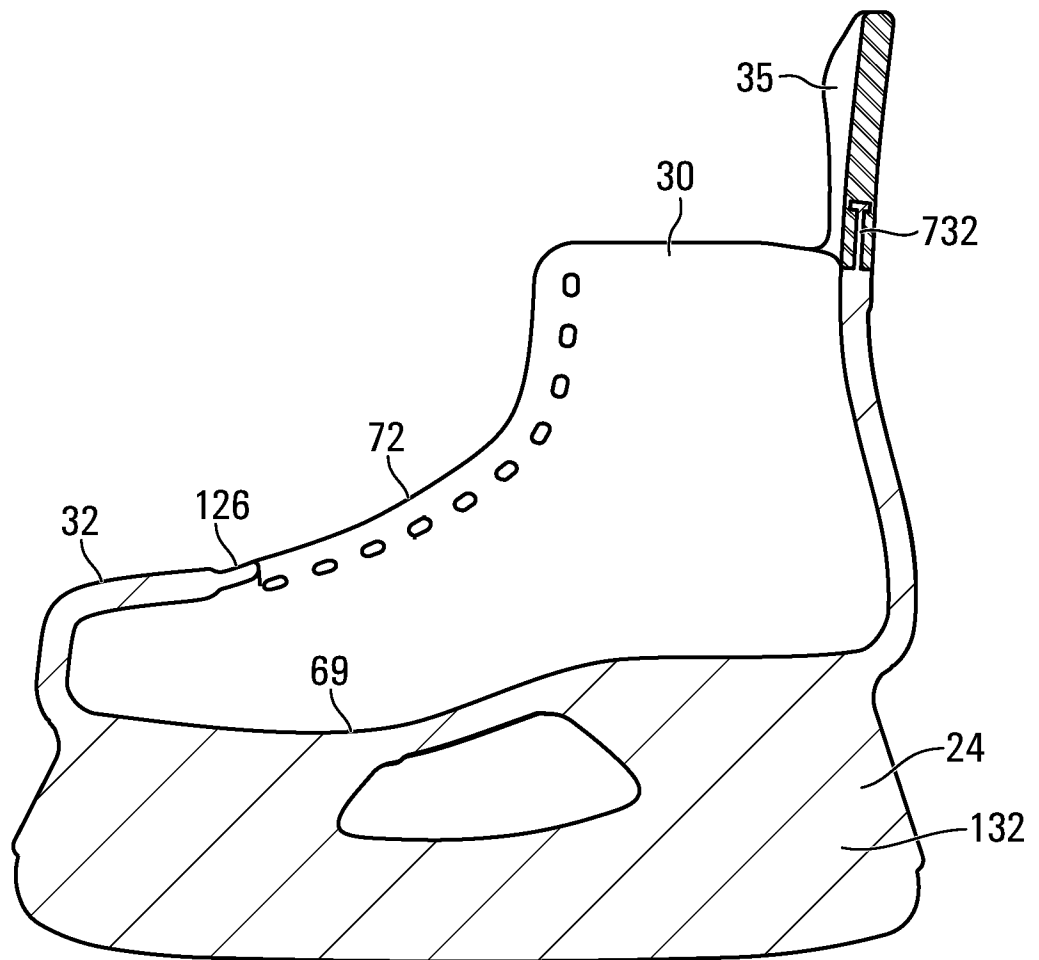


FIG. 175

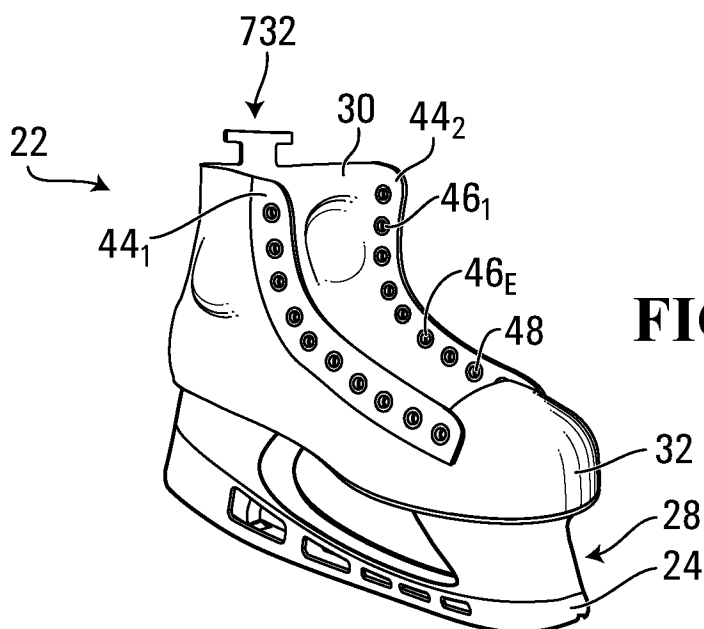


FIG. 176A

111/121

FIG. 176B

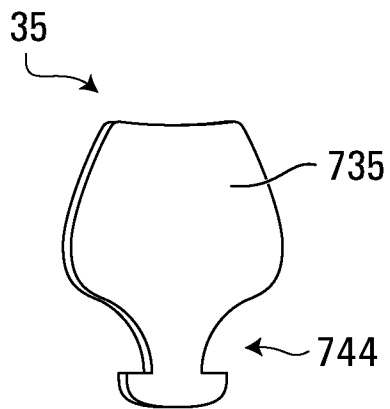
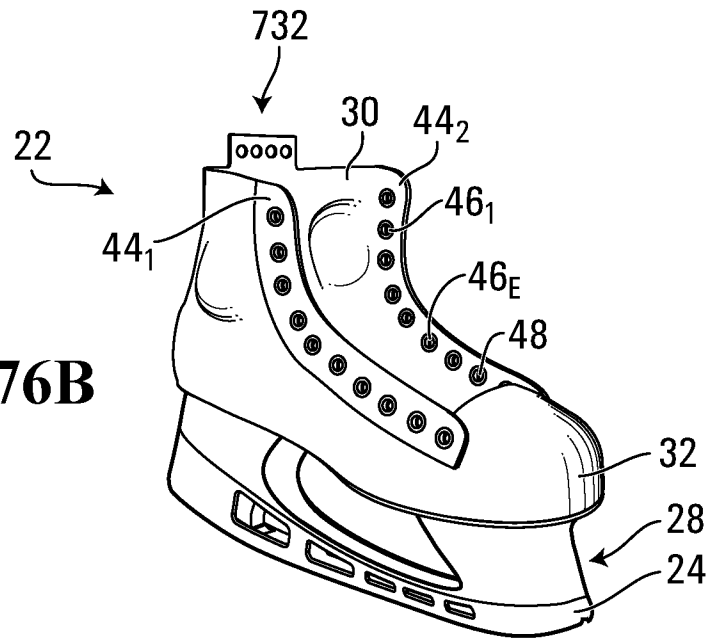


FIG. 177A

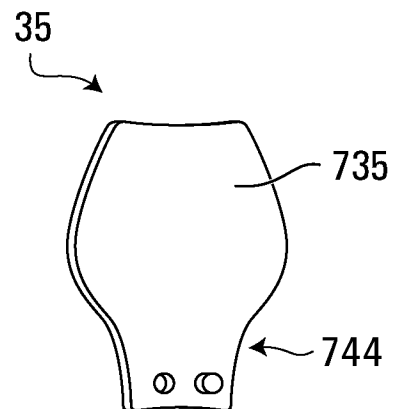


FIG. 177B

112/121

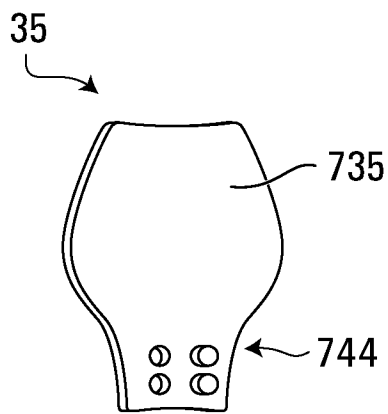


FIG. 177C

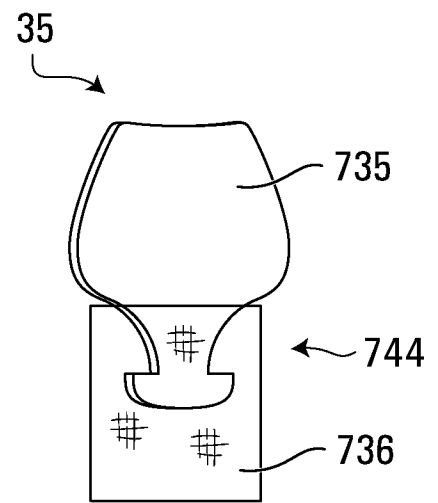


FIG. 177D

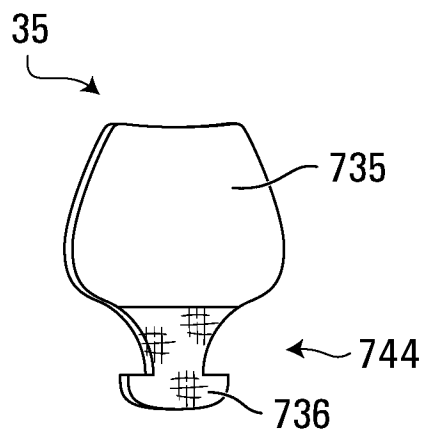


FIG. 177E

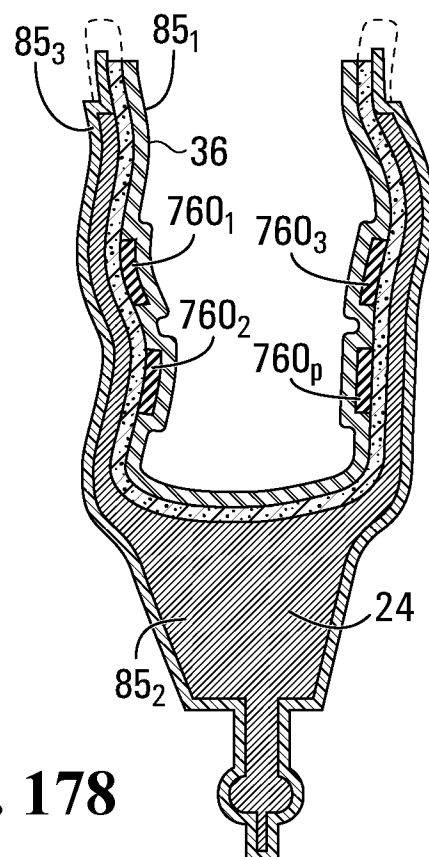


FIG. 178

113/121

FIG. 179

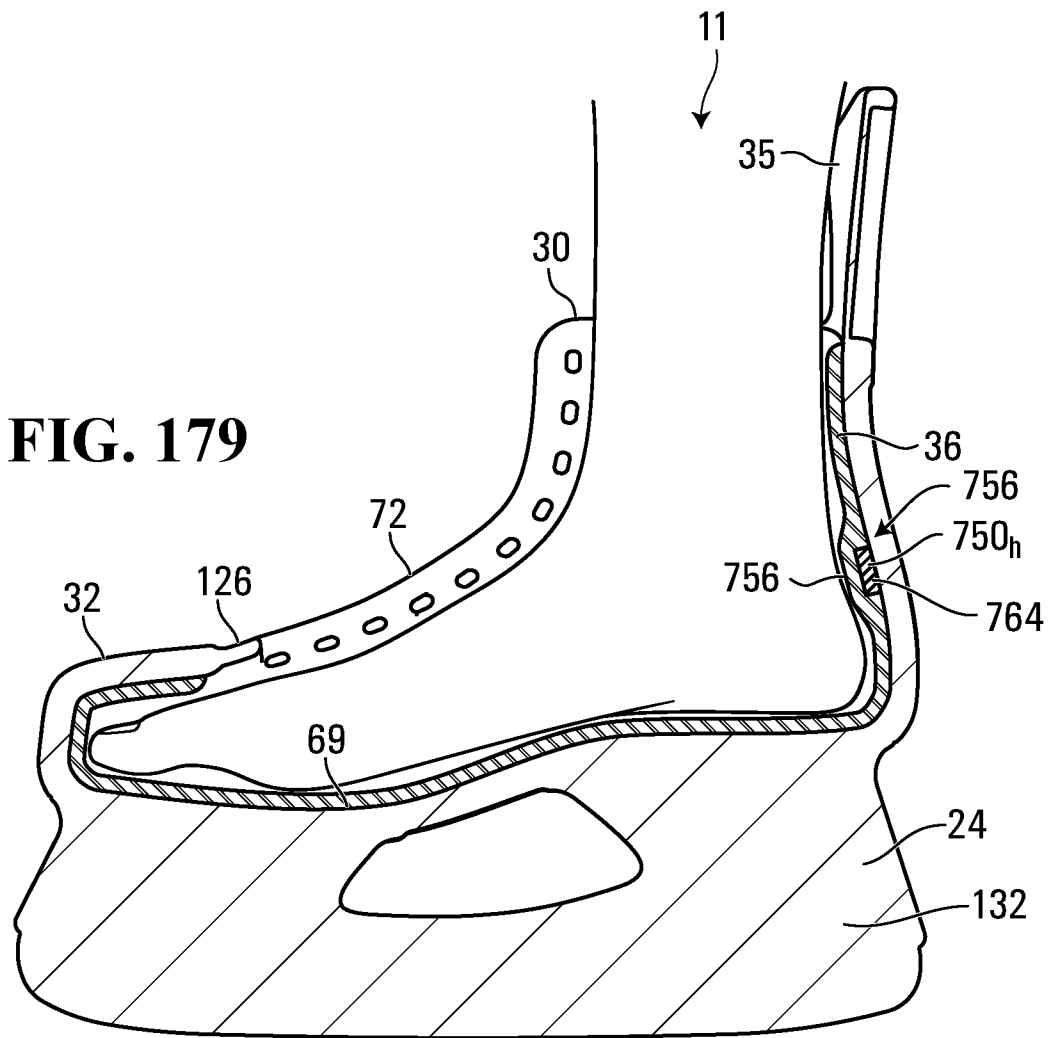
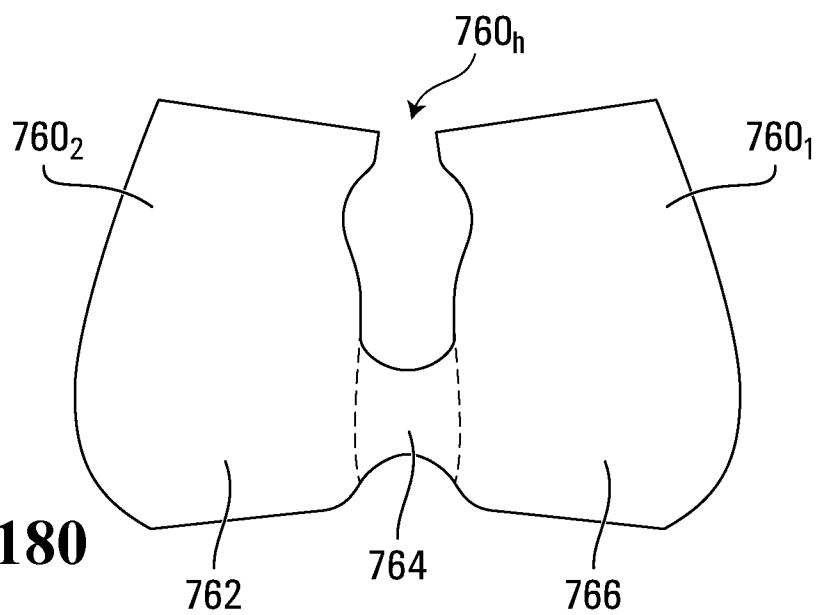


FIG. 180



114/121

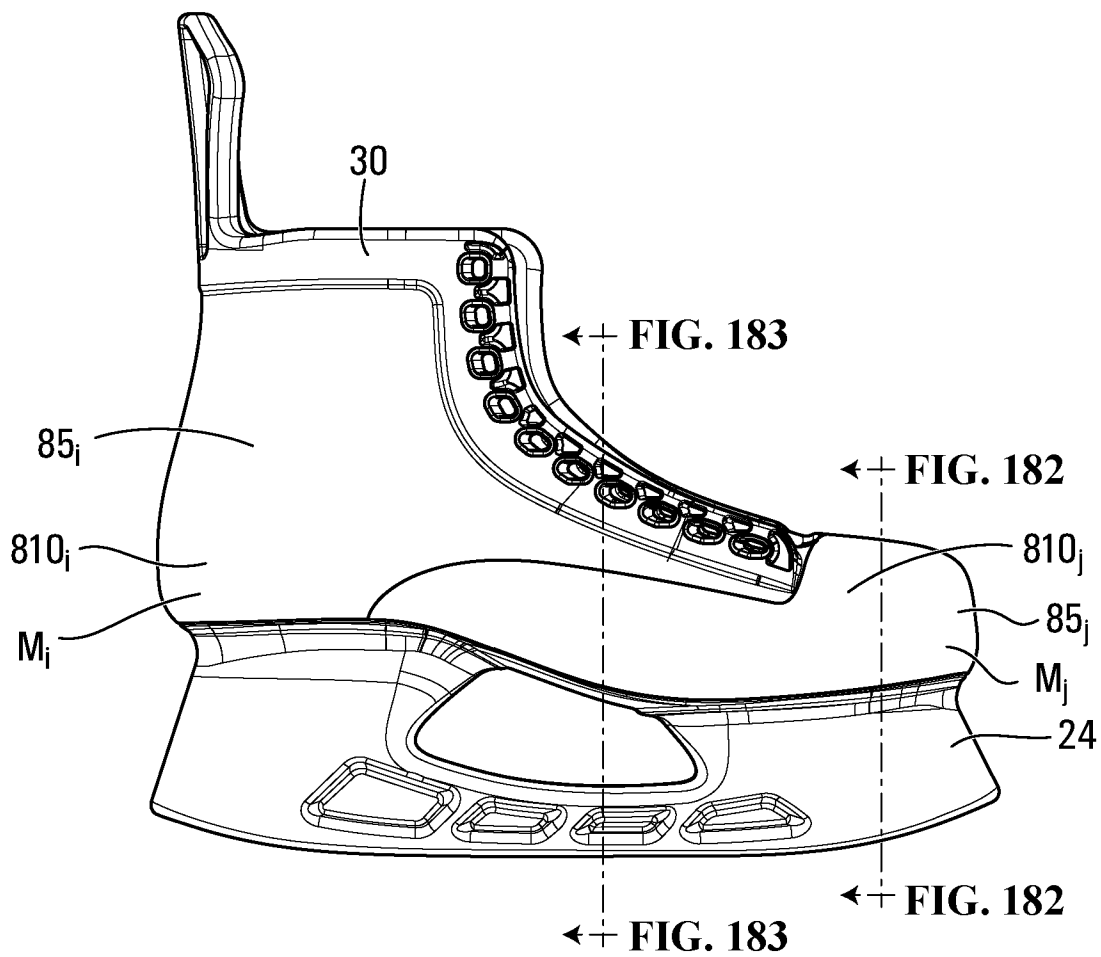


FIG. 181

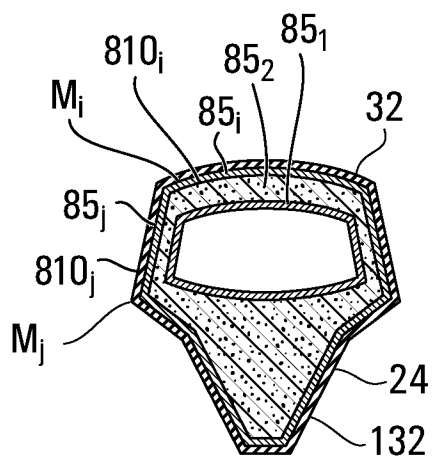


FIG. 182

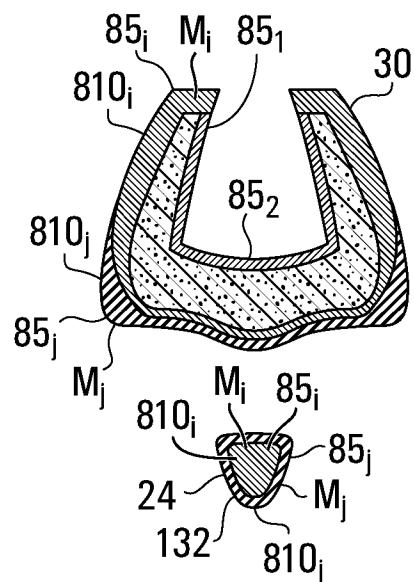
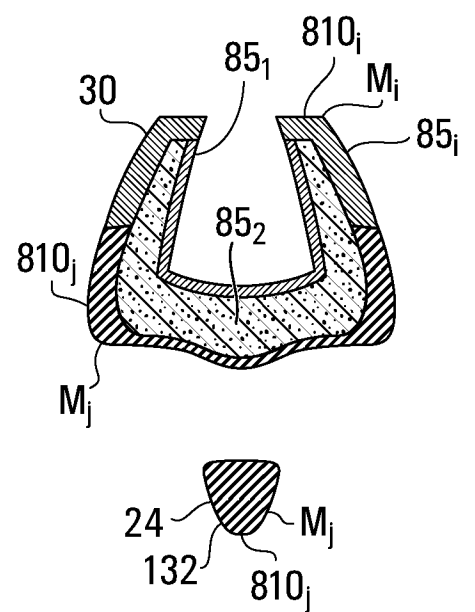
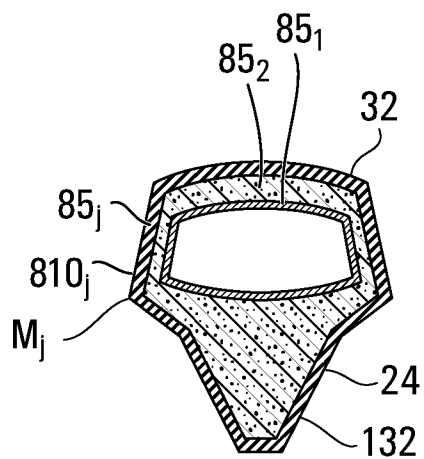
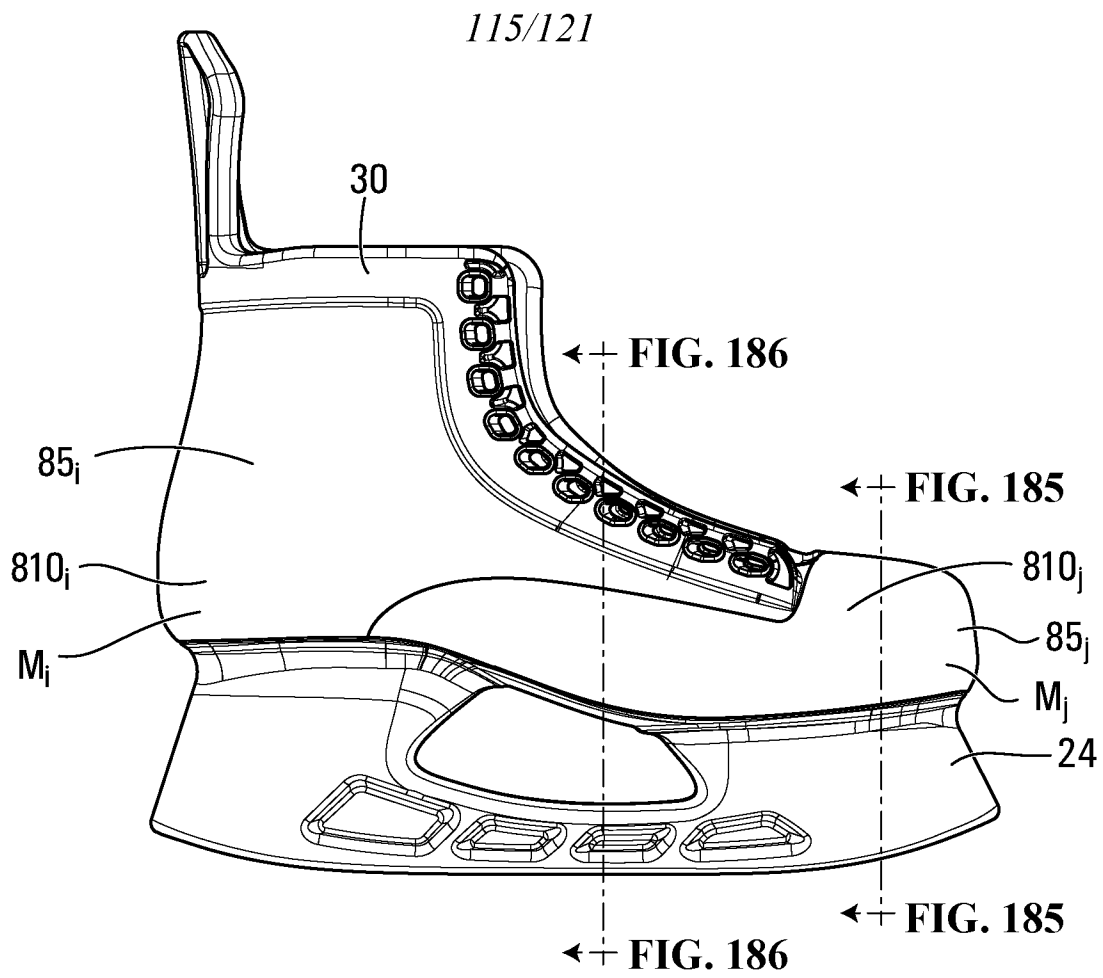
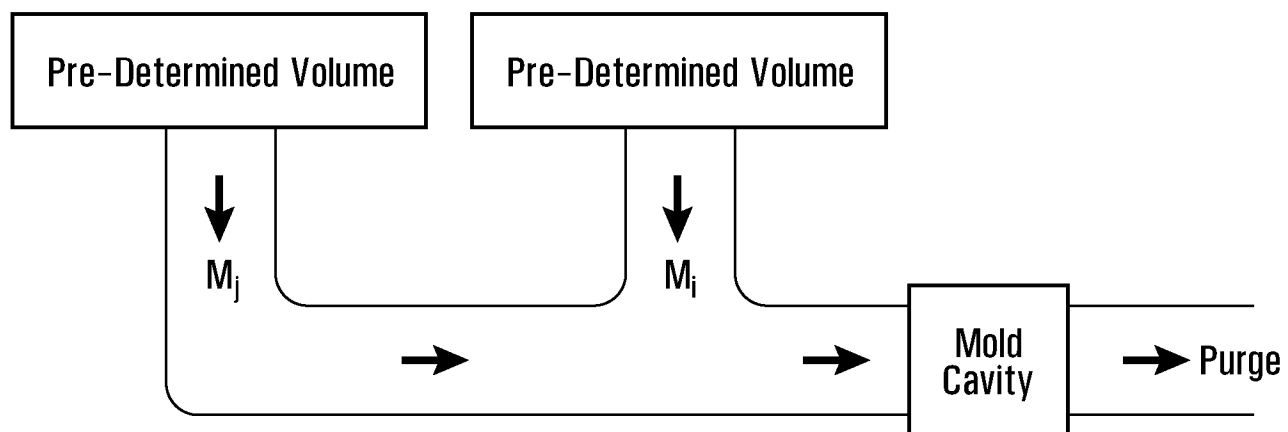
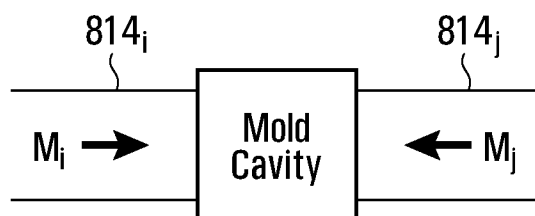


FIG. 183



116/121

**FIG. 187****FIG. 188**

117/121

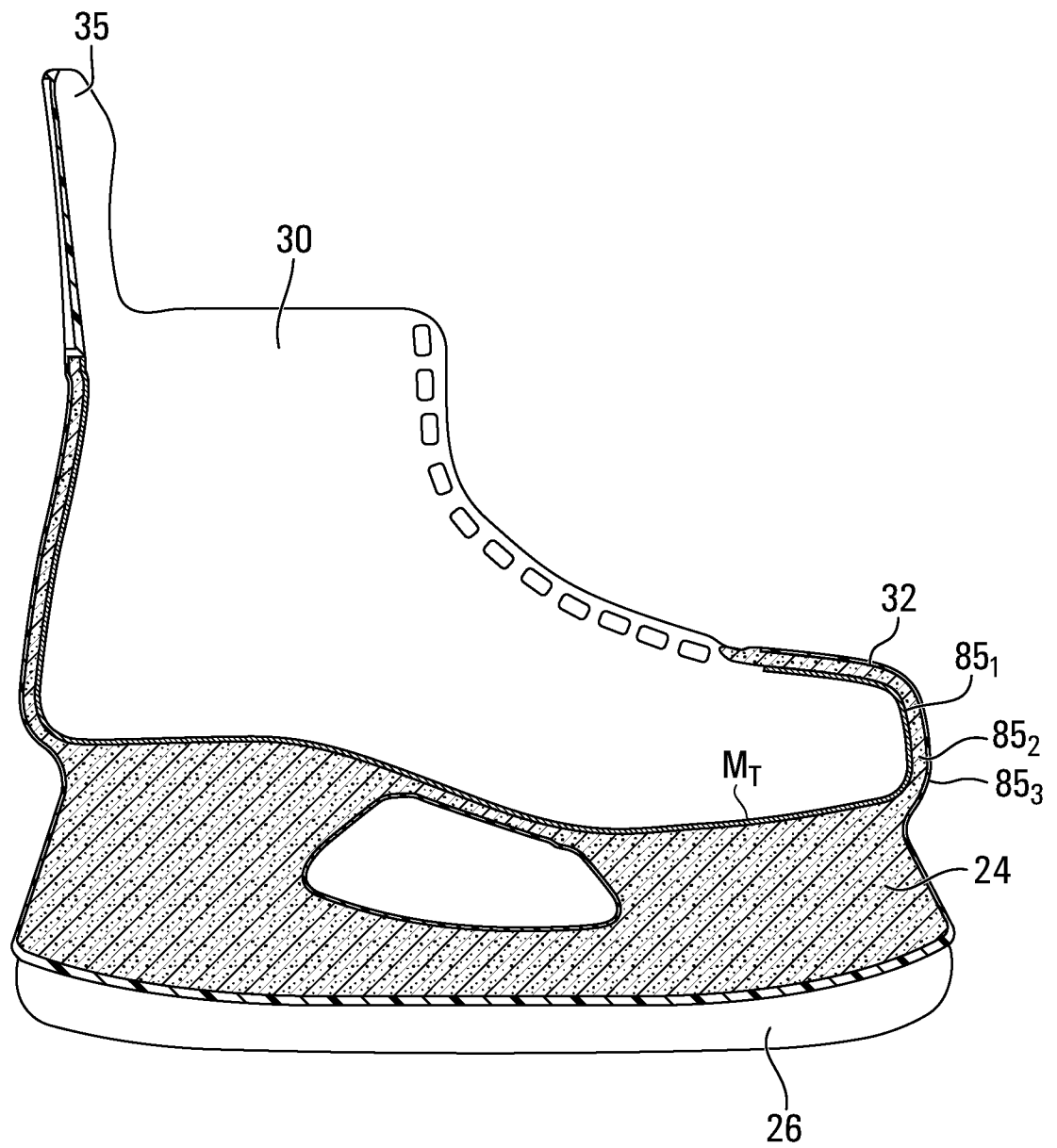


FIG. 189

118/121

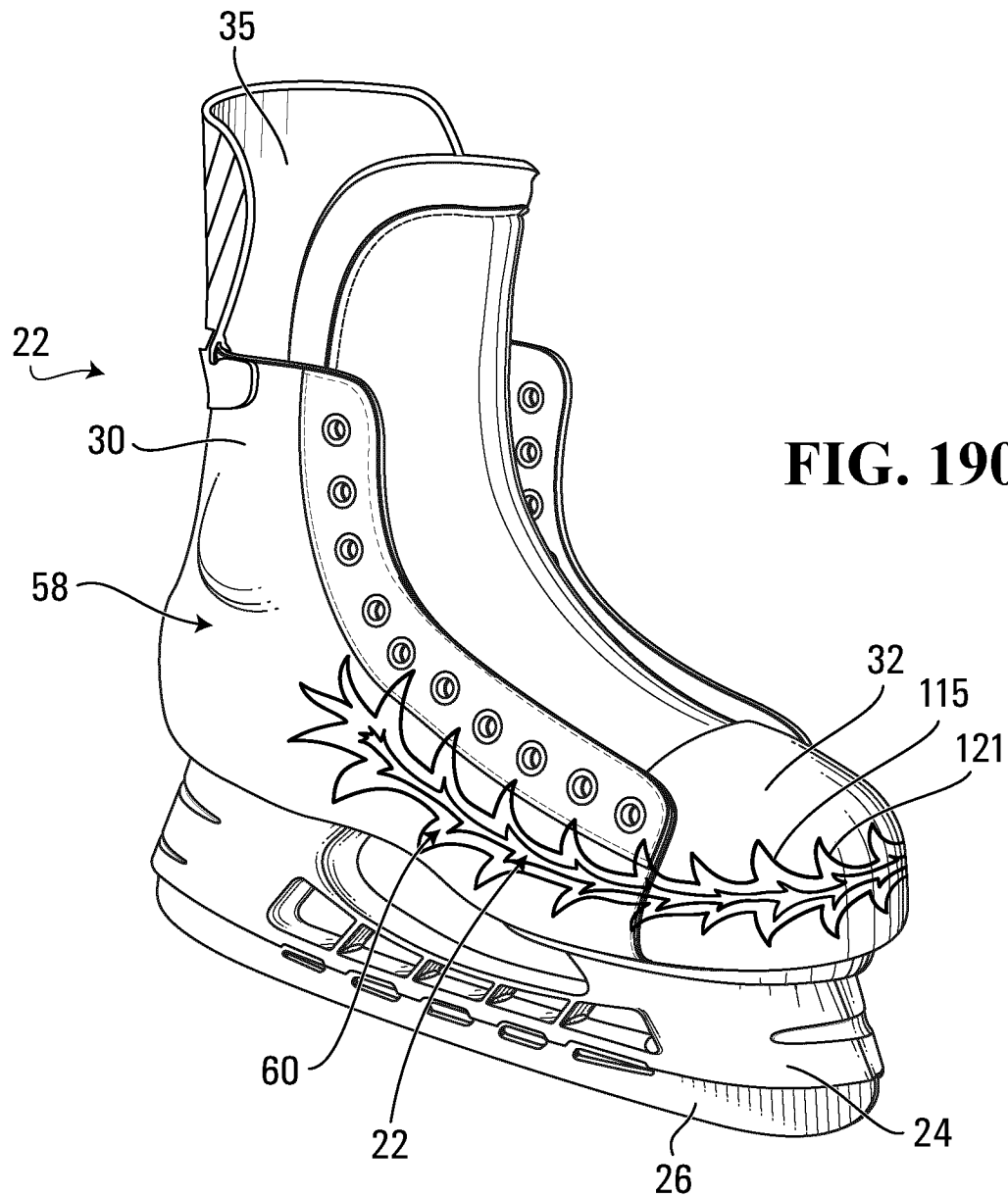


FIG. 190

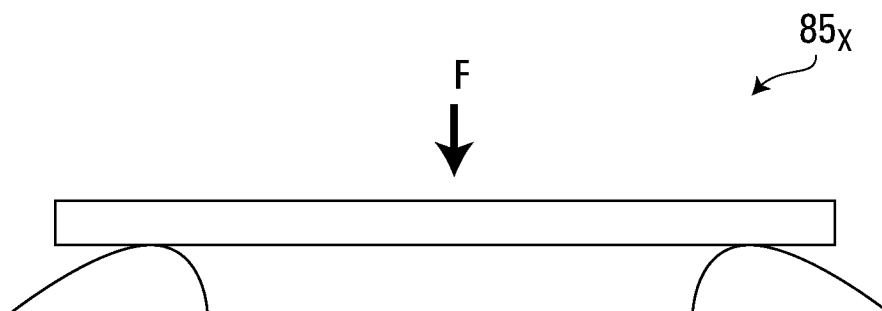
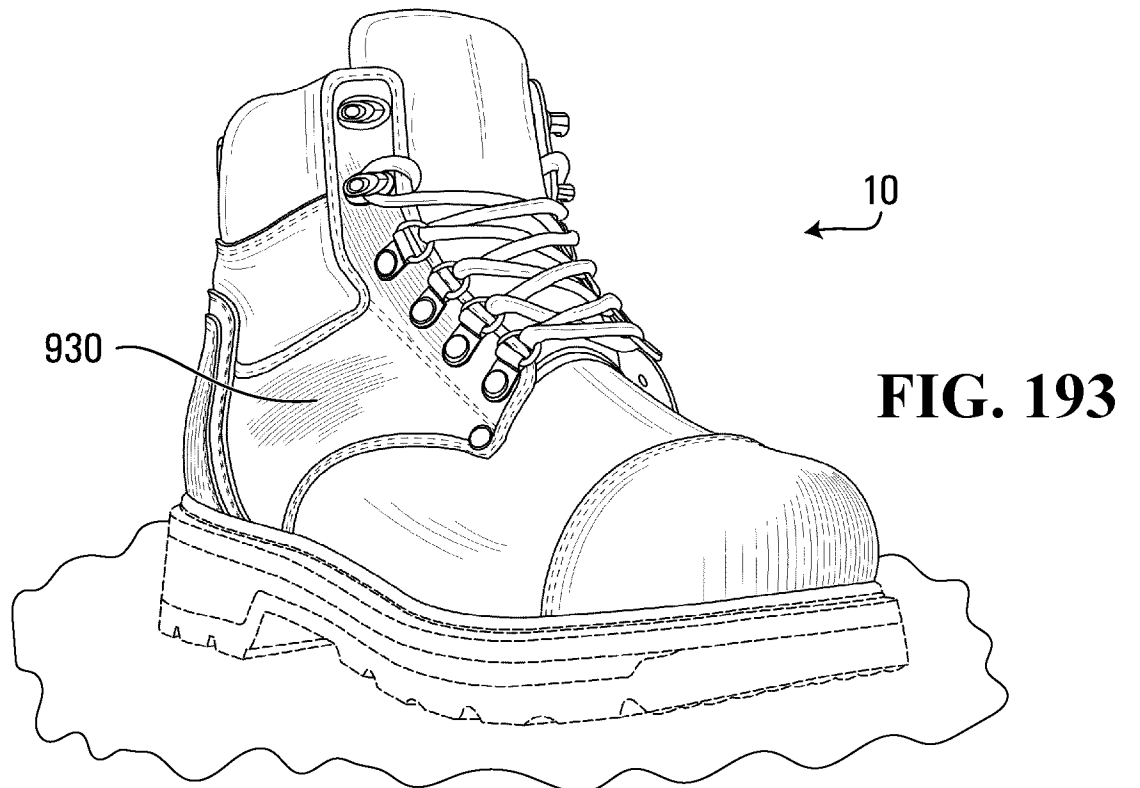
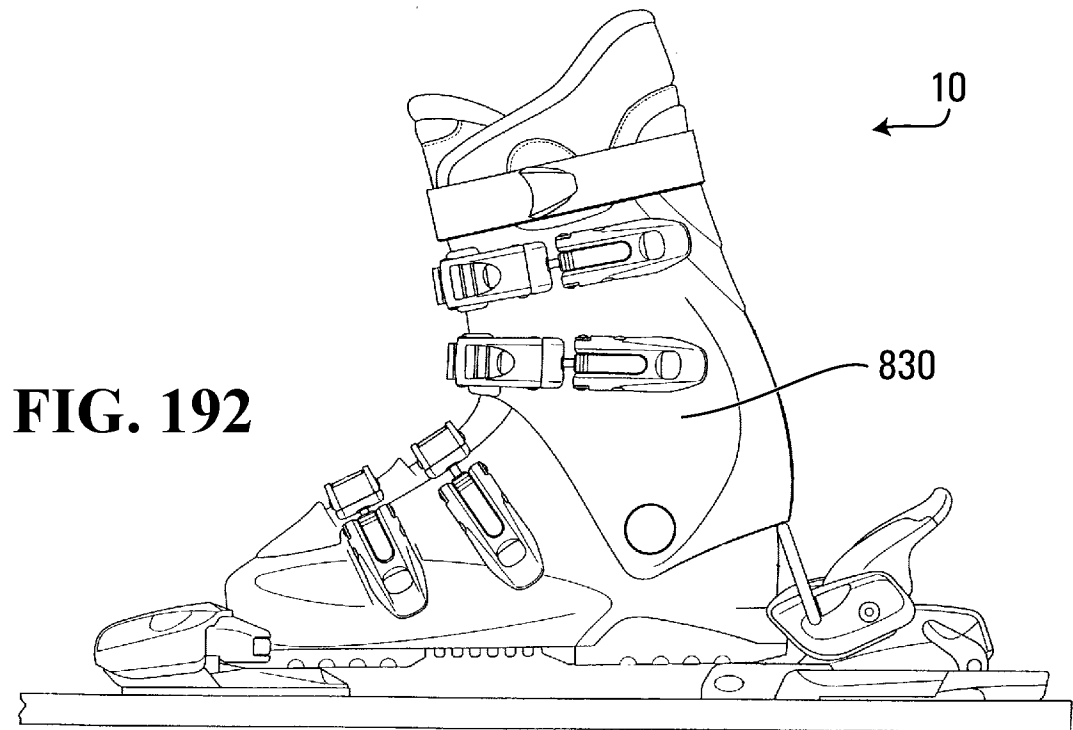


FIG. 191

119/121



120/121

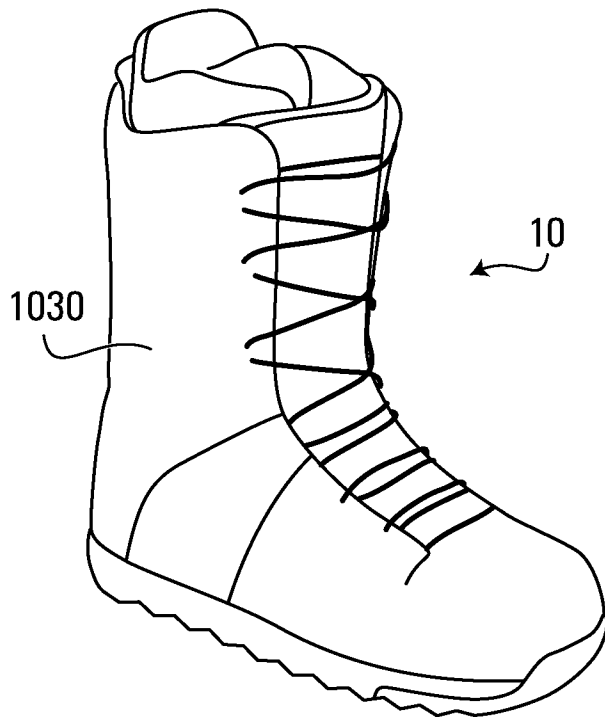


FIG. 194

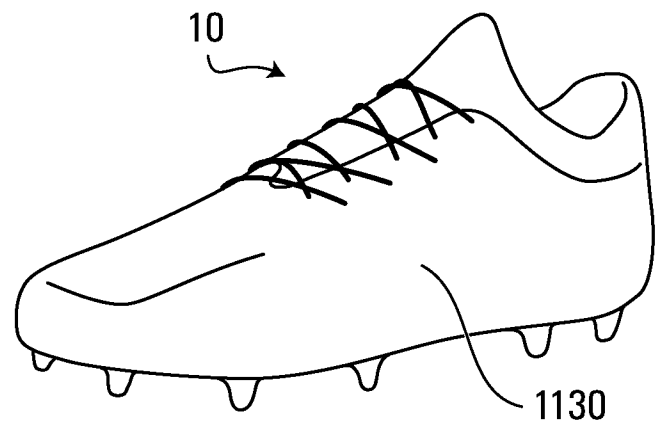
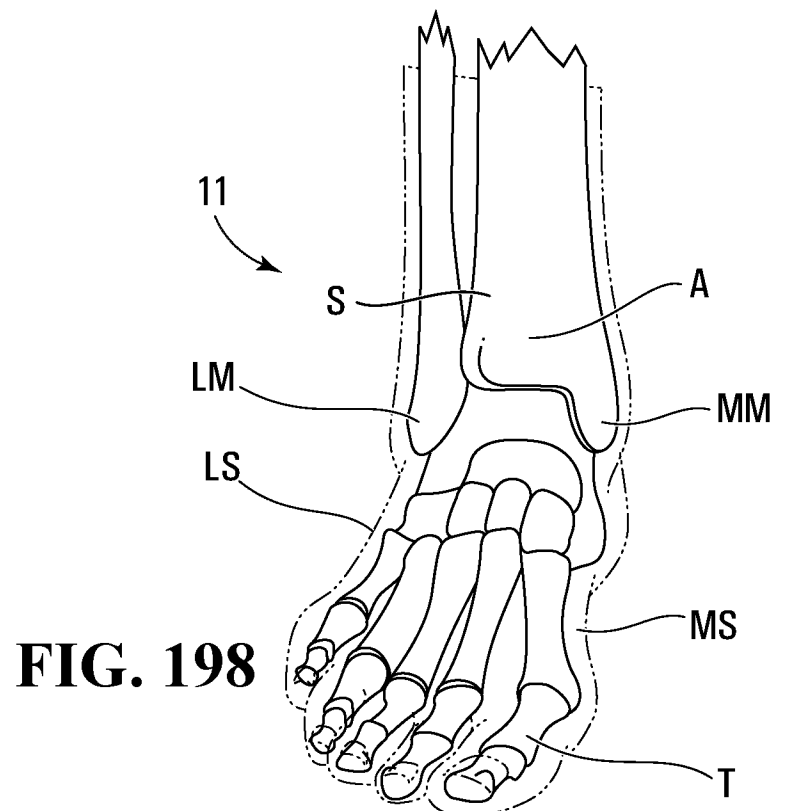
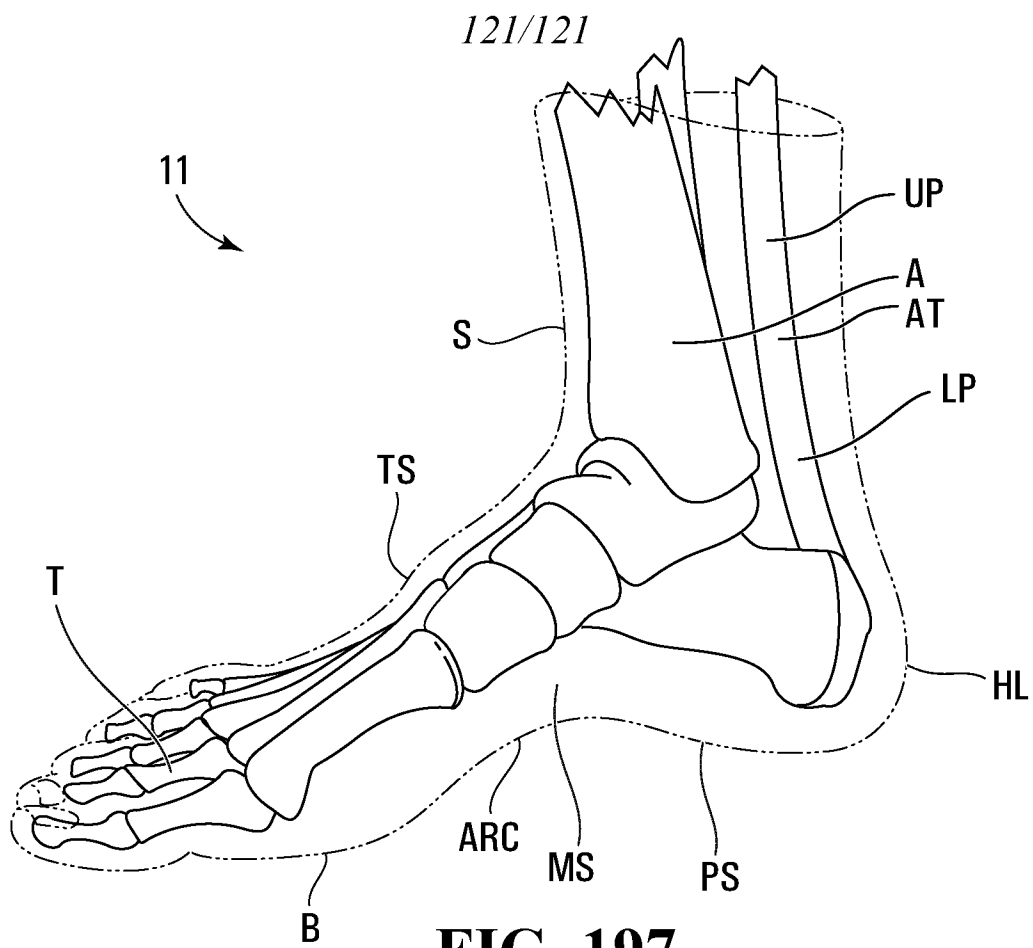


FIG. 195



FIG. 196



INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2021/050727

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **B29D 35/06** (2010.01), **A43B 5/16** (2006.01), **A63C 1/02** (2006.01), **A63C 1/42** (2006.01),
A63C 17/00 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B29D 35/06 (2010.01), A43B 5/16 (2006.01), A63C 1/02 (2006.01), A63C 1/42 (2006.01),
A63C 17/00 (2006.01)

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Canadian Patents Database, Questel Orbit: skate, mold, inject, polyurethane, isocyanate, polyol, foam, medial, lateral, heel, ankle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	CA 2,523,481 (BLEYS, Gerhard Jozef et al) 23 December 2004 (23-12-2004) whole document	53-64, 78, 83, 84 1-52, 65-77, 79-82
Y	CA 2,174,042 (SALISBURY, Wayne G. et al) 6 November 1996 (06-11-1996) page 10, lines 1-18	1-52, 79-82
D,X D,Y	WO 2020/087163 (LABONTE, Ivan et al) 7 May 2020 (07-05-2020) whole document	85-143, 153-158, 182-205 13-25, 41-51, 65-77
A	CA 3,028,419 (SEGUIN, Alexis et al) 22 June 2019 (22-06-2019) page 2, lines 2-6; page 10, line 2	1-143, 153-158, 182-205

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

☒ See patent family annex.

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

Date of the actual completion of the international search
26 July 2021 (27-07-2021)

Date of mailing of the international search report
03 September 2021 (03-09-2021)

Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
Place du Portage I, C114 - 1st Floor, Box PCT
50 Victoria Street
Gatineau, Quebec K1A 0C9
Facsimile No.: 819-953-2476

Authorized officer

David Dalrymple
Ph: 1-873-354-5237

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2021/050727**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

****See Supplemental Sheet****

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:
1-143, 153-158, 182-205
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

****Continued from Box III: Lack of Unity of Invention****

The present application contains claims directed to seven different inventions which are not linked together to form a single general inventive concept (Rule 13.1 PCT).

The separate groups of inventions are:

Group 1: Claims 1-84

A method of making footwear (including a boot for a skate) comprising a material produced by injection molding a plurality of constituents, as well as footwear produced by that method.

Group 2: Claims 85-143, 153-158

A skate comprising a blade holder having a portion formed integrally with the body of the skate, and the blade holder also having a core which is formed separately from the integrally-formed portion of the blade holder.

Group 3: Claims 144-163

A skate comprising a blade holder with front and rear pillars, where the front and rear pillars are at least 80% as wide as the respective front and rear portions of the sole of the skate's body.

Group 4: Claims 164

A skate wherein the blade is unsupported by the blade holder between the front and rear pillars.

Group 5: Claims 165-181

A skate having a blade-retaining base with a slot which is wider in the middle than at either end.

Group 6: Claims 182-205

Footwear (including a skate boot) comprising graphical ink.

Group 7: Claims 190, 191, 197-200, 206-212

Footwear (including a skate boot) formed by flow molding.

The potential inventions listed as groups 1-7 do not relate to a single general inventive concept, because they lack the same or corresponding technical feature for the following reasons:

The only technical feature common to all seven groups is an article of footwear. Groups 1 and 7 share the common technical feature of injection molding, but Group 7 is silent on the plurality of constituents. Groups 2-7 share the common technical feature of a body comprising a medial side portion, a lateral side portion, a heel portion, and an ankle portion. These common technical features are known from CA 3,028,419, which discloses a skate with a body comprising a medial side portion, a lateral side portion, a heel portion, and an ankle portion (page 2, lines 2-6). Furthermore, CA 3,028,419 discloses that the body may be injection molded (page 10, line 2).

Therefore, the common elements of the seven groups noted above are not "special technical features" which make a contribution over the prior art. The potential special technical features of the seven groups are as noted above. Consequently, these groups of claims concern different concepts expressed through different potential special technical features (Rule 13.2 PCT). Therefore, they are not linked to form a common inventive concept (Rule 13.1 PCT) involving one or more of the same or corresponding technical features.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2021/050727

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
CA2523481A1	23 December 2004 (23-12-2004)	CA2523481C AT521651T AU2004247421A1 AU2004247421A2 AU2004247421B2 BRPI0409963A BRPI0409963B1 CN1802395A CN100513450C EP1631606A1 EP1631606B1 ES2370718T3 JP2006527295A JP4818104B2 JP2011190457A KR20060017641A KR101074615B1 MXPA05012544A PL1631606T3 RU2006101063A RU2372358C2 US2006084777A1 WO2004111101A1 WO2004111101A9	01 May 2012 (01-05-2012) 15 September 2011 (15-09-2011) 23 December 2004 (23-12-2004) 23 December 2004 (23-12-2004) 13 March 2008 (13-03-2008) 25 April 2006 (25-04-2006) 05 August 2014 (05-08-2014) 12 July 2006 (12-07-2006) 15 July 2009 (15-07-2009) 08 March 2006 (08-03-2006) 24 August 2011 (24-08-2011) 22 December 2011 (22-12-2011) 30 November 2006 (30-11-2006) 16 November 2011 (16-11-2011) 29 September 2011 (29-09-2011) 24 February 2006 (24-02-2006) 17 October 2011 (17-10-2011) 08 February 2006 (08-02-2006) 30 November 2011 (30-11-2011) 27 May 2006 (27-05-2006) 10 November 2009 (10-11-2009) 20 April 2006 (20-04-2006) 23 December 2004 (23-12-2004) 23 February 2006 (23-02-2006)
CA2174042A1	06 November 1996 (06-11-1996)	DE69629515D1 DE69629515T2 EP0740987A2 EP0740987A3 EP0740987B1 ES2204974T3 JPH091594A KR960040614A KR100426755B1 US5562883A	25 September 2003 (25-09-2003) 17 June 2004 (17-06-2004) 06 November 1996 (06-11-1996) 17 December 1997 (17-12-1997) 20 August 2003 (20-08-2003) 01 May 2004 (01-05-2004) 07 January 1997 (07-01-1997) 17 December 1996 (17-12-1996) 27 March 2006 (27-03-2006) 08 October 1996 (08-10-1996)
WO2020087163A1	07 May 2020 (07-05-2020)	WO2020087163A9 CA3118214A1	11 February 2021 (11-02-2021) 07 May 2020 (07-05-2020)
CA3028419A1	22 June 2019 (22-06-2019)	US2019191816A1	27 June 2019 (27-06-2019)