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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 September 2012 (27.09.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/129041 A2

(51) International Patent Classification:
B29D 30/72 (2006.01) *B29D 30/10* (2006.01)

(21) International Application Number:
PCT/US2012/029183

(22) International Filing Date:
15 March 2012 (15.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/052,218 21 March 2011 (21.03.2011) US

(71) Applicant *(for all designated States except US)*: **BRIDGESTONE AMERICAS TIRE OPERATIONS, LLC** [US/US]; 535 Marriott Drive, Nashville, Tennessee 37214 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **DEMPSEY, John E** [US/US]; 715 Woodhaven Drive, Mogadore, Ohio 44260 (US).

(74) Agents: **JUPINA, Matthew** et al.; 10 East Firestone Blvd., Akron, Ohio 44317 (US).

(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, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2012/129041 A2

(54) **Title**: TIRE MOLD HAVING SIDEWALL STRUCTURE

(57) **Abstract**: An apparatus for molding a tire includes a first mold section having a first cavity, with an annular ridge disposed thereon. The apparatus also includes a second mold section having a second cavity. A plurality of lugs are removably attached to the first mold section. The apparatus further includes a ring having a plurality of projections, wherein the lugs retain the ring in a fixed position against the first mold section about the annular ridge.

TIRE MOLD HAVING SIDEWALL STRUCTURE

FIELD OF INVENTION

[0001] The present disclosure relates to the field of tire molding. More particularly, the present disclosure relates to a tire mold for forming voids in a tread and sidewall of a tire.

BACKGROUND

[0002] Tire molds are used to vulcanized uncured or green tires. The molds may have a top mold section and a bottom mold section, having top and bottom cavities, respectively, within which the green tire is vulcanized. Tread forming elements and void forming members may be attached to the top and bottom mold sections to impart voids, grooves, sipes, patterns, and lettering onto the tire.

SUMMARY OF THE INVENTION

[0003] In one embodiment, a tire mold kit includes a bottom mold section having a bottom cavity configured to define a first sidewall of a tire and a first portion of a tread of a tire. The tire mold kit also includes a top mold section having a top cavity configured to define a second sidewall of the tire and a second portion of the tread of the tire. A plurality of void forming members are removably attached to the top mold section, and retain a top ring in a fixed position against the top mold section. The top ring has a plurality of projections configured to form voids in the second sidewall of the tire.

[0004] In another embodiment, a tire mold includes a bottom mold section having a bottom cavity, a plurality of bottom lugs removably attached to the bottom mold section, and a bottom ring having a plurality of projections. The plurality of bottom lugs retain the bottom ring in a fixed position against the bottom mold section, and each of the projections of the bottom ring is adjacent one of the bottom lugs. The tire mold further includes a top mold section having a top cavity, a plurality of top lugs removably attached to the top mold section, and a top ring having a plurality of projections. The

plurality of top lugs retain the top ring in a fixed position against the top mold section, and each of the projections of the top ring is adjacent one of the top lugs.

[0005] In yet another embodiment, an apparatus for molding a tire includes a first mold section having a first cavity, with an annular ridge disposed thereon. The apparatus also includes a second mold section having a second cavity. A plurality of lugs are removably attached to the first mold section. The apparatus further includes a ring having a plurality of projections, wherein the lugs retain the ring in a fixed position against the first mold section about the annular ridge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the accompanying drawings, structures are illustrated that, together with the detailed description provided below, describe exemplary embodiments of the claimed invention. Like elements are identified with the same reference numerals. It should be understood that elements shown as a single component may be replaced with multiple components, and elements shown as multiple components may be replaced with a single component. The drawings are not to scale and the proportion of certain elements may be exaggerated for the purpose of illustration.

[0007] **Figure 1** is a perspective view of one embodiment of a tire mold;

[0008] **Figure 2** is an exploded perspective view of one embodiment of a bottom mold section;

[0009] **Figure 3** is an exploded perspective view of one embodiment of a top mold section;

[0010] **Figure 4** is a partial cross-section of one embodiment of a lug and a ring inside a tire mold section;

[0011] **Figure 5A** is a rear view of one embodiment of a lug;

[0012] **Figure 5B** is a side view of one embodiment of a lug;

[0013] **Figure 6A** is a rear view of one embodiment of a replacement lug;

[0014] **Figure 6B** is a side view of one embodiment of a replacement lug;

[0015] **Figure 7** is a front view of one embodiment of a ring;

[0016] **Figure 8** is a front view of one embodiment of a replacement ring;

[0017] **Figure 9A** is a rear view of one embodiment of a second replacement lug; and

[0018] **Figure 9B** is a side view of one embodiment of a second replacement lug.

DETAILED DESCRIPTION

[0019] **Figure 1** illustrates a perspective view of one embodiment of a tire mold **100** having a bottom mold section **105** and a top mold section **110**. The bottom mold section **105** has a bottom cavity configured to define a first sidewall of a tire and a first portion of a tread of a tire (not shown). The top mold section **110** has a top cavity configured to define a second sidewall of the tire and a second portion of the tread of the tire. It should be understood that the tire mold **100** need not be oriented as depicted, but instead may be rotated. For example, the tire mold **100** may be rotated by 90°, in which case the top and bottom sections depicted would be right and left sections. The terms "top" and "bottom" as well as "upper" and "lower" are therefore terms that are used for convenience, and are not intended to limit the tire mold to a particular orientation.

[0020] Each of the top and bottom mold sections **105**, **110** include a plurality of apertures **115**. Some of the apertures **115** are configured to receive fasteners for attaching tread forming elements and void forming elements (not shown) to inner surfaces of the top and bottom mold sections **105**, **110**. Additional apertures (not shown) may be used to vent air into or out of the cavities.

[0021] The tire mold **100** further includes a locking mechanism **120** for locking the bottom mold section **105** to the top mold section **110** during the curing process. In one embodiment, the bottom mold section **105** and top mold section **110** are placed in a pot heater (not shown) for vulcanizing the green tire. After vulcanization, the mold sections are manually separated. In an alternative embodiment, the bottom mold section **105** is pivotally connected to the top mold section **110**. For example, the bottom mold section **105** may be connected to a bottom of a tire press and the top mold section **110** may be connected to a top of the tire press, where the top of the tire press is pivotally connected to the bottom of the tire press. In other alternative embodiments, the tire mold **100** may open by lowering the bottom mold section **105** or by raising the top mold section **110**.

[0022] In one embodiment, the tire mold **100** has an outer diameter of 117 inches (297 centimeters) and a width of 55 inches (140 centimeters). In alternative embodiments, the tire mold may have an outer diameter ranging from 10 inches (25

centimeters) to 200 inches (508 centimeters) and a depth ranging from 2 inches (5 centimeters) to 100 inches (254 centimeters). It should be understood that such a tire mold may be scaled according to the type of tire that is desired, such as tires for a passenger car, a light truck, a sports utility vehicle, a motorcycle, an all-terrain vehicle, a truck, an airplane, agriculture equipment, mining equipment, industrial equipment such as a bulldozer, or any other type of tire.

[0023] **Figure 2** illustrates an exploded perspective view of one embodiment of the bottom mold section **105**. The bottom mold section **105** is comprised of a bottom disk **125** and a lower annular sidewall **130** that is connected to the bottom disk **125** to define the bottom cavity. In an alternative embodiment (not shown), the bottom mold section **105** is a unitary component having a base with an annular sidewall.

[0024] The bottom disk **125** includes a bottom annular ridge **135** disposed thereon. The bottom annular ridge **135** may also be referred to as a bottom annular rib. The bottom annular ridge **135** is configured to contact a sidewall of a green tire (not shown) and includes raised portions and indentations that will form complementary shapes on the sidewall of the green tire. The bottom annular ridge is defined by an outer ledge **140**.

[0025] A bottom ring **145** is positioned against the bottom disk **125** about the bottom annular ridge **135**, such that the interior edge of the bottom ring **145** abuts the outer ledge **140**. The bottom ring **145** has a plurality of projections **150** that are configured to form voids in the first sidewall of the green tire. The bottom annular wall **130** may include an internal flange or lip (not shown in this view) that abuts the exterior edge of the ring **145**, such that the bottom ring **145** is sandwiched between the bottom annular ridge **135** and the bottom annular wall **130**.

[0026] In an alternative embodiment (not shown), the bottom disk **125** does not include a bottom annular ridge **135**. In such an embodiment, the bottom ring **145** is simply positioned on the bottom disk **125** at a desired location. In such an embodiment, the bottom ring **145** may be broader, and include the raised portions and indentations that are shown on the bottom annular ridge **135** in **Figure 2**. Alternatively, the bottom ring **145** may be replaced with a solid disk having the raised portions and indentations that are shown on the bottom annular ridge **135** in **Figure 2**.

[0027] The bottom mold section **105** further includes a plurality of bottom lugs **155**. The bottom lugs **155** are void forming members that are configured to form a void in the first sidewall or the tread of the green tire. In the illustrated embodiment, the plurality of bottom lugs **155** are removably attached to the bottom mold section **105**. Each bottom lug may be attached to the bottom disk **125**, the bottom annular sidewall **130**, or both. Each bottom lug includes at least one aperture **160** configured to receive a fastener. Exemplary fasteners include bolds, screws, pegs, rivets, nails, or ties. In one known embodiment, at least one aperture **160** of each bottom lug **155** is aligned with an aperture **115** in one of the bottom disk **125** and the bottom annular sidewall **130**, and a bolt (not shown) is passed through both apertures **115**, **160** to secure the bottom lug **155** in position. The bolt may be fastened to a nut, or one or more of the apertures may be threaded. In an alternative embodiment (not shown), the bottom lugs **155** are fixedly attached to the bottom mold section **105**. For example, the bottom lugs may be welded or riveted in place, or fixedly attached with an adhesive. Alternatively, the bottom lugs may be an integral extension of the bottom mold section **105**.

[0028] In one embodiment, all of the bottom lugs **155** have substantially the same shape and dimensions. In one known embodiment, each bottom lug is approximately 5 inches (13 centimeters) deep, 4 inches (10 centimeters) wide, and 17 inches (43 centimeters) long. In an alternative embodiment, the bottom lugs **155** have a plurality of different shapes. The bottom lugs may have a depth ranging from 1 inch (3 centimeters) to 12 inches (30 centimeters), a width ranging from 1 inch (3 centimeters) to 12 inches (30 centimeters), and a length ranging from 3 inches (8 centimeters) to 40 inches (102 centimeters). However, it should be understood that the lugs may have any dimension for forming a void of a desired shape and dimension.

[0029] In one embodiment, at least some of the bottom lugs **155** are positioned such that they retain the bottom ring **145** against the bottom disk **125**. In one particular embodiment, the bottom ring **145** does not have any apertures for receiving fasteners. The bottom lugs **155** may retain the bottom ring **145** with a friction fit. Alternatively, the bottom lugs **155** and the bottom ring **145** may be keyed, such that they have complementary projections and indentations to aid in retention.

[0030] **Figure 3** illustrates an exploded perspective view of one embodiment of the top mold section **110**. The top mold section **110** is comprised of a top disk **165** and an upper annular sidewall **170** that is connected to the top disk **165** to define the top cavity. In an alternative embodiment (not shown), the top mold section **110** is a unitary component having a ceiling with an annular sidewall.

[0031] The top disk **165** includes a top annular ridge **175** disposed thereon. The top annular ridge **175** may also be referred to as a top annular rib. The top annular ridge **175** is configured to contact a sidewall of the green tire and includes raised portions and indentations that will form a complementary shape on the sidewall of the green tire. The top annular ridge is defined by an outer ledge **180**.

[0032] A top ring **185** is positioned against the top disk **165** about the top annular ridge **175**, such that the interior edge of the top ring **185** abuts the outer ledge **180**. The top ring **185** has a plurality of projections **190** that are configured to form voids in the second sidewall of the green tire. The top annular wall **170** may include an internal flange or lip (not shown in this view) that abuts the exterior edge of the top ring **185**, such that the top ring **185** is sandwiched between the top annular ridge **175** and the top annular wall **170**.

[0033] In an alternative embodiment (not shown), the top disk **165** does not include a top annular ridge **175**. In such an embodiment, the top ring **185** is simply positioned on the top disk **165** at a desired location. In such an embodiment, the top ring **185** may be broader, and include the raised portions and indentations that are shown on the top annular ridge **175** in **Figure 3**. Alternatively, the top ring **185** may be replaced with a solid disk having the raised portions and indentations that are shown on the top annular ridge **175** in **Figure 3**.

[0034] The top mold section **110** further includes a plurality of top lugs **195**. The top lugs **195** are void forming members that are configured to form a void in the second sidewall or tread of the green tire. In the illustrated embodiment, the plurality of top lugs **195** are removably attached to the top mold section **110**. Each top lug may be attached to the top disk **165**, the top annular sidewall **170**, or both. Each top lug includes at least one aperture **200** configured to receive a fastener. Exemplary fasteners include bolds, screws, pegs, rivets, nails, or ties. In one known embodiment, at least one aperture **200** of each

top lug **195** is aligned with an aperture **115** in one of the top disk **165** and the top annular sidewall **170**, and a bolt (not shown) is passed through both apertures **115**, **200** to secure the top lug **195** in position. The bolt may be fastened to a nut, or one or more of the apertures may be threaded. In an alternative embodiment (not shown), the top lugs **195** are fixedly attached to the top mold section **110**. For example, the top lugs may be welded or riveted in place, or fixedly attached with an adhesive. Alternatively, the top lugs may be an integral extension of the top mold section **110**.

[0035] In one embodiment, all of the top lugs **195** have substantially the same shape and dimensions, and are substantially the same as the bottom lugs **155**. In one known embodiment, each bottom lug is approximately 5 inches (13 centimeters) deep, 4 inches (10 centimeters) wide, and 17 inches (43 centimeters) long. In an alternative embodiment, the bottom lugs **155** have a first shape and dimension, and the top lugs **195** have a second shape and dimension. In another alternative embodiment, the top lugs **195** have a plurality of different shapes. The top lugs may **195** have a depth ranging from 1 inch (3 centimeters) to 12 inches (30 centimeters), a width ranging from 1 inch (3 centimeters) to 12 inches (30 centimeters), and a length ranging from 3 inches (8 centimeters) to 40 inches (102 centimeters). However, it should be understood that the lugs may have any dimension for forming a void of a desired shape and dimension.

[0036] In one embodiment, at least some of the top lugs **195** are positioned such that they retain the top ring **185** against the top disk **165**. In one particular embodiment, the top ring **185** does not have any apertures for receiving fasteners. The top lugs **195** may retain the top ring **185** with a friction fit. Alternatively, the top lugs **195** and the top ring **185** may be keyed, such that they have complementary projections and indentations to aid in retention.

[0037] While the illustrated embodiment depicts a tire mold **100** having a bottom ring **145**, bottom lugs **155**, a top ring **185**, and top lugs **195**, it should be understood that any of these components may be omitted. For example, in one embodiment, the bottom mold section **105** includes a bottom ring **145** and bottom lugs **155**, while the top mold section **110** includes integrated void forming elements. In another alternative embodiment, the top mold section **110** includes a top ring **185** and top lugs **195**, while the bottom mold section **105** includes integrated void forming elements.

[0038] In one embodiment, each of the bottom ring **145**, bottom lugs **155**, top ring **185**, and top lugs **195** are constructed of the same material. Exemplary materials include stainless steel, aluminum, other metals, or a polymeric material. In an alternative embodiment, one or more of the bottom ring **145**, bottom lugs **155**, top ring **185**, and top lugs **195** may be constructed of different materials.

[0039] **Figure 4** illustrates a partial cross-section of one embodiment of a top lug **195** and the top ring **185** inside the top mold section **110**. It should be understood that the bottom lugs **155** and bottom ring **145** may have substantially the same configurations, including the alternatives described herein.

[0040] The top ring **185** is positioned on the top disk **165** about the top annular ridge **175** such that the interior edge of the top ring **185** abuts the ledge **180**. Additionally, the annular wall **170** has an internal flange **210** (or lip) that abuts the exterior edge of the top ring **185**, such that the top ring **185** is sandwiched between the top annular ridge **175** and the internal flange **210**. In an alternative embodiment (not shown), the top ring **185** may be spaced from one of the top annular ridge **175** and the internal flange **210**. In another alternative embodiment (not shown), the top annular wall **170** does not have an internal flange **210**.

[0041] After the top ring **185** is so positioned, the top lugs **195** are removably attached to the top mold section **110** with bolts **205**. The top lugs **195** are positioned such that each projection **190** of the top ring **185** is adjacent one of the top lugs **195**. The top ring **185** dovetails to the plurality of top lugs **195** and the top lugs **195** retain the top ring **185** by a friction fit. In the illustrated embodiment, each projection **190** of the top ring **185** and the adjacent top lug **195** form a continuous surface. In an alternative embodiment (not shown), the projections **190** of the top ring **185** and the adjacent top lug **195** may form a broken surface.

[0042] It may be desirable to produce tires that have the same diameter and axial width, but having voids of different depths. For example, a manufacturer may produce a "deep skid" version of a tire having voids of a first depth, a "shallow skid" version of the tire having voids of a second depth shallower than the first depth, and a "plain tread" version of the tire, which does not include voids formed by lugs. It should be understood that any number of versions of a tire may be produced, and that the depth of the void may

be selected to optimize performance in a given condition. For example, a deep skid version may perform better in muddy conditions.

[0043] **Figures 5A** and **5B** illustrate a rear view and a side view, respectively, of one embodiment of a lug **500** that may be employed for a deep skid version of a tire. The lug **500** may be referred to as a deep lug or a first lug. However, it should be understood that this designation is merely for convenience, and a tire mold may be initially assembled for a shallow skid or a plain tread version of a tire.

[0044] The lug **500** has a major segment **505** extending in a first direction, and a minor segment **510** extending in a second direction. In the illustrated embodiment, the minor segment **510** is substantially orthogonal to the major segment **505**. In an alternative embodiment (not shown) the minor segment **510** is disposed at an acute angle with respect to the major segment **505**. In another alternative embodiment (not shown), the minor segment **510** is disposed at an obtuse angle with respect to the major segment **505**.

[0045] The lug **500** may be employed as a top lug or a bottom lug. As explained above, the top lugs and the bottom lugs in a tire mold may all be substantially the same. Alternatively, lugs of different shapes and sizes may be employed.

[0046] The lug **500** includes a first aperture **515**, a second aperture **520**, and a third aperture **525** for receiving fasteners (not shown). The first aperture **515** and the second aperture **520** are disposed on the major segment **505** of the lug **500**. The third aperture **525** is disposed on the minor segment **510** of the lug **500**. The lug **500** is positioned in a tire mold such that the major segment **505** abuts a tread forming surface (*e.g.*, bottom annular sidewall **130** or top annular sidewall **170**), and is secured thereto with fasteners. Additionally, the minor segment **510** abuts a sidewall forming surface (*e.g.*, top disk **125** or bottom disk **165**), and is secured thereto with a fastener. It should be understood, however, that any number of apertures may be employed in each segment, as may be desired for securely fastening a lug to a mold.

[0047] **Figures 6A** and **6B** illustrate a rear view and a side view, respectively, of one embodiment of a lug **600** that may be employed for a shallow skid version of a tire. The lug **600** may be referred to as a shallow lug, a second lug, or a replacement lug. However, it should be understood that this designation is merely for convenience. In one

embodiment, a tire mold may be initially assembled for a deep skid version of a tire with first lugs **500**. The first lugs **500** may then be removed and replaced with replacement lugs **600** for making a shallow skid version of a tire. Then the replacement lugs **600** may later be removed for making a plain tread version of a tire. In alternative embodiments, a tire mold may be initially assembled for a shallow skid or a plain tread version of a tire, and then later modified to produce other versions.

[0048] The lug **600** has a major segment **605** extending in a first direction, and a minor segment **610** extending in a second direction. In the illustrated embodiment, the minor segment **610** is substantially orthogonal to the major segment **605**. In an alternative embodiment (not shown) the minor segment **610** is disposed at an acute angle with respect to the major segment **605**. In another alternative embodiment (not shown), the minor segment **610** is disposed at an obtuse angle with respect to the major segment **605**.

[0049] The lug **600** may be employed as a top lug or a bottom lug. As explained above, the top lugs and the bottom lugs in a tire mold may all be substantially the same. Alternatively, lugs of different shapes and sizes may be employed.

[0050] The lug **600** includes a first aperture **615**, a second aperture **620**, and a third aperture **625** for receiving fasteners (not shown). The first aperture **615** and the second aperture **620** are disposed on the major segment **605** of the lug **600**. The third aperture **625** is disposed on the minor segment **610** of the lug **600**. The lug **600** is positioned in a tire mold such that the major segment **605** abuts a tread forming surface (*e.g.*, bottom annular sidewall **130** or top annular sidewall **170**), and is secured thereto with fasteners. Additionally, the minor segment **610** abuts a sidewall forming surface (*e.g.*, top disk **125** or bottom disk **165**), and is secured thereto with a fastener. It should be understood, however, that any number of apertures may be employed in each segment, as may be desired for securely fastening a lug to a mold.

[0051] **Figure 7** illustrates a front view of one embodiment of a ring **700** having a plurality of projections **705**. In the illustrated embodiment, the ring has twenty projections **705**. However, it should be understood that any number of projections may be employed.

[0052] The ring **700** may be employed as a top ring or a bottom ring. In one embodiment, the top ring and the bottom ring in a tire mold have substantially the same shape. In an alternative embodiment, the top ring and bottom ring have different shapes.

[0053] In the illustrated embodiment, the ring **700** does not include any apertures for receiving fasteners. Instead, the ring is configured to be held in a desired position by a friction fit or by a clamping action.

[0054] In one embodiment, the same ring may be employed for both a deep skid version of a tire, and a shallow skid version of a tire. In an alternative embodiment, a first ring is used for a deep skid version of a tire, and a second ring is used for a shallow skid version of a tire. The ring may be removed from the tire mold for a plain tread version of a tire.

[0055] **Figure 8** illustrates a front view of one embodiment of a replacement ring **800** for a plain tread version of a tire. The replacement ring **800** does not have any projections, but instead has a smooth surface. The ring **800** does not include any apertures for receiving fasteners. Instead, the ring is configured to be held in a desired position by a friction fit or by a clamping action.

[0056] **Figures 9A** and **9B** illustrate a rear view and a side view, respectively, of one embodiment of a lug **900** that may be employed for a plain tread version of a tire. The lug **900** may be referred to as a plain tread lug, a third lug, or an additional replacement lug. However, it should be understood that this designation is merely for convenience. In one embodiment, a tire mold may be initially assembled for a deep skid version of a tire with first lugs **500**. The first lugs **500** may then be removed and replaced with replacement lugs **600** for making a shallow skid version of a tire. Then the replacement lugs **600** may later be removed and replace with additional replacement lugs **900** for making a plain tread version of a tire. In one embodiment, only two additional replacement lugs **900** are employed in the top mold section and another two additional replacement lugs **900** are employed in the bottom mold section. The additional replacement lugs **900** are shorter and thinner than the other lugs. They may be used to produce voids in the tire that serve as tread wear indicators.

[0057] The lug **900** includes a first aperture **905**, a second aperture **910**, and a third aperture **915** for receiving fasteners (not shown). It should be understood, however, that

any number of apertures may be employed in each segment, as may be desired for securely fastening a lug to a mold.

[0058] The lug **900** may be employed as a top lug or a bottom lug. As explained above, the top lugs and the bottom lugs in a tire mold may all be substantially the same. Alternatively, lugs of different shapes and sizes may be employed. For example, in one alternative embodiment, the top mold section includes shallow lugs and the bottom mold section includes deep lugs. In another alternative embodiment, the bottom mold section includes shallow lugs and the top mold section includes deep lugs. In yet another alternative embodiment, each mold section includes a mixture of deep lugs and shallow lugs. In still another alternative embodiment, each mold section includes a mixture of deep lugs, shallow lugs, and plain tread lugs. In yet another alternative embodiment, lugs of different shapes not shown may be employed.

[0059] To the extent that the term "includes" or "including" is used in the specification or the claims, it is intended to be inclusive in a manner similar to the term "comprising" as that term is interpreted when employed as a transitional word in a claim. Furthermore, to the extent that the term "or" is employed (e.g., A or B) it is intended to mean "A or B or both." When the applicants intend to indicate "only A or B but not both" then the term "only A or B but not both" will be employed. Thus, use of the term "or" herein is the inclusive, and not the exclusive use. See, Bryan A. Garner, A Dictionary of Modern Legal Usage 624 (2d. Ed. 1995). Also, to the extent that the terms "in" or "into" are used in the specification or the claims, it is intended to additionally mean "on" or "onto." Furthermore, to the extent the term "connect" is used in the specification or claims, it is intended to mean not only "directly connected to," but also "indirectly connected to" such as connected through another component or components.

[0060] While the present disclosure has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the disclosure, in its broader aspects, is not limited to the specific details, the representative apparatus and method, and illustrative

examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.

CLAIMS

What is claimed is:

1. A tire mold kit comprising:

a bottom mold section having a bottom cavity configured to define a first sidewall of a tire and a first portion of a tread of a tire;

a top mold section having a top cavity configured to define a second sidewall of the tire and a second portion of the tread of the tire;

a top ring having a plurality of projections configured to form voids in the second sidewall of the tire; and

a plurality of void forming members removably attached to the top mold section, wherein the plurality of void forming members retain the top ring in a fixed position against the top mold section.

2. The tire mold kit of claim 1, wherein each of the plurality of projections of the top ring is adjacent one of the plurality of void forming members.

3. The tire mold kit of claim 1, wherein the plurality of void forming members are removably attached to the top mold section by a plurality of bolts.

4. The tire mold kit of claim 1, further comprising a plurality of replacement void forming members having dimensions different from the plurality of void forming members.

5. The tire mold kit of claim 4, wherein the plurality of replacement void forming members are configured to be removably attached to the top mold section after the plurality of void forming members are removed, wherein the plurality of replacement void forming members retain the top ring in a fixed position against the top mold section.

6. The tire mold kit of claim 1, further comprising a bottom ring having a plurality of projections configured to form voids in the first sidewall of the tire, and a plurality of lower void forming members removably attached to the bottom mold section, each of the

plurality of lower void forming members being configured to form a void in at least one of the first sidewall and the first portion of the tread of the tire.

7. The tire mold kit of claim 6, wherein the plurality of lower void forming members retain the bottom ring in a fixed position against the bottom mold section.

8. The tire mold kit of claim 7, further comprising a plurality of replacement lower void forming members having dimensions different from the plurality of lower void forming members.

9. A tire mold comprising:

a bottom mold section having a bottom cavity;

a plurality of bottom lugs removably attached to the bottom mold section;

a bottom ring having a plurality of projections,

wherein the plurality of bottom lugs retain the bottom ring in a fixed position against the bottom mold section, and

wherein each of the plurality of projections of the bottom ring is adjacent one of the plurality of bottom lugs;

a top mold section having a top cavity;

a plurality of top lugs removably attached to the top mold section; and

a top ring having a plurality of projections,

wherein the plurality of top lugs retain the top ring in a fixed position against the top mold section, and

wherein each of the plurality of projections of the top ring is adjacent one of the plurality of top lugs.

10. The tire mold of claim 9, wherein each of the projections of the bottom ring and the adjacent one of the bottom lugs form a continuous surface.

11. The tire mold of claim 9, wherein each of the projections of the top ring and the adjacent one of the top lugs form a continuous surface.

12. The tire mold of claim 9, wherein the plurality of bottom lugs retain the bottom ring by a friction fit, and wherein the plurality of top lugs retain the top ring by a friction fit.

13. The tire mold of claim 9, wherein the bottom ring dovetails to the plurality of bottom lugs, and wherein the top ring dovetails to the plurality of top lugs.

14. The tire mold of claim 9, wherein the bottom mold section includes a bottom annular rib that abuts an inner surface of the bottom ring, and wherein the top mold section includes a top annular rib that abuts an inner surface of the top ring.

15. The tire mold of claim 9, wherein the top mold section is pivotally connected to the bottom mold section.

16. An apparatus for molding a tire, the apparatus comprising:

a first mold section having a first cavity, the first mold section having an annular ridge disposed thereon;

a second mold section having a second cavity;

a plurality of lugs removably attached to the first mold section; and

a ring having a plurality of projections, wherein the plurality of lugs retain the ring in a fixed position against the first mold section about the annular ridge.

17. The apparatus of claim 16, further comprising a second plurality of lugs removably attached to the second mold section.

18. The apparatus of claim 17, further comprising a second ring having a plurality of projections, wherein the second plurality of lugs retain the second ring in a fixed position against the second mold section.

19. The apparatus of claim 16, wherein each of the plurality of lugs includes at least one aperture for receiving a fastener.

20. The apparatus of claim 16, wherein the ring does not have any apertures for receiving fasteners.

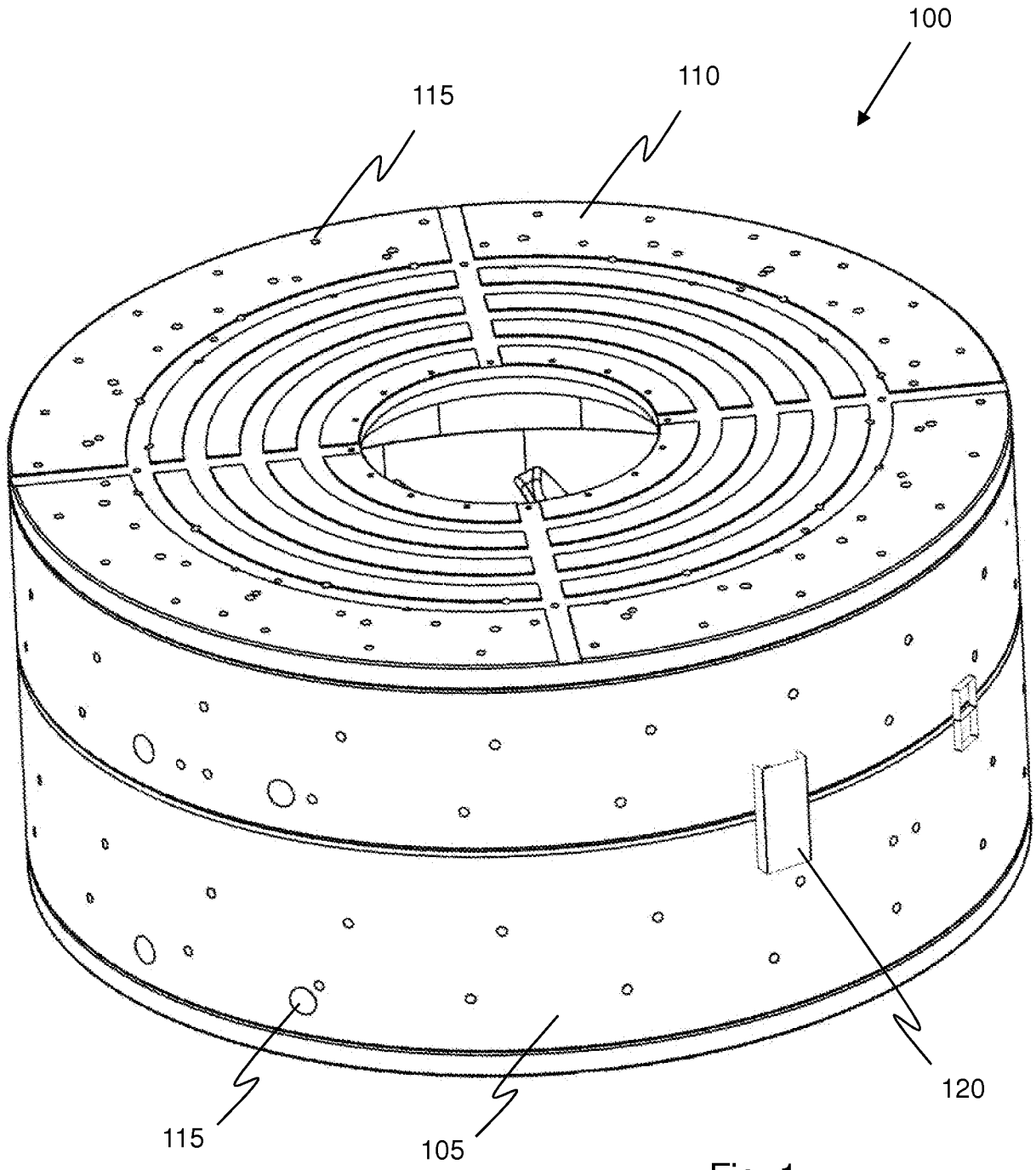

Fig. 1

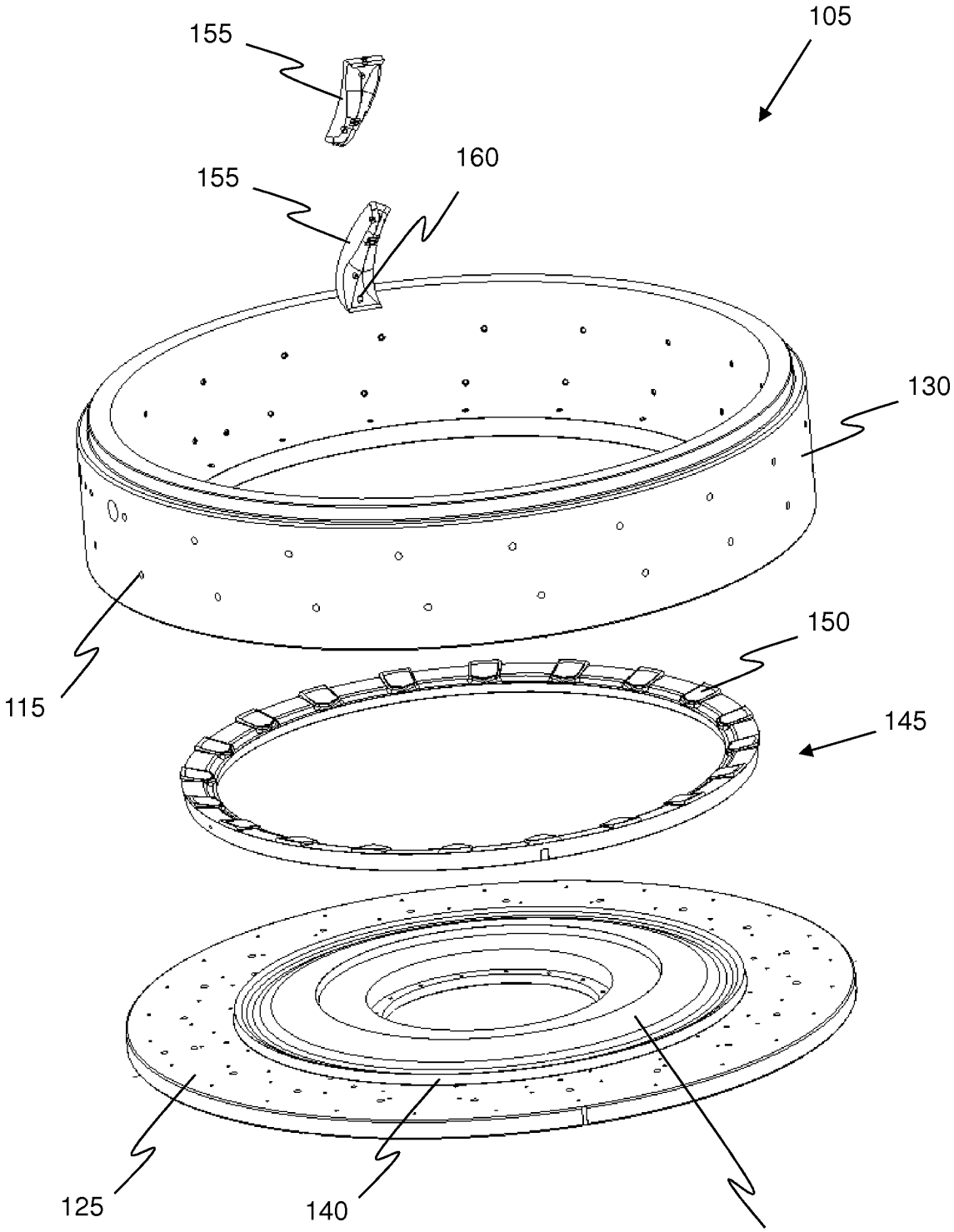

Fig. 2

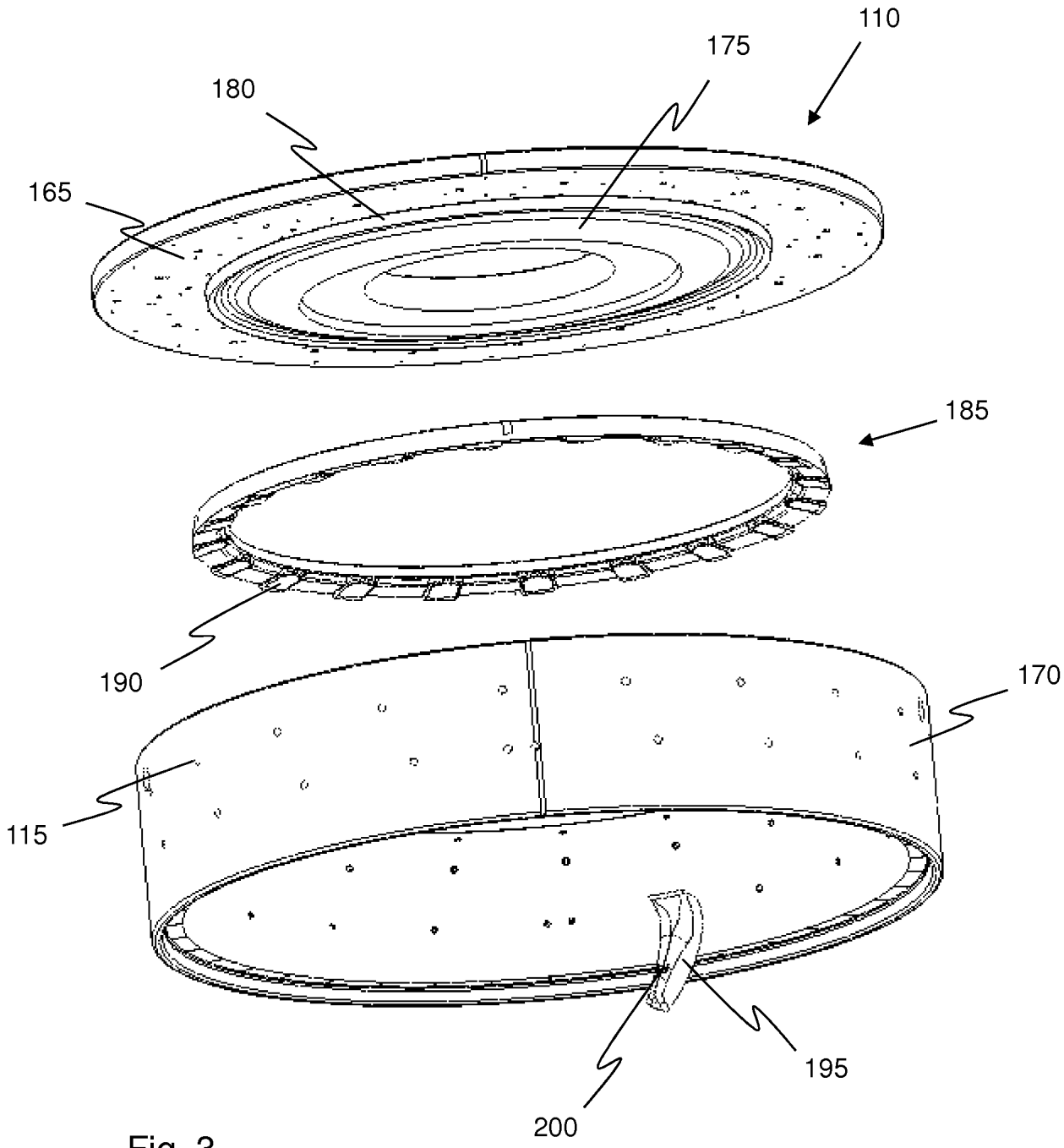

Fig. 3

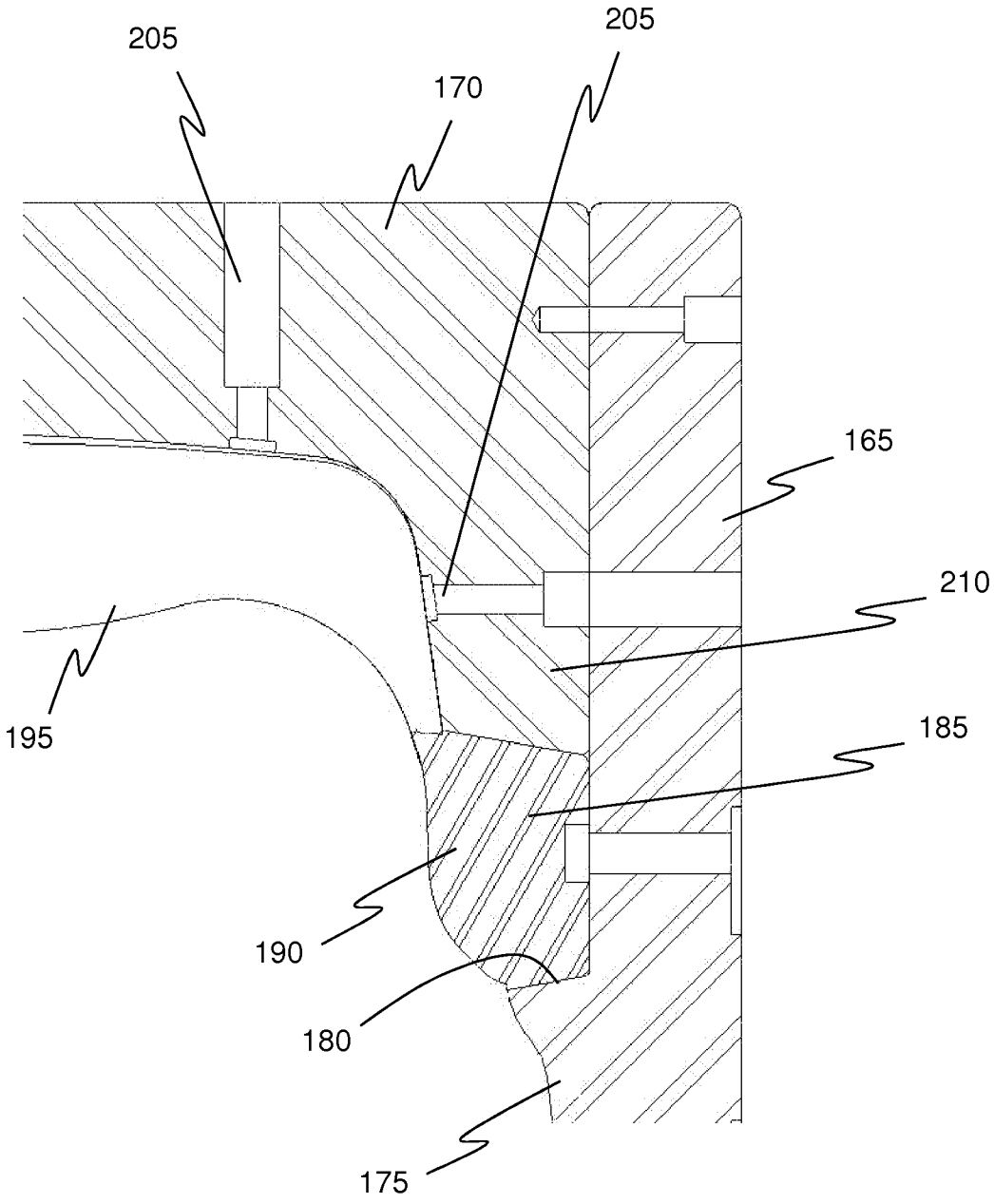

Fig. 4

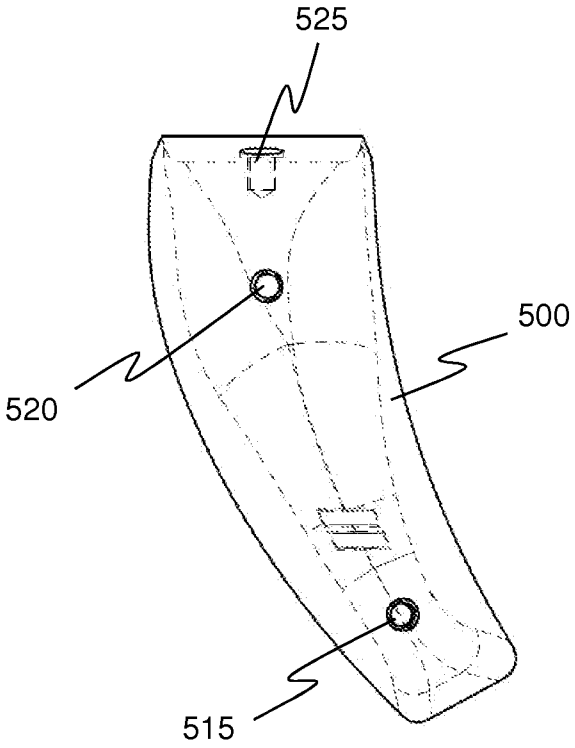

Fig. 5A

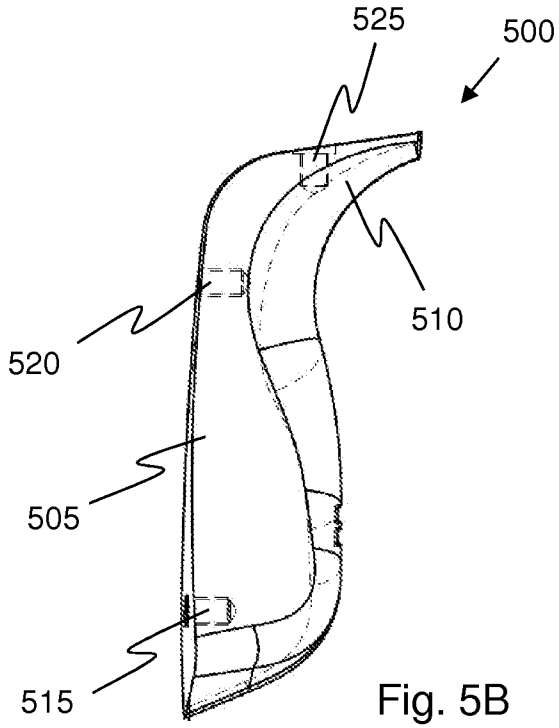

Fig. 5B

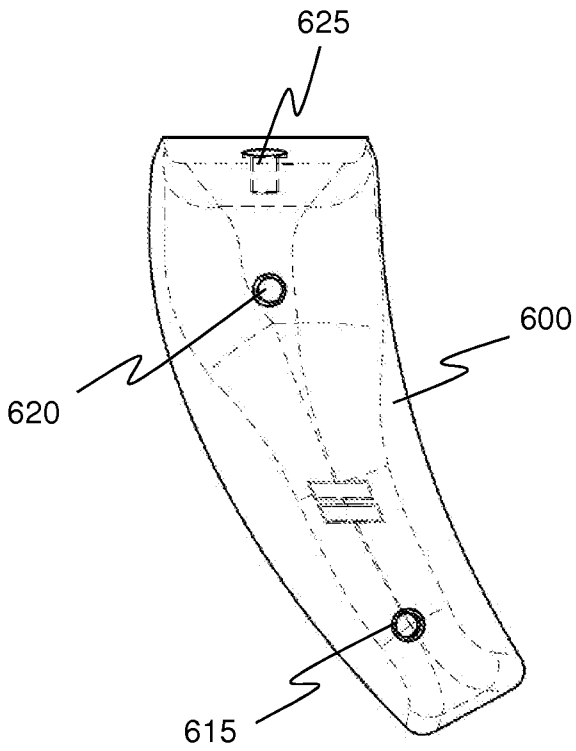

Fig. 6A

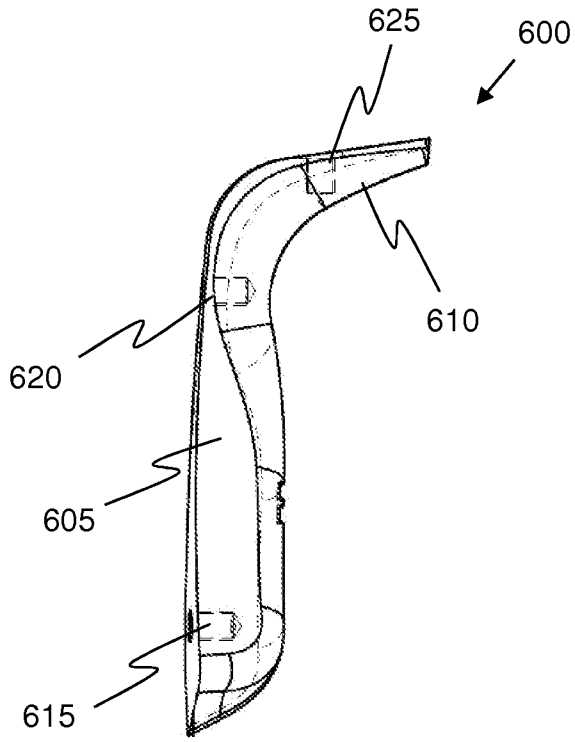

Fig. 6B

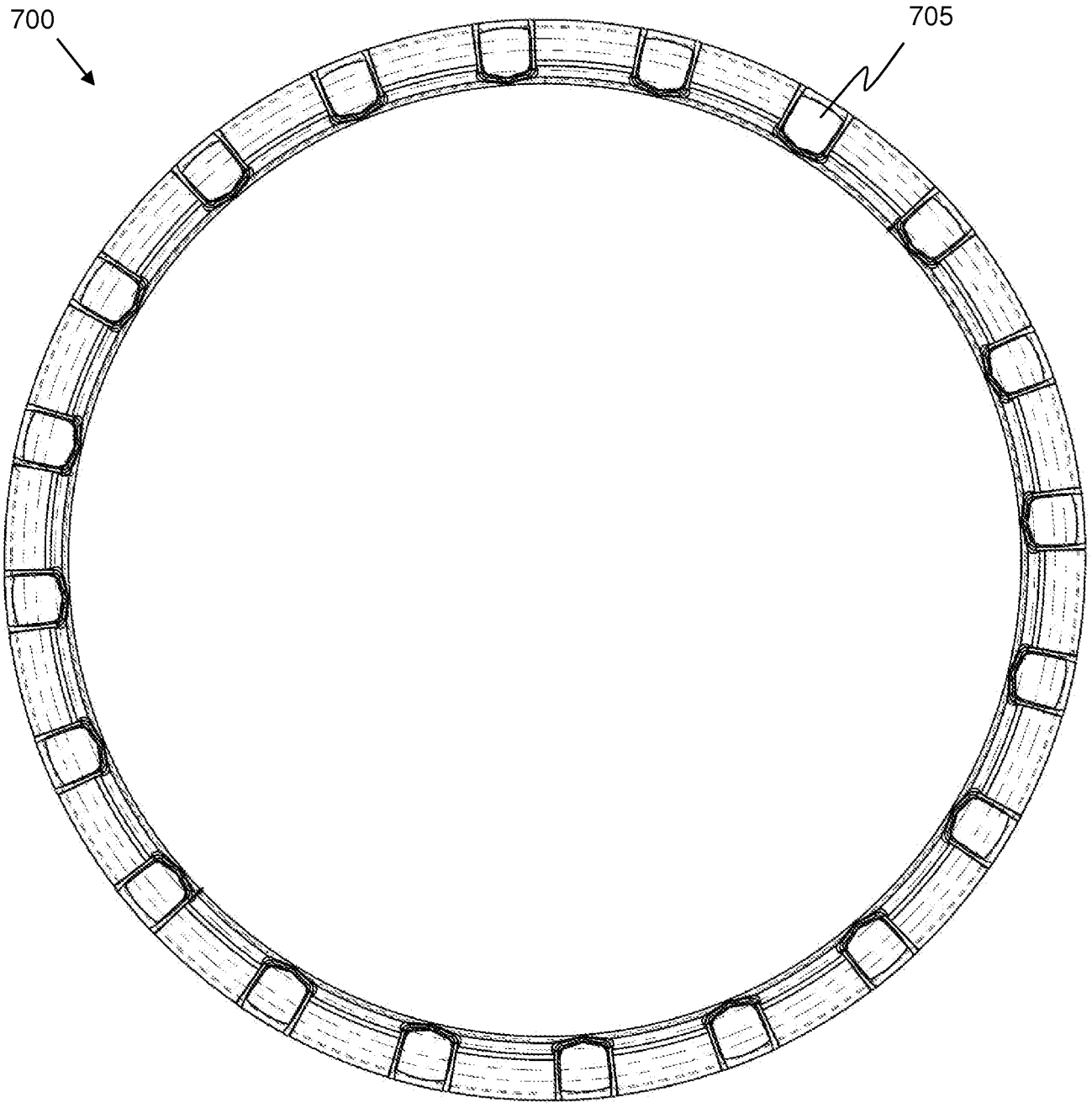

Fig. 7

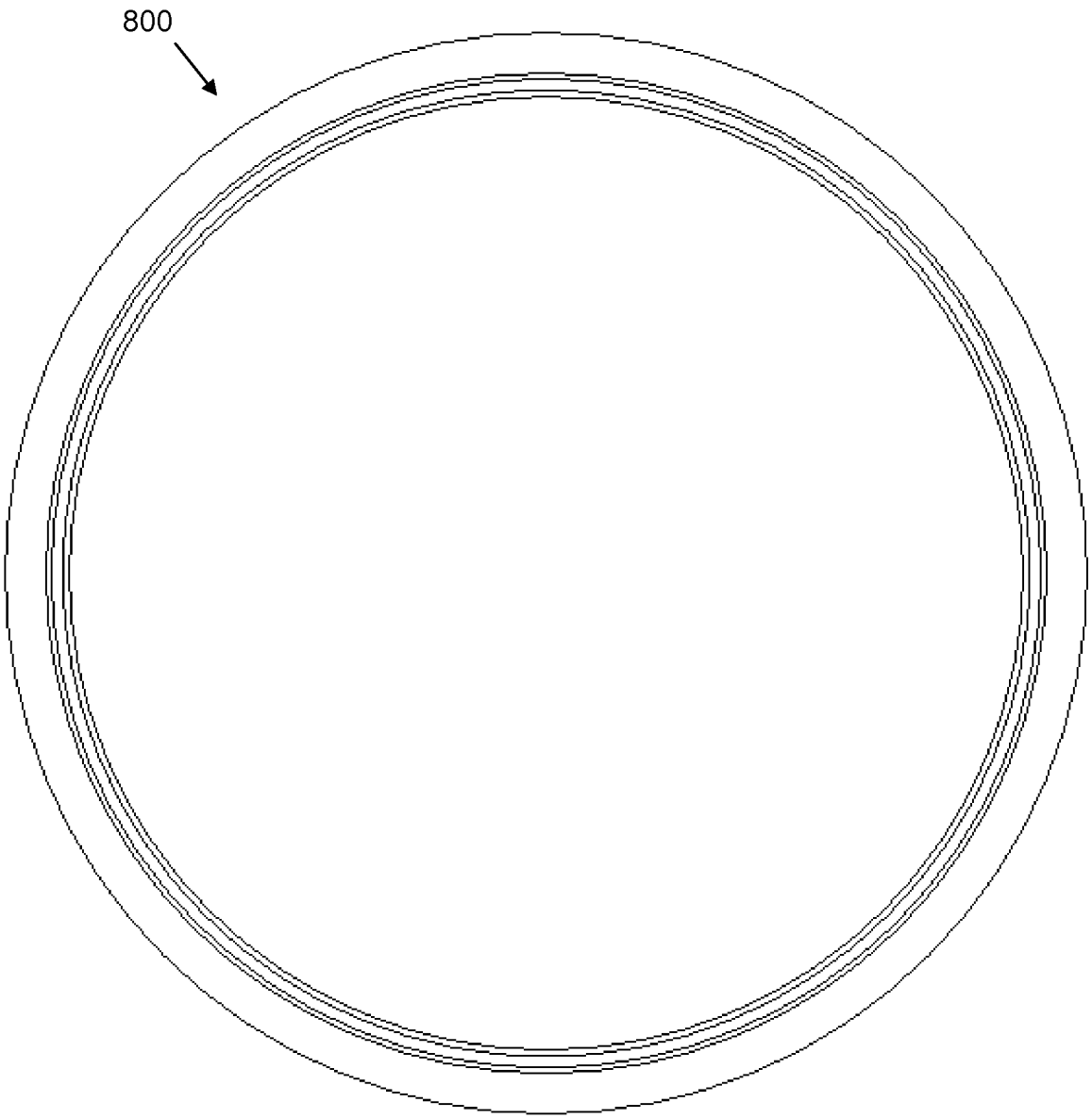

Fig. 8

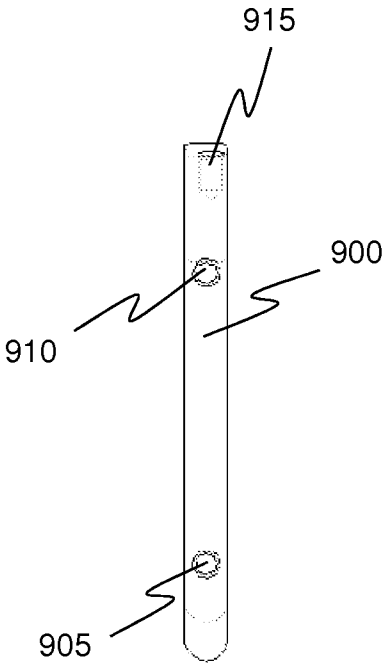

Fig. 9A

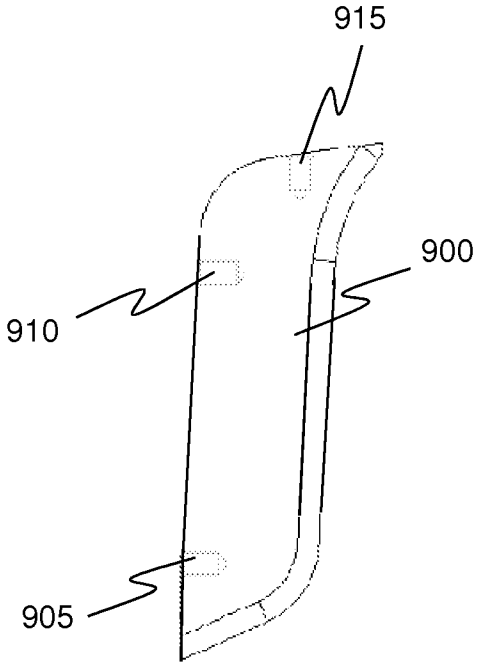

Fig. 9B