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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
06 March 2025 (06.03.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/049414 A1

(51) International Patent Classification:
A43B 13/26 (2006.01) *A43C 15/16* (2006.01)

(21) International Application Number: PCT/US2024/043932

(22) International Filing Date: 26 August 2024 (26.08.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/629,957 28 August 2023 (28.08.2023) US

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(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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, 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, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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,

(54) Title: DYNAMIC SOLE PROTRUSIONS FOR CLEATED FOOTWEAR

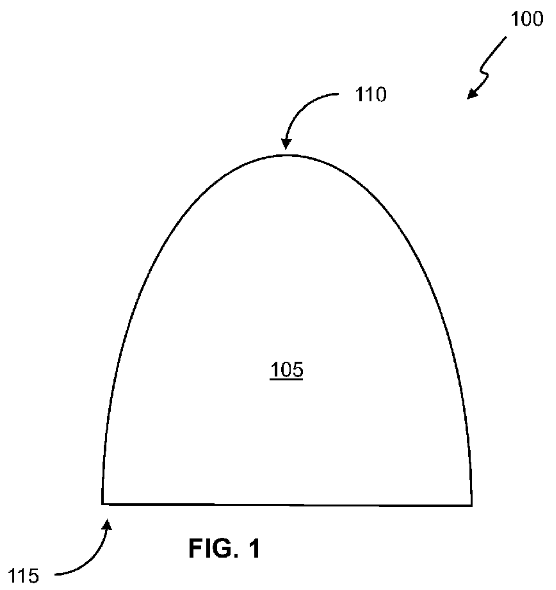

FIG. 1

(57) Abstract: Embodiments of the instant disclosure provide dynamic sole protrusions (DSPs) and shoe soles that contain the same. The shoe sole includes a plurality of DSPs as well as a sole surface having a heel region and a forefoot region. The sole surface includes a first polymeric material. Each DSP includes a second polymeric material, is affixed to and extends from the heel region, as well as is substantially oriented perpendicular to the sole surface. Each DSP longitudinally flexes when a predetermined longitudinal force is applied thereto to thereby allow the heel region to move laterally relative to the forefoot region. Each DSP includes a main body with a parabolic front profile. The DSPs are symmetrically and divaricately positioned relative to a medial line of the heel region. The DSPs are positioned proximate to the medial line. The DSPs are substantially positioned in a V-shape on the sole surface.

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DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, 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).

Declarations under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

DYNAMIC SOLE PROTRUSIONS FOR CLEATED FOOTWEAR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application No. 63/629,957 filed August 28, 2023. The application is hereby incorporated herein by reference.

TECHNICAL FIELD

The instant disclosure relates generally to footwear and specifically to footwear having dynamic sole protrusions.

BACKGROUND ART

Until now, cleats have been hard, inflexible protrusions from a shoe's outsole designed to dig into the dirt and hold a player's foot in place, creating traction to enhance movement on the field. Cleated protrusions, whether they be a cylinder-shaped nub or an elongated triangle, have an inherent design flaw – by anchoring the athlete's foot to the ground, the foot and lower leg become forced into an un-natural position where injury can take place. Adding in a player's weight and acceleration creates a scenario where lower extremity injury, especially to the ligaments of the knee, occurs all too often.

Once a cleated shoe is implanted in the turf, turning becomes more difficult and torque is passed up the lower extremity to the knee, where the Anterior Cruciate Ligament (ACL) and Medial Cruciate Ligament (MCL) undergo extreme forces that can permanently damage the knee. Such injuries can occur in football when a player is hit laterally by another player but are actually more likely to happen without contact, as a result of self-injury. In football and soccer, it is not a physical blow to the knee itself, it is the twisting of the leg, while the foot is anchored to the ground by cleats that results in abnormally high strain on knee ligaments. There exists a need in the art for soles that reduce the likelihood of injury to the user's ACL and/or MCL when attempting to suddenly stop forward momentum and/or twist their leg while the foot is anchored to the ground by cleats.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** depicts a front view of a dynamic sole protrusion (hereinafter "DSP"), in accordance with some embodiments.

FIG. **2** depicts a perspective view of the DSP of FIG. **1**, in accordance with other embodiments.

FIG. **3** depicts a shoe sole, in accordance with certain embodiments.

FIG. **4** illustrates a bottom skeletal view of a foot, in accordance with yet still other embodiments.

FIG. **5** depicts perspective view of the DSP of FIG. **3**, in accordance with some embodiments.

FIG. **6** depicts a side view of the shoe sole of FIG. **3**, in accordance with other embodiments.

FIG. 7 depicts bottom view of a heel region of a shoe sole, in accordance with certain embodiments.

FIG. **8** depicts a perspective view of perspective of a segment of the heel region of FIG. 7, in accordance with yet still other embodiments.

FIG. **9** depicts a bottom view of a heel region of a sole surface, in accordance with some embodiments.

FIG. **10** depicts a side perspective view of the heel region of FIG. **9**, in accordance with other embodiments.

FIG. **11** depicts a perspective view of a heel region of a sole surface, in accordance with certain embodiments.

FIG. **12** depicts a top perspective view of the heel region of FIG. **11**, in accordance with yet still other embodiments.

FIG. **13** depicts a bottom perspective view of a DSP, in accordance with some embodiments.

FIG. **14** depicts a front view of the DSP of FIG. **13**, in accordance with other embodiments.

FIG. **15** depicts a top perspective view of a heel region of a sole surface, in accordance with certain embodiments.

DISCLOSURE OF INVENTION

The descriptions of the various embodiments of the instant disclosure have been presented for purposes of illustration but are not intended to be exhaustive or limited to the embodiments disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the described embodiments. The terminology used herein was chosen to best explain the principles of the embodiments, the practical application or technical improvement over technologies found in the marketplace, or to enable others of ordinary skill in the art to understand the embodiments disclosed herein.

Certain terminology may be employed in the following description for convenience rather than for any limiting purpose. For example, the terms “forward” and “rearward,” “front” and “rear,” “right” and “left,” “upper” and “lower,” and “top” and “bottom” designate directions in the drawings to which reference is made, with the terms “inward,” “inner,” “interior,” or “inboard” and “outward,” “outer,” “exterior,” or “outboard” referring, respectively, to directions toward and away from the center of the referenced element, the terms “radial” or “horizontal” and “axial” or “vertical” referring, respectively, to directions or planes which are perpendicular, in the case of radial or horizontal, or parallel, in the case of axial or vertical, to the longitudinal central axis of the referenced element, the terms “proximate” and “distal” referring, respectively, to positions or locations that are close or away from a point of reference, the terms “downstream” and “upstream” referring, respectively, to directions in and opposite that of fluid flow, the term “axis” referring to a line or to a transverse plane through such line as will be apparent from context, the term “sole protrusion” referring to a projection that is affixed to the sole to prevent slipping, the indefinite articles “a” and “an” designating “one,” “one or more,” or “at least one,” the term “flex” designating a pivoting or bending motion, and the term “about” designating ± 5% of the associated value. Terminology of similar import other than the words specifically mentioned above likewise is to be considered as being used for purposes of convenience rather than in any limiting sense.

In the figures, elements having an alphanumeric designation may be referenced herein collectively or in the alternative, as will be apparent from context, by the numeric portion of the designation only. Further, the constituent parts of various elements in the figures may be designated with separate designations which shall be understood to refer to that constituent part of the element and not the element as a whole. General references, along with references to spaces, surfaces, dimensions, and extents, may be designated with arrows. Angles may be designated as “included” as measured relative to surfaces or axes of an element and as defining a space bounded internally within such element therebetween, or otherwise without such designation as being measured relative to surfaces or axes of an element and as defining a space bounded externally by or outside of such element therebetween.

Generally, the measures of the angles stated are as determined relative to a common axis, which axis may be transposed in the figures for purposes of convenience in projecting the vertex of an angle defined between the axis and a surface which otherwise does not extend to the axis.

Until now, cleats have been hard, inflexible protrusions from a shoe's outsole designed to dig into the dirt and hold a player's foot in place, creating traction to enhance movement on the field. Cleated protrusions, whether they be a cylinder-shaped nub or an elongated triangle, have an inherent design flaw – by anchoring the athlete's foot to the ground, the foot and lower leg become forced into an un-natural position where injury can take place. Adding in a player's weight and acceleration creates a scenario where lower extremity injury, especially to the ligaments of the knee, occurs all too often.

Once a cleated shoe is implanted in the turf, turning becomes more difficult and torque is passed up the lower extremity to the knee, where the Anterior Cruciate Ligament (ACL) and Medial Cruciate Ligament (MCL) undergo extreme forces that can permanently damage the knee. Such injuries can occur in football when a player is hit laterally by another player but are actually more likely to happen without contact, as a result of self-injury. In football and soccer, it is not a physical blow to the knee itself, it is the twisting of the leg, while the foot is anchored to the ground by cleats that results in abnormally high strain on knee ligaments. There exists a need in the art for soles that reduce the likelihood of injury to the user's ACL and/or MCL when attempting to suddenly stop forward momentum and/or twist their leg while the foot is anchored to the ground by cleats.

Embodiments of the instant disclosure seek to provide flexible protrusions (hereinafter "dynamic sole protrusions" or "DSPs") for cleated footwear and shoe soles that incorporate such DSPs. DSPs are configured to provide a moderate anchoring and traction quality to prevent the user from slipping, which thereby allows the user to stop, pivot and backpedal. Other aspects of the instant disclosure seek to provide dynamic sole protrusions that are configured to bend and flex when the wearer plants their heels to come to stop. Such flexibility can lessen the resulting strain and stress experienced by the ACL when compared to standard fixed cleats known in the art, which transfer a higher degree of force onto the ACL when it becomes firmly anchored into the turf for a stop.

Not to be limited by theory, by employing a thin, disc-shaped design as opposed to a standard cleated nub, the sole of the footwear is not locked onto the ground by the DSP but can pivot or "skate" laterally by several millimeters. Thus, the pivot motion can reduce the tortional stress experienced by the various ligaments of the knee. The instant disclosure further seeks to provide shoe soles that include a cleated turntable in the forefoot region and DSPs in the heel region. Additional aspects of the instant disclosure seek to prove dynamic sole protrusions that can be configured to be thin and provide reduced resistance to a lateral hit (i.e., a sudden lateral force) compared to traditional fixed cleats known in the art.

Referring now to the FIGS. To begin, DSPs of the instant disclosure are preferably made of a polymeric material (e.g., elastomeric material) that allows each DSP to longitudinally flex when a predetermined longitudinal force (see Force A and Force B of FIG. **2**) is applied thereto. DSPs of the instant disclosure include a main body, apex, and base as well as share one or more features, characteristics, method of manufacture, and materials with each other. DSPs can be formed via a plurality of manufacturing processes, including, but limited to, molding, additive manufacturing, as well as stamping. DSPs are preferably configured in a manner to unflex (i.e., regain about 95% of its original position) within about .7 seconds once the longitudinal force is removed For example, some DSPs (e.g., a DSP **100**) includes a main body (e.g., a main body **105**) that has a parabolic front profile. Each main body includes a base (e.g., base **115**) positioned opposite an apex (e.g., apex **110**). Each base has either a rectangular cross-section (see FIG. **2**) or an ovular cross-section (see FIG. **13**). To be sure, when the base is ovular, the base is thicker than the apex.

As depicted in FIG. **3**, applicable shoe soles (e.g., a shoe sole **300**) of the instant disclosure have a heel region (e.g., heel region **320**) and a forefoot region (e.g., forefoot region **315**). In preferred embodiments, the shoe sole is made of a first polymeric material (or blends thereof) and the DSPs are made of a second polymeric material (or blends thereof). However, in certain embodiments, the shoe sole and DSP can be made of the same polymeric material (or blends thereof). Applicable polymeric materials can include, but are not limited to, thermosets, thermoplastics, rubbers (natural and/or synthetic), elastomers, polybutadiene, chloroprene rubbers, styrene-butadiene rubbers, nitrile rubbers, EPM rubbers, EPDM rubbers, ACM, ABR, silicones, polyether block amides, TPE, polysulfide rubbers, elastolefins, as well as similar polymers with viscoelasticity (i.e. both viscosity and elasticity) and with weak intermolecular forces, generally low Young's modulus (E) and high failure strain compared with other materials.

The heel region **320** includes a DSP area **325** that includes a plurality of DSPs (e.g., DSP **326**, DSP **327**, DSP **328**, and DSP **329**) affixed to and extending from the heel region **320**. Preferably, the plurality of DSPs are each substantially oriented perpendicular (e.g., extend normal) to the sole surface **305**). As shown in FIG. **3**, the plurality of DSPs are symmetrically and divaricately positioned relative to a medial line **310** of the heel region **320**. In preferred embodiments, the plurality of DSPs are positioned proximate to the medial line **310**.

The "V-shaped" placement of the DSP **326**, the DSP **327**, the DSP **328**, and the DSP **329** is significant because their placement and orientation mimics the position of the medial longitudinal arch and the lateral longitudinal arch of the foot (see FIG. **4**). As such, the placement and orientation of the DSP **326**, the DSP **327**, the DSP **328**, and the DSP **329** is deliberately canted at an oblique angle between 20°-35° from the medial line **310**. The "V-shaped" placement of the DSP **326**, the DSP **327**, the DSP **328**, and the DSP **329** allows the heel region **320** to move laterally relative to the forefoot region **315**. This lateral movement further benefits the user with sufficient traction for starts, stops and cutting moves at sharp angles. In addition, the canted angle allows for a lateral "skating" movement, independent of contact with another player. Preferably, the DSP **326**, the DSP **327**, the DSP **328**, and/or the DSP **329** can depress up to a 45° angle (relative to the sole surface) when it receives a longitudinal force of about 5.2 PSI or less, and up to a 46°-90° angle (relative to the sole surface) when it receives a longitudinal force of about 5.4-24.3 PSI.

In other embodiments, the shoe sole **300** further includes a rotating cleat assembly **330**. The rotating cleat assembly **330** is a cleated turntable that is rotatably coupled to the forefoot region **315** in a manner that allows independent rotation of the rotating cleat assembly **330** relative to the sole surface **305**. The rotating cleat assembly **330** includes one or more cleat protrusions **335** that extends normal to the sole surface **305**. The cleat protrusions **335** are preferably peripherally positioned on the rotating cleat assembly **330**. The rotating cleat assembly **330** can be formed via a plurality of manufacturing processes, including, but not limited to, molding, additive manufacturing, as well as stamping. The rotating cleat assembly **330** can be formed using a polymeric material (e.g., polypropylene, polyethylene, polyvinyl chloride, polystyrene, polyethylene terephthalate polycarbonate, similar plastics, as well as two or more thereof). In certain embodiments, applicable polymeric materials have a hardness shore of at least about 88-90 A, tensile strength of at least 9 MPa, Young's modulus of at least 85 MPa, elongation at break of at least 280%, and rebound resilience of at least 63%. For example, applicable rotating cleating assemblies include, but are not limited to, the rotary cleat system disclosed in U.S. Patent Serial No. 11,388,947 B1 (issued to July 19, 2022, to Barnes) that allows the heel to rotate on a radius that originates at the forefoot (i.e., the center or origin). The patent is incorporated by reference herein in its entirety.

In certain embodiments, the dynamic sole protrusions are configured to be utilized with other forefoot cleating systems. As a result of not locking the player's foot to the ground, the DSP **326**, the DSP **327**, the DSP **328**, and the DSP **329** operate in conjunction with the rotating cleat assembly **330** to create a critical "disengagement space" of several centimeters in which the foot can slide, move or rotate and respond to forces placed upon it during foot strike, thereby lessening strain and torquing forces that are transferred up the extremity to the knee.

FIG. 7 depicts bottom view of a heel region, generally **720**, of a shoe sole (e.g., the shoe sole **300**), in accordance with certain embodiments. Here, the sole surface **705** includes DSPs that present a high amount of resistive surface area to counteract lateral forces. The heel region **720** include a plurality of DSPs **725**, which include a first pair of DSPs (e.g., DSP **726a** and DSP **729b**) oriented parallel to a medial line **710** of the heel region and a second pair of DSPs (e.g., DSP **727a** and DSP **727b**) positioned between the first pair of DSPs and oriented perpendicular to the medial line. The second pair of DSPs include a first DSP (e.g., the DSP **727a**) and a second DSP (e.g., the DSP **727b**) that are oriented parallel to each other. The second DSP includes a second main body, which has a side **731** and a wedge **730** that extends from and along the side **731** (e.g., towards the rear of the heel region **720**). The wedge **730** has a triangular side profile and is positioned above the sole surface **705** and contacts the sole surface **705** when the second DSP longitudinally flexes (e.g., 20°-40°) rearward. In other words, the wedge **730** halts further flexing of the second DSP when it contacts the sole surface **705**. In other words, the DSP **727b** has predefined flexibility provided by the wedge **730**.

The DSP **727b**, the DSP **726a**, and the DSP **726b** each preferably have an ovular base and a parabolic side profile. The DSP **727b**, which is the widest DSP, can have a width of about 45-55 mm, a height of about 15-23 mm, and a thickness of about 3-8 mm. The DSP **727a** is a supplementary, lower, and thinner protrusion designed to implant and flex after the DSP **727a** contacts the turf to thereby provide a secondary braking solution to the player. The DSP **727a** is thinner (e.g., a width of about 30-40 mm), shorter (e.g., a height of about 10-18 mm), and leaner (e.g., a thickness of about 2-6 mm) than the DSP **727b**. The DSP **727a** can have a parabolic side profile, rectangular base, and uniform thickness.

The DSP **726a** and the DSP **726b** each have a parabolic side profile and ovular base as well as the ability to present a curved interface to the turf/surface when a front, back, or lateral force is applied to the sole surface **705**. The DSP **726a** and the DSP **726b** are flexible structures purposed to provide traction when a user "cuts" (i.e., changes direction suddenly) but are thin and flexible enough to bend and "give" when high-speed turning movements are performed, again absorbing some of the forces that occur when lateral movement or a sideways blow occur. For example, the DSP **726a** and the DSP **726b** are engineered to bend/pivot/flex at up to about 40°-50° (relative to the sole surface **705**) when a lateral force is applied thereto and implant between about 40%-70% of their total depth into the ground/turf/surface. Unlike traditional studs and/or cleats, the DSP **726a** and the DSP **726b** are positioned at least about 8-14 mm from the periphery of the sole surface **705** to increase the safety of the shoe sole **705**.

Turning now to FIGS. **9** and **10**. Here, a sole surface **905** includes DSPs that present a low amount of resistive surface area to counteract lateral forces. The sole surface **905** includes a plurality of DSPs **925** (e.g., a DSP **926a**, a DSP **926b**, a DSP **927**, and a DSP **928**) each oriented perpendicular to and symmetrically positioned about a medial line **910** of the heel region **920** in a manner to be substantially positioned in an a "V-shape" relative to the medial line **910**. In preferred embodiments, the DSP **926a**, the DSP **926b**, the DSP **927**, and the DSP **928** each have a parabolic side profile and rectangular base. The DSP **927** is symmetrically positioned relative to the medial line **910** and has the greatest thickness of the structures. The DSP **928** is also symmetrically positioned relative to the medial line **910** and is posteriorly positioned about 0.5-2.5 mm from the DSP **927**. The DSP **926a** and the DSP **926b** are anteriorly positioned at least about 5 mm from the DSP **927** opposite the DSP **928**.

The DSP **926a** and the DSP **926b** are preferably positioned at least about 2.5 mm from each other and symmetrically positioned on opposite sides of the medial line **910**. The DSP **927** is preferably the thickest, tallest, and widest DSP structure and configured to provide the most surface resistance. The DSP **928** is the second thickest DSP structure while the DSP **926a** and the DSP **926b** are the thinnest DSP structures. In general, these DSP structures can have a length of about 15-40mm, width of about 2.5-5.5mm, and height of about 8-20mm.

Referring now to FIGS. **11-12**. Sole surface **1105** includes a DSP **1110** and a wedge **1115** each symmetrically positioned along a medial line **1135** of the sole surface **1105**. The DSP **1110** includes a main body **1111**, a base **1125**, and an apex **1130**. The base **1135** preferably has a rectangular cross section. The DSP **1110** includes a semi-circular shaped depression **1115** that extends from the apex **1130** towards the base **1125**. The wedge **1115** anteriorly extends from the main body **1111** and is coupled to the sole surface **1105**. The wedge **1115** is symmetrically positioned proximate to the depression **1115**. The main body **1111** preferably has a width of about 4-8 mm, length of about 40-60 mm, and height of about 10-20 mm. The wedge **1320** preferably has a length and width of about 15-25 mm as well as a height of about 6 mm. The wedge **1115** extends from and/or is coupled to the main body **1111** proximate to the base **1125**. Both the wedge **1115** and the base **1125** are coupled to the sole surface **1105**. The wedge **1320** can have a base angle of about 10°-20°.

Referring now to FIGS. **13** and **14**, which each depict a DSP **1300**. The DSP **1300** includes a main body **1305** and a wedge **1320** symmetrically coupled thereto. The main body **1305** includes a base **1310** and an apex **1315** positioned oppositely thereto. The DSP **1300** couples to a sole surface via the base **1310**. The base **1310** has an ovular cross section and the apex **1315** is tapered, which allows the main body **1305** to laterally compress or bend to a greater extent than if the main body **1305** had a uniform thickness. The base **1310** can have a length of about 52-72 mm, width of about 2-8 mm, and height of about 12-20 mm. The wedge **1320** is configured to anteriorly extend from the main body **1305** and couple to a sole surface. The wedge **1320** has a triangular side profile with a notch **1320** positioned in it adjacent side. The wedge **1320** is symmetrically coupled to the main body **1305** proximate to the base **1310** in a manner that allows the main body **1305** to sit in the notch **1320**.

FIG. **15** depicts a top perspective view of a heel region, generally **1520**, of a sole surface, generally **1505**, in accordance with certain embodiments. The heel region **1520** includes a DSP **1510** symmetrically and orthogonally positioned to the medial line of the heel region **1520**. In this manner, the DSP **1510** extends along the width of the heel region **1520**. The DSP **1510** includes a main body **1515**, and an apex **1530** oppositely positioned to a base **1525**. The DSP **1510** has a semi-circular profile. The main body **1530** includes a conclave ovular depression (e.g., conclave ovular depression **1535** and conclave ovular depression **1540**) positioned on each side of the main body **1530**. The conclave ovular depressions are symmetrically positioned on the main body **1530**. The concave ovular depressions initiate at the apex **1530** and extend down towards the base **1525**. To further aid in the flexibility of the DSP **1510**, the concave ovular depressions preferably extend along at least 50% of the width of the main body **1515**.

The conclave ovular depressions preferably further extend towards each other. The width of the apex **1530** is lesser than that of the base **1525** (i.e., the base **1525** is wider than the apex **1530**. In other words, the width of the main body **1515** increases when progressing from the apex **1530** towards the base **1525**. The base **1525** preferably has a substantially rectangular cross-sectional shape. The base **1525** can have a length of about 52-72 mm and a width of about 4-10 mm. The conclave ovular depressions allow the DSP **1510** to exhibit the greatest amount of flexibility proximate to the medial line of the main body **1515** and the least amount of flexibility at the periphery (i.e., lateral sides) of the main body **1515**. For example, the DSP **1510** can depress up to about a 45° angle (relative to the sole surface) when it receives a longitudinal force of about 19.3 PSI or less, and up to a 46°-90° angle (relative to the sole surface) when it receives a longitudinal force of about 24.4-32.3 PSI.

Based on the foregoing, dynamic sole protrusions and soles incorporating the same have been disclosed in accordance with the instant disclosure. However, numerous modifications and substitutions can be made without deviating from the scope of the instant disclosure. Therefore, the instant disclosure has been disclosed by way of example and not limitation.

CLAIMS

What is claimed is:

1. A shoe sole, comprising:

a plurality of dynamic sole protrusions (DSPs);

a sole surface having a heel region and a forefoot region;

wherein

the sole surface comprises a first polymeric material;

each DSP

comprises a second polymeric material;

is affixed to and extends from the heel region;

is substantially oriented perpendicular to the sole surface; and

longitudinally flexes when a predetermined longitudinal force is applied thereto to thereby allow the heel region to move laterally relative to the forefoot region.

2. The shoe sole of claim 1, wherein

each DSP comprises a main body; and

the main body comprises a parabolic front profile.

3. The shoe sole of claim 2, wherein

the DSPs are symmetrically and divaricately positioned relative to a medial line of the heel region.

4. The shoe sole of claim 3, wherein

the DSPs are positioned proximate to the medial line.

5. The shoe sole of claim 4, wherein

the DSPs are substantially positioned in a V-shape on the sole surface.

6. The shoe sole of claim 2, wherein

the main body comprises a base positioned opposite an apex;

the base comprises

rectangular cross-section; or

ovular cross-section; and

when the base comprises the ovular cross-section, the base is thicker than the apex.

7. The shoe sole of claim 6, wherein

the DSPs comprise:

a first pair of DSPs oriented parallel to a medial line of the heel region; and

a second pair of DSPs positioned between the first pair of DSPs and oriented perpendicular to the medial line.

8. The shoe sole of claim 6, wherein

the second pair of DSPs comprise a first DSP and a second DSP that are oriented parallel to each other;

the second DSP comprises a second main body comprises a side and a wedge that extends from and along the side;

the wedge

comprises a triangular side profile; and

is positioned above the sole surface and contacts the sole surface when the second DSP longitudinally flexes.

9. The shoe sole of claim 6, wherein

the DSPs are

each oriented perpendicular to a medial line of the heel region;

symmetrically positioned about the medial line; and

substantially positioned in an a V-shape relative to the medial line.

10. The shoe sole of claim 6, wherein

at least one DSP comprises a wedge;

the wedge

extends from and/or along the main body; and

is coupled to the sole surface.

11. The shoe sole of claim 10, wherein

at least one DSP comprises a semi-circular shaped depression that extends from the apex towards the base; and the wedge is positioned proximate to the depression.

12. The shoe sole of claim 6, wherein

at least one DSP comprises concave ovular depressions oppositely positioned on the main body; and

the depressions extend from the apex towards the base.

13. A shoe sole, comprising:

a plurality of dynamic sole protrusions (DSPs);

a sole surface having a heel region and a forefoot region;

a rotating cleat assembly;

wherein

the rotating cleat assembly

is rotatably coupled to the forefoot region in a manner that allows independent rotation of the rotating cleat assembly relative to the sole surface;

comprises a cleat protrusion that extends normal to the sole surface;

the sole surface comprises a first polymeric material;

each DSP

comprises a second polymeric material;

is affixed to and extends from the heel region;

is substantially oriented perpendicular to the sole surface; and

longitudinally flexes when a predetermined longitudinal force is applied thereto to thereby allow the heel region to move laterally relative to the forefoot region.

14. The shoe sole of claim 13, wherein

each DSP comprises a main body; and

the main body comprises a parabolic front profile

15. The shoe sole of claim 14, wherein

the main body comprises a base positioned opposite an apex;

the base comprises

rectangular cross-section; or

ovular cross-section.

when the base is comprises an ovular cross-section, the base is thicker than the apex

16. The shoe sole of claim 15, wherein

the DSPs are symmetrically and divaricately positioned relative to a medial line of the heel region in a manner to form a V-shape.

17. The shoe sole of claim 15, wherein

the DSPs comprise:

a first pair of DSPs oriented parallel to a medial line of the heel region;

a second pair of DSPs;

positioned between the first pair of DSPs and oriented perpendicular to the medial line;

the second pair of DSPs comprise a first DSP and a second DSP that are oriented parallel to each other;

the second DSP comprises a second main body comprises a side and a wedge that extends from and along the side;

the wedge

comprises a triangular side profile; and

is positioned above the sole surface and contacts the sole surface when the reinforced DSP longitudinally flexes

18. The shoe sole of claim 15, wherein

the DSPs are

each oriented perpendicular to a medial line of the heel region;

symmetrically positioned about the medial line; and

substantially positioned in an a V-shape relative to the medial line

19. The shoe sole of claim 15, wherein

at least one DSP comprises at least one of:

a wedge;

a semi-circular shaped depression that extends from the apex towards the base;

the wedge

is positioned proximate to the depression when present;

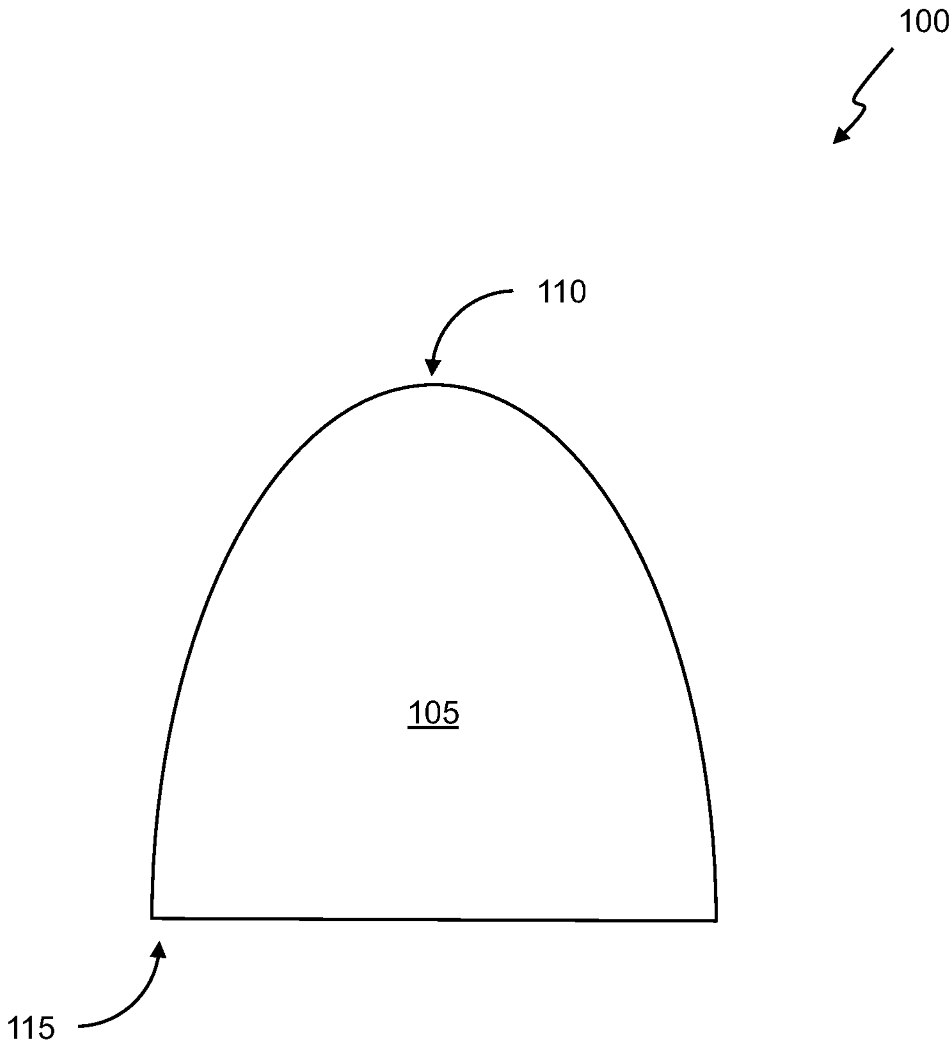
extends from and along the main body; and

is coupled to the sole surface.

20. The shoe sole of claim 6, wherein

at least one DSP comprises concave ovular depressions oppositely positioned on the main body; and

the depressions extend from the apex towards the base.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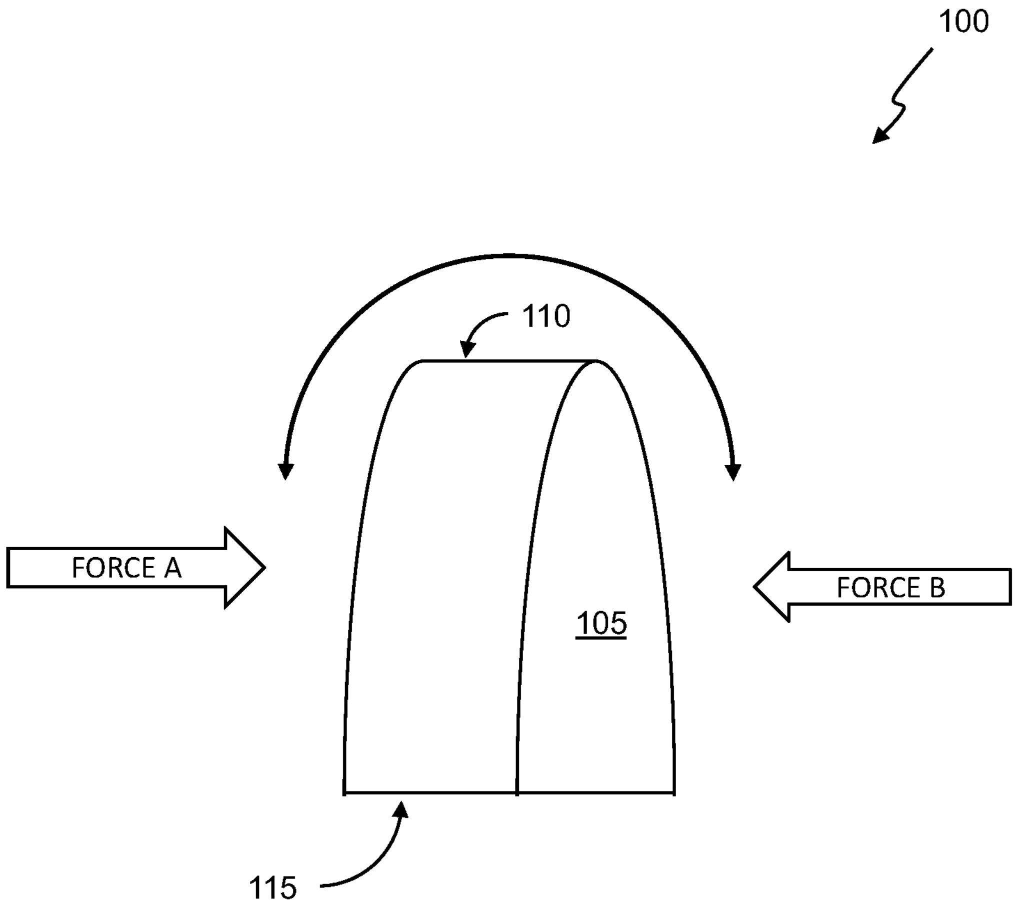
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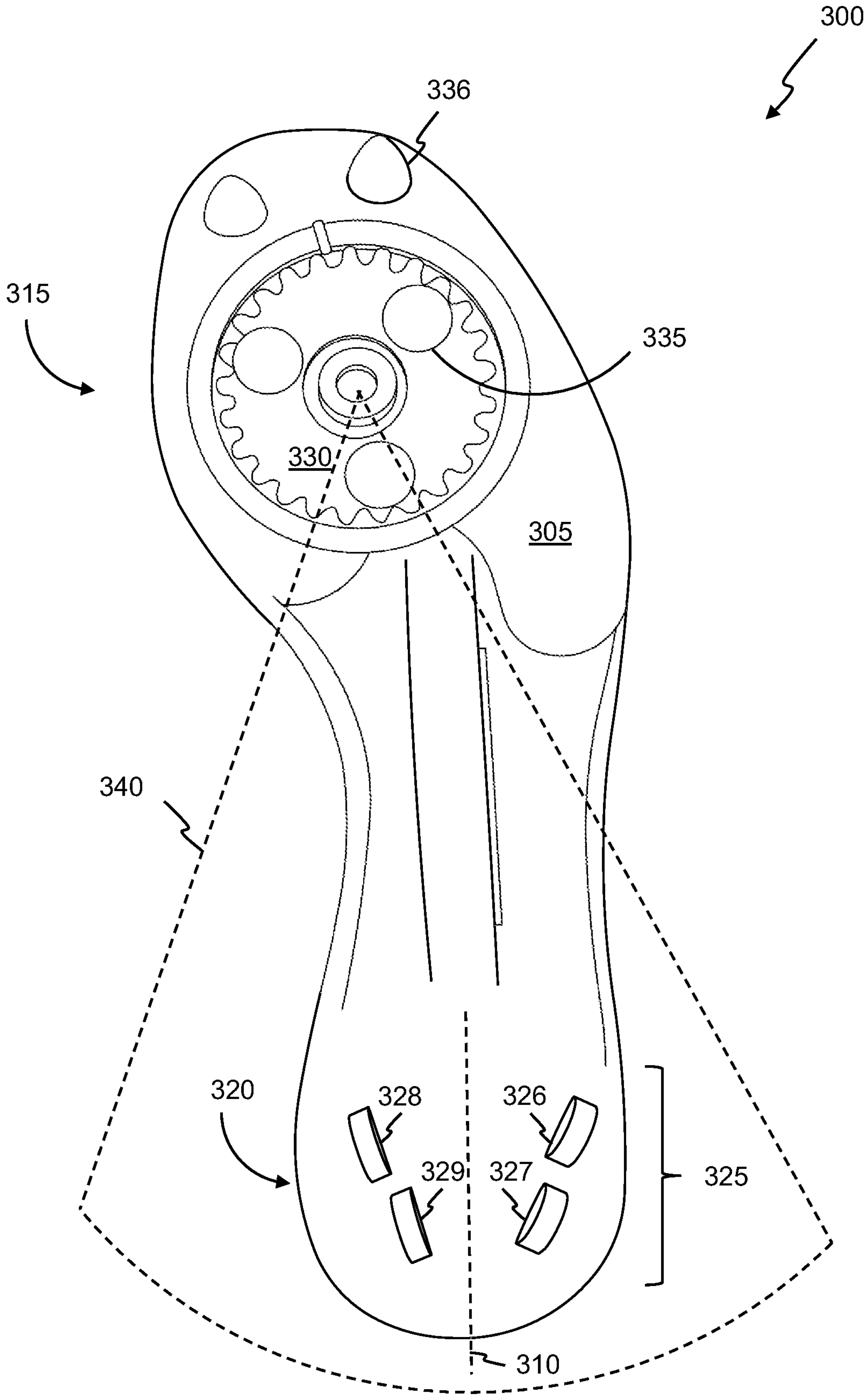
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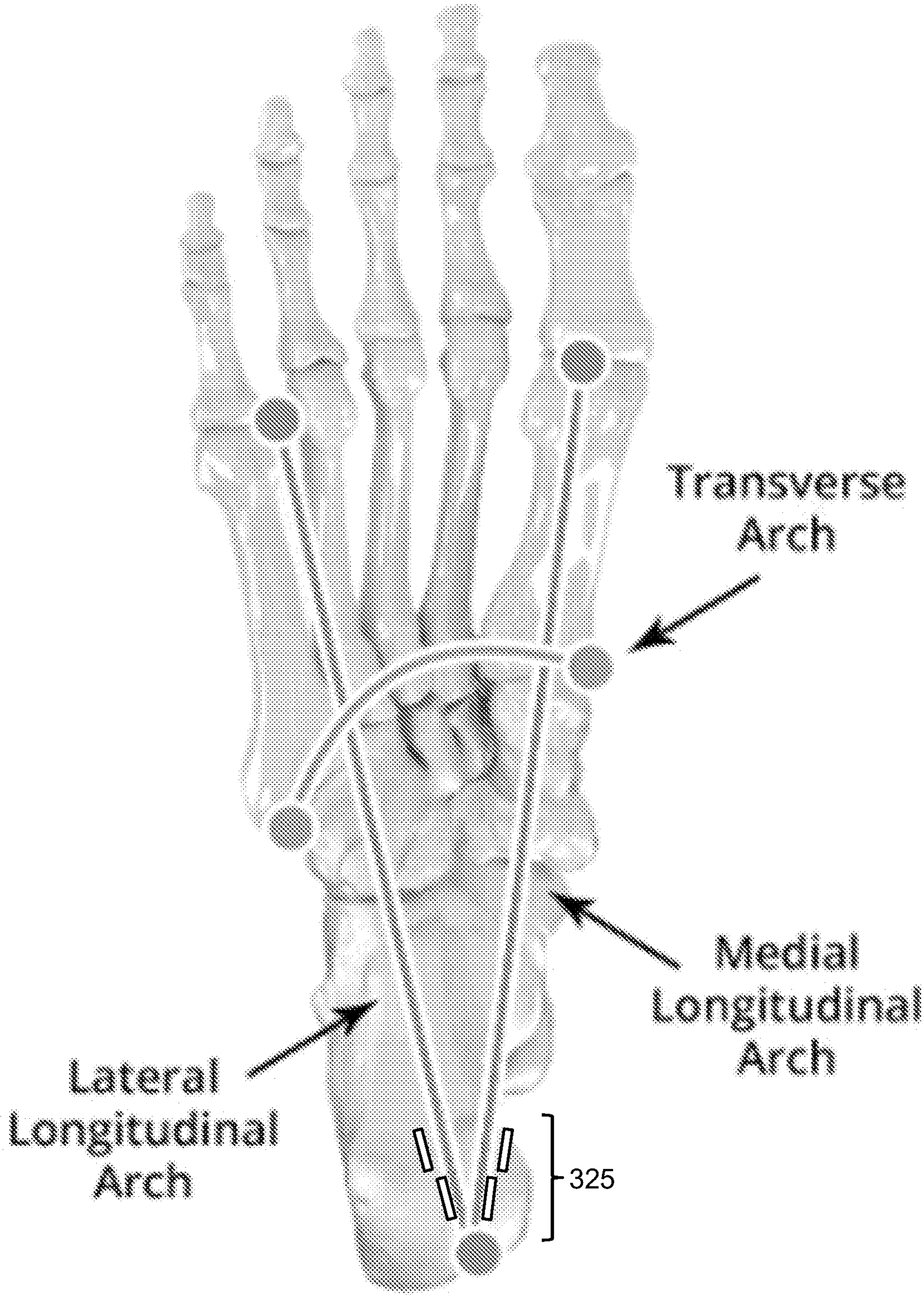
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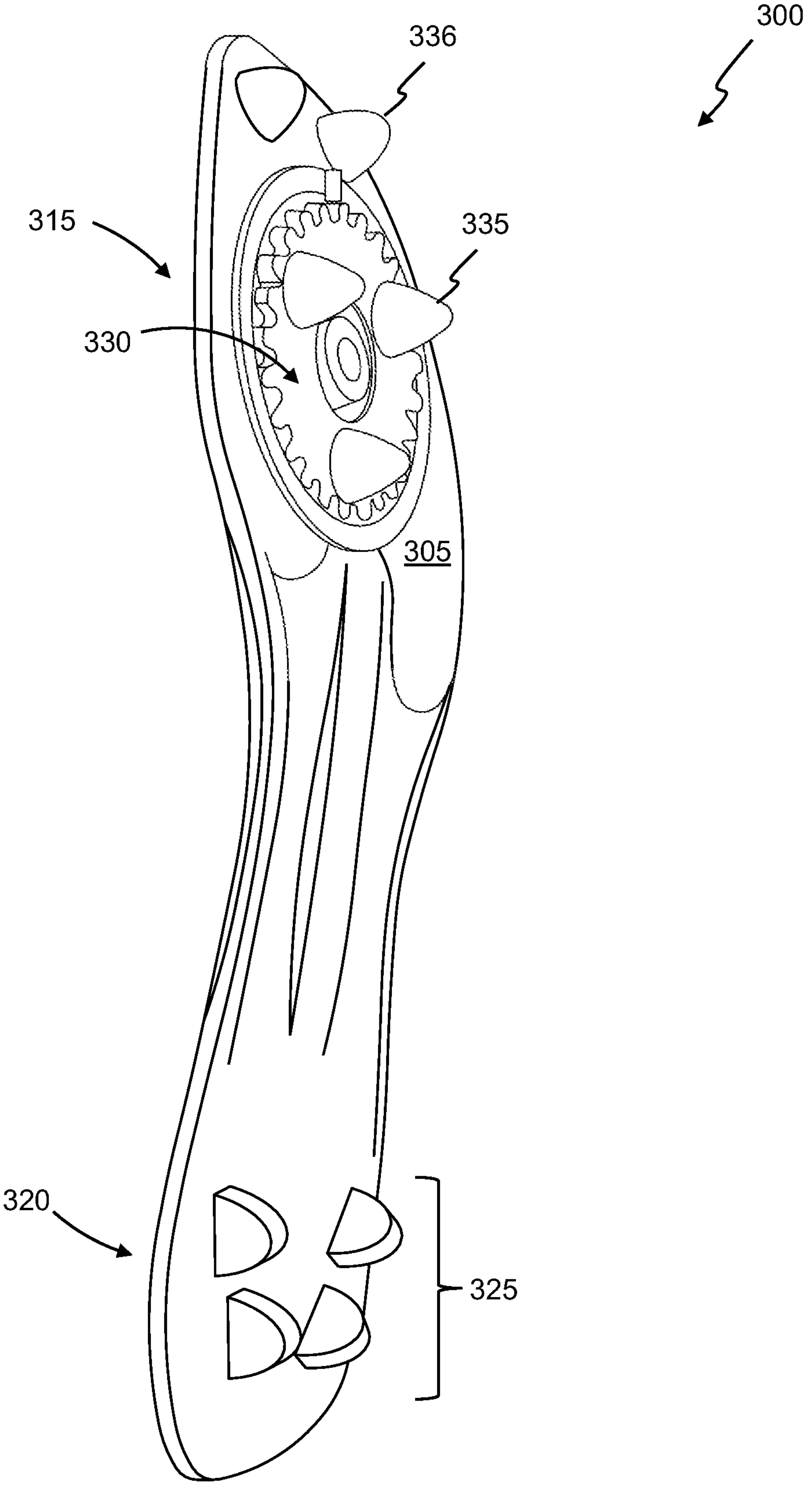
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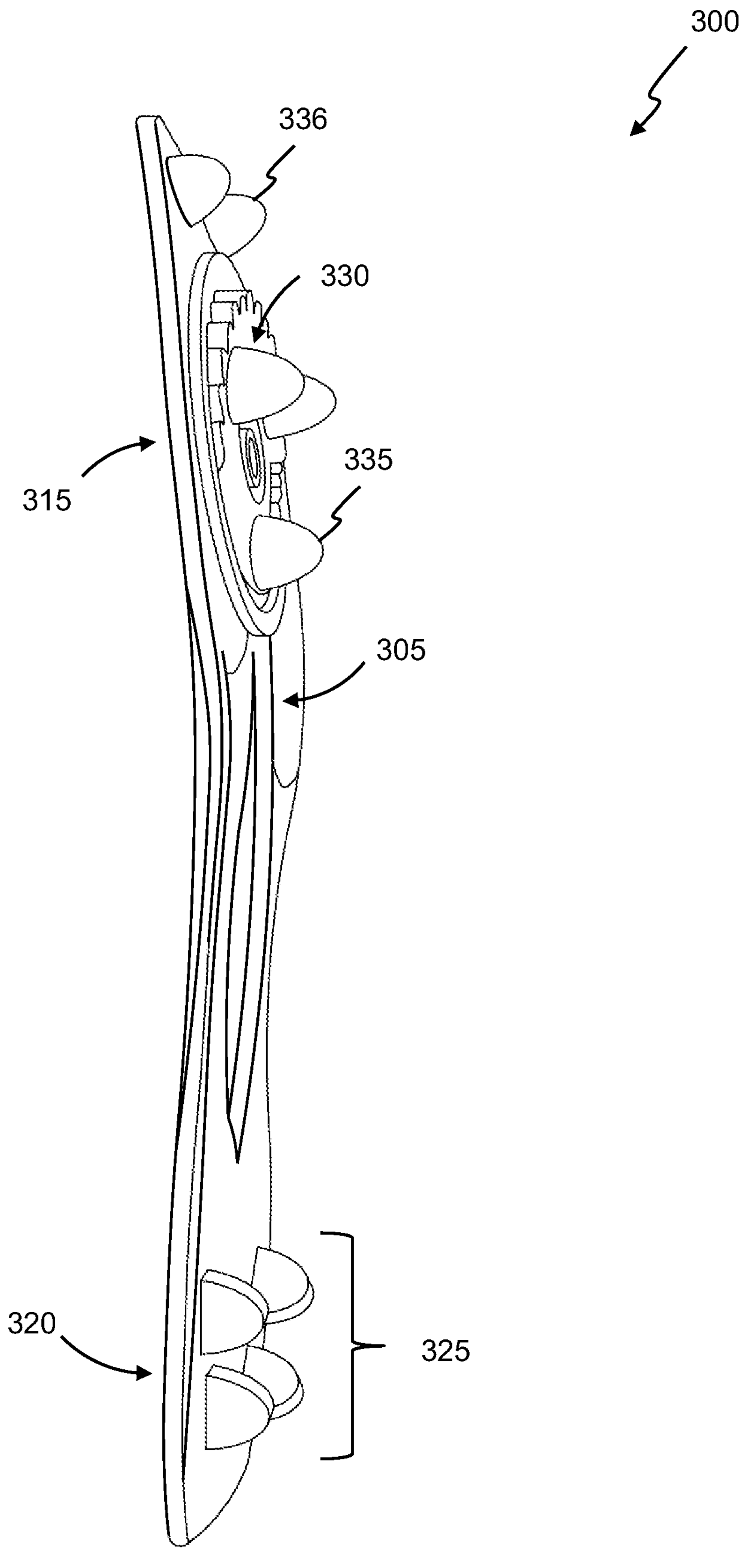
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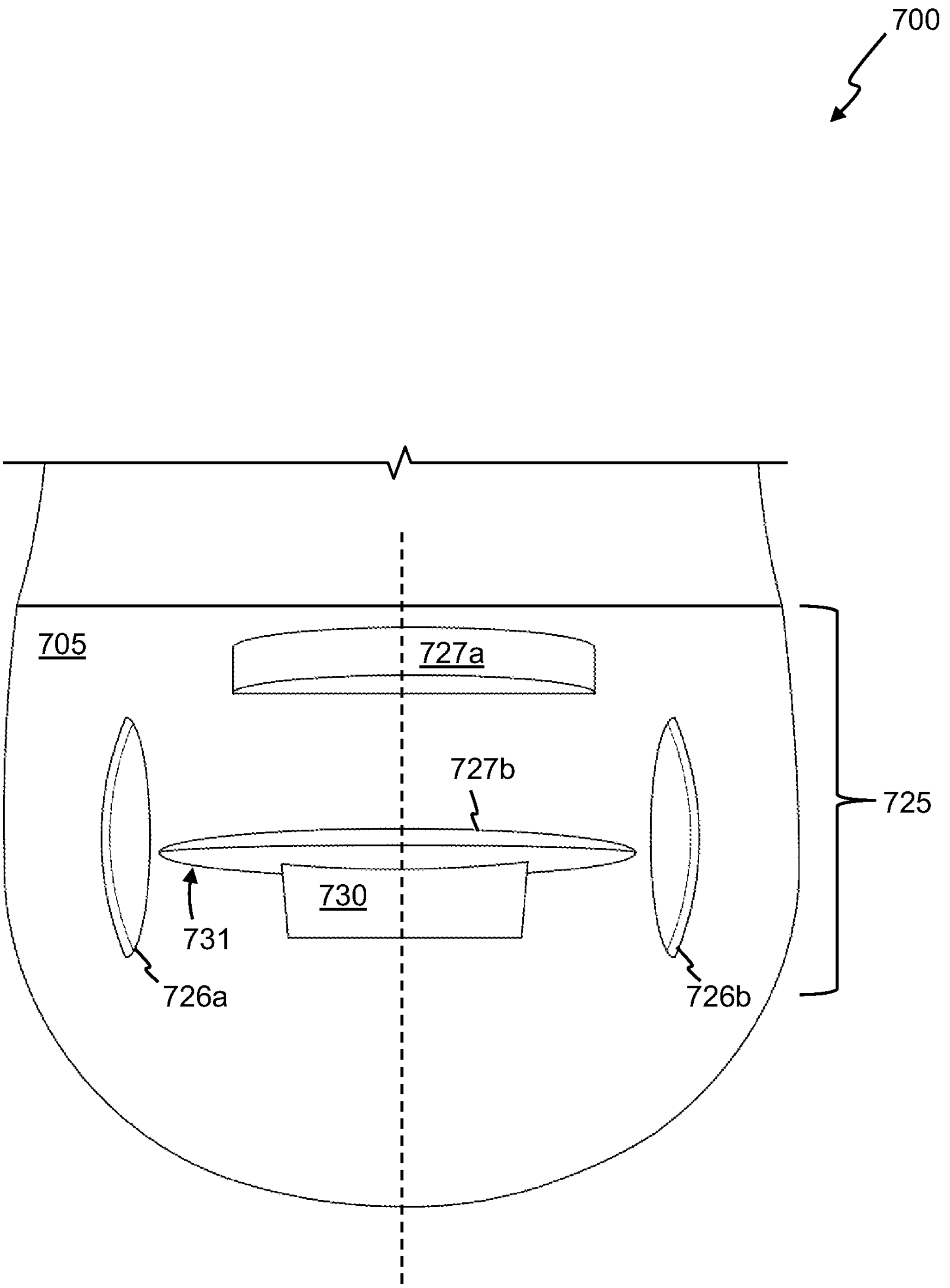
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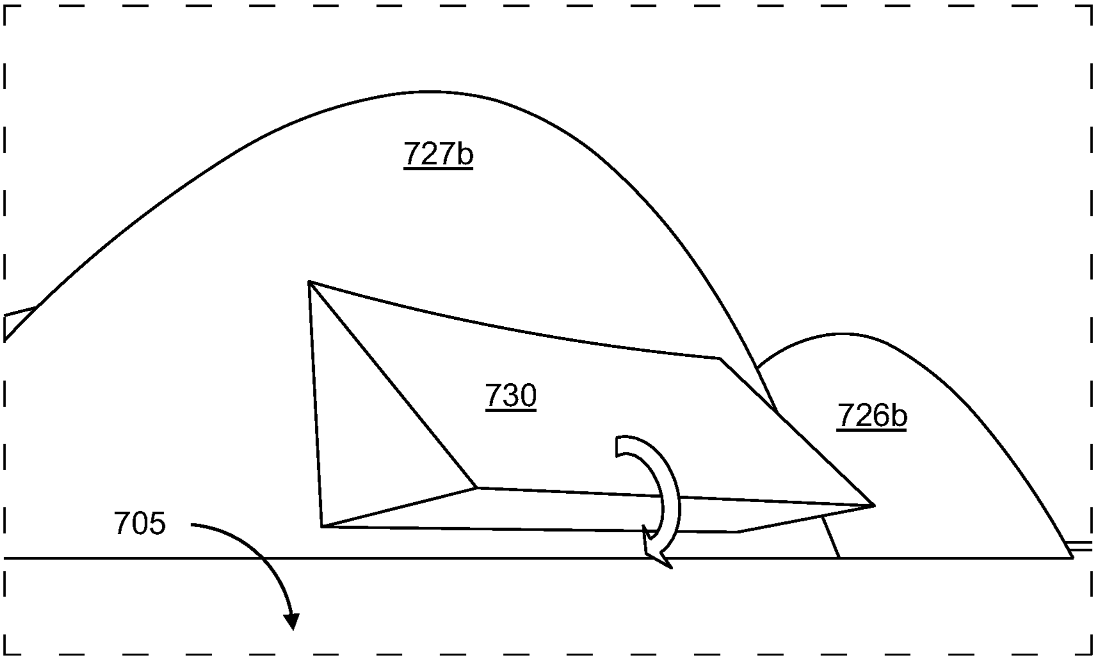
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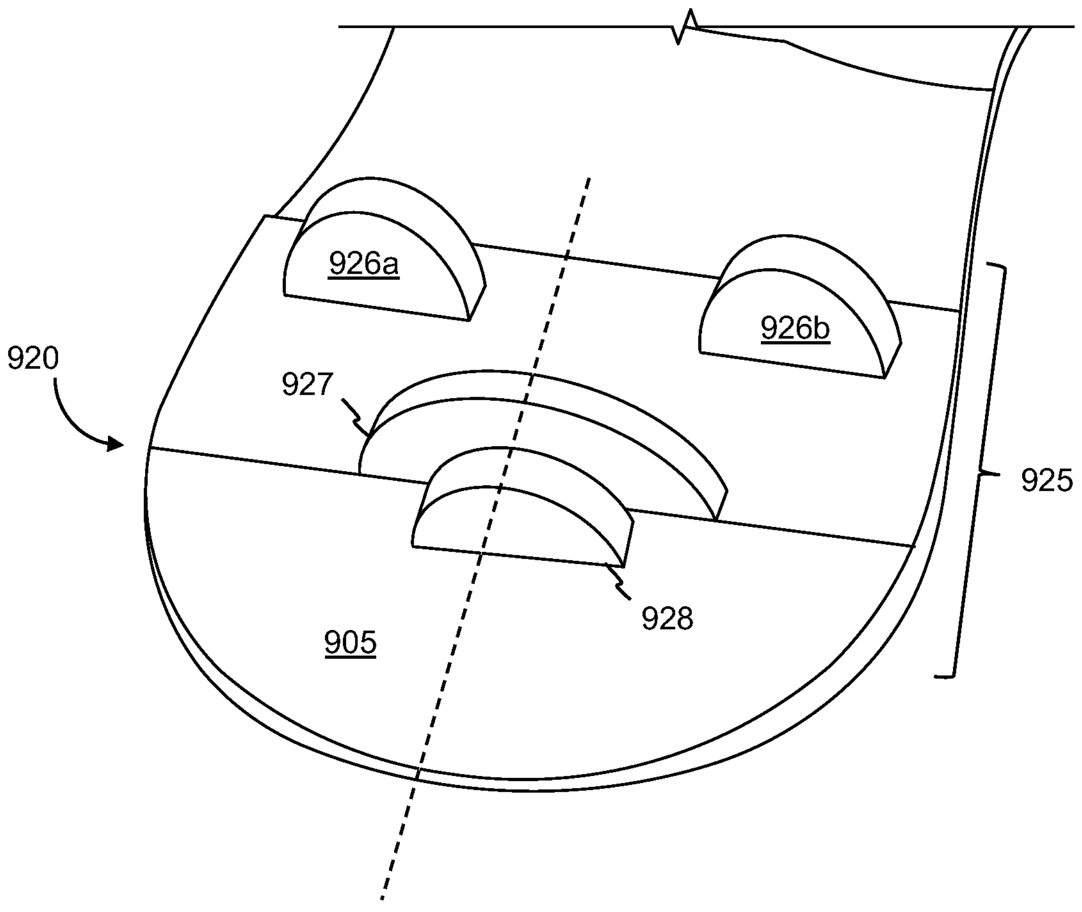
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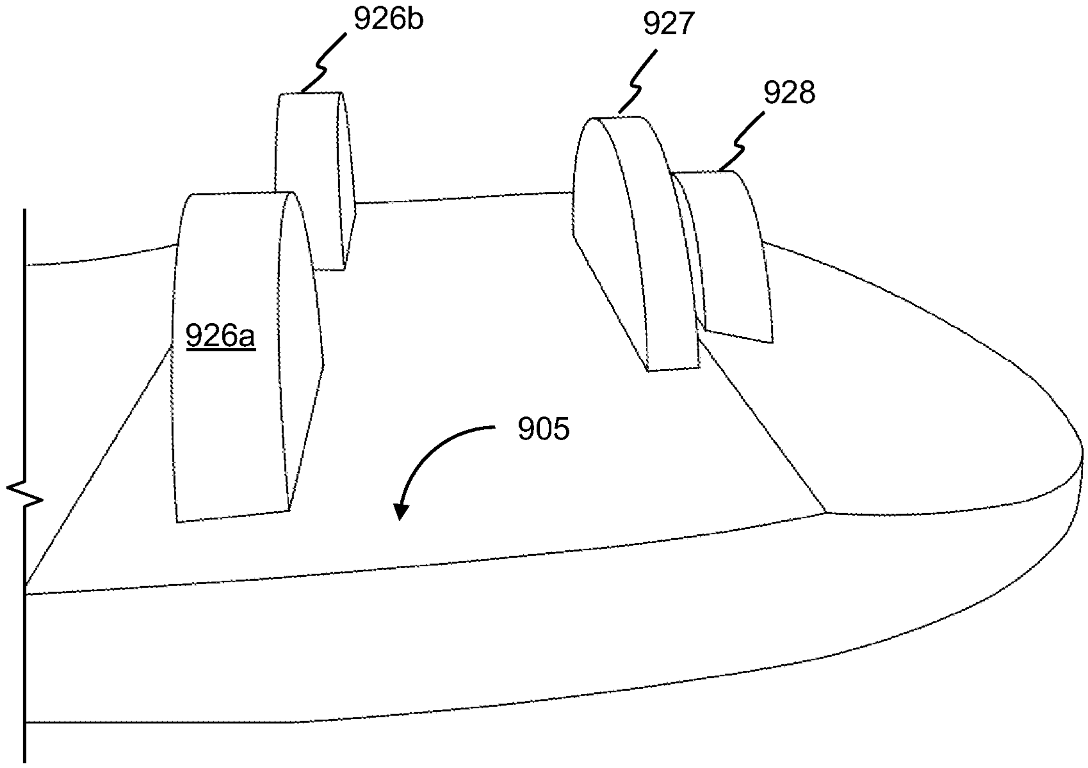
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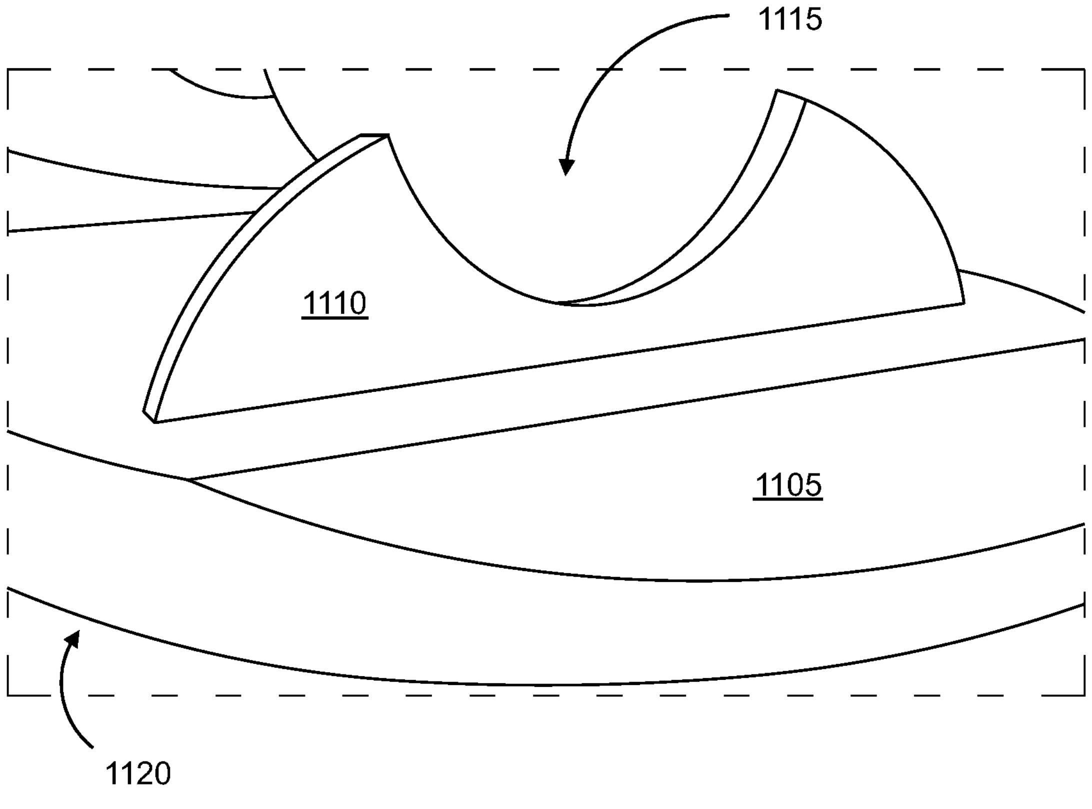
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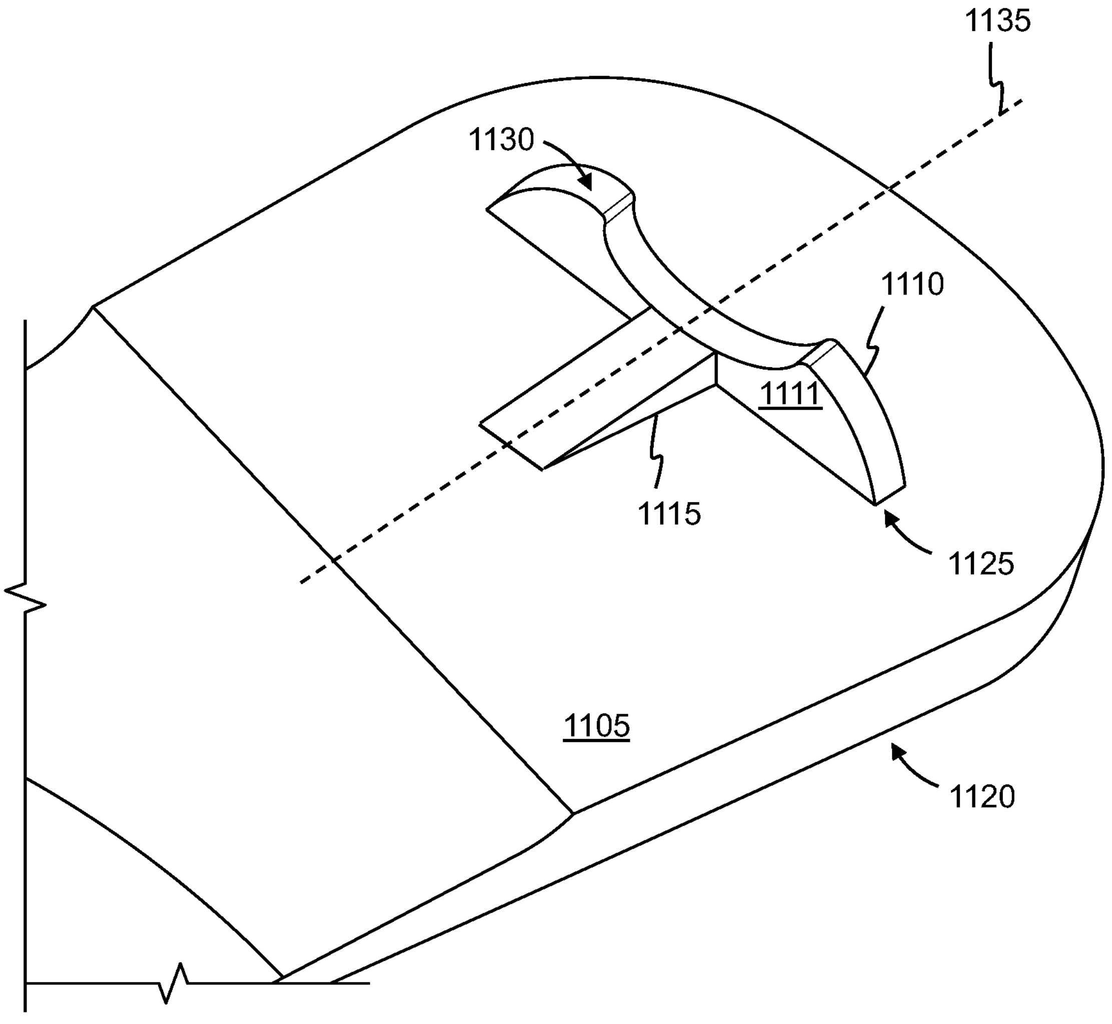
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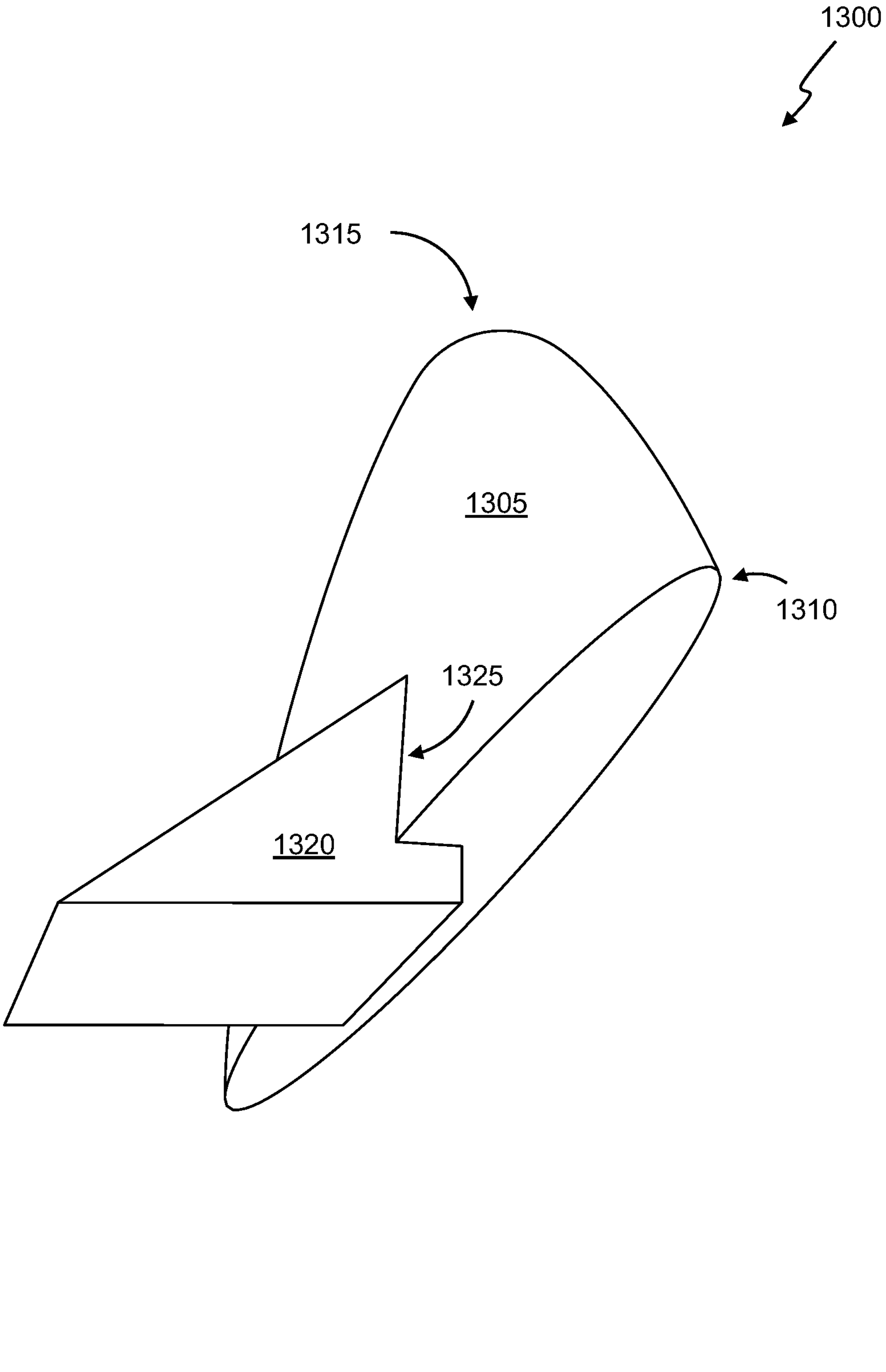
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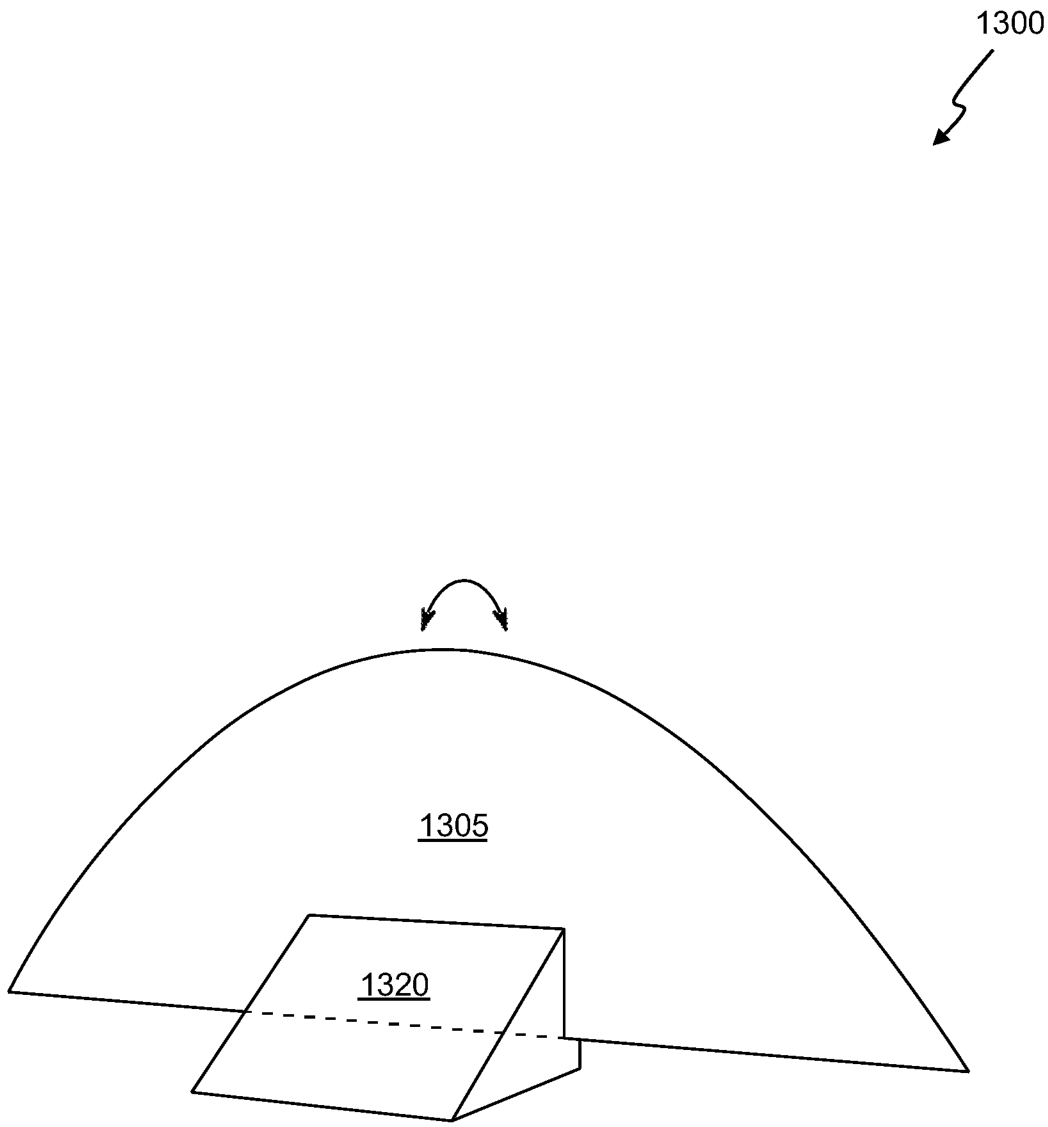
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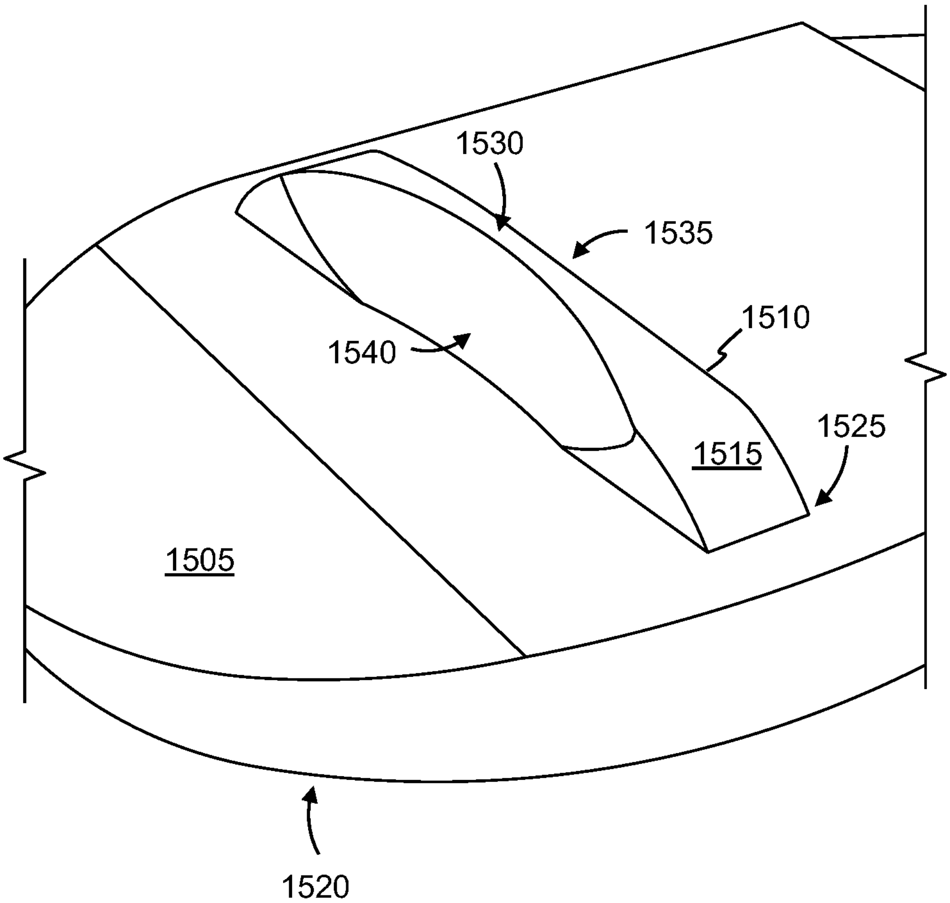
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/043932

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***A43B 13/26*** (2025.01); ***A43C 15/16*** (2025.01)

CPC: ***A43B 13/26; A43C 15/161***

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)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	US 8,555,528 B2 (GERBER) 15 October 2013 (15.10.2013)	
X	entire document	1
Y	entire document	13
	US 11,388,947 B1 (BARNES) 19 July 2022 (19.07.2022)	
Y	entire document	13
	US 10,932,527 B2 (NIKE, INC.) 02 March 2021 (02.03.2021)	
A	entire document	1-20
	US 7,386,948 B2 (SINK) 17 June 2008 (17.06.2008)	
A	entire document	1-20
	US 2010/0115796 A1 (PULLI) 13 May 2010 (13.05.2010)	
A	entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 January 2025 (22.01.2025)	**30 January 2025 (30.01.2025)**

Name and mailing address of the ISA/US	Authorized officer
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