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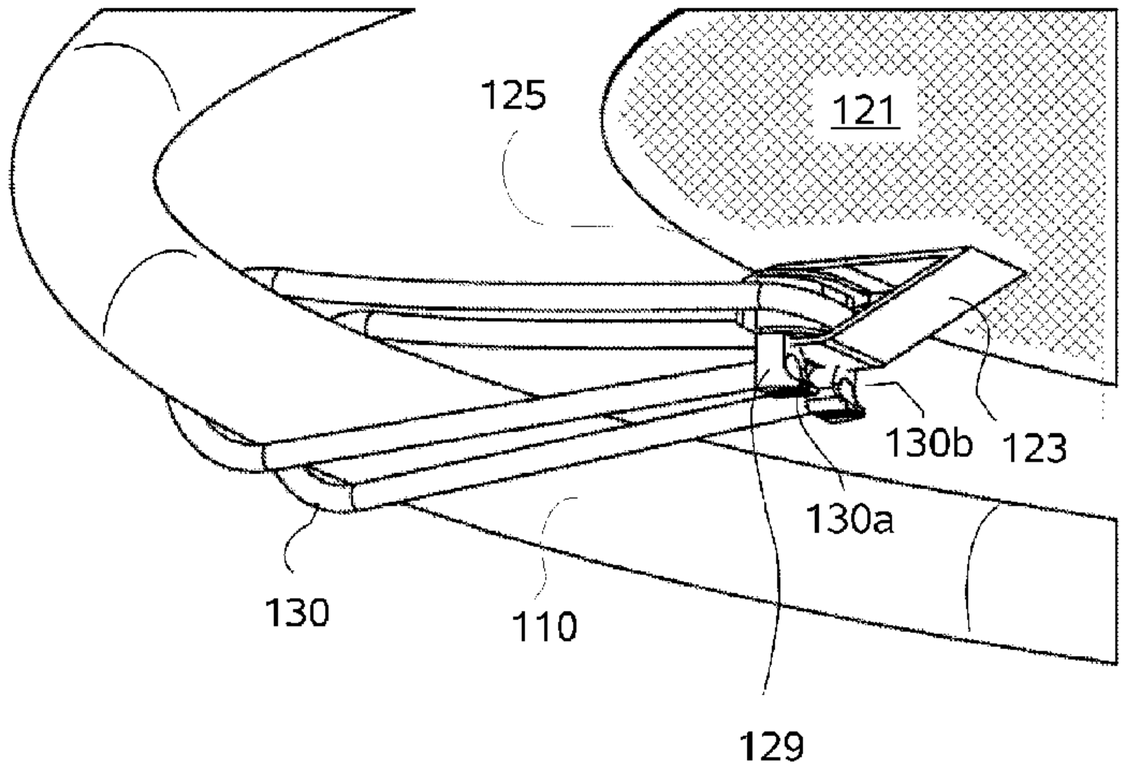

(57) Abrégé/Abstract:
A trampoline with a frame has a rebounding mat that is tensioned to the frame with a plurality of flexible and cordlike linear elastic members. The rebounding mat is configured so that a non-tensioned portion thereof covers the elastic members to increase the trampolines useable area. In the more preferred embodiments, elastic members are cordlike flexible elastic members and the non-tensioned portion is segmented into overlapping petals to move freely with the tensioned portioned of the rebounding mat as it moves vertically. Preferably each cordlike elastic members is connected to the frame and the rebounding mat at one of two alternative positions to alter the tension. The alternative positions permit a tensioning process that extends the lifetime of elastic cords having a fabric sheath. This independent tension of each elastic member is via connector member that grips the rebounding mat but also grasps opposing the ends of the elastic members as well as central portion thereof so that two segment of the cord between each end and the central portion are preferably wrapped around the trampoline frame.

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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(54) **Title**: REBOUNDING APPARATUS WITH TENSIONED ELASTIC CORDS

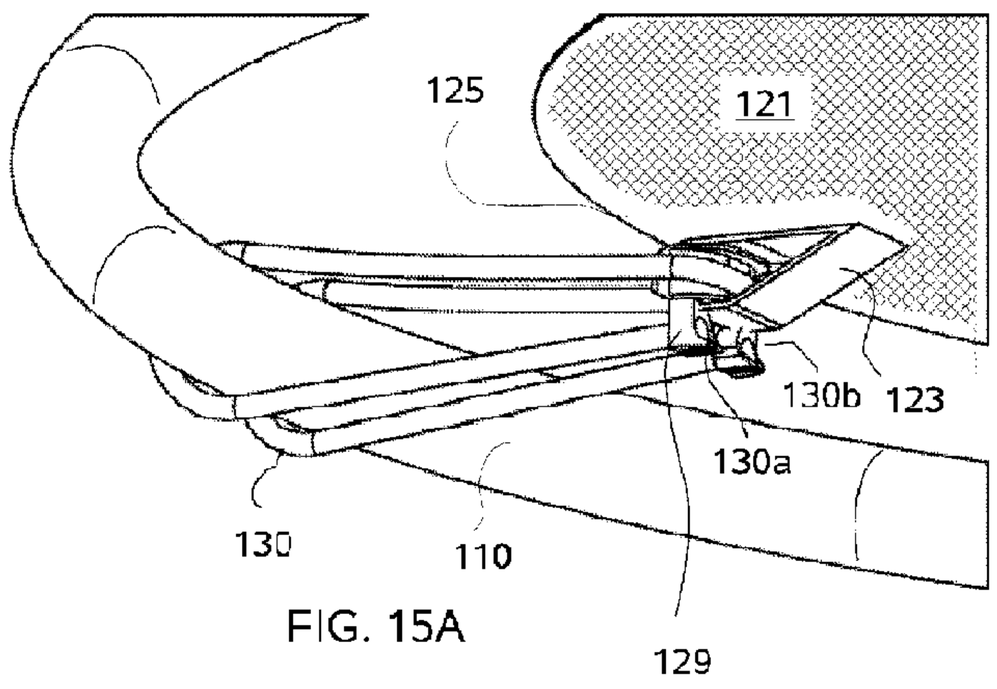

FIG. 15A

(57) **Abstract**: A trampoline with a frame has a rebounding mat that is tensioned to the frame with a plurality of flexible and cord-like linear elastic members. The rebounding mat is configured so that a non-tensioned portion thereof covers the elastic members to increase the trampolines useable area. In the more preferred embodiments, elastic members are cordlike flexible elastic members and the non-tensioned portion is segmented into overlapping petals to move freely with the tensioned portioned of the rebounding mat as it moves vertically. Preferably each cordlike elastic members is connected to the frame and the rebounding mat at one of two alternative positions to alter the tension. The alternative positions permit a tensioning process that extends the lifetime of elastic cords having a fabric sheath. This independent tension of each elastic member is via connector member that grips the rebounding mat but also grasps opposing the ends of the elastic members as well as central portion thereof so that two segment of the cord between each end and the central portion are preferably wrapped around the trampoline frame.

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REBOUNDING APPARATUS WITH TENSIONED ELASTIC CORDS

Background of Invention

[0004] The present invention relates to trampoline-type devices for physical exercise. Such devices commonly referred to as "rebounders," typically are circular and have a relatively small diameter of about 40 inches with a surface area available for jumping of about 615 square inches or less. Examples of such device are shown in U.S. Patent No. 7,094,181 (to Hall, Aug. 22, 2006) and US Patent No.4,331,329 (to Mirkovich et al., May 25, 1982).

[0005] In a typical prior art trampoline and rebounder configuration, the mat is tensioned by elastic or spring elements generally arranged radially between

the mat outer diameter and the inner diameter of the frame. This area is sometimes covered by a static pad which is attached to the frame, and prevents the user from stepping directly onto the elastic elements or springs. However, this design has several disadvantages. Firstly, the nature of the static pad makes it a poor surface for rebounding, since being attached to the frame it has limited freedom of movement. Secondly, the static pad is clearly seen by the user as not useful as a rebounding surface, and leads to the impression of a jumping surface which has a relatively small diameter as compared to the total diameter of the frame.

[0006] It is therefore a first object of the present invention to overcome the above disadvantages by providing a new and improved exercise trampoline or rebounder in which the useable area of the trampoline is increased.

[0007] It is another object to provide such an improved trampoline which is easy to assemble.

[0008] It is a further object of the invention to provide such an increased usable area without other detriment to the user's comfort, or the trampoline performance, yet at the same time due so in a manner also not detrimental to the life of the product by increasing wear on components.

Summary of Invention

[0009] In the present invention, the first object is achieved by providing a rebounding surface comprising a closed frame that is horizontally disposed, a rebounding mat having at least a central portion thereof elastically suspended within said closed frame, at least one cordlike flexible elastic member, each having a first end and an opposing end for coupling the central portion of said rebounding mat in elastic suspension to said frame, a plurality of gripping members attached to the perimeter of the central portion of said rebounding mat, each gripping member connecting a cordlike flexible elastic member to the rebounding mat, wherein at least one of the frame, at least one cordlike elastic member and a gripping member of said plurality are adapted to dispose at least one of the first end and opposing end of the at least one cordlike elastic member at two alternative position to provide at least two alternative levels of tension to the rebounding mat.

[0010] A second aspect of the invention is characterized in that the rebounding surface has at least one cordlike elastic member is connected to the rebounding mat and the frame in a serpentine path having segment that alternatively connect opposing side of each gripping member to alternative positions along the perimeter of the frame.

[0011] A third aspect of the invention is characterized in that the rebounding surface further comprises a plurality of cord like elastic members, wherein at least some of said plurality of cord like elastic member are folded at the center thereof, with the folded center thereof wrapped around the gripping member and each of the two portion thereof between the center and the first and opposing end returning to wrap around an adjacent portion of the frame such that the first and opposing ends are tensioned on return to connect at the periphery of the rebounding mat to provide tension thereto.

[0012] The above and other objects, effects, features, and advantages of the present invention will become more apparent from the following description of the embodiments thereof taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

[0013] The accompanying drawings, incorporated in and forming a part of the specification, illustrate several trampoline and rebounder arrangements. Some, although not all, embodiments of the invention are described in the following description. In the drawings:

[0014] FIG. 1 is a perspective view of a first embodiment of the trampoline.

[0015] FIG. 2 is a plan view from above the trampoline shown in FIG 1.

[0016] FIG. 3 is partial plan view from above another embodiment of the trampoline.

[0017] FIG. 4A is partial radial cross-sectional elevation of the portion of a trampoline at section line A-A in FIG. 2 or 3 when the trampoline in an equilibrium or resting state.

[0018] FIG. 4B is cross-sectional elevation of the portion shown in FIG. 4A immediately after impact by the user.

[0019] FIG. 4C is cross-sectional elevation of the portion shown in FIG. 4B on return to equilibrium.

[0020] FIG. 5 is a plan view from above of another embodiment of the trampoline showing the rebounding surface or mat.

[0021] FIG. 6A is partial radial cross-sectional elevation of the portion of a trampoline at section line A-A in FIG. 2 or 3 of another embodiment of the trampoline in an equilibrium or resting state.

[0022] FIG. 6B is partial tangential cross-sectional elevation of the surrounding portion of the mat at section line B-B in FIG. 6C of another embodiment of the invention.

[0023] FIG. 6C is plan view of the portion of the mat shown in FIG. 6B.

[0024] FIG. 7A is a plan view from above the embodiment of the trampoline shown in FIG. 6B and 6C.

[0025] FIG. 7B is an exploded portion of FIG. 7A.

[0026] FIG. 8A is partial radial cross-sectional elevation at section line A-A in FIG. 2 or 3 of a portion of another embodiment of the trampoline in an equilibrium or resting state.

[0027] FIG. 8B is partial tangential cross-sectional elevation of the surrounding portion of the mat at section line B-B in FIG. 9A in another embodiment of the invention.

[0028] FIG. 9A is a plan view from above the embodiment of the trampoline shown in FIG. 8B.

[0029] FIG. 9B is an exploded portion of FIG. 9A.

[0030] FIG. 10A is a partial radial cross-sectional elevation at section line A-A in FIG. 2 or 3 of a portion of another embodiment of the trampoline in an equilibrium or resting state.

[0031] FIG. 10B is a partial radial cross-sectional elevation at section line A-A in FIG. 2 or 3 of a portion of another embodiment of the trampoline in an equilibrium or resting state showing another embodiment for attaching a gripping member to the elastic cord.

[0032] FIG. 11A is a cross-sectional elevation at section line A-A in FIG. 11B of a portion of the underside of a trampoline showing another embodiment for attaching a gripping member to the elastic cord.

[0033] FIG. 11B is a plan view from below the trampoline showing a portion thereof deploying several of the gripping members of FIG. 11A.

[0034] FIG. 11C is a partial radial cross-sectional elevation at section line B-B in FIG. 11B of a portion of the embodiment shown in FIG. 11A and 11B.

[0035] FIG. 11D is a perspective view of the gripping member of FIG. 11A-C.

[0036] FIG. 12A is a perspective view from the front corner of an alternative embodiment of a gripping member.

[0037] FIG. 12B is a perspective view from the back corner of the gripping member of FIG. 12A.

[0038] FIG. 12C is another perspective view from the side of the gripping member of FIG. 12A and 12B including the attached elastic cord.

[0039] FIG. 13A is a perspective view from the back corner of another alternative embodiment of the gripping member.

[0040] FIG. 13B is a perspective view from the front corner of the gripping member of FIG. 13A.

[0041] FIG. 13C is another perspective view of the gripping member of FIG. 13A and 13B that also illustrates the tensioned elastic cord.

[0042] FIG. 14A-C are perspective views of other alternative embodiments of the gripping member.

[0043] FIG. 14A-D are perspective views of other alternative embodiment of the gripping member.

[0044] FIG. 15A is a perspective views of another alternative embodiment of the gripping member. FIG. 15B is a cross sectional elevation of the embodiment of the gripping member of FIG. 15A. FIG. 15C is a plan view of the underside of the trampoline showing the embodiment of FIG. 15A and B.

[0045] FIG. 16A is a front perspective views of another alternative embodiment of the gripping member whereas FIG. 16B is a rear is a perspective views of the embodiment of the gripping member in FIG. 16A

[0046] FIG. 17A, 17B and 17C are top plan, front elevation and side elevation views respectively of the gripping member in FIG. 16A and 16B.

[0047] FIG. 18A is a rear elevation view of the embodiment of the gripping member in FIG. 16 and 17, whereas FIG. 18B is a side elevation view thereof.

[0048] FIG. 19A is a front perspective views of another alternative embodiment of the gripping member whereas FIG. 19B is a rear is a perspective views thereof.

[0049] FIG. 20 is a side elevation of the embodiment of the gripping member in FIG. 19A and 19B.

[0050] FIG. 21A is a front elevation of the gripping member of FIG. 19-20 whereas FIG. 21C is a rear elevation view thereof. FIG. 21B is a top plan view thereof. FIG. 21D is a cross-sectional plan view at section line A-A in FIG. 21C.

[0051] FIG. 21E is a cross-sectional plan view of a portion of the trampoline apparatus at section line A-A in FIG. 21C showing the location of the elastic cord when the coupler of FIG. 18-21 is deployed.

[0052] FIG. 22 is a corner perspective views of another alternative embodiment of a gripping member used in combination with a one of or more elastic cords as described above with respect to FIG. 3.

[0053] FIG. 23A-D are elevation and plan views of the embodiment of the gripping member in FIG. 22 in which FIG. 23A is a bottom plan view, FIG. 23B is a front elevation, FIG. 23C is a top plan view and FIG. 23D is side elevation thereof.

[0054] FIG. 24A-C illustrate in a plan view the attachment of the gripping member of FIG. 22 and 23 to the rebounding mat, in which FIG. 24A is a plan view of the rebounding mat having holes cut in the perimeter region for receiving the connector of FIG. 22 and 23. FIG. 24B is a plan view of the rebounding mat with the connector of FIG. 22 and 23 disposed adjacent to the holes prior to

completing an attaching seam in the rebounding mat, whereas FIG. 24C is the same region after the seam is completed to secure the coupling members in place.

[0055] FIG. 25A is a cross-sectional elevation corresponding to section line A-A in FIG. 24C.

[0056] FIG. 25B is a plan cross-sectional view corresponding to section line B-B in FIG. 25A.

[0057] FIG. 26A is a cross-sectional elevation of a first embodiment of a frame adapted to adjusting the tension on a cord like elastic member in another embodiment of the invention, whereas FIG. 26B is an exterior elevation of the frame portion in FIG. 26A, with FIG. 26C being a cross-sectional elevation of an alternative embodiment of that shown in FIG. 26A.

[0058] FIG.27A is a perspective view of another embodiment of the invention, whereas FIG. 27B is an underside plan view thereof. FIG. 27C is an enlarged perspective view of a portion of the underside, whereas FIG. 27D is an enlarged plan view of the detailed portion "A" in Fig. 27B.

[0059] FIG.'s 28A-E illustrate in various views a first connector shown in FIG. 27, in which FIG. 28A as a front perspective view thereof, FIG. 28B is a rear perspective view thereof, FIG. 28C is a top plan view thereof, FIG. 28D is a side elevation view thereof, and FIG. 28E is cross-section plan view at section line A-A in FIG. 28D.

[0060] FIG.'s 29A-F illustrate in various views a second connector shown in FIG. 27, in which FIG. 29A as a front perspective view thereof, FIG. 29B is a rear perspective view thereof, FIG. 29C is a top plan view thereof, FIG. 29D is a rear elevation thereof, FIG. 29E is a side elevation thereof and FIG. is a cross-sectional elevation thereof at section line A-A in Fig. 29D.

[0061] FIG. 30 is the stress-strain curves of different fabric covered elastic cords.

[0062] FIG. 31 is the cyclic stress level recorded when an elastic covered fabric cord is repeated cycled with repeated re-tensioning.

Detailed Description

[0063] Referring to FIGS. 1 through 31, wherein like reference numerals refer to like components in the various views, there is illustrated therein a new and improved Trampoline with expanded rebounding surface generally denominated 100 herein.

[0064] In accordance with the present invention trampoline 100 in FIG. 1 -3 has a closed frame 110, a rebounding mat 120 with a central portion 121 having grip members 123 and a surrounding outer portion 125 to cover the grip members. Generally, such a trampoline 100 will also have legs 140 descending downward from the frame 110 for supporting the trampoline above the ground. The shape of frame 110 and rebounding mat 120 are usually roughly the same and can be circular, elliptical, rectangular, hexagonal and the like.

[0065] Elastic members 130 connect the grip members 123 to the closed frame 110 and are at least partially covered by the surrounding outer portion 125. The surrounding outer portion 125 is not attached to or constrained by the closed frame 110. Prior art trampolines connect some portion of an annular or peripheral member that cover the springs (or a similar tensioning device that support the rebounding mat) to the frame, even when this peripheral member or cover is attached to the rebounding mat.

[0066] In one aspect of the invention, the trampoline 100 preferably deploys cordlike flexible elastic members 130 are substantially covered by the surrounding outer portion 125 to effectively expand the area of the rebounding surface beyond the rebounding mat 120 center 121. While the outer portion 125 can be used to expand the rebound surface of a trampoline that deploys metal springs as the elastic member 130, in the preferred embodiments described more fully below, the elastic members 130 are soft and deploy rubber or synthetic elastomeric resins and the like. In more preferable embodiments, the elastic members that tension the mat 120 are cordlike flexible elastic members, such as “Bungee” cords, and similar elastic cords such as those

described in US Pat. No. 1,050,442 9 (to Friswell, Jan 14, 1913); 3,130,630 (to Dawes, Oct. 2,1964); 4,513,063 (to Hashi et al., April 23,1985) and 5,607,736 (to Williams, Mar. 4, 1997). Such cord like elastic members generally compose or more continuous strand or tubes of rubber or an elastomer, covered or otherwise integrated to include one or more layers of woven fabric. Alternatively, the elastic member need not always deploy exterior surrounding fabric sheath as elastic material can be co-woven into a fabric members. In addition, an elastic member 130 can have a relatively non-elastic cord of cable that is attached to one or more shorter elastic members. The cross-section of the elastic member 130, while preferably round, can also be oval or rectangular and the like.

[0067] In another aspect of the invention, it has been discovered that the service life and utility of fabric containing cord like elastic members can be greatly extended by a process of re-tensioning, provided they are not initially strained to what has been discovered to be an excessive level. As re-tensioning involves extending the cord like elastic members beyond the length that provided an initial level of tension, still further aspects of the invention include particular methods and apparatus for conveniently extending the length beyond the initial length so as to achieve a level of tension comparable to level of tension at the first or initial extended length.

[0068] In more preferred embodiments, the closed frame 110 is circular, and the outer surrounding portion 125 of the rebounding mat 120 has an annular shape and extends above the grip members 123 at the edge of the circular central region.

[0069] One or more elastic cords 130 can connect the frame 110 to the rebounding mat 120 in various configurations that are compatible with the various embodiments for the outer surrounding portion or peripheral region 125. Hence, every such combination need not be explicitly described to be appreciated by one of ordinary skill in the art in light of this disclosure. Further, although the invention provides significant benefits to smaller

rebounder style trampolines, no intent is made to limit the scope of the claims to any particular style or size trampoline.

[0070] For example as shown in FIG. 2, a plurality of elastic cords are each relatively short, that is only about 2-3 times the gap between the frame 110 and the point of connection to the rebounding mat 120 and can be directly connected to the frame 110, but are more preferably wrapped around it, with the ends of each cord 130 returning to be connected proximal to the rebounding mat 120.

[0071] In contrast, in FIG. 3, at least one longer elastic cord 130 is alternatively wrapped around frame 110 with the intervening portion that then return and pass through a connection point or member on the periphery of the central portion 121 of the rebounding mat 120, below the outer annular portion 125. In this embodiment, each elastic cord 130 can be considered as being tensioned along a serpentine path that alternates between the frame 110 and the edge of the mat's center portion 121.

[0072] Preferably, when a surrounding outer portion 125 is deployed it is split or otherwise subdivided into segment that move relatively independently of the each other, as illustrated in FIG.4A-4C, which are partial radial cross-sectional elevations of a portion of a trampoline in the stages of rebounding by a user. FIG. 4A is the resting or equilibrium state, whereas FIG. 4B immediately after impact by the user and FIG. 4C is some time after FIG. 4B, as the system returns to mechanical equilibrium, as for example before another impact by the user.

[0073] It should be noted that at equilibrium in FIG. 4A, the outer portion 125 rests on the elastic cords 130. When the elastic cords are closely spaced as in FIG. 1 and 2, the user can actually bounce off this portion, extending the useful area. Wherever a user lands, the trampoline bed or mat 120 will immediately be forced below the equilibrium position by this impact as shown in FIG. 4B. However, the outer portion 125, being connected to the periphery of the central portion and not the frame 110 while being free to fall, will generally

rise at the edge 125a, indicated by arrow 10. Generally the outer portion 125 conforms to whatever shape the elastic bands 130 take on extension. Preferably, the outer portion 125 is sufficiently light in weight so that the air pressure impulse 15 created by the descending mat 120 will actually push them upwards as shown by arrow 10. This minimizes drag on the elastic cords 130, and enables a strong rebounding response from the mat 120. Further, avoiding contact and drag from frictional contact of the outer portion 125 with the elastic members 130 minimizes wear of the fabric covering the elastic members 130, increasing their useful life.

[0074] In the various embodiments it is preferred that the petals 126 of outer portion 125 dynamically conform to the shape of a conical section as the mat 120 moves up and down. In order to more fully accommodate this dynamic shape transformation it is more preferred that the free radial ends 126r of at least some annular portions or petals 126 that overlap are not connected to the free radial ends of the immediately adjacent annular portion, as shown in FIG. 7 and 9.

[0075] To enable such dynamic conformation, the petals 126 also preferably have a high aspect ratio to minimize the total friction, being arc segments that subtend between about 20 degrees to 75 degrees, depending on the trampoline diameter and the optimal stretching of the elastic members 130.

[0076] Accordingly, as shown in FIG. 5, 7 and 9, the annular portion 125 of the rebounding mat comprises a plurality annular sections or petals 126, each such annular section having two free tangential ends 126t and an outer free radial end 126o, where the inner radial end 126i is connected to the central portion of the rebounding mat 120. Petal 126 can be characterized by a tangential length, as indicated by double arrowed headed reference line 701, and a radial width, shown by double arrow headed references line 702. Preferably, at least one of the petals 126 (but more preferably a majority or all of the petals), have tangential length that is at least 3, but more preferably 4 or more time the radial width. More preferably, when adjacent petals 126 partially overlap, the

overlapping portion of at least one of the petal 126ℓ (but more preferably a majority or all of the petals) has a tangential length that is less than the radial width of the petal 126.

[0077] In the embodiment of the mat 120 shown in FIG. 5, the annular portion 125 is subdivided by slits or gaps 501 to define discrete flapping petal 126. It should be appreciated form FIG. 5 through 8 that the petals 126 extend the mat edge beyond the tensioned area of the mat. The petal can vary in radial depth and optionally extend to or beyond the frame 110, but are not attached to it allowing independent. As shown in FIG. 6 and 7, petals 126 may be arranged so that one edge of the petal is on top of the adjacent petal, while the opposite edge of the petal is tucked under the petal on that side, creating a pattern of overlapping petals continuing around the circumference of the mat. In another variation, shown in FIG. 8 and 9 petals may be arranged alternating, where one petal is completely above both adjacent petals and the neighboring petals on either side are both completely under their adjacent petals. The overlapping portions of the petals can be rounded, triangular or any other convenient shape.

[0078] When the petals126 overlap, it is also preferable that the overlapped portion not be more than from about 15% to 25% of the arc of the petal. Thus, for a trampoline with 6 petals, the non overlapping portion of each petal might have an arc length of about 60 degrees, with the overlapping portion ranging in arc length from about 9 to 15 degrees, for a total arc of about 69 to 75 degrees.

[0079] More preferably, the outer portion 125 and petals 126 is cushioned by internal padding 6129, as shown in FIG. 6. Further, by subdividing the outer portion 125 into petals 126, each petal can be separately padded as shown in FIG. 6A to further reduce the potential for friction for with elastic cord 130, as a padded fabric, being thicker than ordinary fabric would be slower to dynamically conform to the conical shape described above.

[0080] It is also preferable that the aspect ratio of the petals is higher when adjacent petal overlap as shown in FIG. 6 and 7, but less so for the embodiment in FIG. 5 and 9. It is more preferable to minimize the friction of padded petals 126 by limited the padding to the central portion 126c that does not overlap with another petal, leaving the overlapping portion 126ℓ of at least one of the petals as a thin flat that has a seam 126s at the overlap of the adjacent petal 126 to promote the dynamic movement thereof, and their sliding one over or under the other adjacent petal 126.

[0081] It should also be appreciated that the cordlike elastic members 130 can be arranged in numerous alternative configurations without departing from an important purpose of expanding the trampoline rebounding area. For example, one or more such elastic members 130 can be in a serpentine configuration to connect a plurality of grip members 123 to the frame 110, as shown in FIG. 3, or there can be a single elastic member 130 per grip member 123, as shown in FIG. 1 and 2.

[0082] It should be further appreciated that the petal 126 should be constructed taking into account the supporting nature of the elastic members 130. When the elastic members 130 are closely spaced elastic cords as shown in FIG. 1, the material that forms the petal 126 can be relatively thin and use light padding to distribute the user's weight on the elastic cords 130. However, when the spacing is wider, or the elastic cords are very narrow, it may be desirable to use thicker material and/or padding to form petals 126, and thicker and/or firmer internal padding 6129. It should be appreciated that such spacing of the elastic member is determined by the density of the grip members 123 around the periphery of central portion 121 of the rebounding mat 120, as well as the cross-sectional shape of the elastic members 130. Thus, the padding thickness may also take into account the density and size of the connecting grip members 123 and any intermediate connector member 129 described below and in FIG. 10-13. It should be appreciated that as the preferred embodiment of the intermediate connector member 129 described below are fairly rigid, it

is preferably that they are attached to the grip member 123 in a manner that disposes then under the portion of the petals 126 having internal padding 6129.

[0083] The grip members 123 that connect the mat 120 to the frame 110 via elastic cords 130 can be simple loops of tough fabric, and may include an intermediate connector or coupler 129 body that is preferably, but not necessary covered by the outer portion 125 of the rebounding mat 100, as shown in FIG. 8A. The central 121 and outer 125 portions of the rebounding mat 120 can be integral or stitched together, or attached with other means such as hook and loop fasteners, rivets, button, snaps and the like.

[0084] FIG. 10A illustrates an embodiment in which the loop 123 and the outer portion 125 are both stitched to the periphery of the central area 121 after being covered at the top and bottom by reinforcing fabric strips 127 and 127' respectively. The stitching is represented by thread 128.

[0085] FIG. 10C of an alternative embodiment in which elastic bands 130 are attached to the circumference of the mat 120 at an elastic band coupler 129. The coupler 129 may be an integral and generally cylindrical unit that has a sculpted annular concave depression around the periphery to support the elastic cord 130 of the same or smaller cross-section and shape. As shown in FIG. 10B, coupler 129 is attached to below both the periphery of the central area 121 and the mat's outer portion 125, which are also stitched together as shown in FIG. 10A. Alternatively, the coupler 129 may be attached to mat 120 by means of a through screw or bolt which holds its upper part 129a and lower part 129b together on the top and bottom of the mat 120. Coupler 129 may also be attached via a tab sewn onto the mat 130. The upper part 129a and lower part 129b each receives the respective upper loop and lower loop of elastic bands 130. Other embodiments for the connection of elastic bands 130 include in-molded hooks which can form an elastic band coupler 129. Further embodiments for such gripping members 123 and connecting or coupling

members 129 are illustrated in FIG. 11-25 which are described in more detail below.

[0086] In FIG. 11A-11D the coupler 129 is a single disk that has sculpted annular concave depression around the periphery to support the elastic cord 130 of the same or smaller cross-section and shape. The coupler disk 129 also has a transverse slot 1291 that extends to bisect the disk 129 through an upper or lower half thereof. On the opposite side of the transverse slot 1291 the disk 129 may include holes that extend from the top to the bottom thereof 1292 and 1292' for receiving fastener for connecting to the rebounding mat. It should be appreciated from FIG. 11B, that a single elastic cord 130 is used to connect the rebounding mat 120 via three such couplers 129 by wrapping around the central of the three, 129', with the end on opposite side of coupler 129' extending outward to wrap around the frame 110, before returning to be secured by the surrounding couplers 120 and 129''. The ends 130a and 130b of elastic cords 130 have knots or bulbous protrusions that are grasped by the edge of coupler 129 and 129'' when the cord portion just before the knots is placed in the transverse slot 1291. The ends 130a and 130b of elastic cords 130 are grasped by the edge of coupler 129 and 129'' when the cord portion just before the knots is placed in the transverse slot 1291.

[0087] FIG. 12-21 illustrate alternative embodiment in which a single coupler 129 is simultaneously wrapped by the elastic cord 130 and holds the opposing ends 130a and 130b.

[0088] One such alternative embodiment to the bungee clip/coupler 129 shown in FIG. 10B is seen in FIG. 12 and 13. The coupler or bungee clip 129 has loop retaining feature 1288 for supporting the elastic cord 130, nominally a bungee cord, and also has two bores 290 with side openings for retaining the terminal ends of the bungee. Webbing attachment feature 292 is a handle or flat slot is for securing flat webbing that is preferably deployed as the grip member 123. In FIG. 12C connector/bungee clip 129 is shown as installed with a central portion of the bungee between the ends formed into a loop 1284 that is seated

in the loop retaining feature 1288. The loop retaining feature 1288 is preferably a smooth sculpted annular concave depression around a portion of a cylindrical surface. Also shown is bungee 130 with bungee terminator 1286, which is optionally either a knot or the bulbous protrusion, and is secured to a fixed location on the bungee 130 as shown. Optionally, a second terminator 1287 secured to the bungee 130 inward of the first terminator 1286 may also be used to attach the bungee 130 to the coupler 129, providing an adjustment to the length of the active bungee section. Thus as the elastic cord or bungee tension decreases over time due to use, it may be incrementally adjusted to maintain the tension within the desired range, greatly extending the useful life of the elastic cords and avoiding the time and expense to replace these components. A further benefit is that the tension of the bungee 130 may be adjusted to the weight and jumping preference of the user.

[0089] FIGS. 13A-C shows a bungee clip/coupler 129 capable of being attached to the triangular or V-ring 200 of a typical trampoline, to allow for the use of bungee 130 instead of the typical metal spring. In this embodiment, the V-ring 200 and any webbing holding it to the periphery of the central portion 121 of the rebounding mat would be considered a grip member 123. Bungee clip or coupler 129 includes loop retaining feature or handle 1394, a V-ring retaining slot of having V-shaped indentation 1298 to receive two side of the ring 200, as well as the bungee terminator retaining features 1286. FIG. 14C shows the bungee clip 129 with the central looped portion of bungee cord 1284 seated in this loop retaining feature1288. Also shown is bungee 130 with bungee terminator 1286 inserted into bungee terminator retaining feature 290. V-ring 200 is shown in V-ring retaining feature 1394. In a typical installation, the V-ring 200 is sewn into a loop of webbing attached to the trampoline mat, such as 123 in FIG. 15.

[0090] FIGS. 14A-D illustrate additional embodiments of a coupler or bungee clip 129 similar to that shown in FIGS. 13A-C and all provide the user with the ability to adjust the active length of the bungee or similar cord like elastic

members 130. FIG. 14A illustrates a coupler 129 which has surfaces 232 and 230 which form a serrated V, which forcibly secures the bungee end 130a at the desired length. It's method of operation is similar to that of a cleat as used in a sailboat. In such an embodiment, the cord like elastic member may be grasped at two or more alternative positions at either or both opposing ends by a corresponding chevron shaped appendage attached to or surrounding the member 130, which the chevron (s) pointing to the center of the cord. FIG. 14B shows a clip 129 having lower body 242 which may be adjusted relative to upper body 235 so as to vary the position of bungee terminators 1286 and 1286' of bungee 130, and thereby adjust the tension of said bungee. The method of adjustment may utilize a ratcheting mechanism, a rail, or a track which provides for the movement of lower body 242 relative to upper body 235 and may be locked in the desired position. An alternative embodiment of a clip 129 which allows for the adjustment of bungee tension is shown in FIG. 14C. As shown coupler/clip assembly 129 allows additional bungee tension to be added by wrapping a portion of the bungee 130 in a loop 258 about post 260. The post 260 descends from the portion of the clip 129 that forms loop retaining feature 1288. In the last of these embodiments shown in FIG. 14D, the coupler clip assembly 129 includes a nesting spacer 272 that engages into bores 290, extending the ends thereof such that the location of bungee terminators 1268 and 1268' are moved distal from the end of the bores that they would normally engage. The effect of inserting this nesting spacer 272 is to increase the stretched length of the bungee and thus increase bungee tension. In the embodiment of FIG. 14A deploying a cleat, the nesting spacer may be a chevron shaped cleat that is inset into the first cleat.

[0091] FIG. 15 to 18 illustrate another embodiment of a connecting or gripping member 129 and its means for attachment to the perimeter of the trampoline rebounding mat. As shown in FIG. 15A, coupler 129 is attached to below the periphery of the mat's outer portion 125, via a tab or flap loop of strap 123 that is stitched to this outer periphery . As illustrated in more detail in FIG. 16B, the coupler 129 has a rounded channel 1288 on the front surface of the

upper portion 129a to receive the central portion of the looped elastic cord 130.

[0092] The lower part 129b of coupler 129 receives the opposing ends of the elastic cord that are at opposite sides of this central portion. The ends of the elastic cords 130a and 130b are held in the spaced apart bores 290 and 290' formed in the lower portion of the coupler 129b. The elastic cord 130 may be inserted or removed from each bore 290 and 290 from the respective side openings 291 and 291' also formed in the lower portion 129b. On the opposite and back side of the upper part 129a is a grasping member 1692 having opposing arms 1693 and 1693' that form a partially open slot 1694 to releasably secure the fabric tab 123. The hole 1610 that extends vertical between the upper and lower portion 129a and 129b is preferred when the coupler 129 is injection molded plastic to provide even shrinkage of material in the solidification process after molding to consistently provide the same exterior dimension of the coupler as the mold shape.

[0093] FIG. 19 to 21 illustrate another embodiment of a connecting or gripping member 129 having similar means for attachment to the perimeter of the trampoline rebounding mat as that shown in FIG. 15-18. Disposed in the horizontal center of the front side of gripping member 129, shown in FIG. 19A, is the rounded channel 1288 that receives the central portion of the looped elastic cord 130. However, in this embodiment of coupler 129 the ends of the elastic cords 130a and 130b are held in the spaced apart bores 290 and 290'on the same horizontal portion of the coupler 129 as the rounded channel 1288 being separated from the rounded channel 1288 by inner bores 1990 and 1990'. The inner bores 1990 and 1990' receive the portions of the elastic cord 130 that are supported on the rounded channel 1288. The inner and outer bores are shown as optionally connected by a narrow channel. On the back side of gripping member or coupler 129 is a grasping member 1692 having opposing arms 1693 and 1693' that form a partially open slot 1694 to releasably secure the fabric tab 123 shown in FIG. 15A-C. The ends of the

elastic cords 130a and 130b are held in the spaced apart bores or apertures 290 and 290' formed in the end of the coupler 129 most distal from the opposing arms 1693 and 1693', which are disposed farthest from the horizontal center of the coupler 129. The elastic cord 130 may be inserted or removed from each bore 290 and 290 from their respective side openings 291 and 291' which are in formed narrow vertical sides of the coupler 129. FIG. 21E is a cross-sectional plan view showing the connected path of the elastic cord 130, including ends 130a and 130b as retained by edges around bores 290' and 290 respectively. When the coupler 129 is formed by injection molding plastic it preferably includes the hole 1610 that extends vertically though the center of coupler 129 as it ensures even shrinkage of material in the solidification process after molding to achieve exterior dimension of the coupler 129 that are consistent with respect to the mold shape.

[0094] FIG. 22 to 25 illustrate another embodiment of a connecting or gripping member 129 intended for attaching the perimeter of the trampoline rebounding mat 120 to the frame 110 of the trampoline using one or more elastic cords 130 wound in a serpentine fashion as shown in FIG. 3.

[0095] In this embodiment, connector 129 has an elongated rectangular body 2210 with a bored centrally disposed cylinder 2220 attached to the center at the upper surface or side thereof. The cylinder 2220 is disposed with its principal cylindrical axis 2221 aligned, but off set above the principle body 2210, being laterally disposed generally at the center thereof. The body 2210, being a flattened rectangle, has a principle axis 2211. This cylinder 2220 has a central bore 2223 that is coincident with the principal cylindrical axis 2221 for receiving an elastic cord 130. Further, a flat triangular region 2230 is preferably is disposed on the opposite side of the body 2210 from the cylinder 2220. The flat triangular region 2220 extends outward to its apex 2230a in the direction transverse to axis 2211.

[0096] As shown in FIG. 24A and 24B, the mat 120 has holes 2410 cut close to the perimeter 125, the holes 2410 being slightly larger than the height, H, of the

cylinder, but much less than the length, L, of the body 2210. The inside edge of the holes 2410 are set inward form the perimeter 125 by a distance that is at least the combined height of the principal body and the triangular portion, H', in dimension of coupler 129, which is indicated in FIG. 23D. Generally the inset distance is slightly greater to account for the width, W, of the coupler 129 so that the folded portion of the edge clears the apex 2230a so that it can be fastened to the rebounding mat 120, such as by stitching.

[0097] As shown in FIG. 24B, to assemble the mat, a coupler 129 is ideally attached to the periphery of the mat at each hole 2410 location. This is accomplished by setting the cylinder portion 2220 direction over the slightly larger diameter the holes 2410, with the body principal axis 2211 lying transverse to the radial direction of the circular mat 120. Then, as shown in FIG. 24C, the edge portion of the mat 120 that bisects the holes 2410 is folded over towards the center of the mat to cover the body portion of the connectors 129, so that the cylinder portion 2220 extends through the holes. Then at least one, but preferably two or more seams are stitched to connect the folded over portions of the mat, thus securing the body and triangular portion within the seam, holding the connector 129 in place. Hence, the cylindrical portion 2220 of the connector 2220 having the bore 2223 then extends outward from the mat so that the elastic cord(s) 130 can extend through the bores 2223 to connect the mat 120 to the frame 110.

[0098] Thus, as shown in FIG. 25A, corresponding to section line A-A in FIG. 24C, the bore 2223 extends beyond the periphery of the folded edge of the mat 130, so that it can receive the single elastic cord 130 that is wrapped in a serpentine fashion between the periphery of the mat 130 and the frame 110.

[0099] To retighten the elastic cord 130 in the serpentine configuration of FIG. 3 and FIG. 25, at least one knots or bulbous protrusions 131 at either one or both ends 130a and 130b of the elastic cord 130 is preferably secured as shown in FIG. 26A in a first grip member 2610 on the frame 110 and then displaced to a be secured in a second grip 2610'member more distal from the last

connector 129 than the first grip member. The grip member can simply be a plate 2610 with two or more adjacent partial holes 2611 and 2611' that accommodate the diameter or the cord, of which the edge of the partial holes supports the knots or bulbous protrusion 131 at ends 130a or 130b. Such a plate is illustrated in FIG. 26B. Alternatively, the partial holes 2611 and 2611 need not be adjacent in the tangentially direction on the frame 110, but can be radially adjacent, as shown in FIG. 26C. It should be appreciated that the frame may alternatively employ just a single grip member 2610, and that one or more ends of the cord 130 may have proximal thereto a plurality of adjacent bulbous protrusions or other appendages that can mate to and grasp grip member 2610. It should further be appreciated that grip member 2610 can take the form of any other embodiment of a means for gripping the end portion of an elastic cord disclosed herein, as well as equivalents thereto.

[00100] It should be appreciated that although the application describes a variety of couplers or gripping members for use with serpentine wrapped and single wrapped elastic cords, such diverse couple or gripping member types can be used together on the periphery of the rebounding mat. In the spirit of the serpentine wrapping example above, the end of the cord 130a/b need not terminate at the frame, but can also terminate in any of the end gripping portion of the couplers shown in FIG. 10 through 21, which provide for grasping the elastic cord at two alternative positions to vary the tension thereon. Further, the serpentine wrapping configuration may use a plurality of elastic cords to traverse the entire perimeter of the trampoline frame 110 and rebounding mat's 120 perimeter 125.

[00101] FIG. 27-29 illustrate another embodiment of the invention that deploys a plurality of elastic cords 130 that connect the frame 110 to the ends, perimeter or central portion of the rebounding mat 120 using two different type of couplers, specifically a first coupler 129 (shown in FIG. 28A-D) and a second coupler 129' (shown in FIG. 29A-F). Couplers 129 and 129' alternate in placement around the periphery where they connect to the rebounding mat

120. Couplers 129 and 129' can optionally both deploy the slot 292 to securely receive flat webbing that is preferably deployed as the grip member 123 for connection to the rebounding mat 120. Preferably, each of coupler 129 and 129' are attached to below the periphery of the mat's outer portion 125, via a tab or flap loop of strap 123 that is stitched to this outer periphery before petals that form an outer skirt.

[00102] As illustrated in more detail in FIG. 28, the coupler 129 has a rounded channel 1288 on the back surface to receive the central portion of the looped elastic cord 130. Each cord 130 is connected to the trampoline mat at ends 130a and 130b by adjacent first couplers 129, with a central portion there between again connected to the mat 120 via the intervening second coupler 129'. The portion of the elastic cord 130 between adjacent couplers 129 and 129' is wrapped around the frame 110, before returning to be secured by the surrounding couplers 129'. The ends 130a and 130b of elastic cords 130 have at least one but preferably plural adjacent knots or bulbous protrusions that are grasped by the edge of coupler 129 and 129' when the cord portion just before the knots is placed in the transverse slot 1291. Thus, coupler 129' receives the opposing ends of the elastic cord that are at opposite sides of this central portion. The ends of the elastic cords 130a and 130b are held in the spaced apart bores 290 and 290' formed the edge portions of the coupler 129. The elastic cord 130 may be inserted or removed from each bore 290 and 290 from the respective side openings 291 and 291'.

[00103] it should be appreciated that the couplers 129 disclosed herein while suitable for low cost manufacture by injection molding plastic, can be made by other processes, as well as be formed of wire to provide the same or equivalent function described herein. Further the elastic cords 130 can terminate in other mating features for connection to the couplers 129, such as hooks, clips, latches and the like, as well as the knots and bulbous protrusions disclosed in the preferred modes above.

[00104] Elastic cords covered with a woven fabric, typically referred to as bungee cords, undergo continuous fatigue when stretched between a low and high tension state when deployed as the elastic member in supported the rebounding mat of a trampoline. The low tension state is the minimum strain to tension the rebounding mat at equilibrium position, whereas the maximum tension state is reached by the maximum mat displacement by the user. During this fatigue the cords effectively soften in that the tension applied to the rebounding mat in the equilibrium state decreases.

[00105] It has been discovered that such loss in stress can be overcome by repeated re-tensioning, that is re-stretching the fabric covered elastic cord in the equilibrium state. However, in the preferred embodiments of the invention the elastic cord is selected for such repeated re-tensioning according to the criteria that is best appreciated with reference to FIG. 30 that illustrates the stress elongation curves of three different commercial bungee cords, that is elastic cords covered with a woven fabric.

[00106] However, in any case it is first generally preferred that the rubber used in the fabric covered elastic cord be of high quality to exhibit by itself an ultimate elongation (before significant strain hardening or failure) of at least about 200%, but more preferably 300%, but most preferably over 350%. When such elastic cords are covered with woven fabric, the apparent modulus (slope of the stress strain curve), which is referred to as strain hardening, will increase when the strain limit of the woven fabric is reached. This strain level, is labeled “T” for each of the commercial bungee cords labeled “A”, “B” and “C” in FIG. 30.

[00107] In so far as the actual tension applied to a rebounding mat of the trampoline, any number of lower modulus elastic cords can be provided to reach the same total tension of fewer elastic cords.

[00108] As a non-limiting example, in the case of trampolines sized so that it is preferable that elastic cords are initially tensioned at about 18 Lb-f in the equilibrium state, also reach 35-40 Lb-f, when the rebounding mat almost reaches the floor. This range of force is also indicated on the graph in pounds-force (Lb-f) and Newton (N) units.

[00109] FIG. 31 illustrated the force decrease when such a cord is cycled between strain levels typical of the low and high tension states. After about 1 million (M) cycles, the low tension drops by about 3 lbs to about 15 Lb-f with an almost corresponding drop in the high force level. Each dramatic jump in force represents a re-tensioning in the test apparatus by re-setting a terminal knot position to return the force to the initial level of about 18 Lb-f. It is truly surprisingly and unexpected re-stretching the cord repeated times (after about 1M, 3.8M, 6.4M and 9M cycles) greatly extends the useful life to more than 1000 %, as it is only after about 10 M cycles that the high tension level greatly exceed the objective of a maximum force of about 40 Lb-f. These results are fully summarized in the Table below:

Cycles	Initial Low Force	Initial High Force	Knot Position	Notes
0	18	38.5	1:1	First Position
1,025,300	17.4	37.8	1:2	
3,846,700	17.6	37.2	2:2	
6,351,450	19.5	41.1	2:3	
8,997,440	18.4	55.25	3:3	
10,406,041	13		3:3	Failure

[00110]

[00111] It is believed that the increase in maximum force after the 5th re-stretching is caused by reaching the effective strain limit of the fabric covering, indicated as transition point "T" in FIG. 30.

[00112] Hence, depending on the stress-strain and cyclic fatigue behavior of fabric covered elastic cords that are commercial available, it may be more preferred to deploy a large number of elastic cords that reach the "T" point in FIG. 1 at higher strain levels (about 2.6X for "C" and 2.0X for "B" in contrast to the lower level of 1.8X for "A") to provide the most opportunities for re-tensioning to extend the products useful life without replacing all the elastic cords. Accordingly, it is further preferred that the elastic cords are re-

tensioned when the equilibrium force drops about 25% but more preferably by about 16%, that is from about 18 Lb-f to 13 Lb-f.

[00113] It is also preferable that the re-tensioning occur no further than when the maximum stress reaches, when the rebounding mat is fully extended, no more than about 150% or the initial value, but more preferably no more than about 125% thereof.

[00114] Thus it is believed that the ultimate limit to multiple re-tensioning to extend the useful service life of elastic cords may be the means to apply additional tension, such as by typing knots to provide a shorter length or a closer end grip point, as well as reaching close to ultimate elongation of the covered fabric sheathing. The ultimate elongation of the fabric is not necessarily the strain that will tear the fabric, but rather a straining level at which the fabric limits the elasticity of the rubber that will induce further abrasion of the fabric threads on each other, or induce abrasion ore related deterioration of the elastic cord itself.

[00115] From the forgoing it should be appreciated that numerous variations are possible, and thus the invention is not intended to be limited to the specific arrangements shown in the drawings. While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be within the spirit and scope of the invention as defined by the appended claims.

CLAIMS:

1) A rebounding surface for a trampoline or a rebounder comprising:

a) a closed frame,

b) a rebounding mat having at least a central portion thereof elastically suspended within the closed frame,

c) at least one cordlike elastic member, each having a first end and an opposing end for coupling the central portion of the rebounding mat in elastic suspension to the closed frame,

d) a plurality of couplers attached to the perimeter of the central portion of the rebounding mat, the plurality of couplers being configured to couple the at least one cordlike elastic member to the rebounding mat,

e) wherein at least one of the closed frame, the at least one cordlike elastic member and a coupler of the plurality of couplers is configured to attach the at least one cordlike elastic member to the same coupler at at least two alternative positions to provide an adjustment of an active section of the at least one cordlike elastic member between the first end and the opposing end to provide at least two alternative levels of tension to the rebounding mat.

2) A rebounding surface according to claim 1 wherein the at least one cordlike elastic member is connected to the rebounding mat and the closed frame in a serpentine path having a segment that alternatively connects opposing sides of the couplers to alternative positions along the perimeter of the closed frame.

3) A rebounding surface according to claim 1 further comprising a plurality of cordlike elastic members, wherein at least some of the plurality of cordlike elastic members have a central portion and are folded at the central portion thereof, with the folded central portion thereof wrapped around the coupler and each of the two portion thereof between the central portion and the first and opposing end returning to wrap around an adjacent portion of the closed frame such that the first and opposing ends are

tensioned on return to connect at the periphery of the rebounding mat to provide tension thereto.

4) A rebounding surface according to claim 1 comprising:

a) a plurality of first couplers;

b) a plurality of second couplers, wherein each of the first and second couplers of their respective pluralities are attached to the perimeter of the central portion of the rebounding mat, and each of the first couplers is located between adjacent second couplers,

c) wherein a plurality of cordlike elastic members have a central portion and are folded at the central portion thereof, with the folded central portion thereof wrapped around the first coupler and each of the two portion thereof between the central portion and the first and opposing end returning to wrap around an adjacent portion of the closed frame such that the first and opposing ends are tensioned on return to connect to the pair of second couplers that are adjacent to each of the first couplers, wherein each second coupler supports substantially the end of two adjacent elastic cords in tension, whereby each adjacent elastic cord is in turned wrapped around a first coupler of the plurality of first couplers that is located on opposite sides of a second coupler of the plurality of second couplers.

5) A rebounding surface according to claim 3 wherein each of the first and opposing ends of the cordlike elastic members returns to connect to the same coupler engaged by the central portion thereof.

6) A rebounding surface according to claim 3 wherein each of the couplers has at least one aperture for receiving and grasping a bulbous protrusion located proximal to the first and opposing ends of a cordlike elastic member.

7) A rebounding surface according to claim 6 wherein at least one of the first and opposing ends of the cordlike elastic members has a plurality of adjacent bulbous

protrusions, in which the alternative mated engagement in an aperture of the coupler provide the alternative levels of tension on the cordlike elastic members.

8) A rebounding surface according to claim 3 wherein the coupler comprises two apertures, the portion of the coupler surrounding each apertures adapted to grasp the first and opposing end of the cordlike elastic member.

9) A rebounding surface according to claim 3 wherein the coupler has at least a first central portion that provides a curved path for engaging the central portion of the looped cordlike elastic member and at least one aperture for receiving and grasping a bulbous protrusion located proximal to the first and opposing ends of a cordlike elastic member.

10) A rebounding surface according to claim 9 wherein the two aperture of the coupler are located on opposite side of the first central portion that received the central portion of the looped cordlike elastic member.

11) A rebounding surface according to claim 9 wherein the two aperture of the coupler are located on opposite sides and under the first central portion that received the central portion of the looped cordlike elastic member.

12) A rebounding surface according to claim 9 wherein the coupler has a single aperture that is disposed below the central portion thereof and the first and opposing ends of each cordlike elastic member engage the single apertures of the couplers that are immediately adjacent and on opposing side of the coupler that engages the central looped portion thereof.

13) A rebounding surface according to claim 5 wherein at least one coupler has a downward extending post for wrapping the elastic cord one or more times for varying the tension.

14) A rebounding surface according to claim 8 wherein at least one coupler further comprising a nesting spacer for insertion between the end portion of the elastic cords and the two aperture, the nested coupler having substantially the same shape as the apertures on the side that engages the cordlike elastic members and the complimentary shape on the opposite side that engage the aperture when the nested spacer is inserted to increase the tension on the cordlike elastic members.

15) A rebounding surface according to claim 8 wherein the two aperture of the couplers are disposed on a body that is capable of being radially displaced with respect to the center of the rebounding mat on the portion of the coupler that engages the central portion of the folded cordlike elastic member.

16) A rebounding surface according to claim 3 wherein at least one coupler has a flat open channel formed by a least two arms on the opposite side of the portion for receiving the elastic cord and a looped strap that removable disengage the channel connecting it to the periphery of the rebounding mat.

17) A rebounding surface according to claim 3 wherein at least one coupler has a V-shaped indentation for engaging a triangular ring that is attached to the periphery of the rebounding mat by a looped strap.

18) A rebounding surface according to claim 1 wherein at least one coupler has a first portion that is a cylindrical bore that extends radially from the periphery of the rebounding mat and the primary cylindrical axis of the bore is oriented tangentially to the periphery of the rebounding mat, where the cordlike elastic member alternatively passes through the bore and wraps around the closed frame in a serpentine path, wherein at least one of the first and opposing end of the cordlike elastic member is connectable to at least one of the closed frame and rebounding mat at two alternative locations to vary the tension thereon.

19) A rebounding surface according to claim 1, wherein:

i) the central portion of the rebounding mat is defined by a series of grip members that are tangentially spaced apart with respect to the geometric center of the central portion, and

ii) the rebounding mat having an outer portion having an inner perimeter and an outer perimeter, being connected to the central portion at the inner periphery and extending over the grip members thereof,

the plurality of elastic member connecting the grip members to the closed frame so as to suspend the central portion of the rebounding mat in tension within the common plane of the closed frame when each elastic member is extended beyond the unstressed length thereof, and

the outer portion of the rebounding mat at least partially covers the plurality of elastic members and the outer perimeter thereof is unrestrained.

20) A trampoline according to claim 19 in which the outer portion of the rebounding mat is subdivided into a plurality of adjacent petals, each petal being at least one of overlapped by or overlapping the adjacent petal in which the non-overlapping portion thereof is filled with a cushioning material and the upwardly disposed overlapping portion is not cushioned, the overlapped portion being attached to the cushioned portion by a flexible seam, in which each petal subtends an arc of between about 20 to 75 degrees and the overlapping portion of each petal subtending an arc that is from about 15 to 25% of the arc of the petal.

21) A trampoline according to claim 19 in which the outer portion of the rebounding mat is subdivided into a plurality of adjacent petals, each petal fully capable of moving independently of the adjacent petals so as to dynamically conform to a conical shape assumed by the plurality of elastic members as the central portion of the rebounding mat moves up and down.

22) A trampoline according to claim 21 in which at least a portion of each petal overlaps a portion of at least one adjacent petal.

23) A trampoline according to claim 21 in which at least a portion of each petal has internal padding.

24) A trampoline according to claim 22 in which each petal has internal padding in a first portion and is attached by a flexible seam to a second portion, wherein the second portion is upwardly disposed above the first portion of the adjacent petal.

25) A trampoline according to claim 24 in which the internal padding is disposed in only a portion of each petal that does not overlap above the adjacent petal.

26) A trampoline according to claim 21 in which the outer portion of the rebounding mat comprises a plurality of adjacent petals divided by slits therein running in the radial direction with respect to the center of the rebounding mat.

27) A trampoline according to claim 19 further comprising a plurality of coupling members disposed between one or more of the couplers and the portion of the elastic members that are not connected to the closed frame.

28) A trampoline according to claim 27 wherein each elastic member has two ends that are connected to a common coupling member.

29) A trampoline according to claim 28 wherein each elastic member has two ends that are connected to a different coupling member.

30) A trampoline according to claim 29 wherein each elastic member has two ends that are connected a different coupling member, wherein each of the different coupling members are separated from the other by a single intervening coupling member in which the elastic member has a central portion between the two ends thereof, the central portion being wrapped around the single intervening coupling member.

31) A trampoline according to claim 30 wherein the elastic member has a central portion between the two ends thereof that is wrapped around the single intervening coupling member.

32) A trampoline according to claim 21 wherein the tangential length of at least one of the petals is at least 3 times the radial width of the petals.

33) A rebounding apparatus comprising:

a frame that defines a central opening;

a rebounding mat that is elastically suspended within the central opening;

at least one cordlike elastic member that couples the rebounding mat to the frame so that the mat is in elastic suspension, the member having an elongated body extending between a first end and a second end; and

a plurality of couplers attached to the rebounding mat, each coupler coupling one or more elastic members to the rebounding mat,

wherein at least one of the couplers is adapted to receive and secure at least two portions of the elongated body at two separate spaced apart locations on the coupler,

wherein at least one cordlike elastic member has a tensioned portion, the tensioned portion having a tension and extending between two spaced-apart positions along the body of the elastic member, the elastic member being secured to the at least one of the couplers at each of the positions, and

wherein at least one of the at least one cordlike elastic member and the at least one of the couplers is adapted to dispose at least one of the first and second ends of the at least one cordlike elastic member at two alternative positions to provide at least two alternative levels of tension to the rebounding mat.

34) The rebounding apparatus of claim 33 wherein at least one of the couplers couples the at least one cordlike elastic member in a manner that the tension of the tensioned portion of the elastic member can be adjusted by moving a portion of the body of the elastic member relative to the coupler.

35) A rebounding apparatus according to claim 33 wherein at least one of the couplers engages a cordlike elastic member at three or more separate locations on the coupler.

36) A rebounding apparatus according to claim 35 wherein

the at least one of the couplers has an indentation located to receive and engage the cordlike elastic member.

37) A rebounding apparatus according to claim 36, wherein the indentation comprises a curvilinear surface.

38) A rebounding apparatus according to claim 35 wherein:

the at least one of the couplers has an indentation located to receive and engage the cordlike elastic member and the at least one of the couplers engages a cordlike elastic member at three or more separate locations on the coupler including

a first location,

a second location, and

a third location where a portion of the cordlike elastic member is received in the indentation.

39) A rebounding apparatus according to claim 38 wherein the indentation is defined by a curvilinear surface.

40) A rebounding apparatus according to claim 33 wherein at least one coupler is engaged with only one member.

41) A rebounding apparatus according to claim 33 wherein:

the mat has a central portion defined by a perimeter; and

the plurality of couplers comprises a plurality of first couplers and a plurality of second couplers,

wherein each of the first and second couplers is attached to the mat at the perimeter of the central portion, and each of the first couplers is located between two second couplers that are adjacent, and

wherein a plurality of cordlike elastic members extends between the couplers with a central portion of each cordlike elastic member wrapped around a first coupler, each of two outer portions of each cordlike elastic member wrapping around an adjacent portion of the frame, and each of two outer portions of each cordlike elastic member connecting to one of a pair of second couplers that are adjacent to the first coupler.

42) A rebounding apparatus according to claim 35 wherein each of the first and second ends of each cordlike elastic member connects to the same coupler that engages the elongated body of the cordlike elastic member.

43) A rebounding apparatus comprising:

a frame that defines a central opening;

a rebounding mat that is elastically suspended within the central opening;

at least one cordlike elastic member that couples the rebounding mat to the frame so that the mat is in elastic suspension, the member having an elongated body extending between a first end and a second end; and

a plurality of couplers attached to the rebounding mat, each coupler coupling one or more elastic members to the rebounding mat,

wherein at least one of the couplers engages a cordlike elastic member at three or more separate locations on the coupler and has at least one aperture through which a cordlike elastic member extends; and

each cordlike elastic member has a bulbous protrusion at or near at least one of the first and second ends, the dimensions of the bulbous protrusion being greater than those of the aperture such that the bulbous protrusion acts as a stop that limits movement of the cordlike elastic member through the aperture.

44) A rebounding apparatus according to claim 43 wherein:

the cordlike elastic member has a tensioned portion, the tensioned portion having a tension;

the cordlike elastic member has a plurality of spaced-apart bulbous protrusions at or near at least one of the first and second ends; and

the coupler is configured to allow the cordlike elastic member to be repositioned so that any one of the bulbous protrusions can be selected to serve as the stop whereby the cordlike elastic member can be moved to adjust the tension of the tensioned portion of the cordlike elastic member.

45) A rebounding apparatus according to claim 43 wherein the bulbous protrusions are knots in the cordlike elastic member.

46) A rebounding apparatus according to claim 43 wherein the bulbous protrusions are molded material connected to the cordlike elastic member.

47) A rebounding apparatus according to claim 33 wherein:

the coupler defines two apertures; and

the cordlike elastic member has a central portion that wraps around the frame and has two outer portions, each of the outer portions being connected respectively to each of the apertures.

48) A rebounding apparatus comprising:

a frame that defines a central opening;

a rebounding mat that is elastically suspended within the central opening;

at least one cordlike elastic member that couples the rebounding mat to the frame so that the mat is in elastic suspension, the member having an elongated body extending between a first end and a second end; and

a plurality of couplers attached to the rebounding mat, each coupler coupling one or more elastic members to the rebounding mat,

wherein at least one of the couplers has a surface that provides a curved path for engaging a central portion of the cordlike elastic member and at least two apertures for receiving outer portions of the cordlike elastic member, and

wherein the at least one cordlike elastic member has a central portion, an outer portion on either side of the central portion, and a bulbous protrusion at or near at least one of the first and second ends, the dimensions of the bulbous protrusion being greater than those of each aperture such that the bulbous protrusion acts as a stop that limits movement of the cordlike elastic member through each aperture.

49) A rebounding apparatus according to claim 48 wherein the at least two apertures of the coupler are located on opposite sides of the curved path.

50) A rebounding apparatus according to claim 43 wherein:

the coupler has a first central portion that receives the elongated body of the cordlike elastic member; and

the at least one aperture of the coupler comprises two apertures located on opposite sides of and under the first central portion.

51) A rebounding apparatus according to claim 43 wherein:

the coupler has a central portion that receives the elongated body of the cordlike elastic member;

the coupler has two apertures that are disposed below the central portion; and

the first and second opposing ends of each cordlike elastic member engage the respective apertures of the couplers that are immediately adjacent and on opposing sides of the coupler that engages the central looped portion thereof.

52) A rebounding apparatus according to claim 39 wherein the at least one of the couplers has a downward extending post for wrapping the cordlike elastic member one or more times for varying the tension.

53) A rebounding apparatus according to claim 50 wherein the at least one of the couplers further comprising a nesting spacer for insertion between an end portion of the at least one cordlike elastic member and the two apertures, the nested coupler having substantially the same shape as the apertures on a side that engages the at least one cordlike elastic member and a complimentary shape on an opposite side that engages the apertures when the nested spacer is inserted to increase the tension on the at least one cordlike elastic member.

54) A rebounding apparatus according to claim 33 wherein each coupler has two apertures and each coupler is disposed on a body that is capable of being radially displaced with respect to the center of the rebounding mat on a portion of the coupler that engages a central portion of the cordlike elastic member.

55) A rebounding apparatus according to claim 33 wherein:

the at least one of the couplers has a curvilinear retaining indentation; and

the rebounding apparatus further comprises a looped strap that extends through the curvilinear retaining indentation and connects the at least one of the couplers to the rebounding mat.

56) A rebounding apparatus according to claim 33 wherein the at least one coupler has a shaped indentation for engaging a metal ring that is attached to the periphery of the rebounding mat.

57) A rebounding apparatus comprising:

a frame that defines a central opening;

a rebounding mat that is elastically suspended within the central opening;

at least one cordlike elastic member that couples the rebounding mat to the frame so that the mat is in elastic suspension, the member having an elongated body extending between a first end and a second end; and

a plurality of couplers attached to the rebounding mat, each coupler coupling one or more elastic members to the rebounding mat,

wherein at least one of the couplers is adapted to receive and secure at least two portions of the elongated body at two separate spaced apart locations on the coupler, and wherein the at least one of the couplers comprises:

a first coupling position having a curved path for seating and retaining a cordlike elastic member;

a second coupling position having means to grasp opposing ends of a cordlike elastic member; and

a third coupling position having means to grasp opposing ends of a cordlike elastic member.

58) A rebounding apparatus according to claim 57 wherein:

the cordlike member has at least one protrusion; and

the at least one coupler has at least two apertures, including an aperture located at each of the second coupling position and the third coupling position, to matingly engage the protrusion.

59) A rebounding apparatus according to claim 33 further comprising at least one elastic member length and tension adjustment device, the device being attached to the at least one cordlike elastic member and comprising an adjustable slotted clover elastic member coupler and a rigid elastic member holder adapted to adjustably engage the slotted clover elastic member coupler such that an elastic member length and tension can be modified.

60) A rebounding apparatus according to claim 59 wherein the device is attached to the at least one cordlike elastic member and comprising an adjustable cone clover bungee coupler.

61) A rebounding apparatus according to claim 59 wherein the device is attached to the at least one cordlike elastic member and comprising an adjustable screw clover bungee coupler.

62) A rebounding apparatus according to claim 59 wherein the device is attached to the at least one cordlike elastic member and comprising an elastic member extender which attaches to a rebounder coupler with a hook at an end where the at least one cordlike elastic member may be connected.

63) A rebounding apparatus according to claim 33 wherein:

the first end of the at least one cordlike elastic member has plural spaced-apart adjustment positions; and

the at least one of the couplers is adapted to connect to the at least one cordlike elastic member at any of the plural adjustment positions.

64) A rebounding apparatus according to claim 63 wherein the first end of the at least one cordlike elastic member has a bulbous protrusion at each of the adjustment positions.

65) A rebounding apparatus according to claim 63 wherein the second end of the at least one cordlike elastic member has plural adjustment positions.

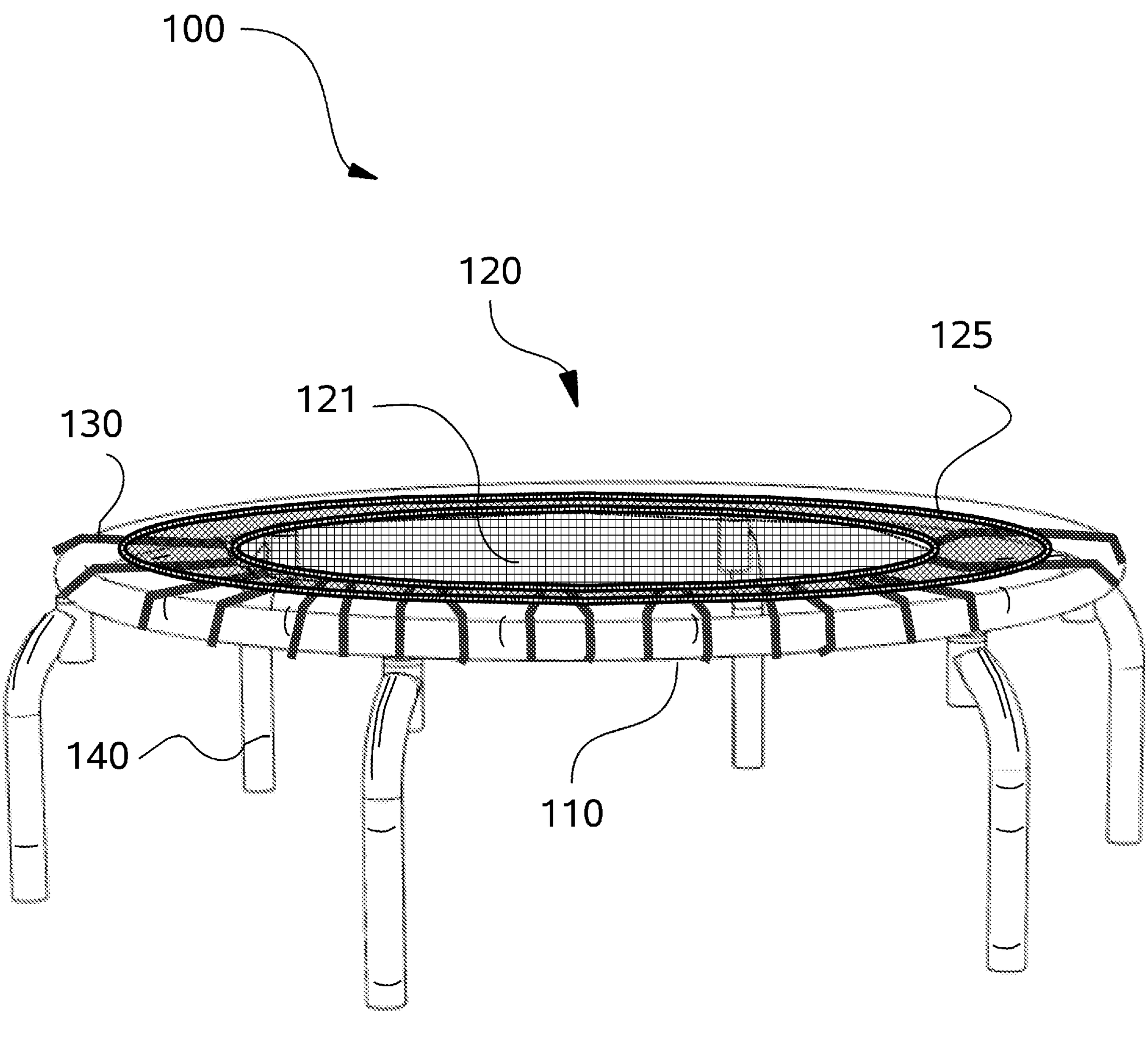


FIG. 1

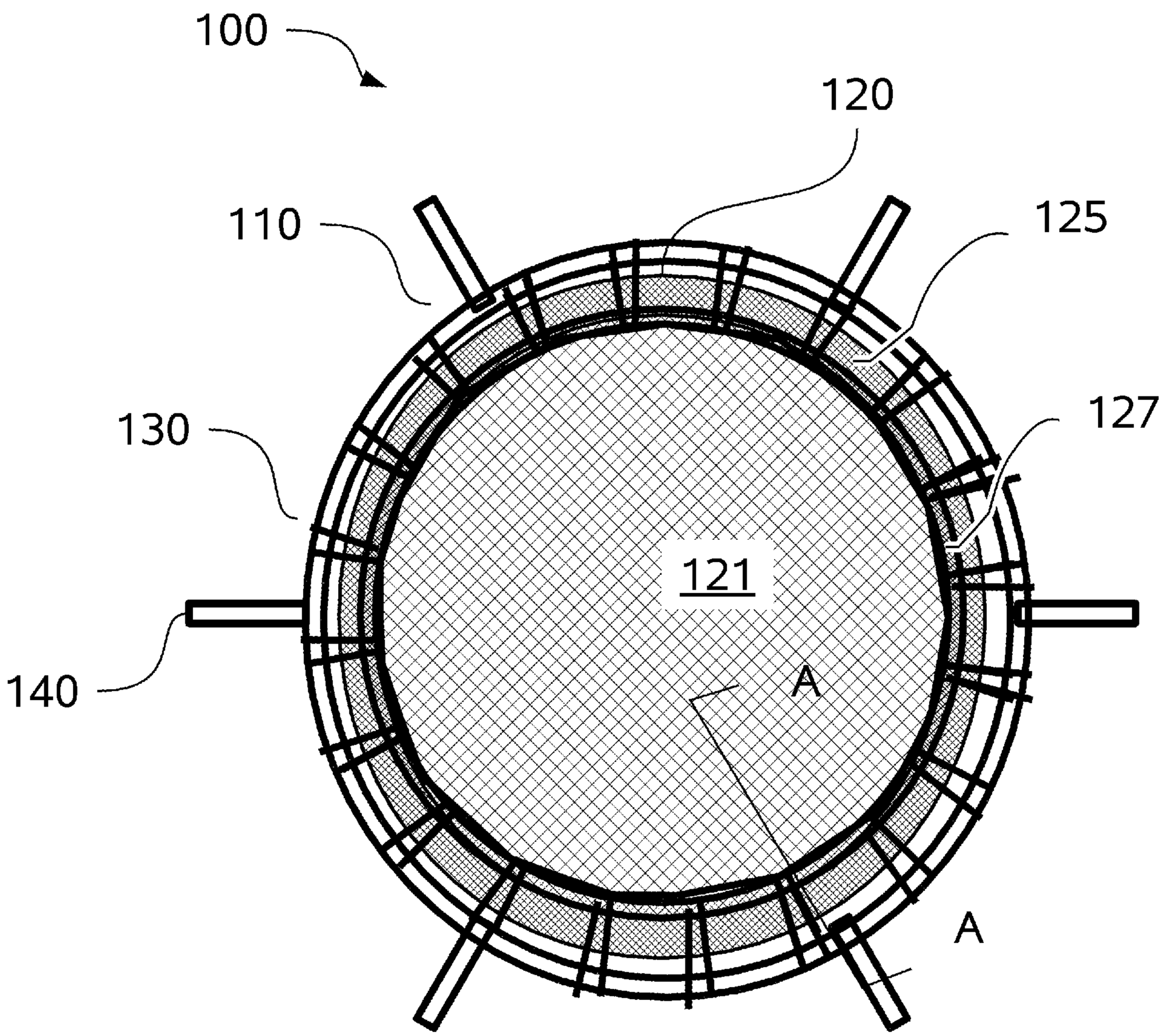


FIG. 2

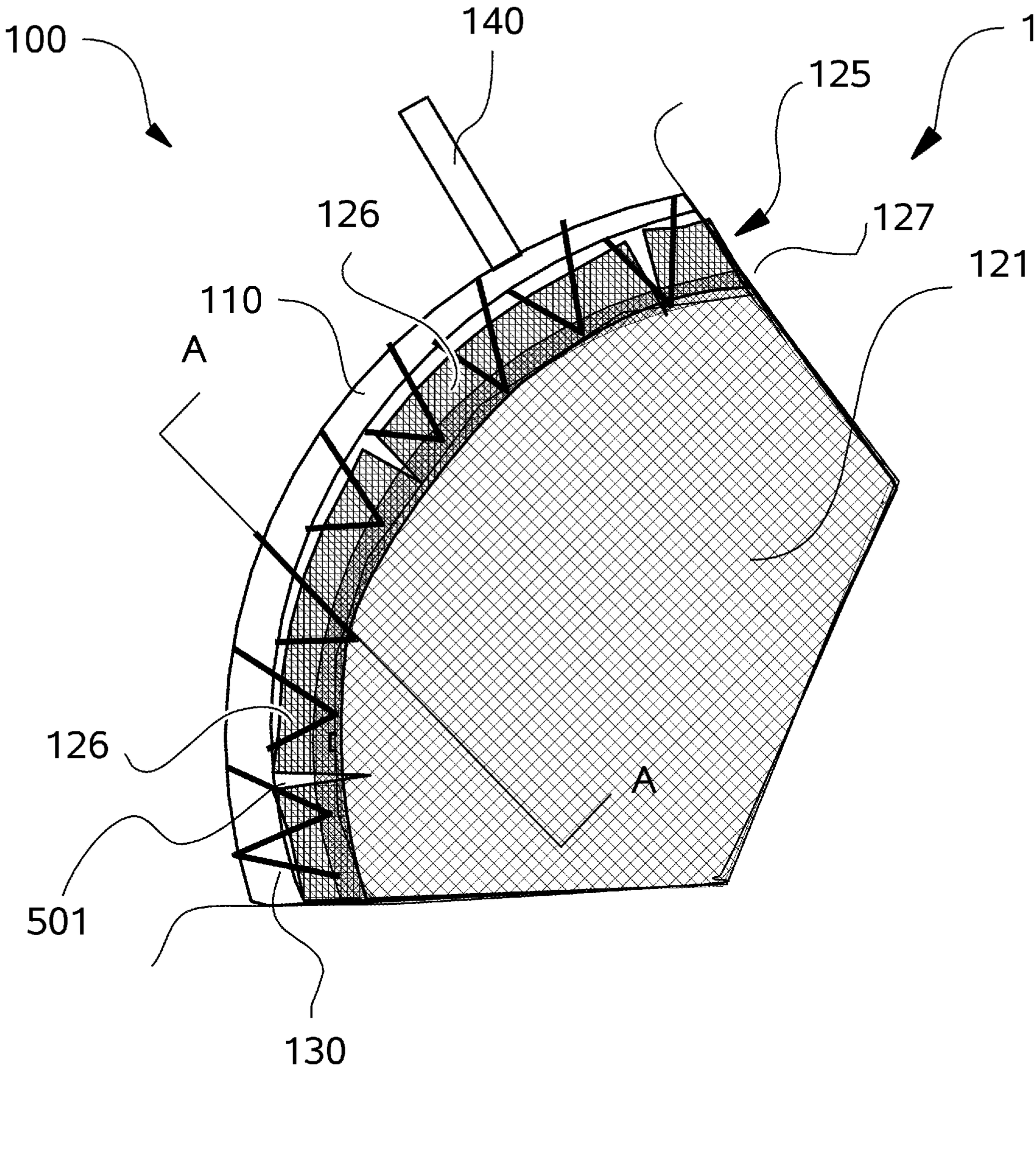


FIG. 3

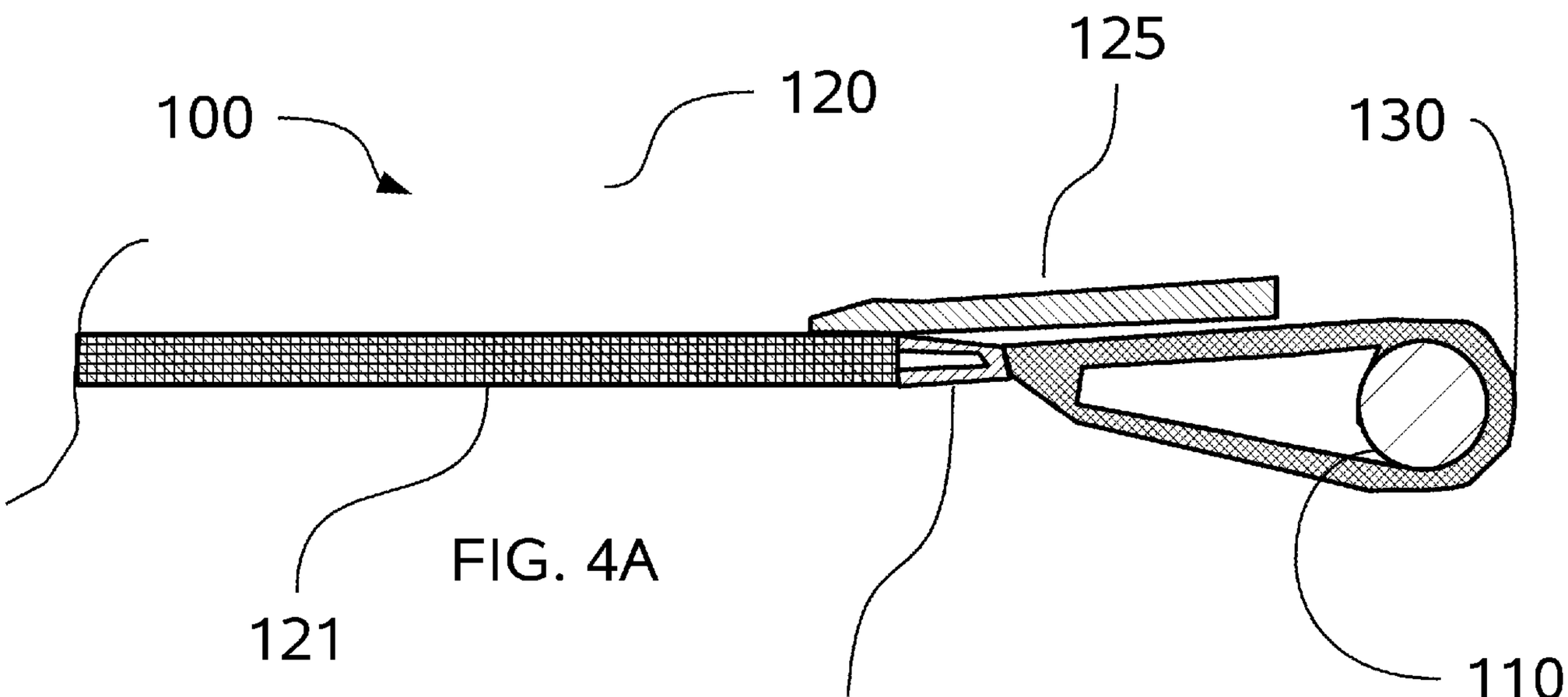


FIG. 4A

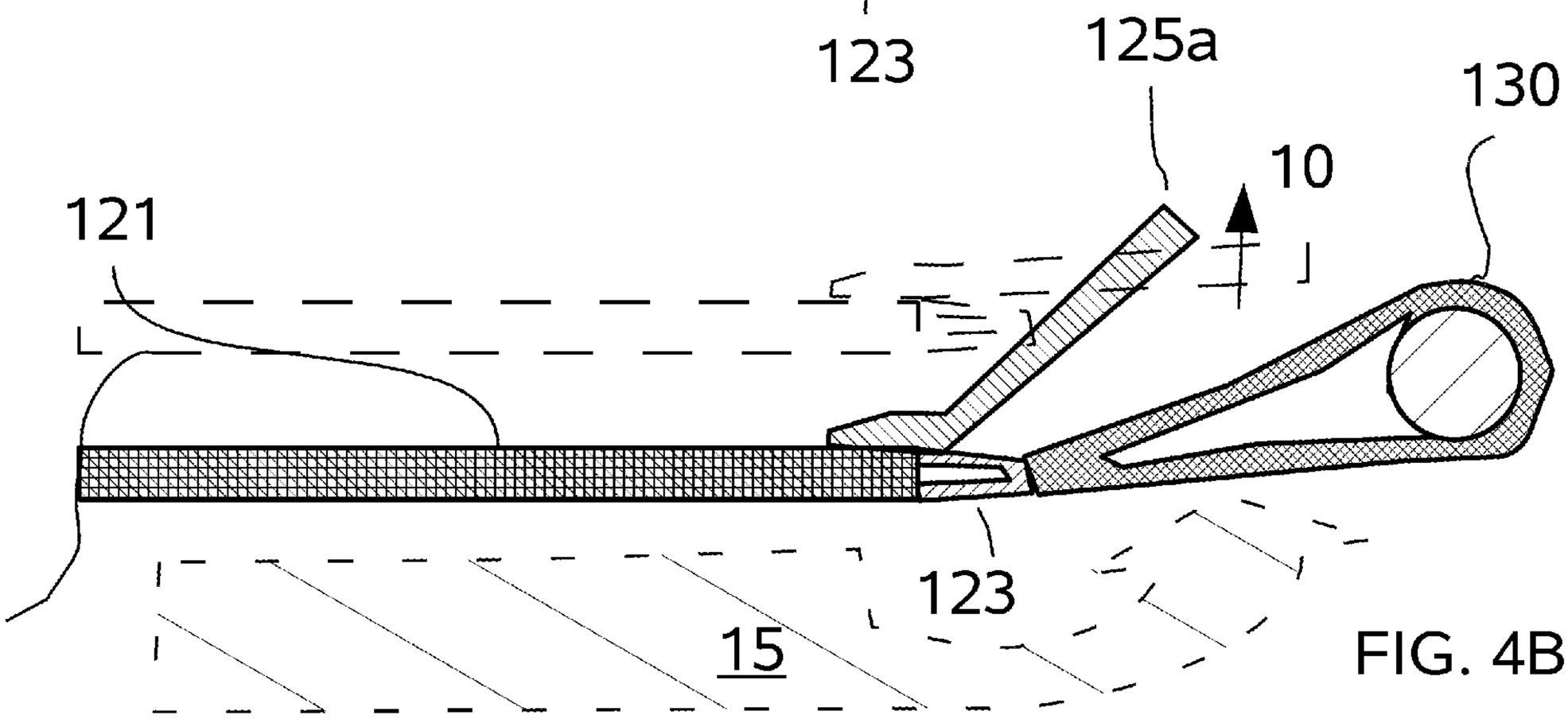


FIG. 4B

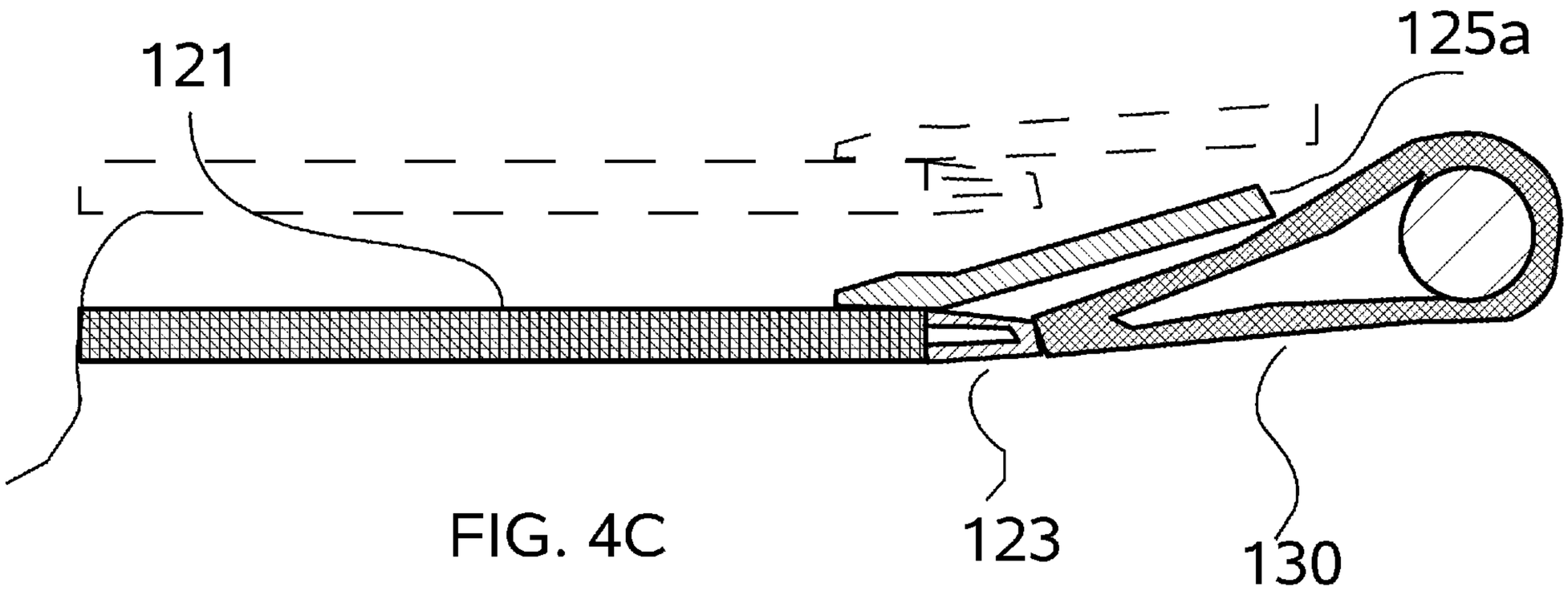


FIG. 4C

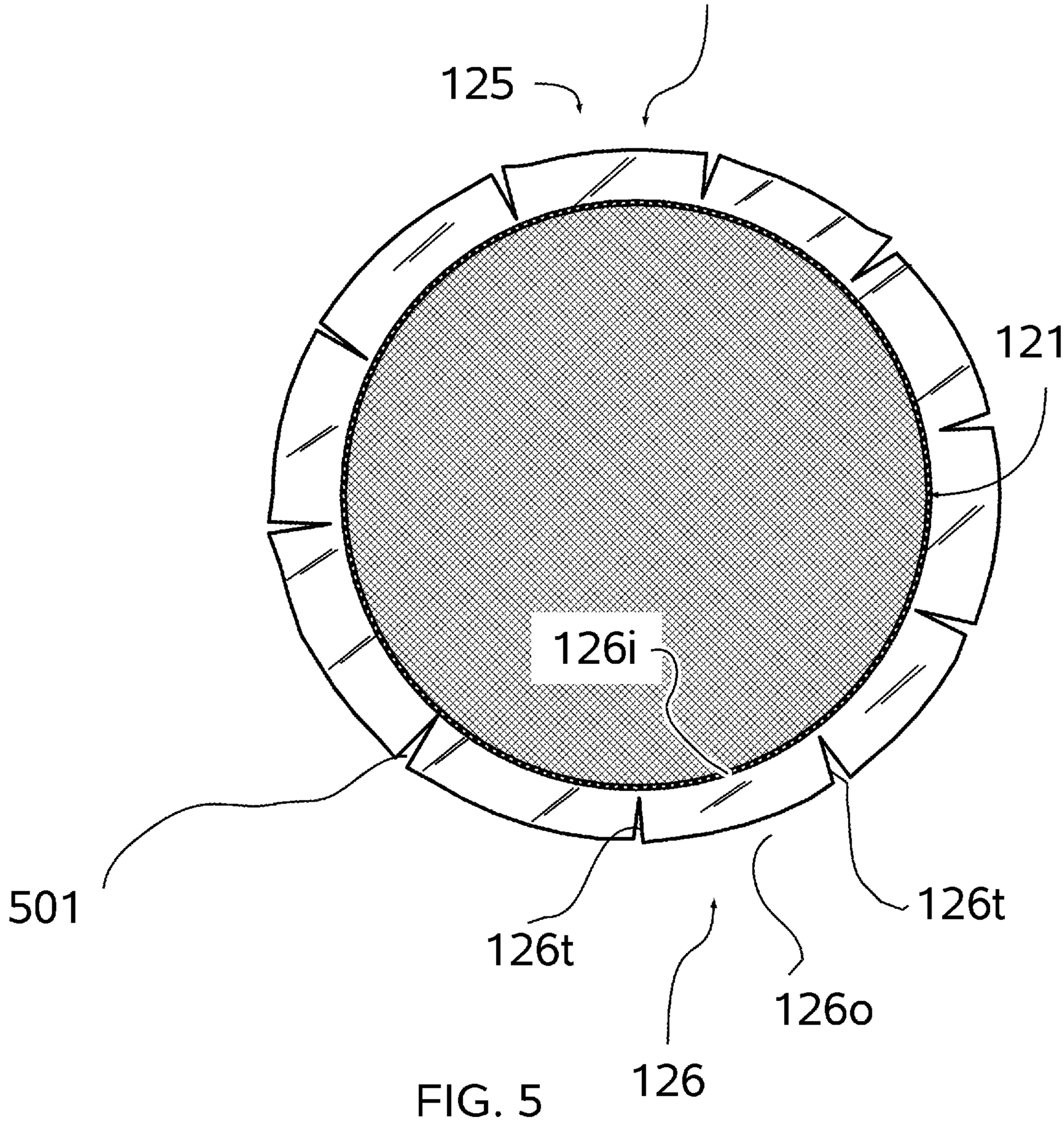


FIG. 5

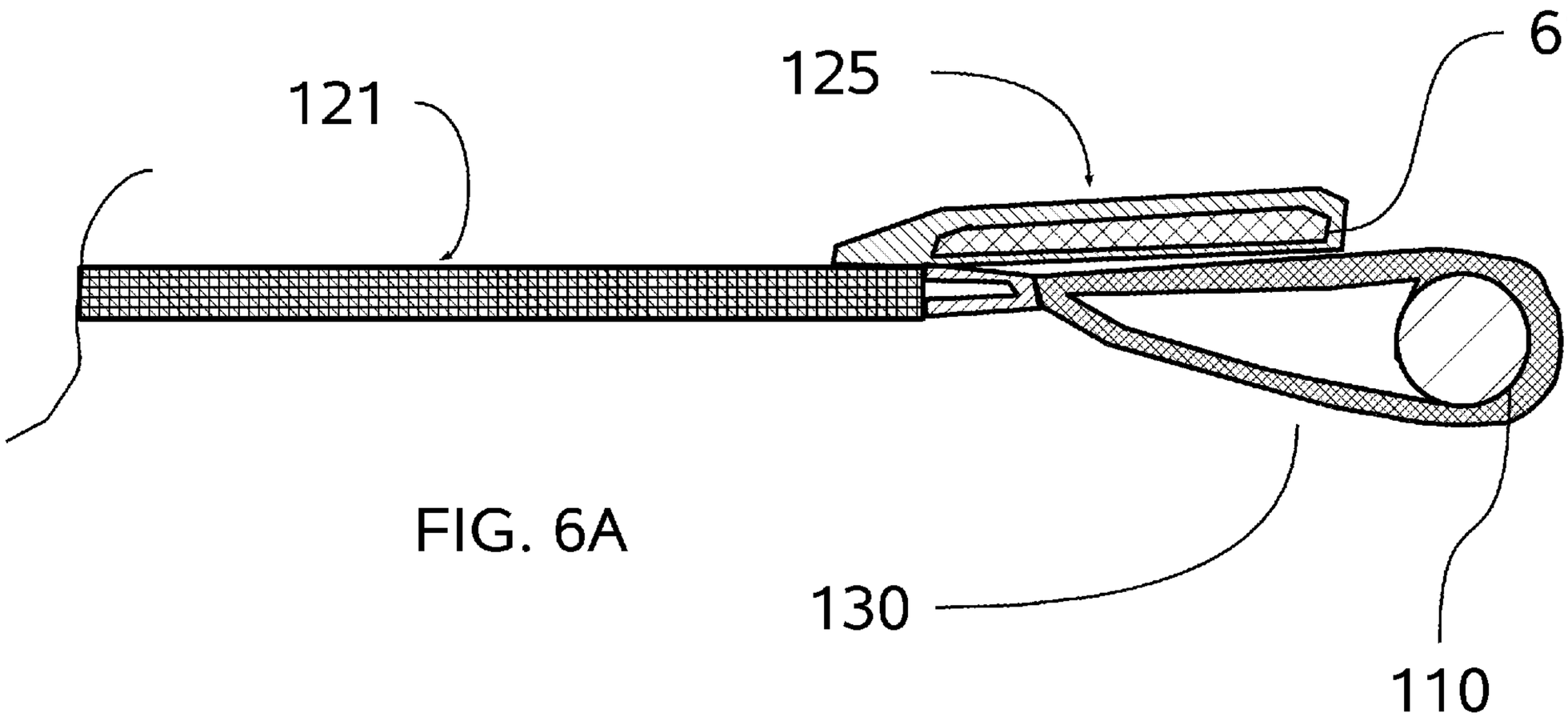


FIG. 6A

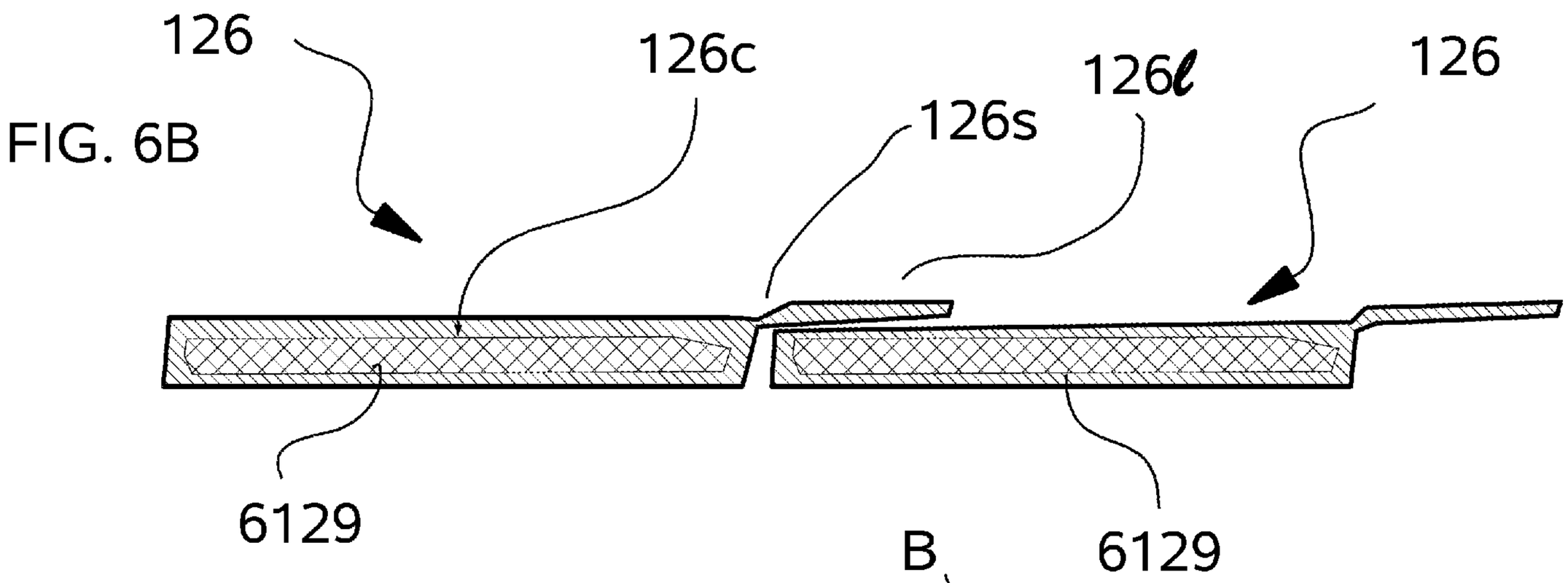


FIG. 6B

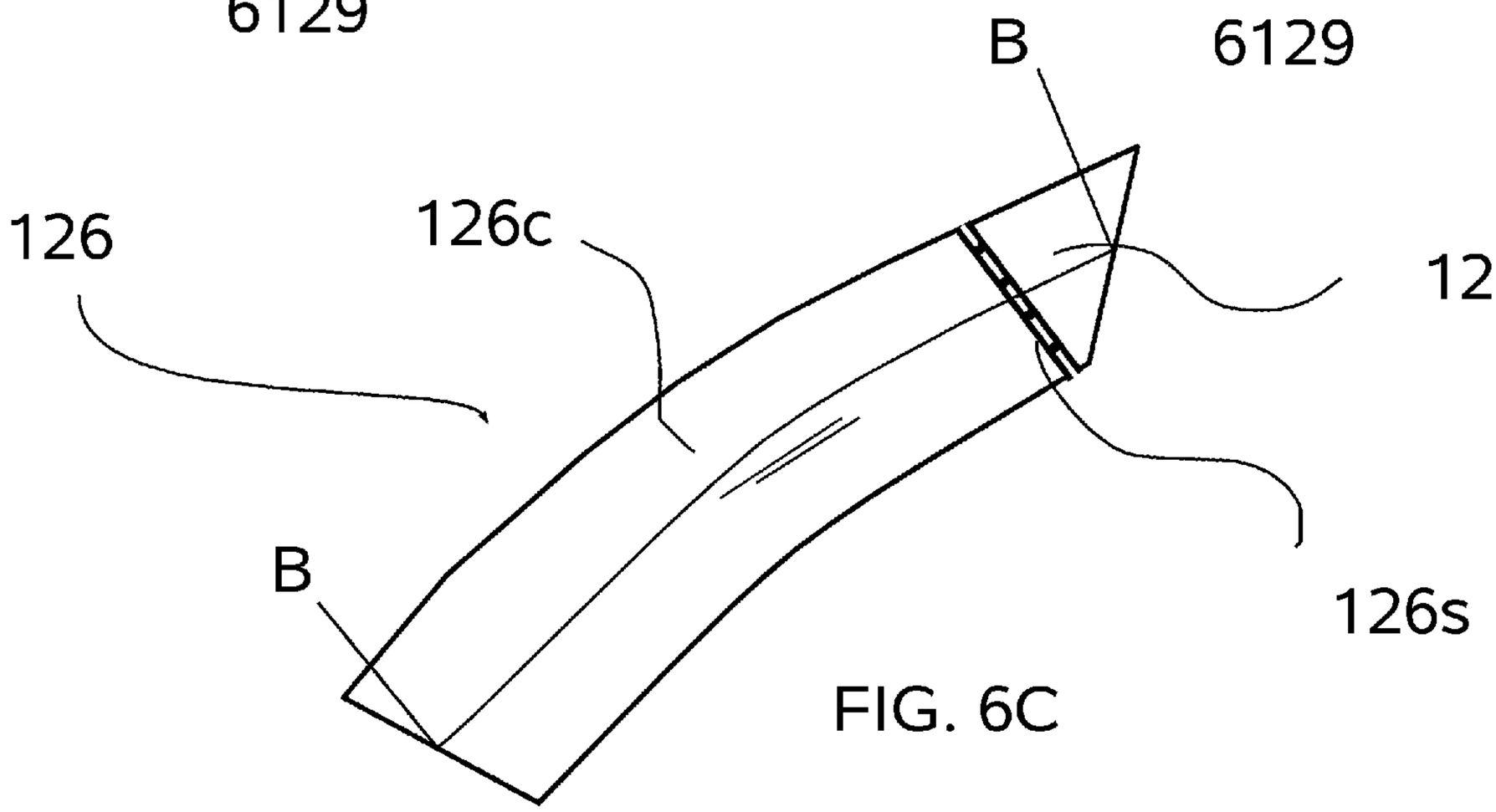


FIG. 6C

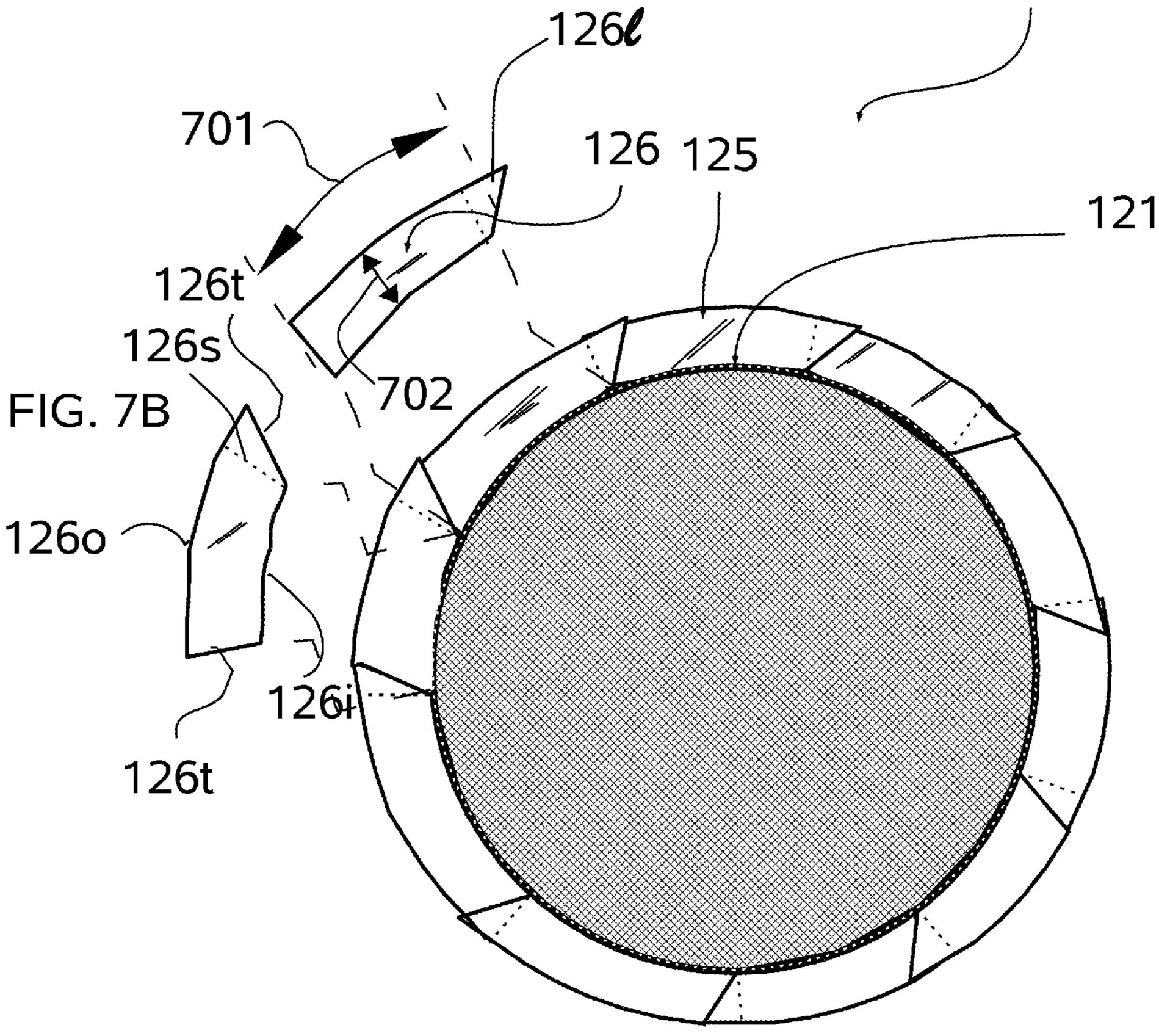


FIG. 7B

FIG. 7A

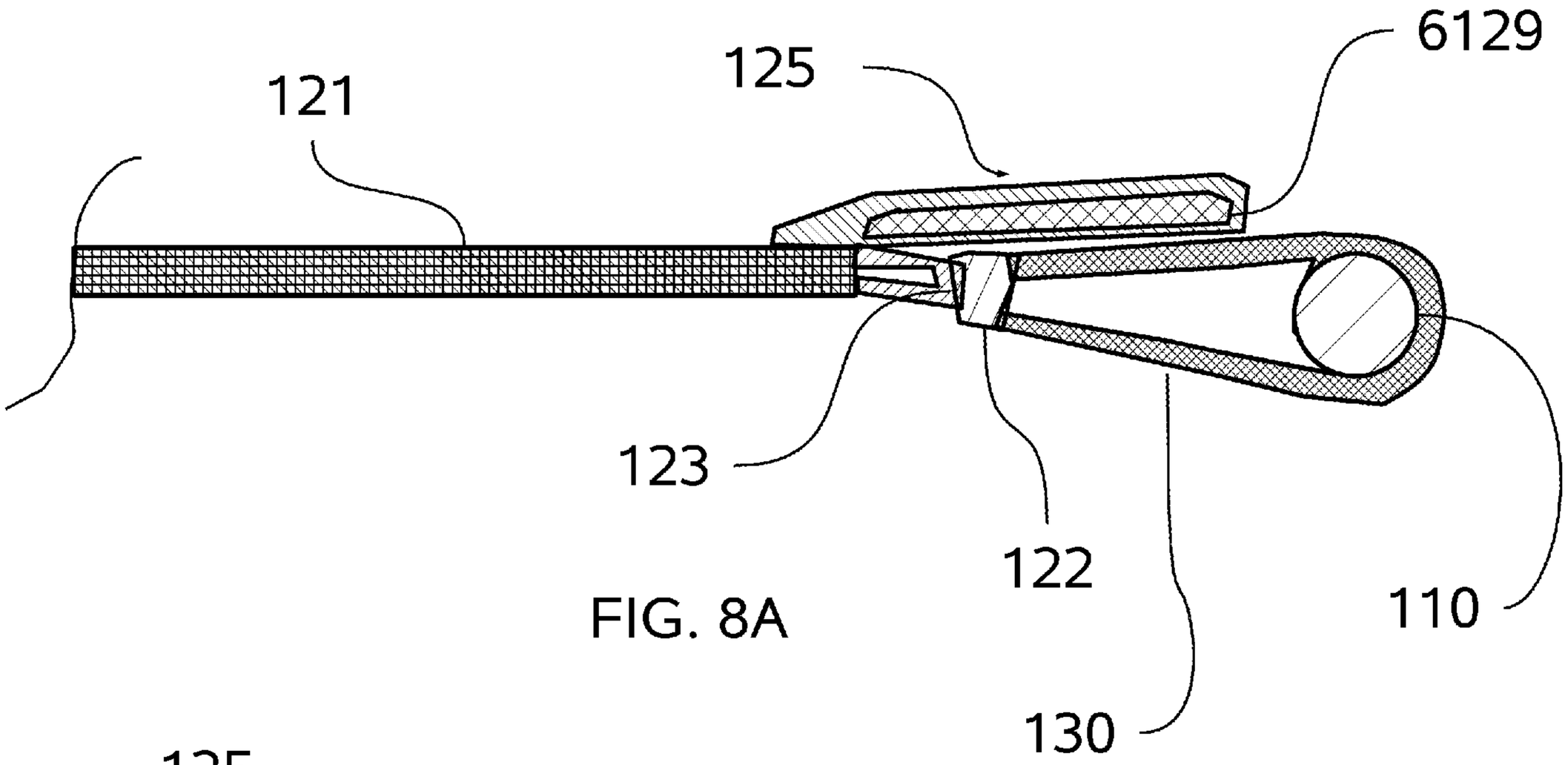

121
125
6129
123
122
130
110

FIG. 8A

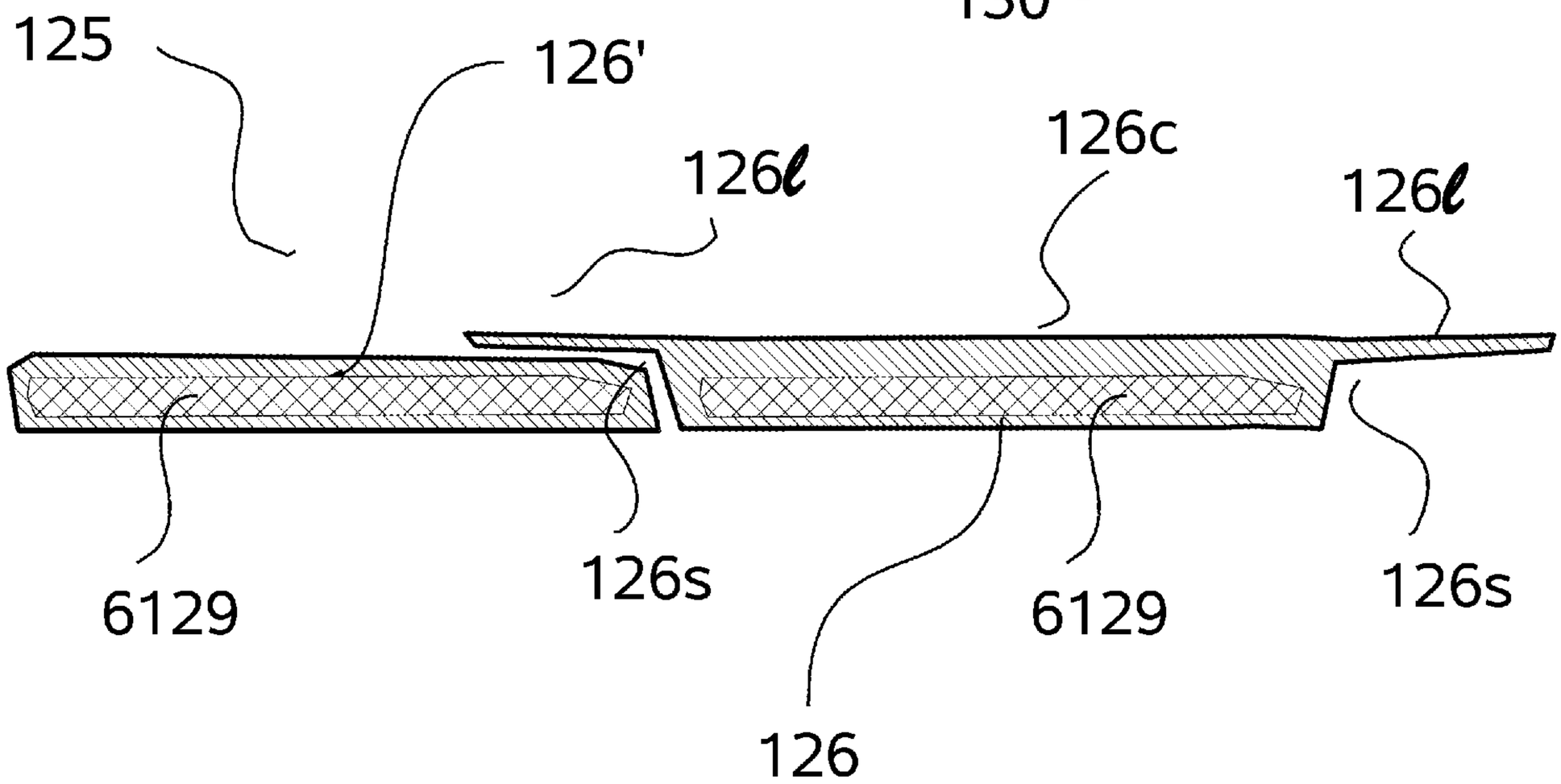

125
126'
126ℓ
126c
126ℓ
6129
126s
6129
126s
126

FIG. 8B

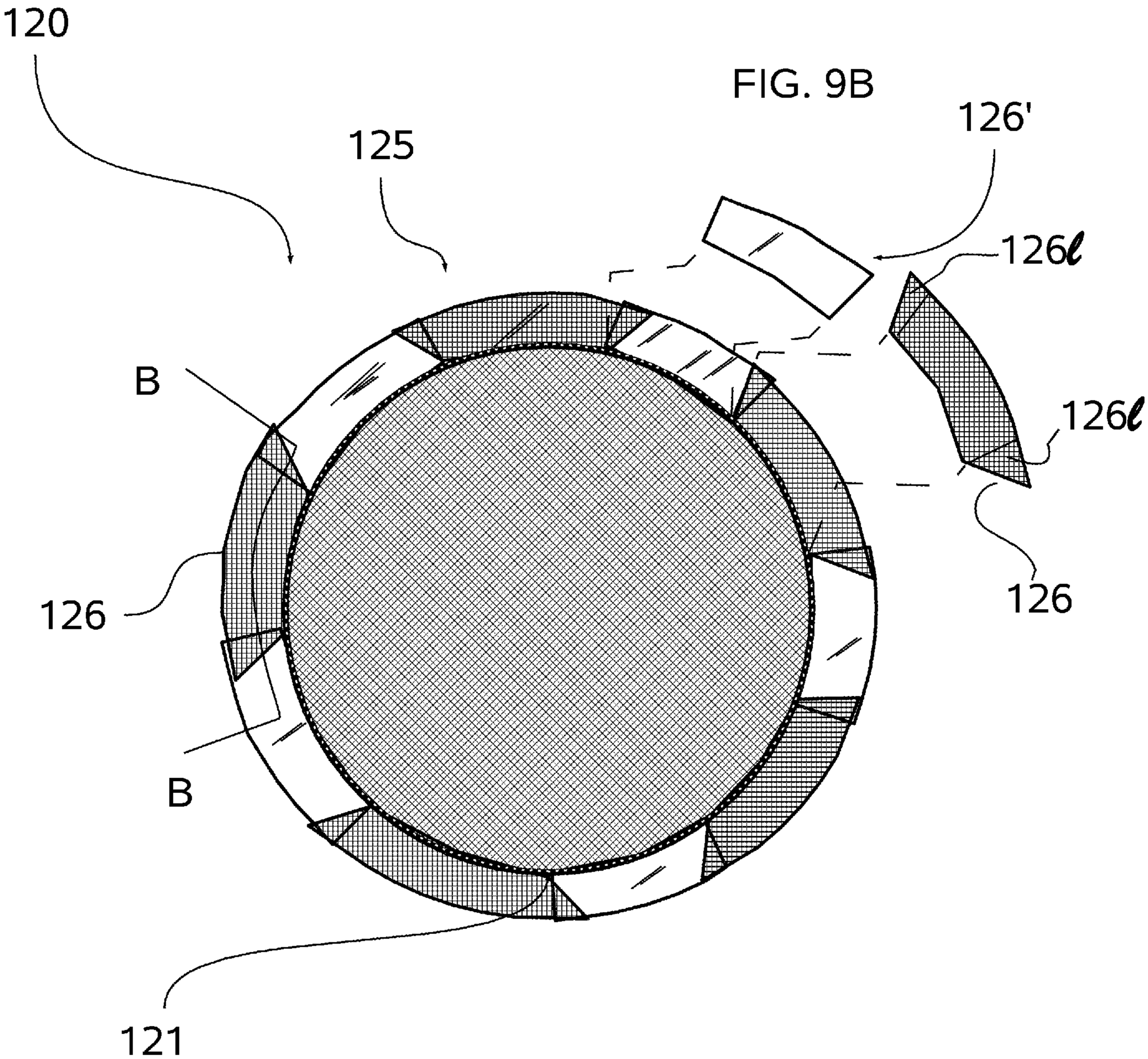
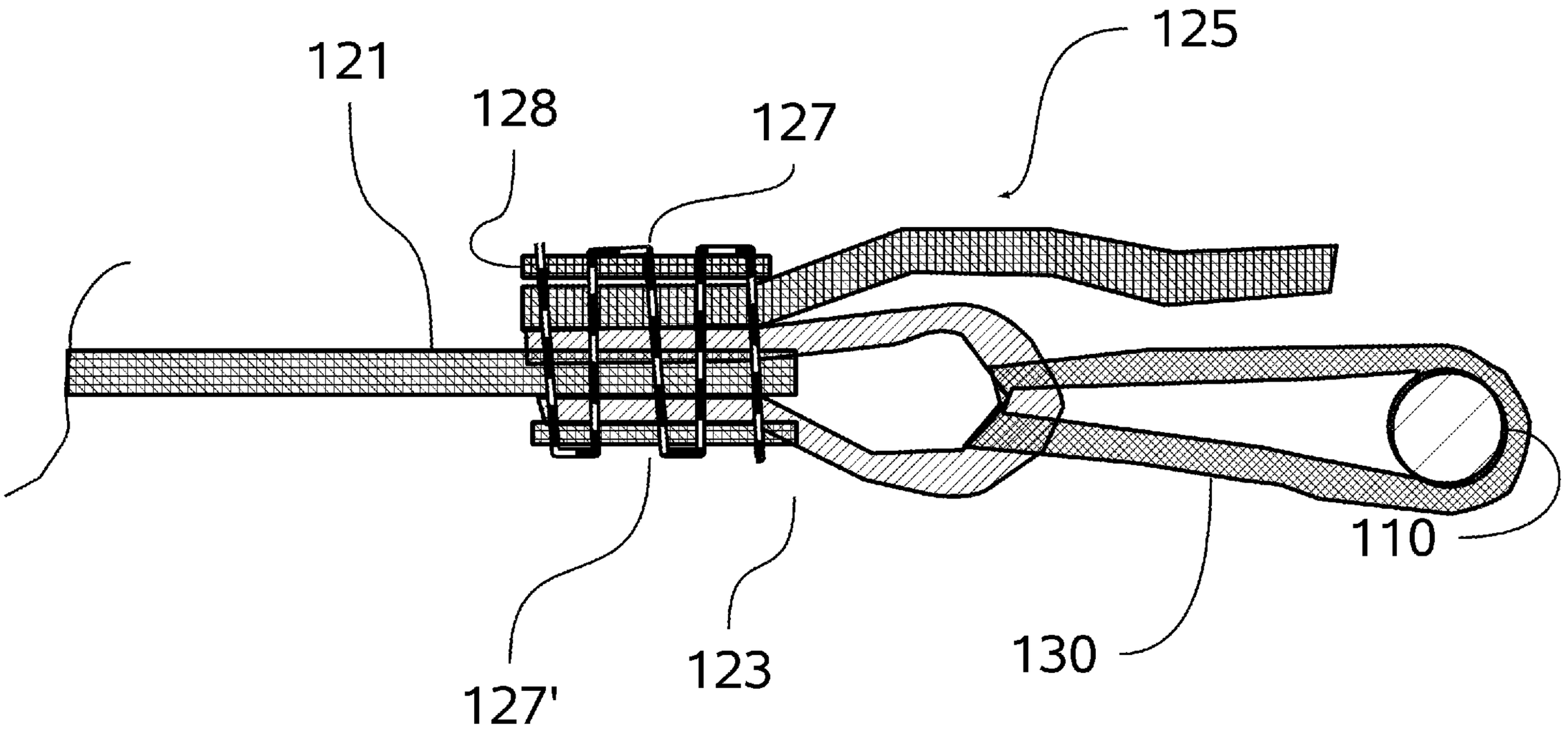


FIG. 9B

FIG. 9A

FIG. 10A



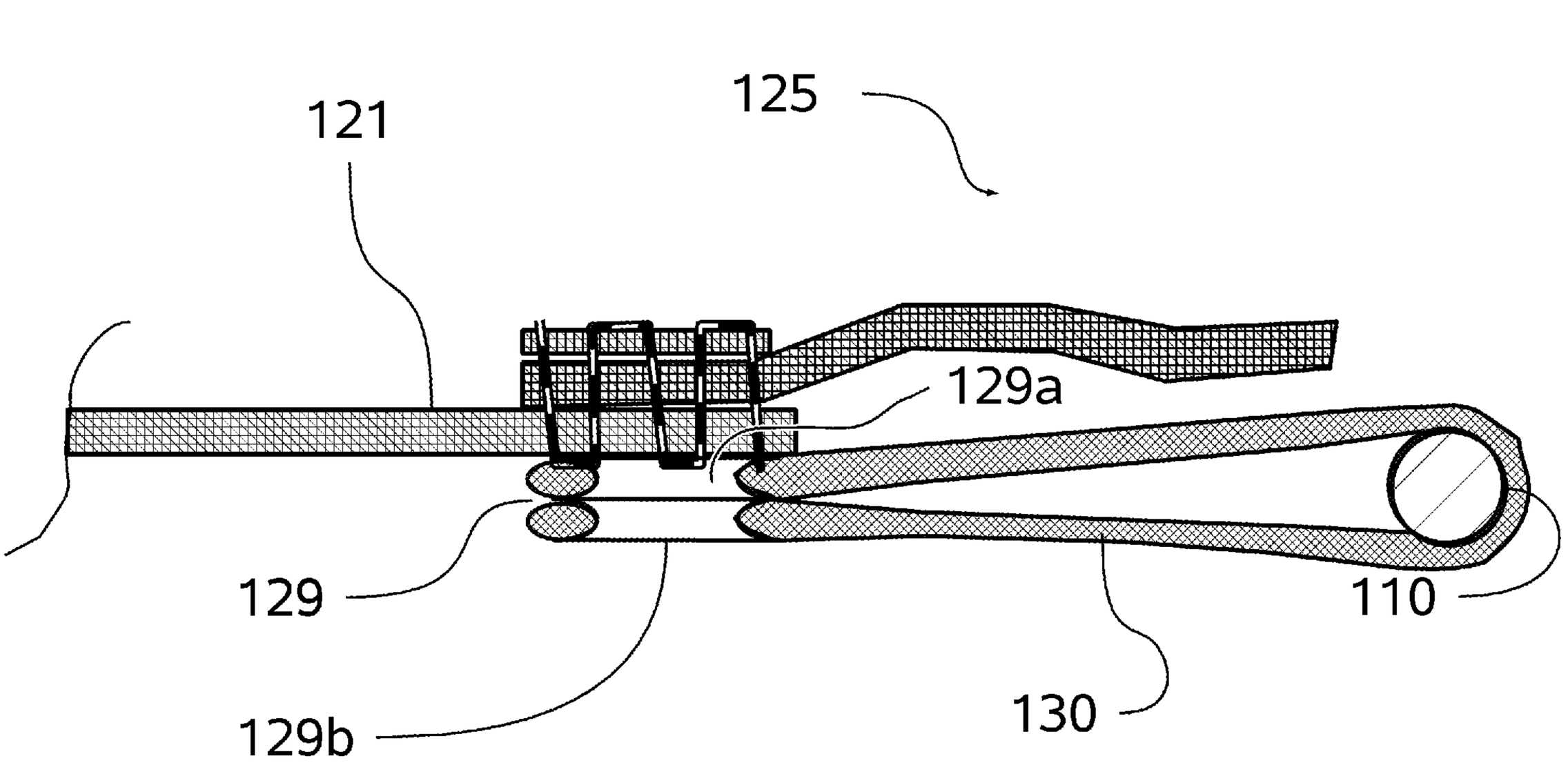


FIG. 10B

FIG. 11A

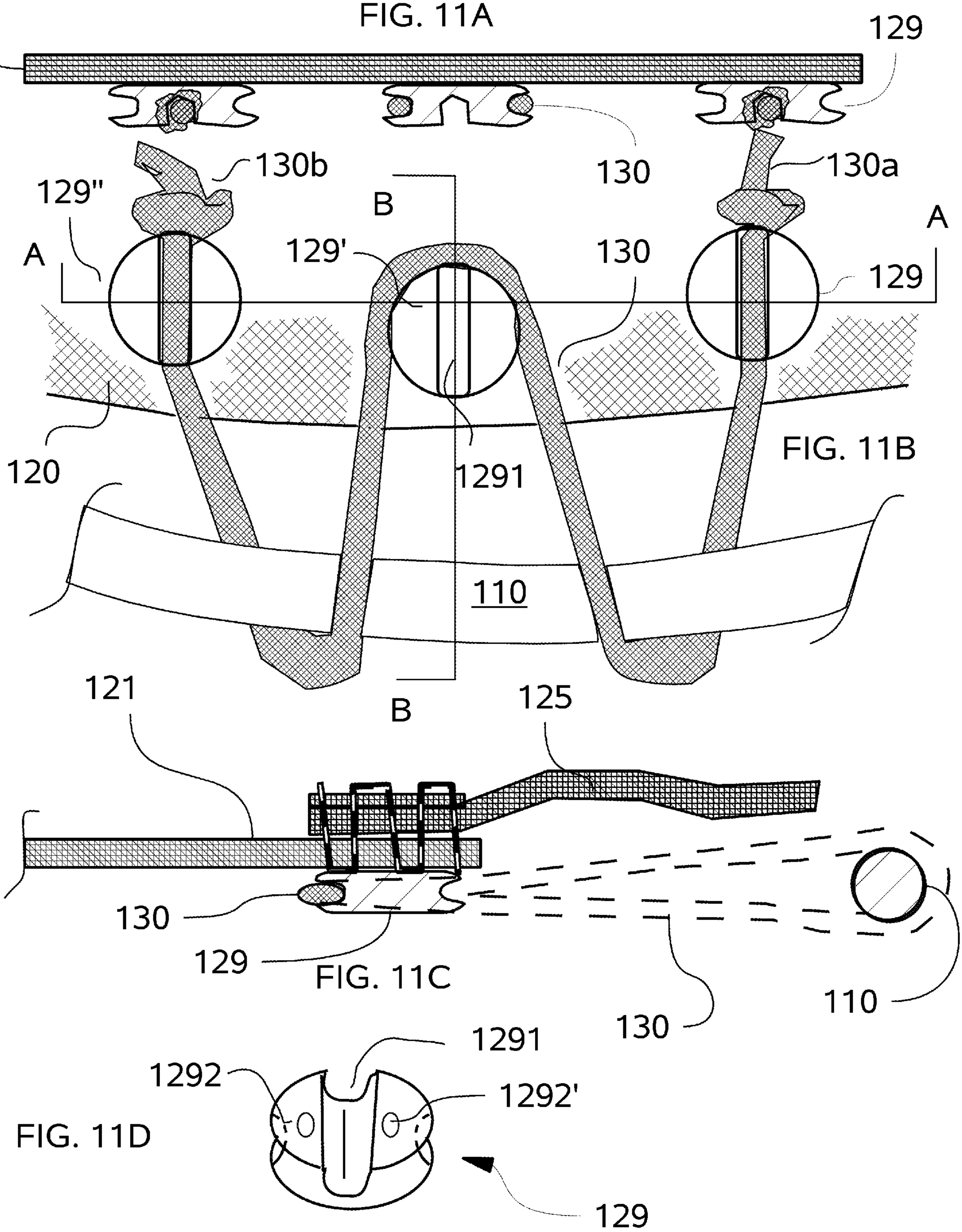


FIG. 11B

FIG. 11C

FIG. 11D

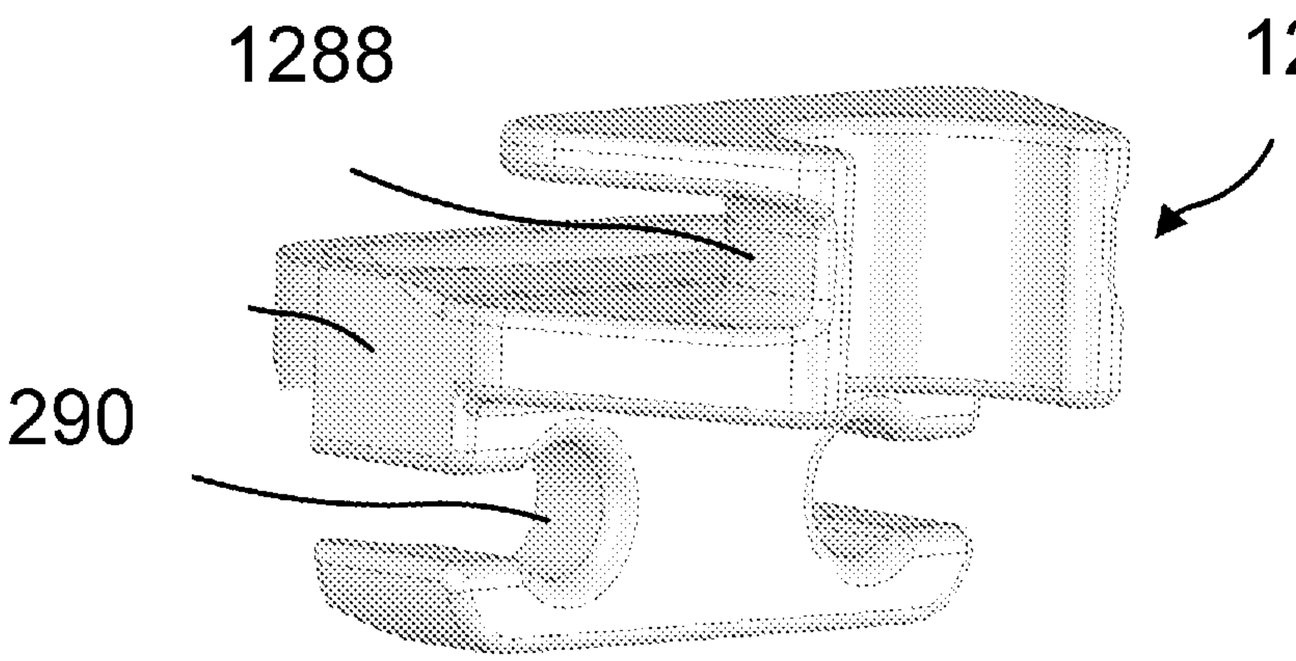


FIG. 12A

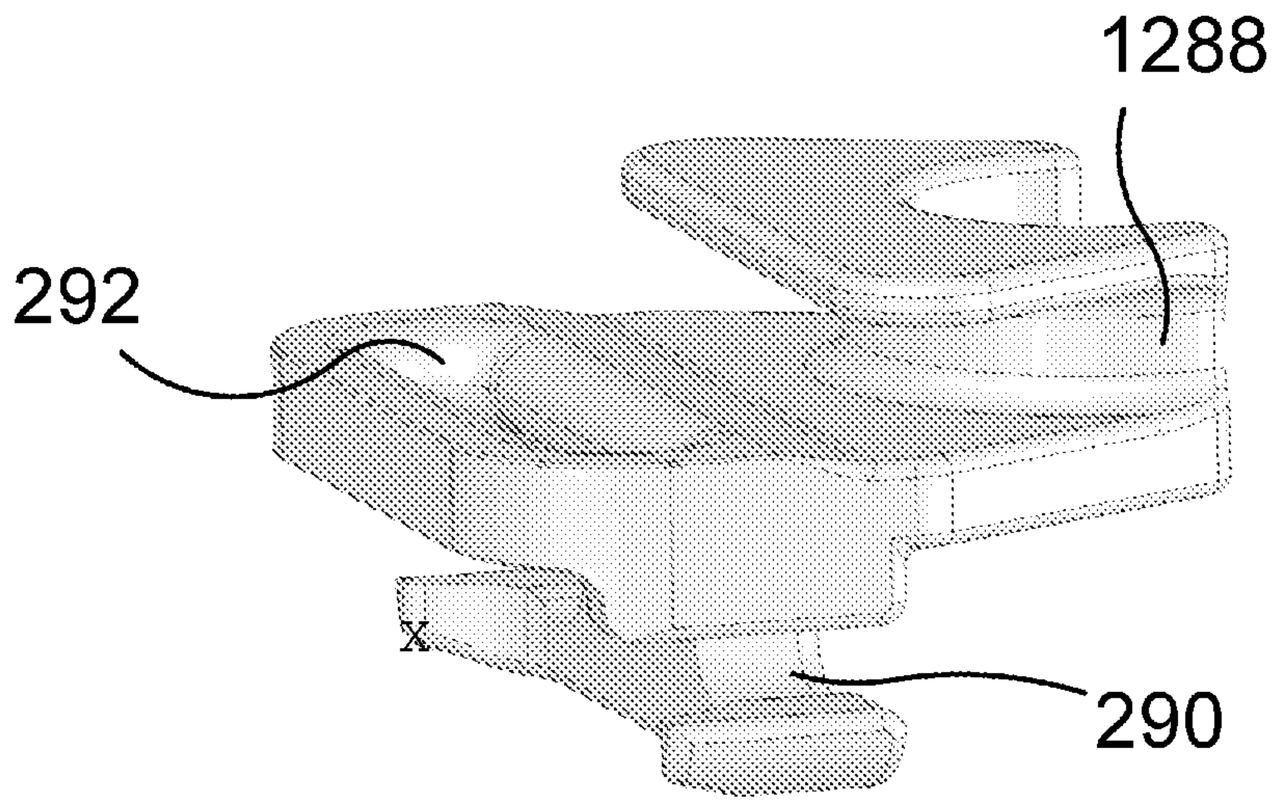


FIG. 12B

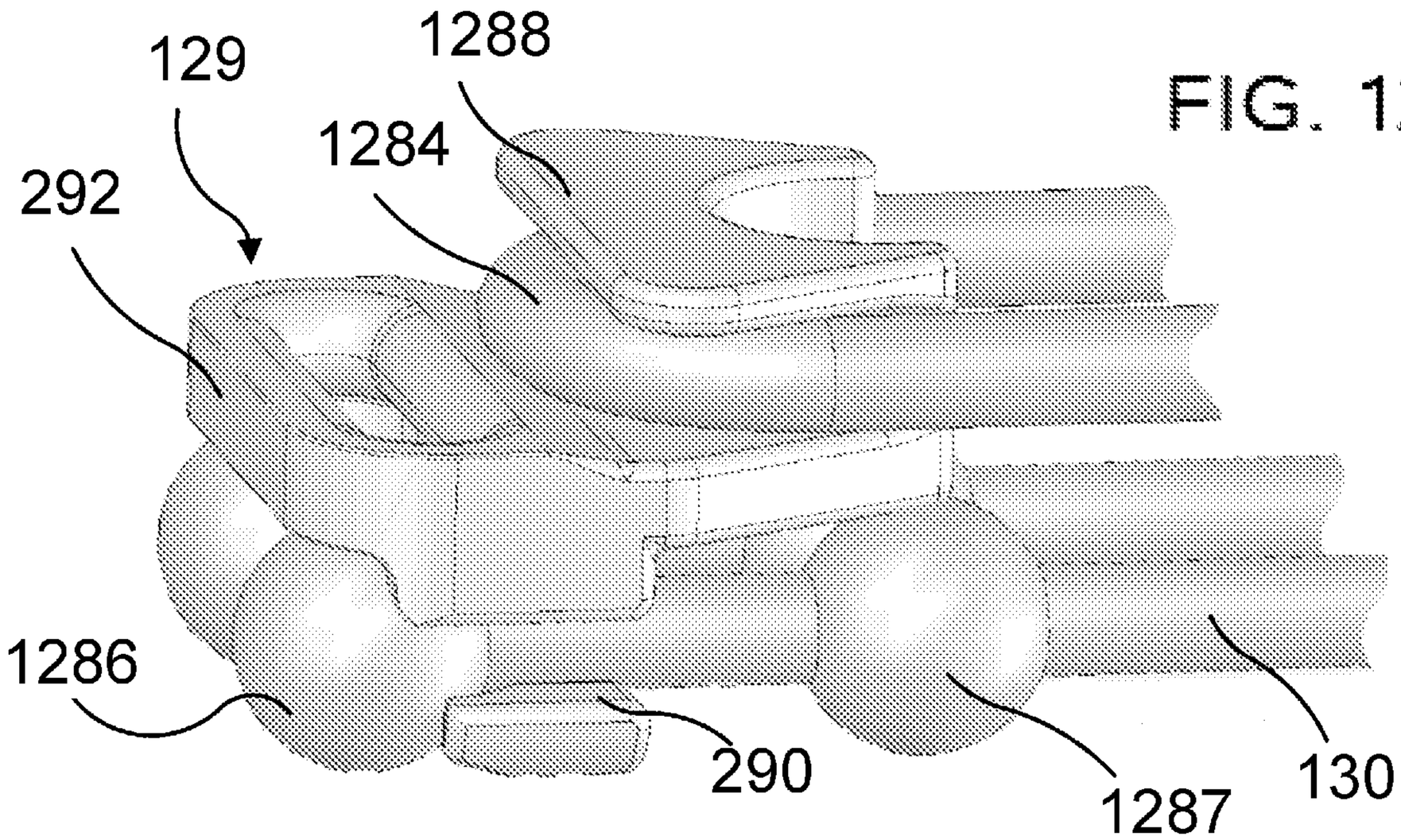


FIG. 12C

FIG. 13A

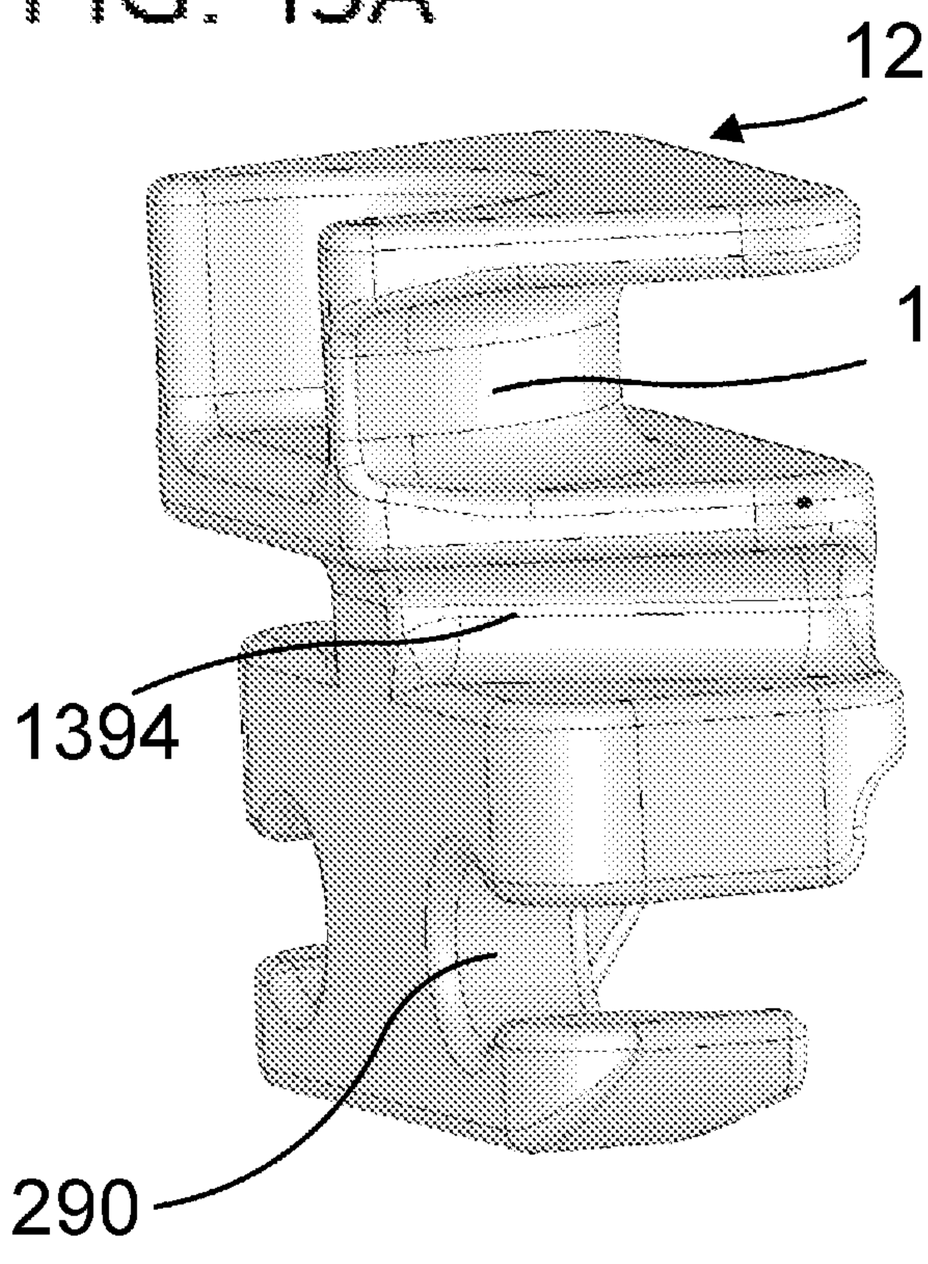
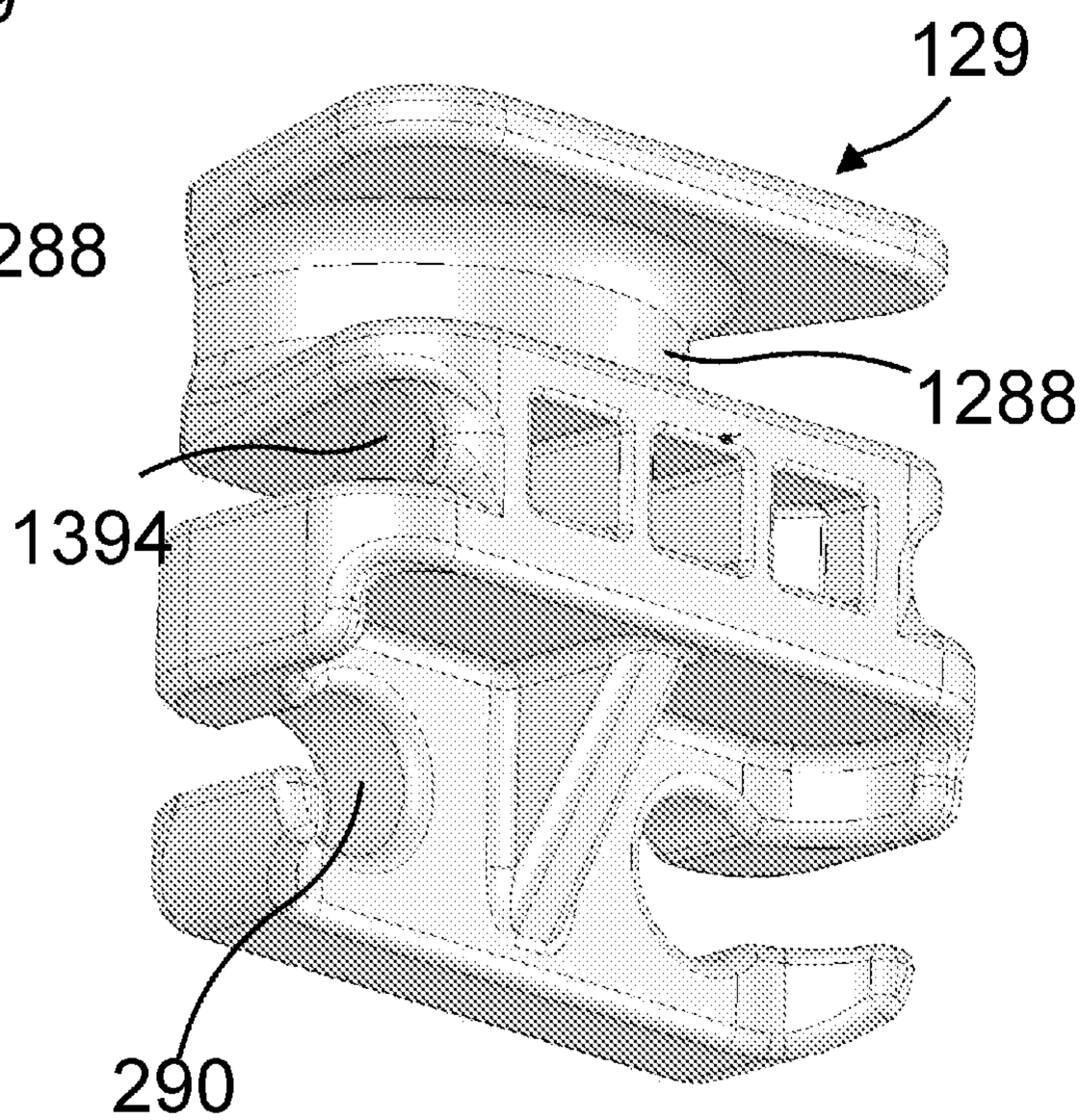


FIG. 13B



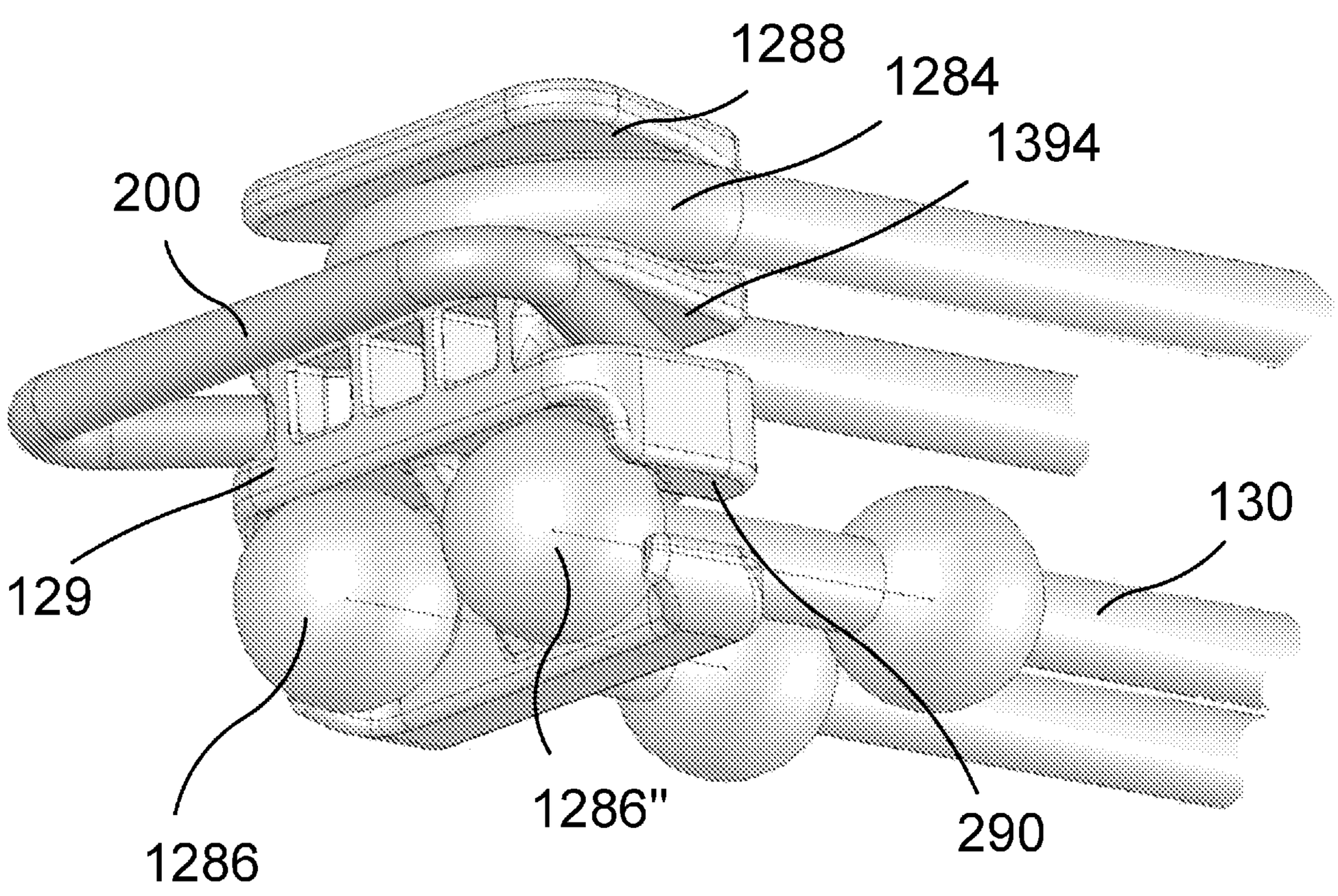


FIG. 13C

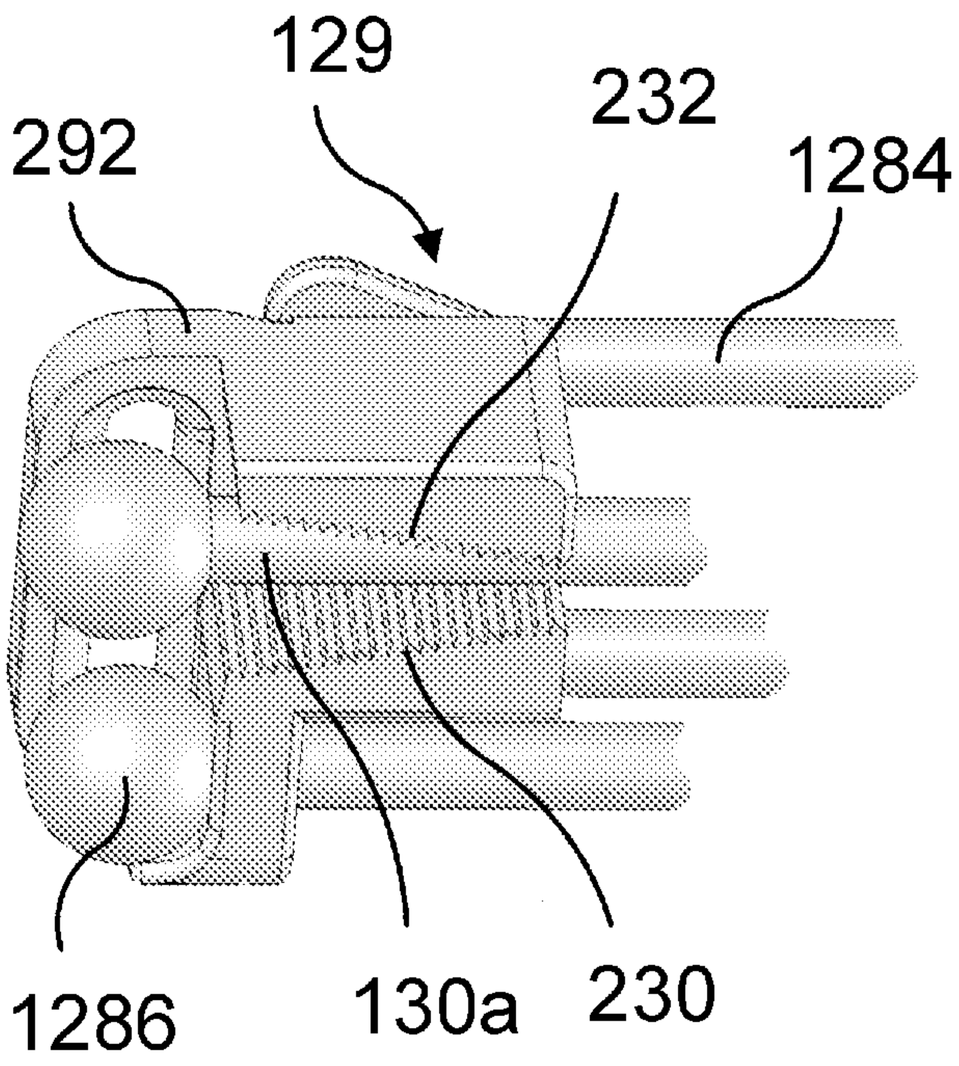


FIG. 14A

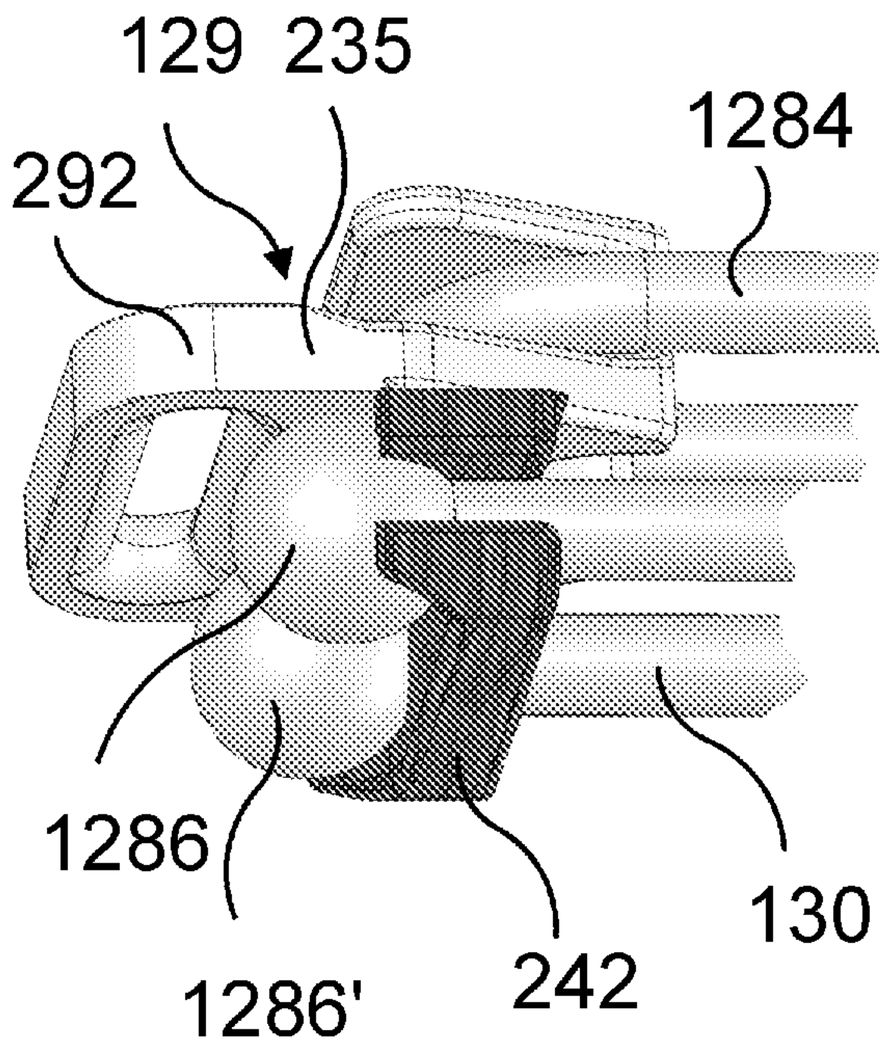


FIG. 14B

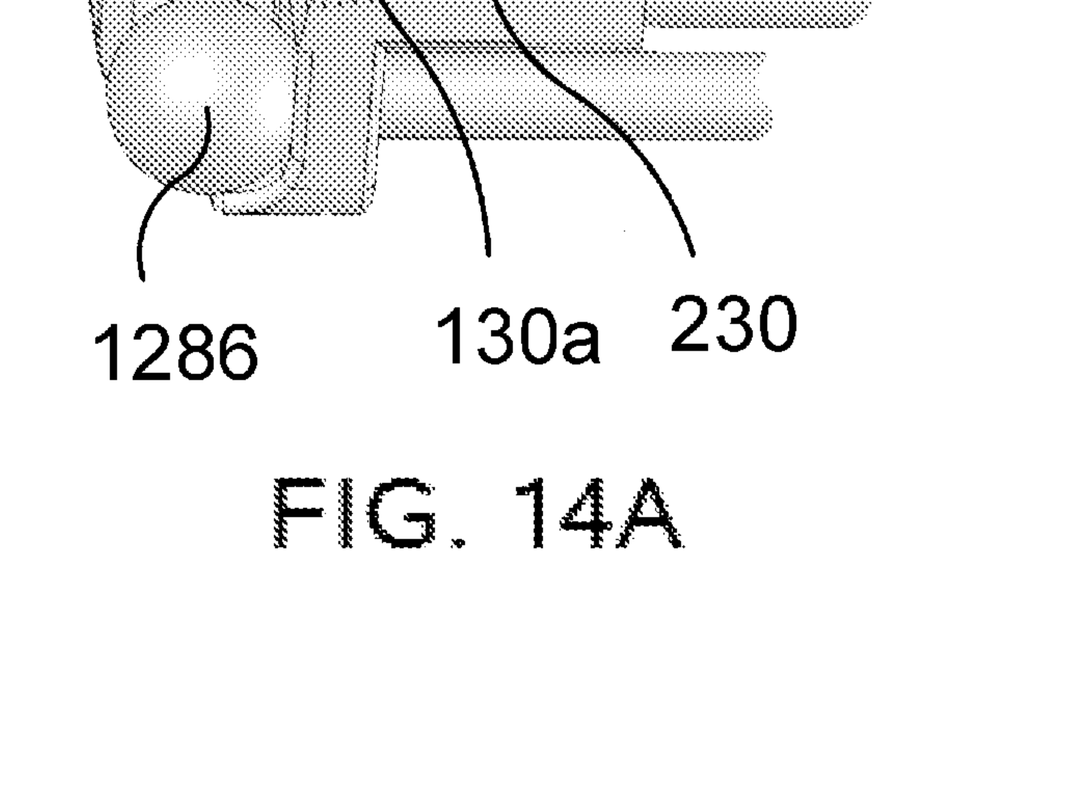


FIG. 14C

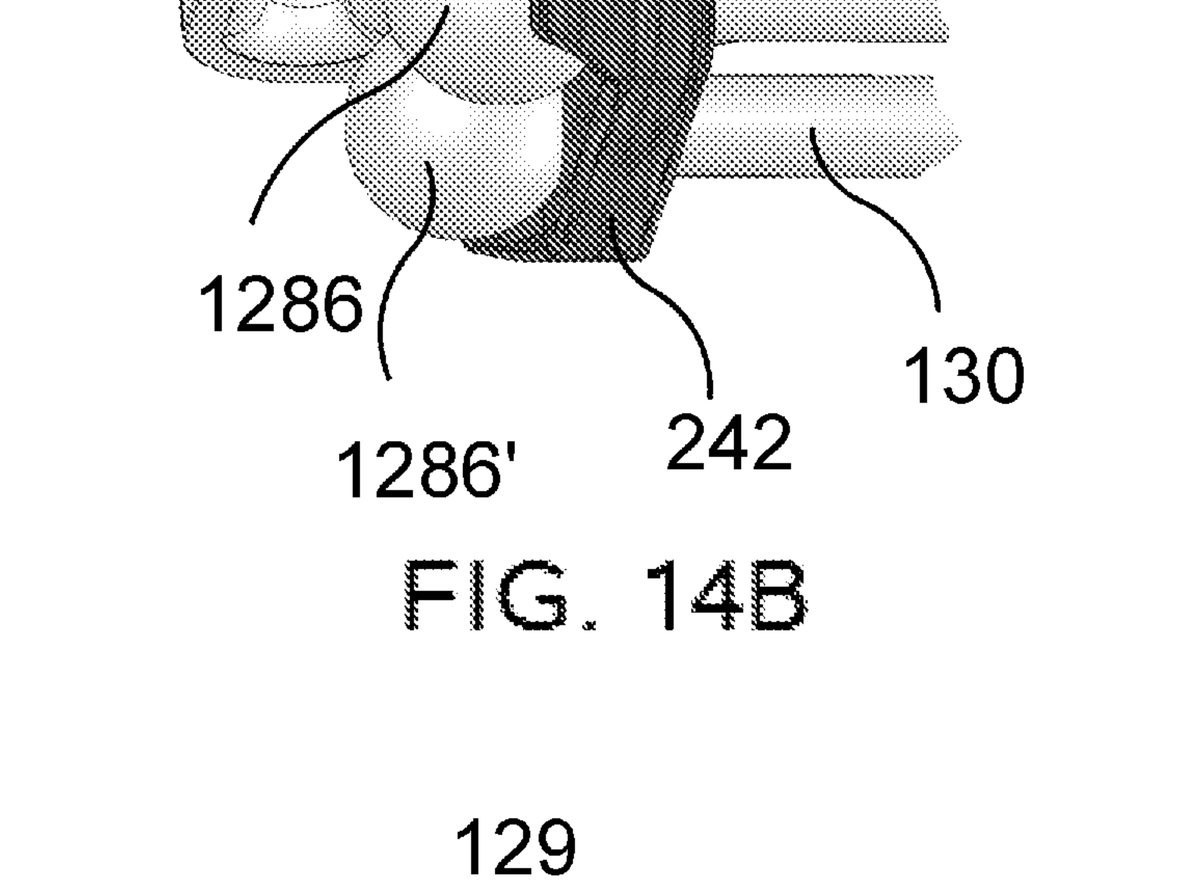


FIG. 14D

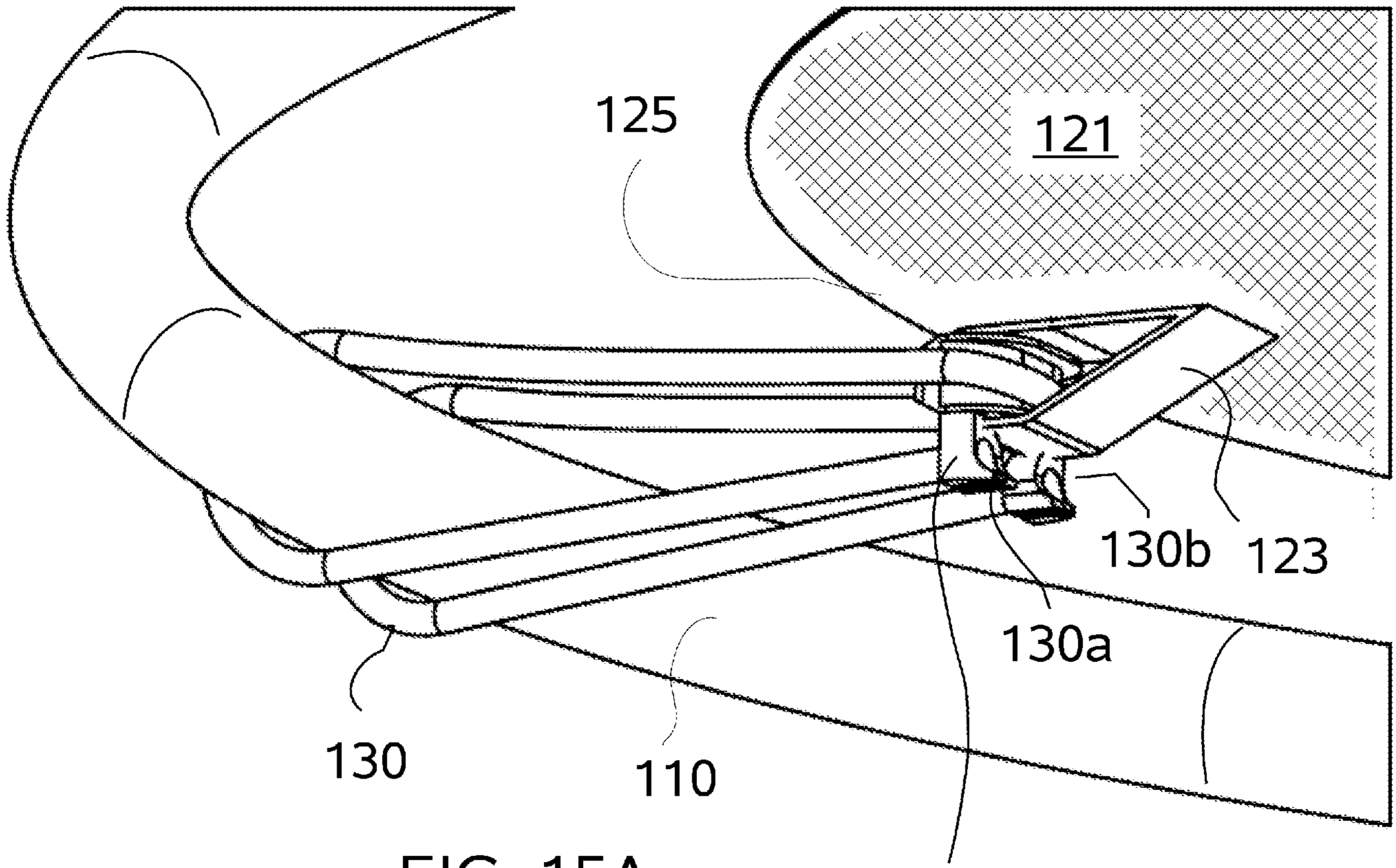


FIG. 15A

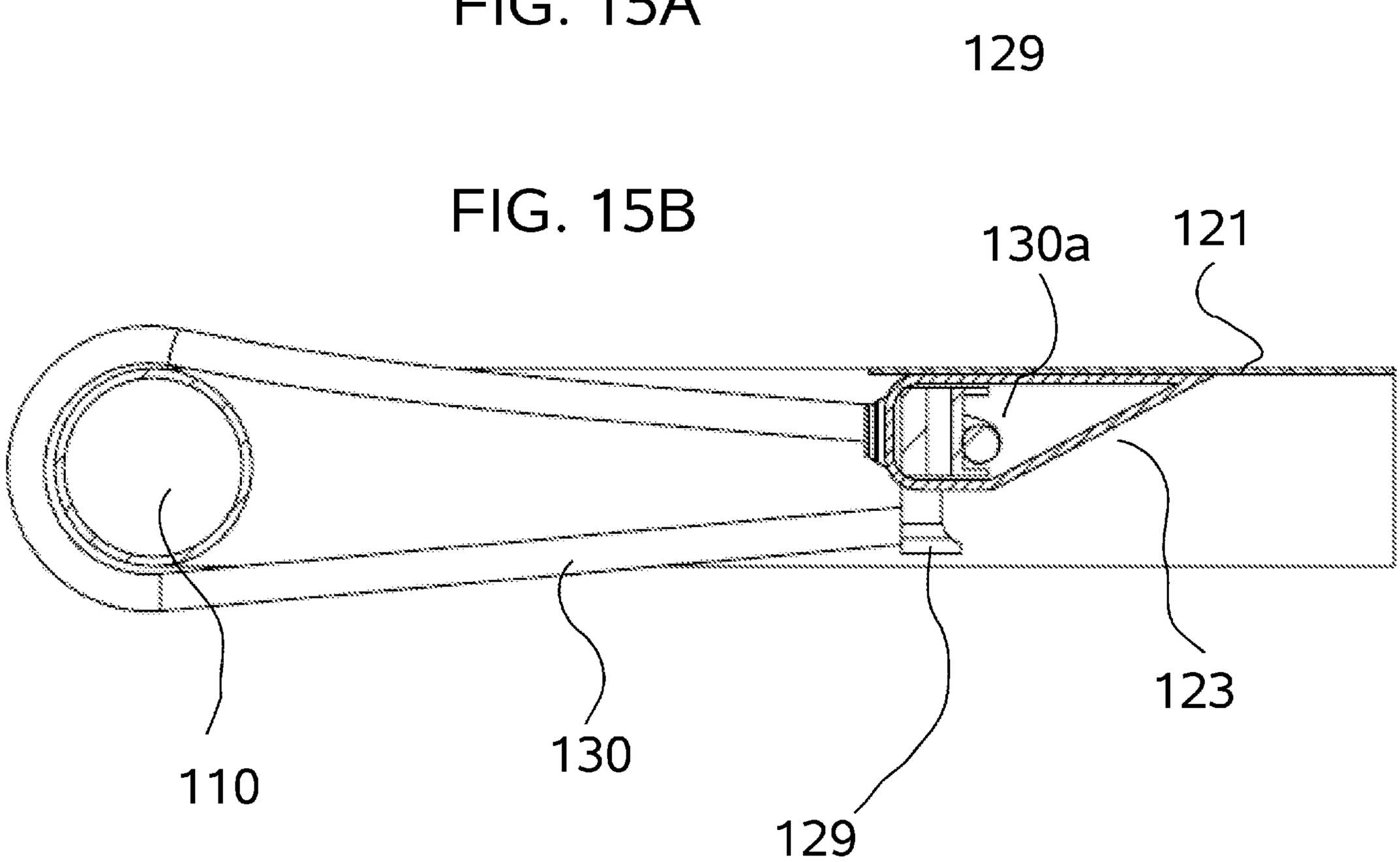
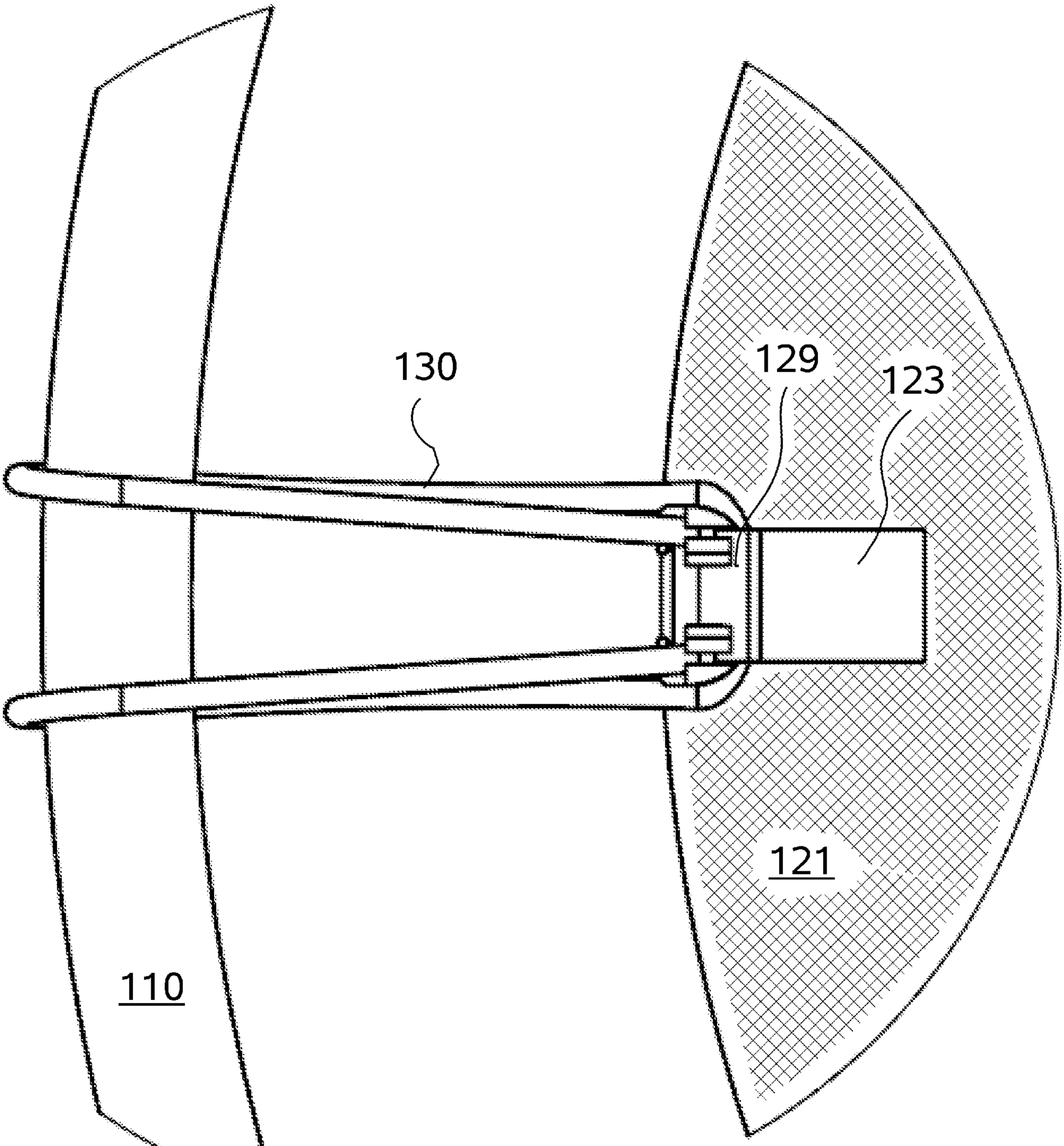


FIG. 15B

FIG. 15C



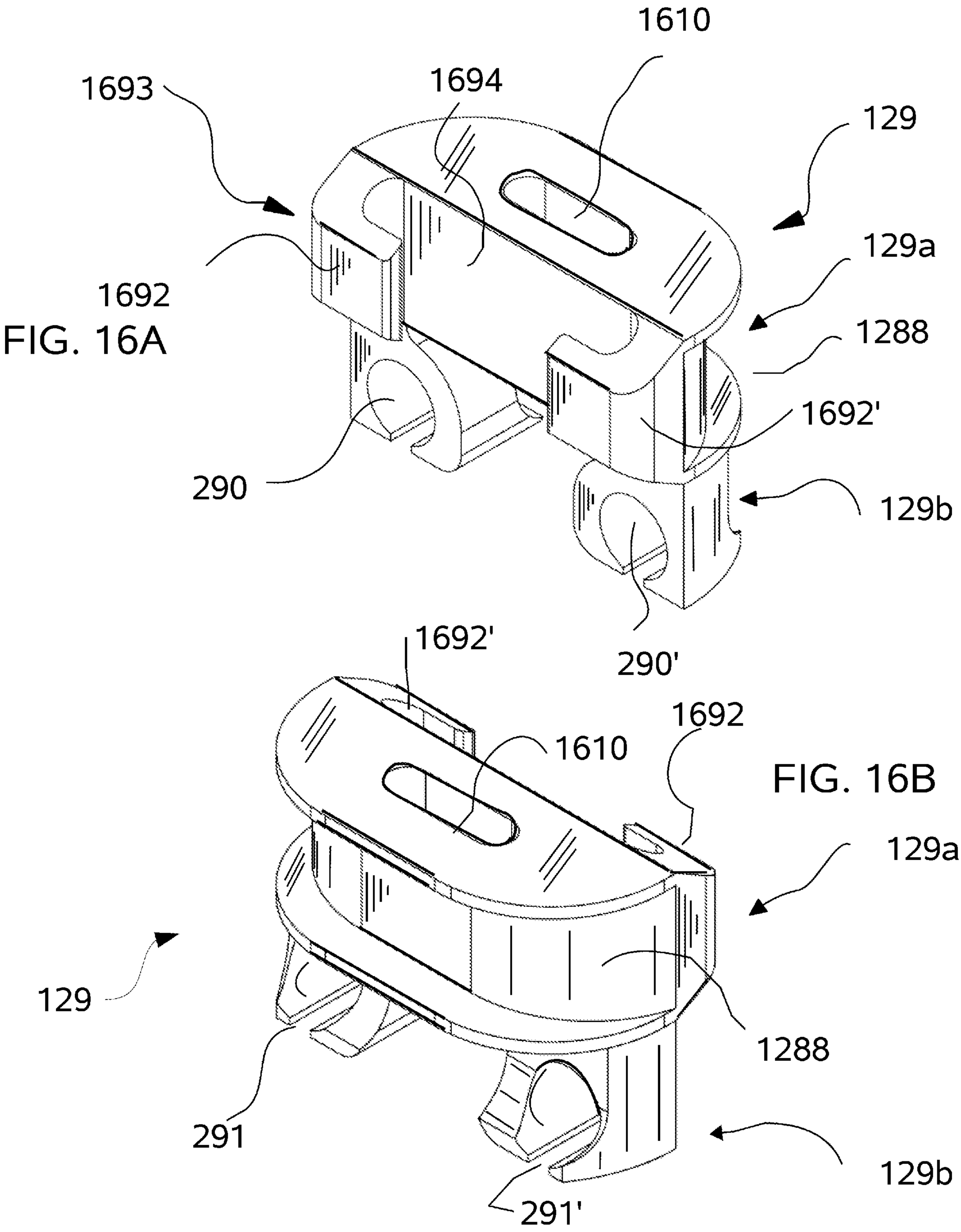
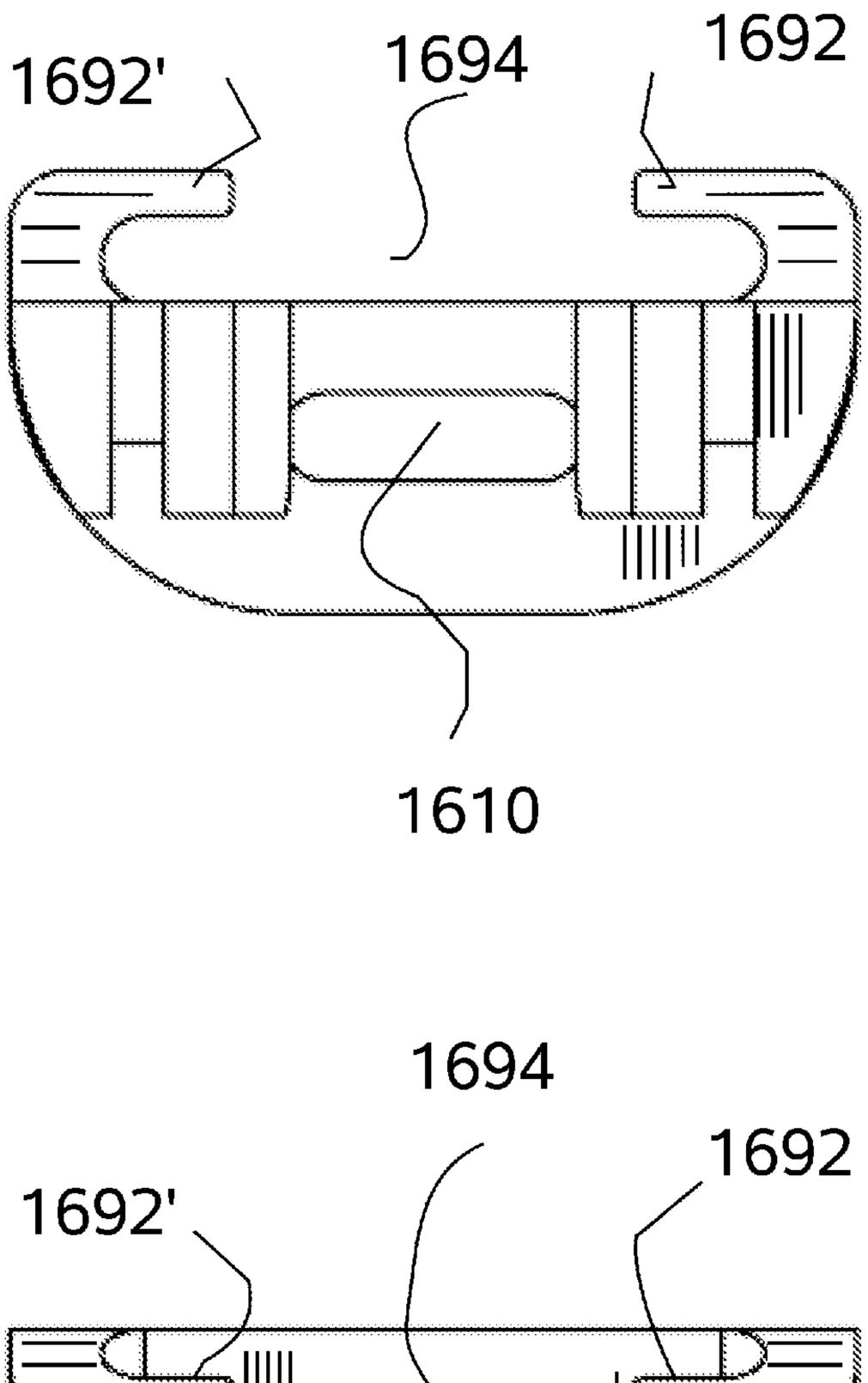


FIG. 16A

FIG. 16B


1692'
1694
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1610
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1692'
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290
290'
291
291'

FIG. 17A

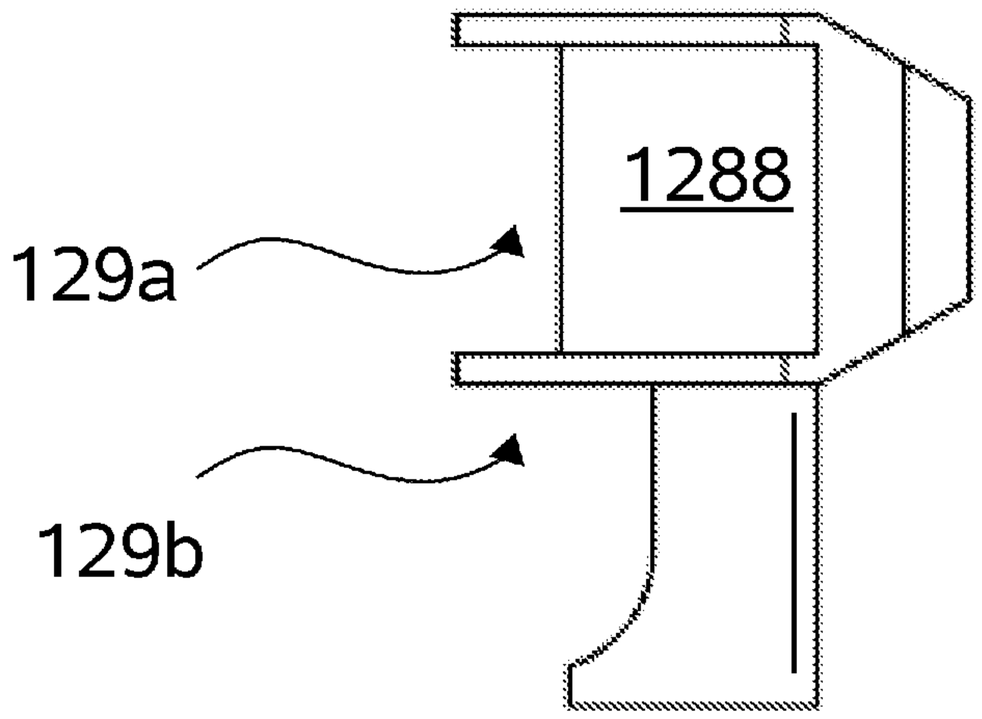

1288
129a
129b

FIG. 18A

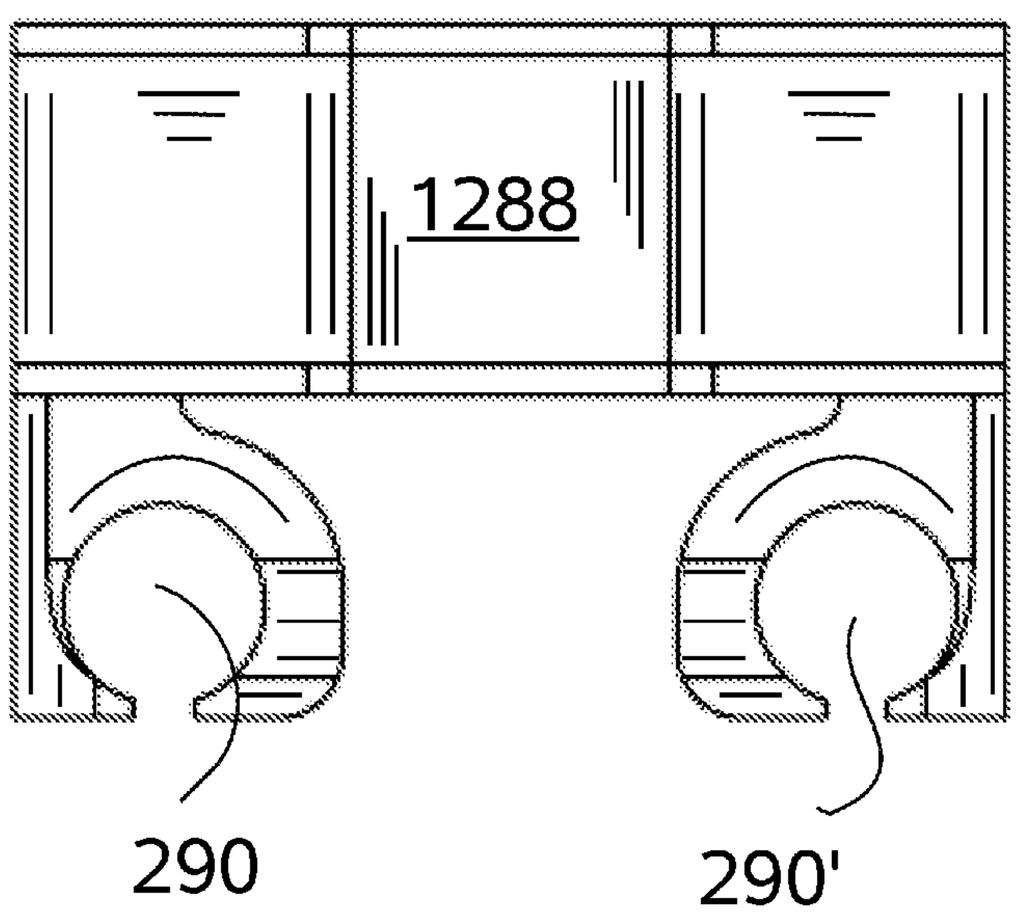
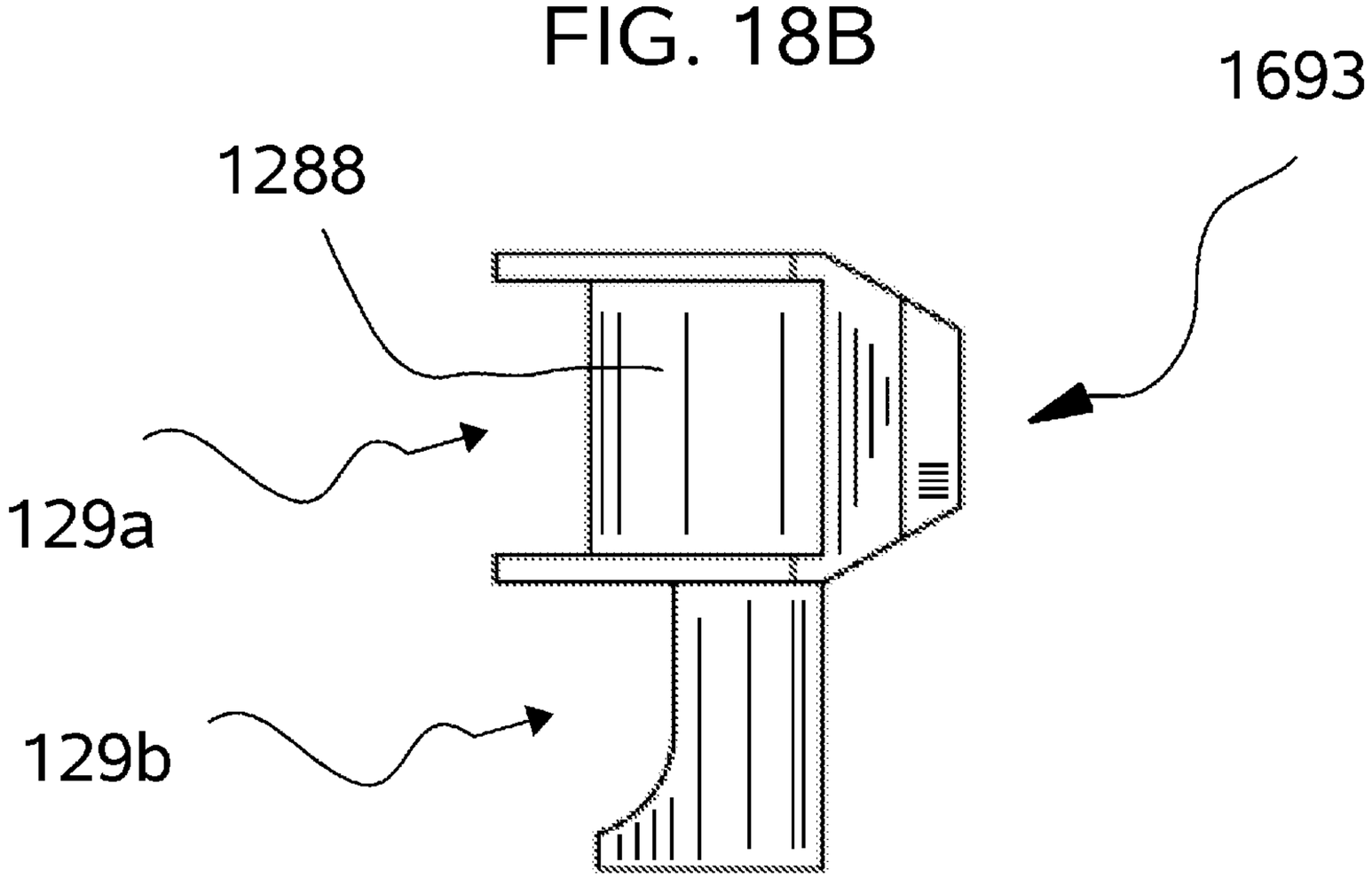


FIG. 18B



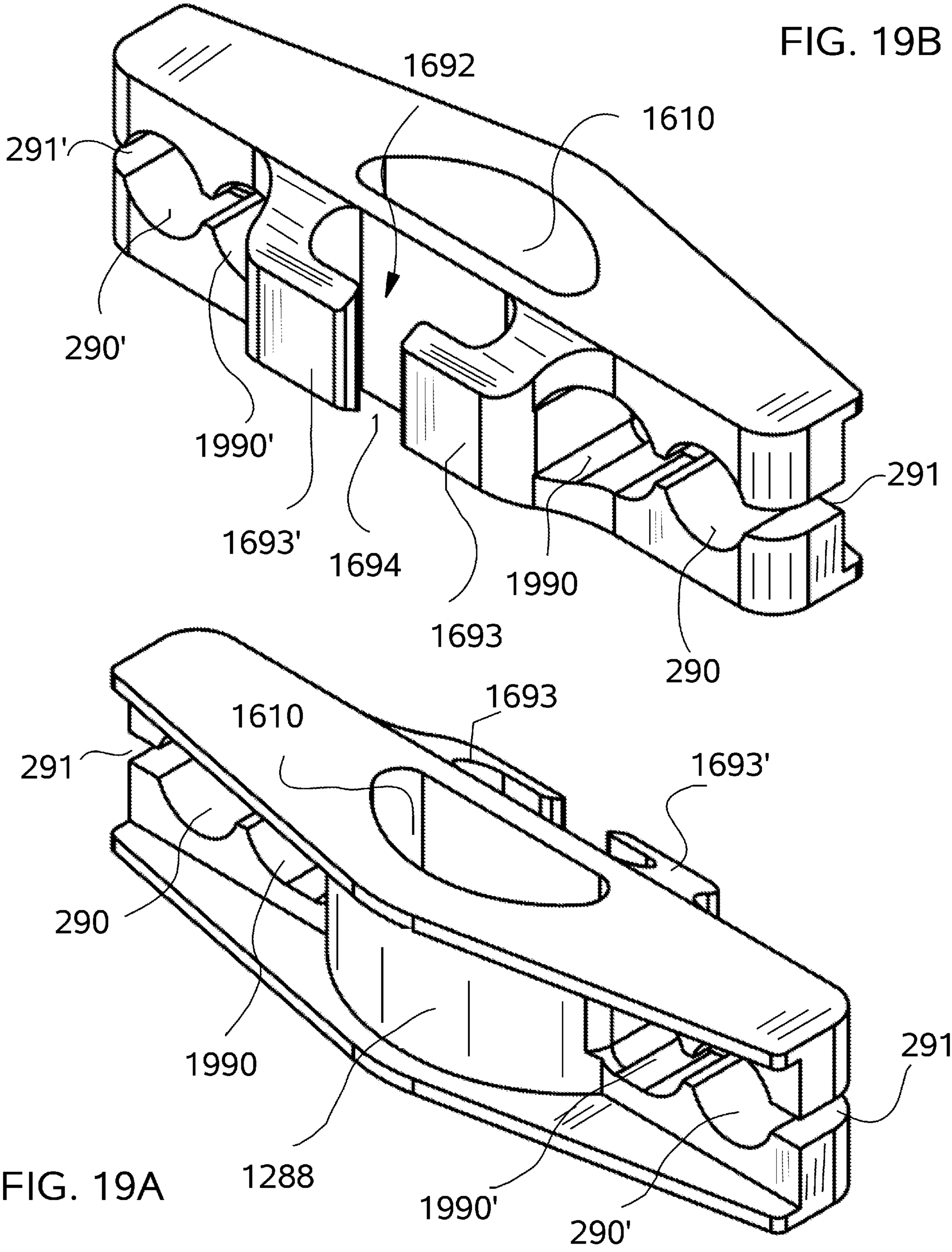
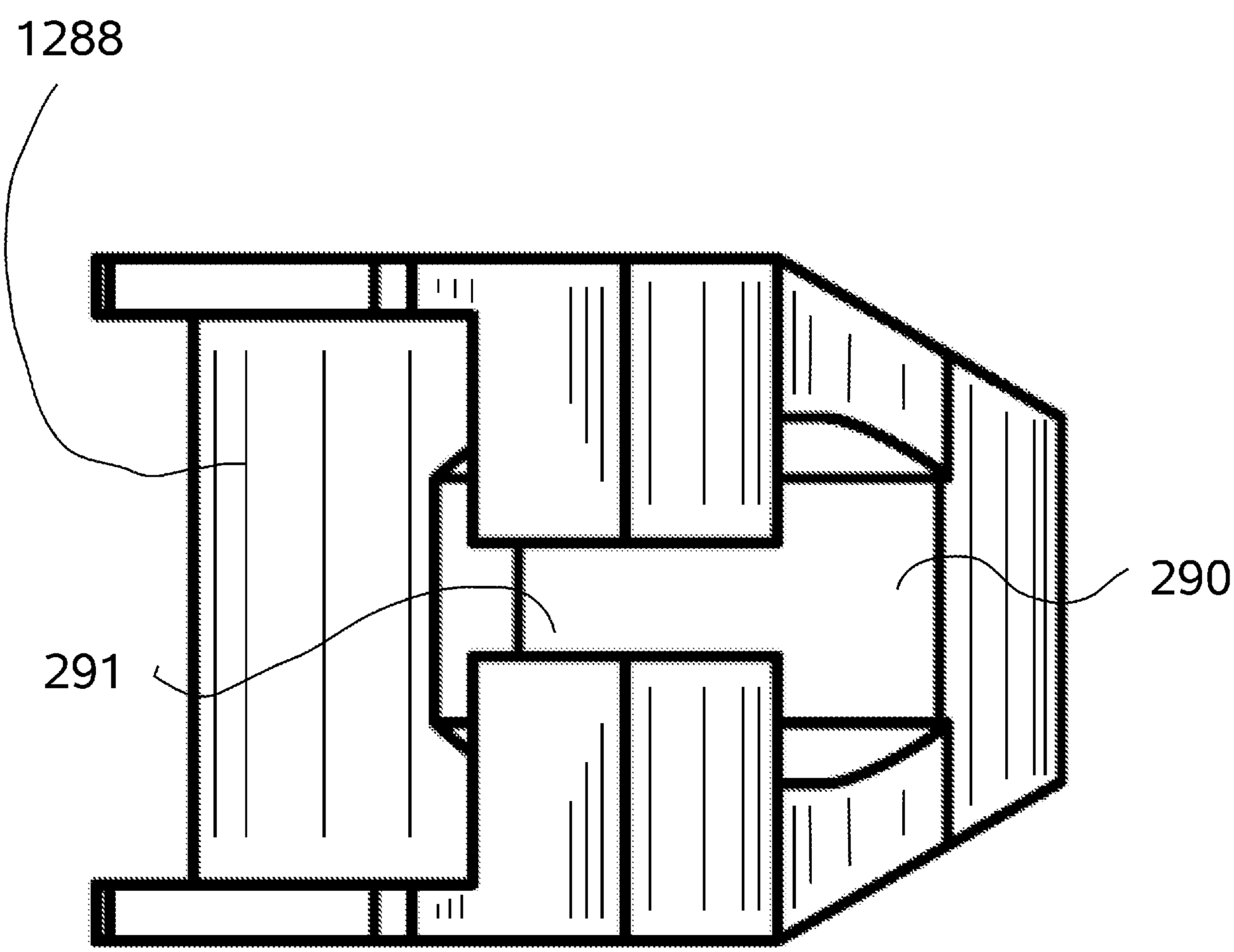


FIG. 19A

FIG. 19B

FIG. 20



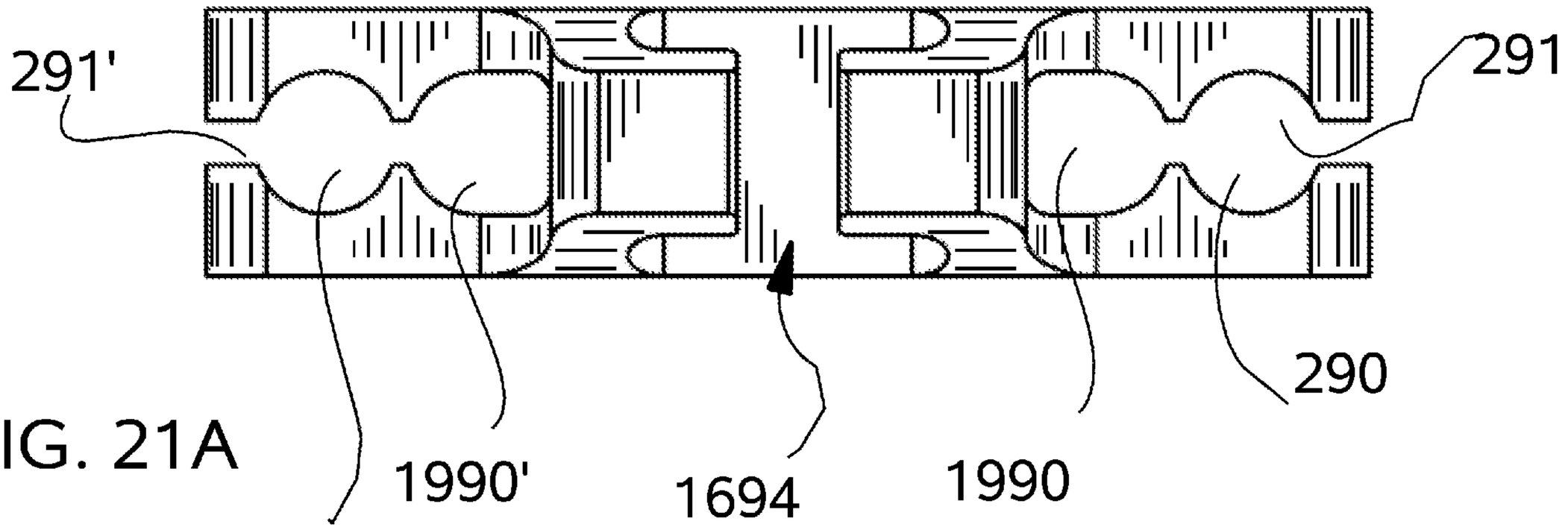
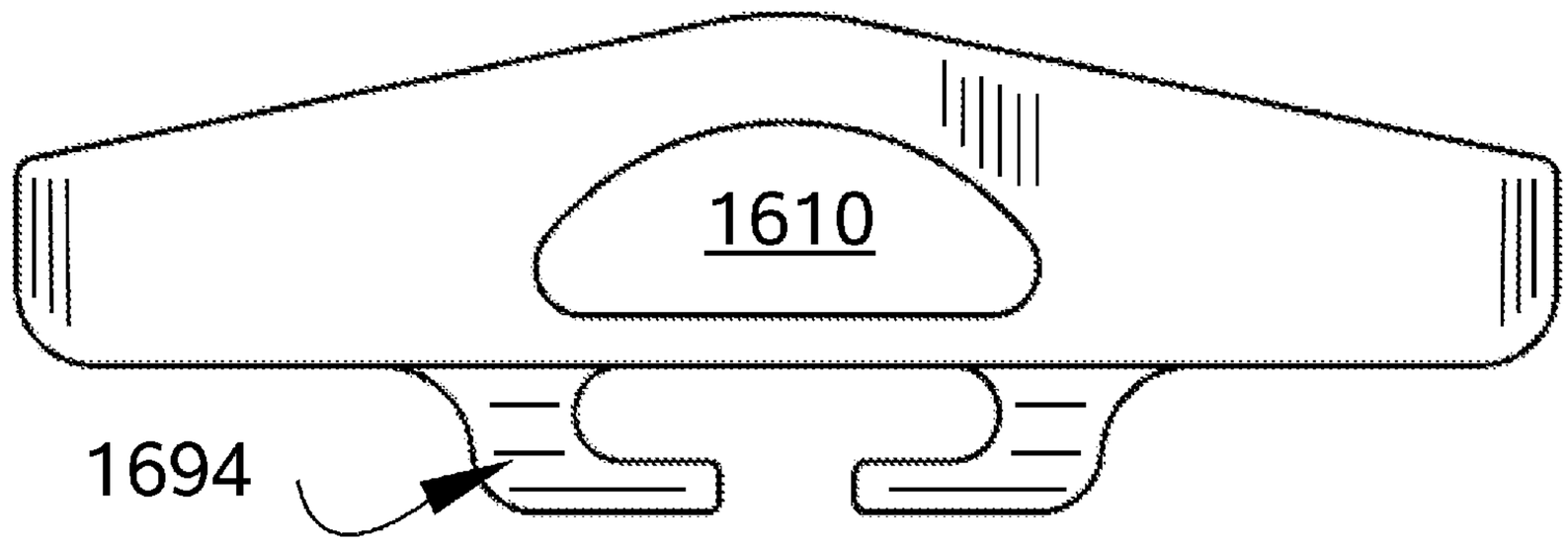


FIG. 21A

FIG. 21B



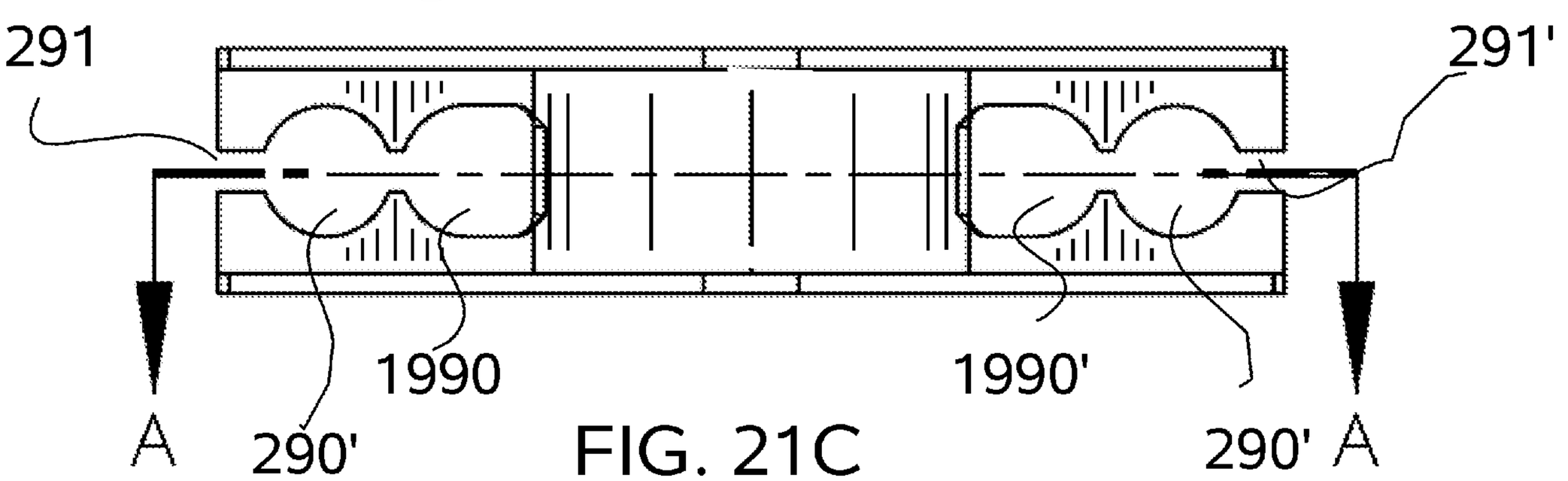


FIG. 21C

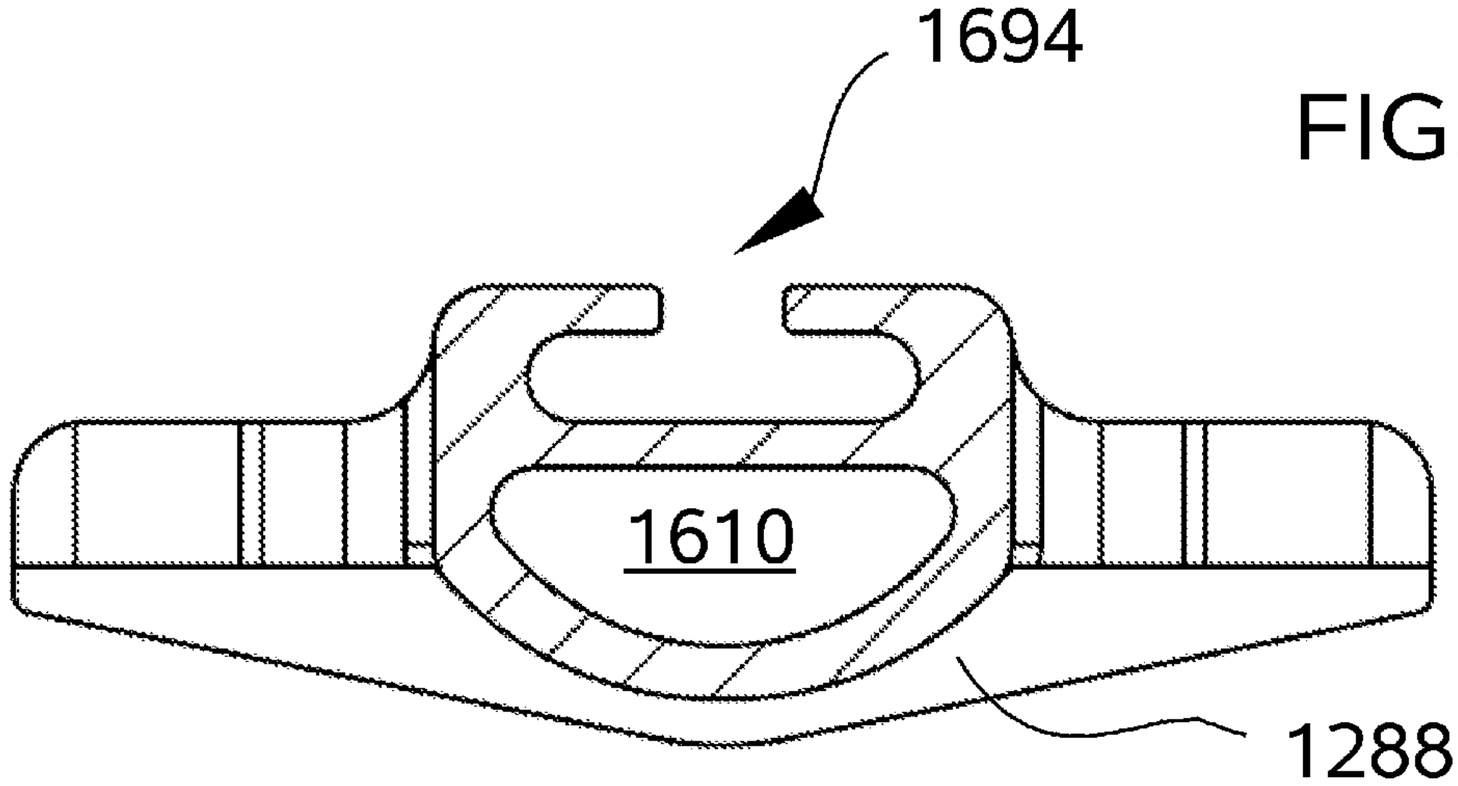


FIG. 21D

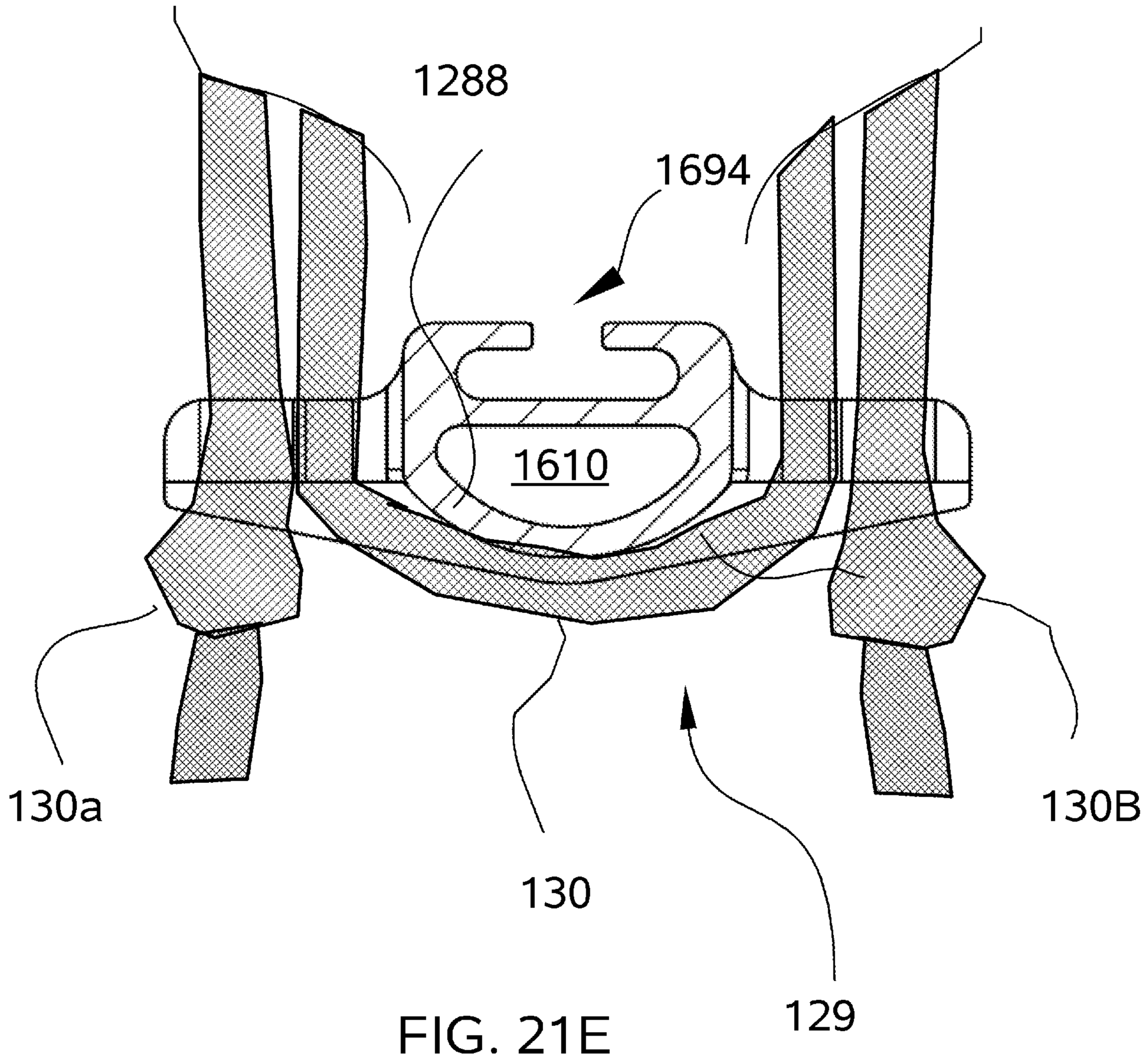


FIG. 21E

FIG. 22

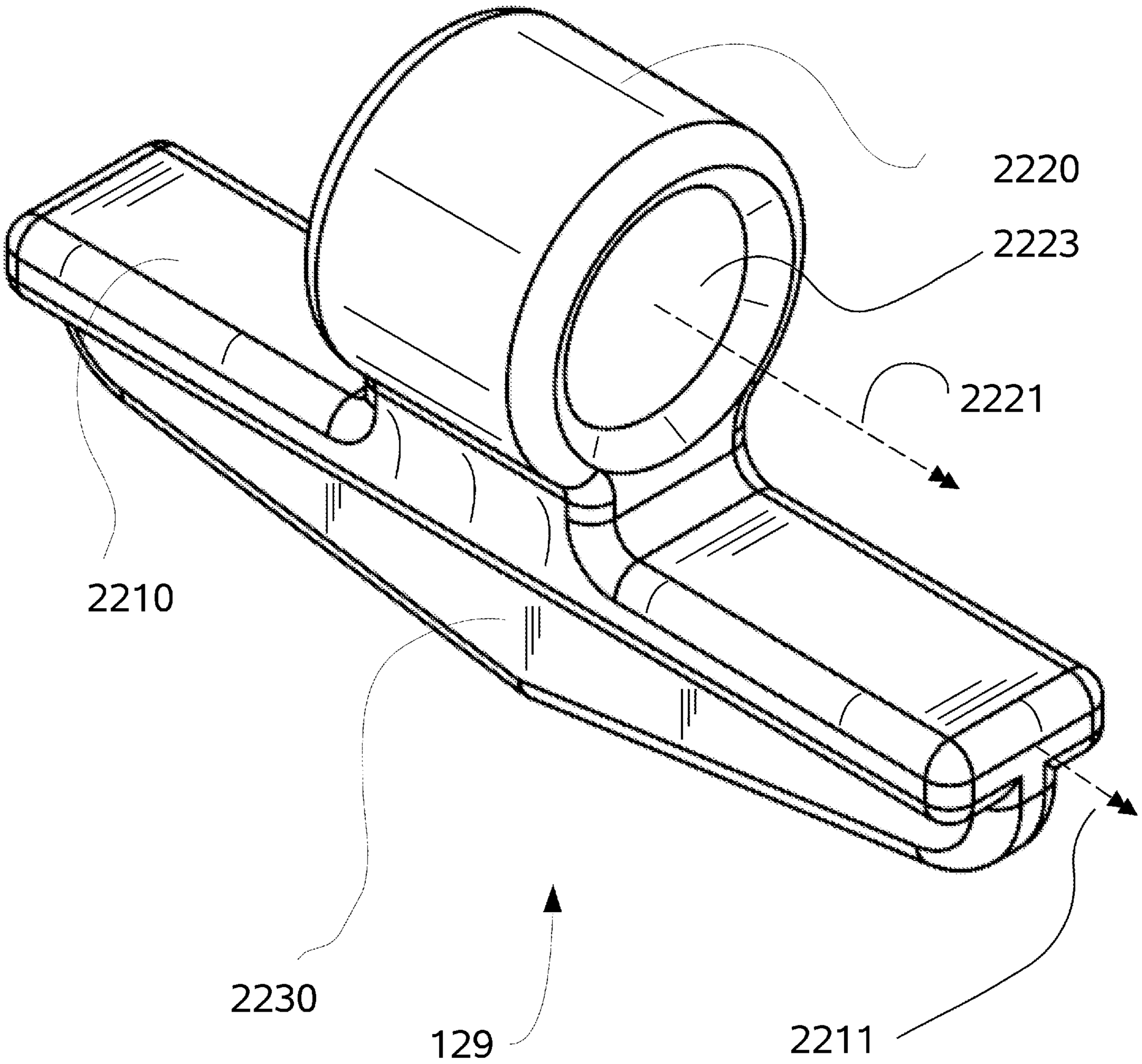


FIG. 23A

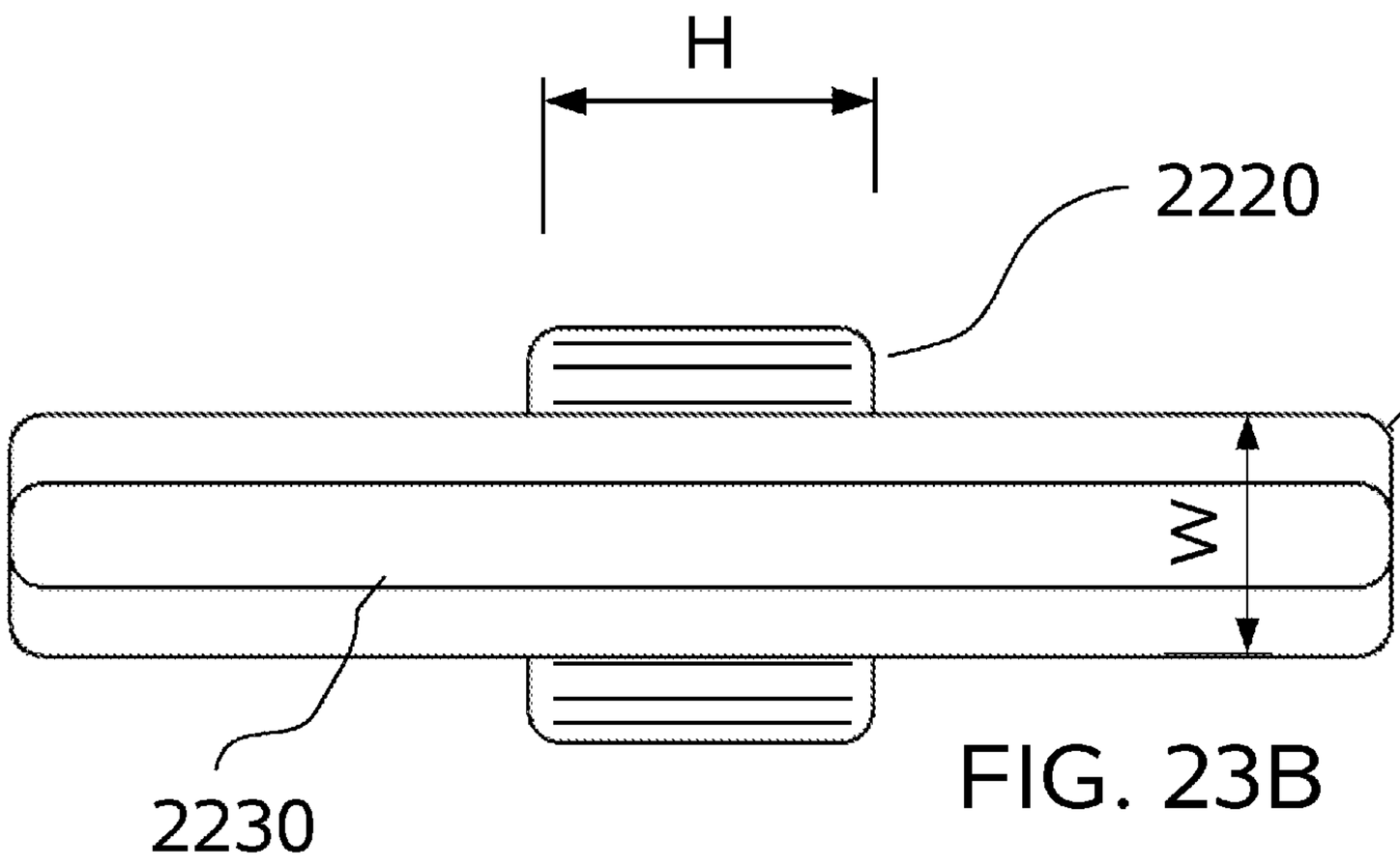


FIG. 23B

FIG. 23D

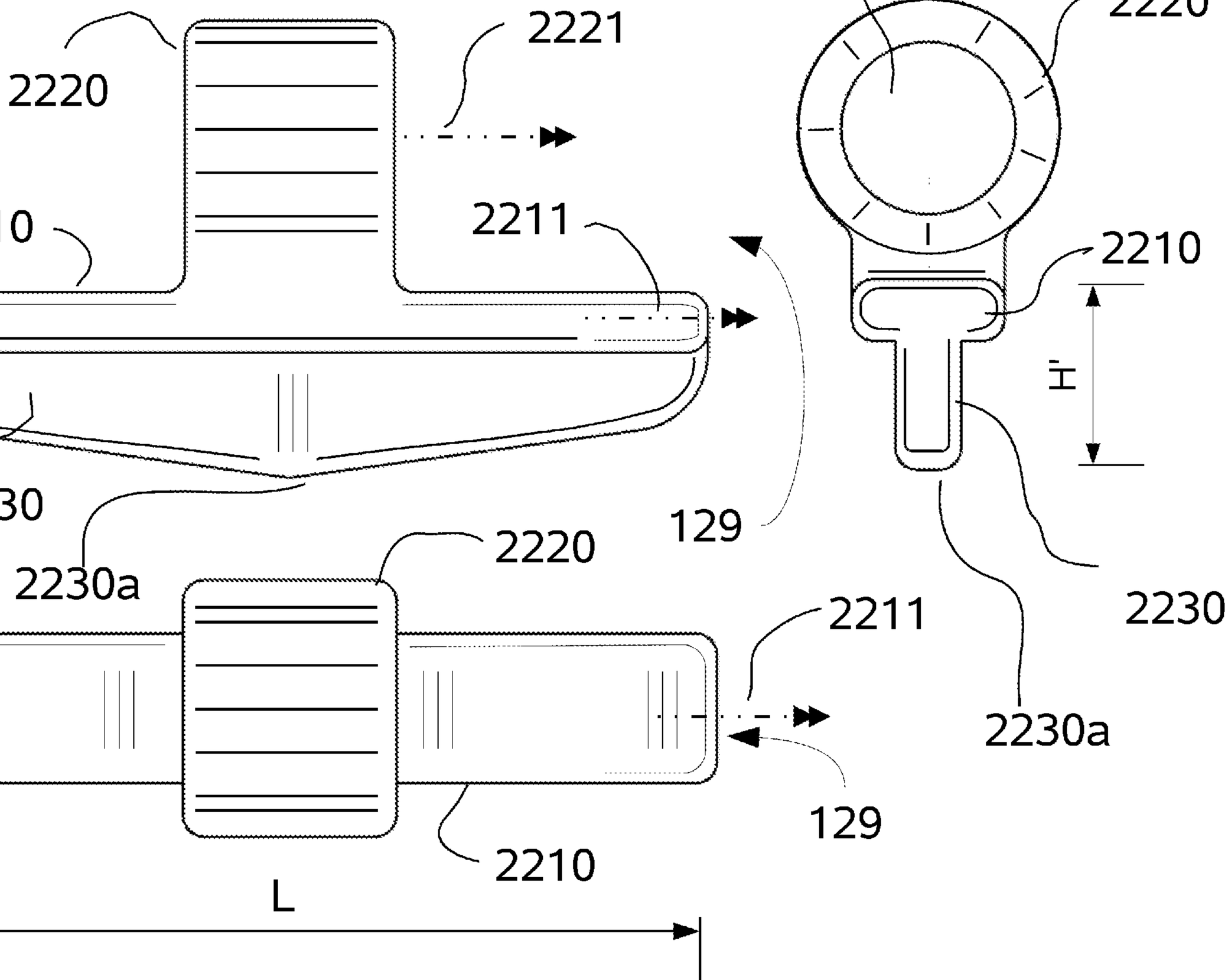


FIG. 23C

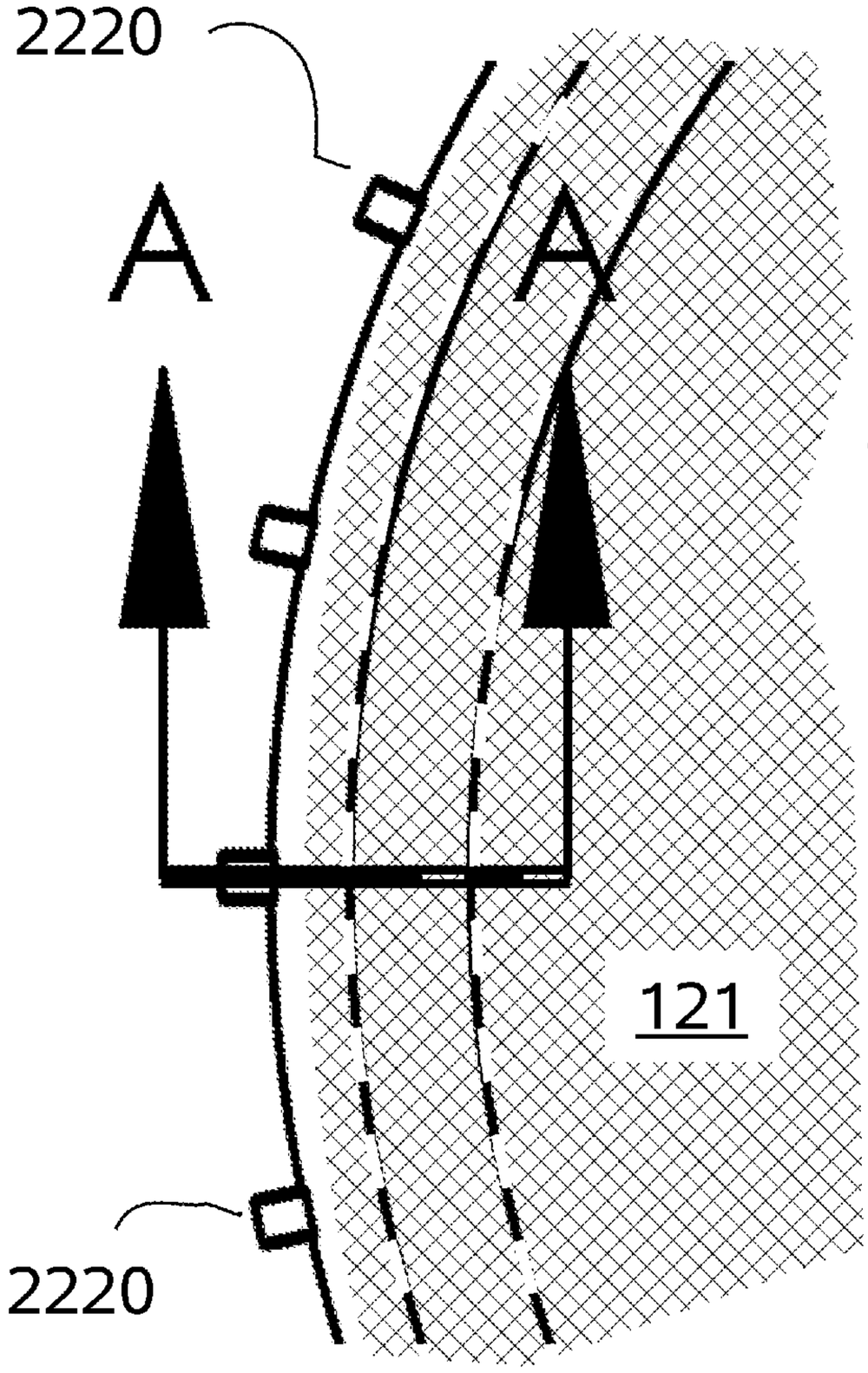


FIG. 24C

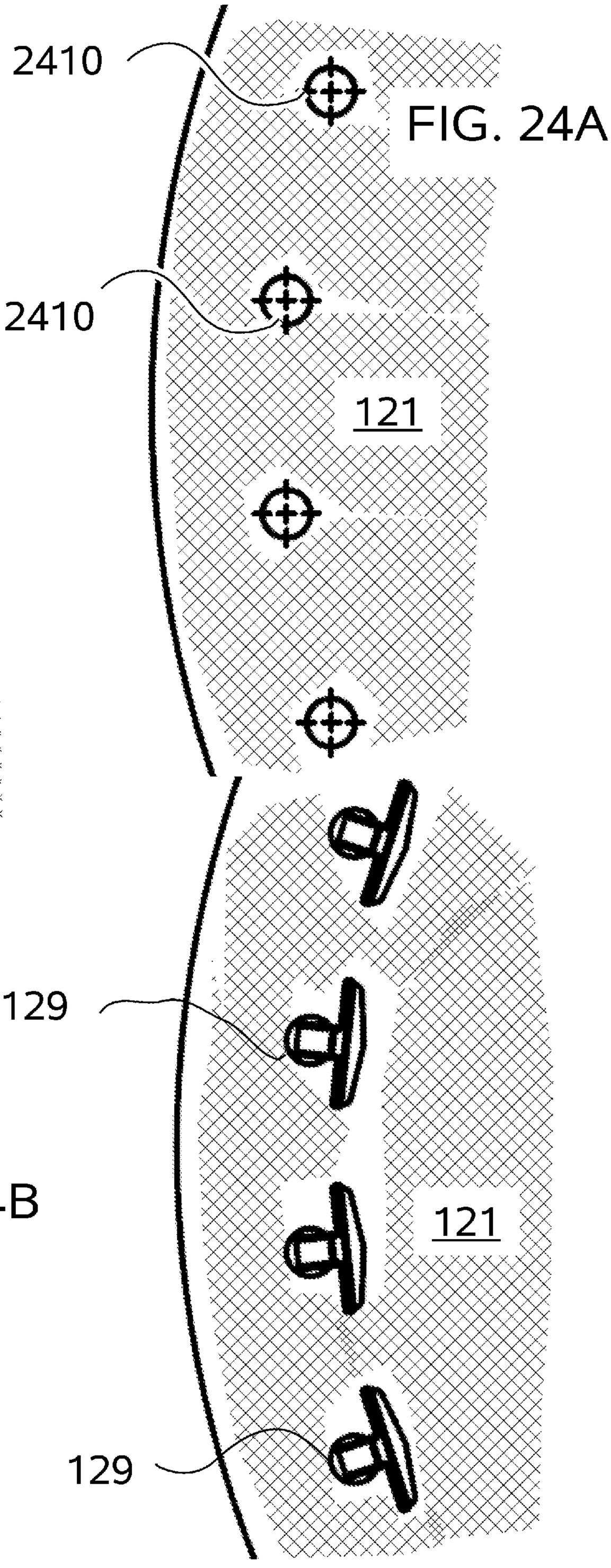


FIG. 24A

FIG. 24B

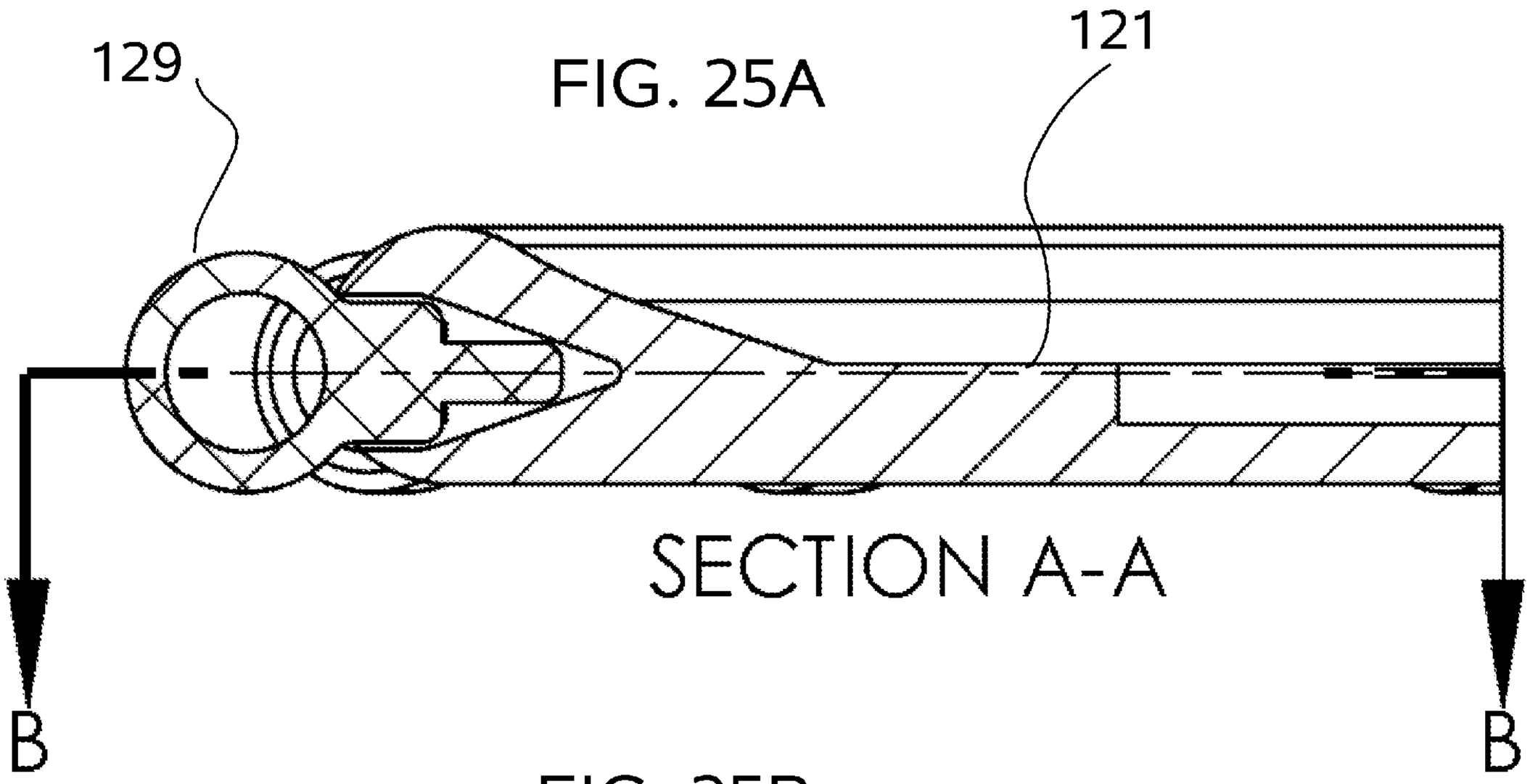


FIG. 25A

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FIG. 25B

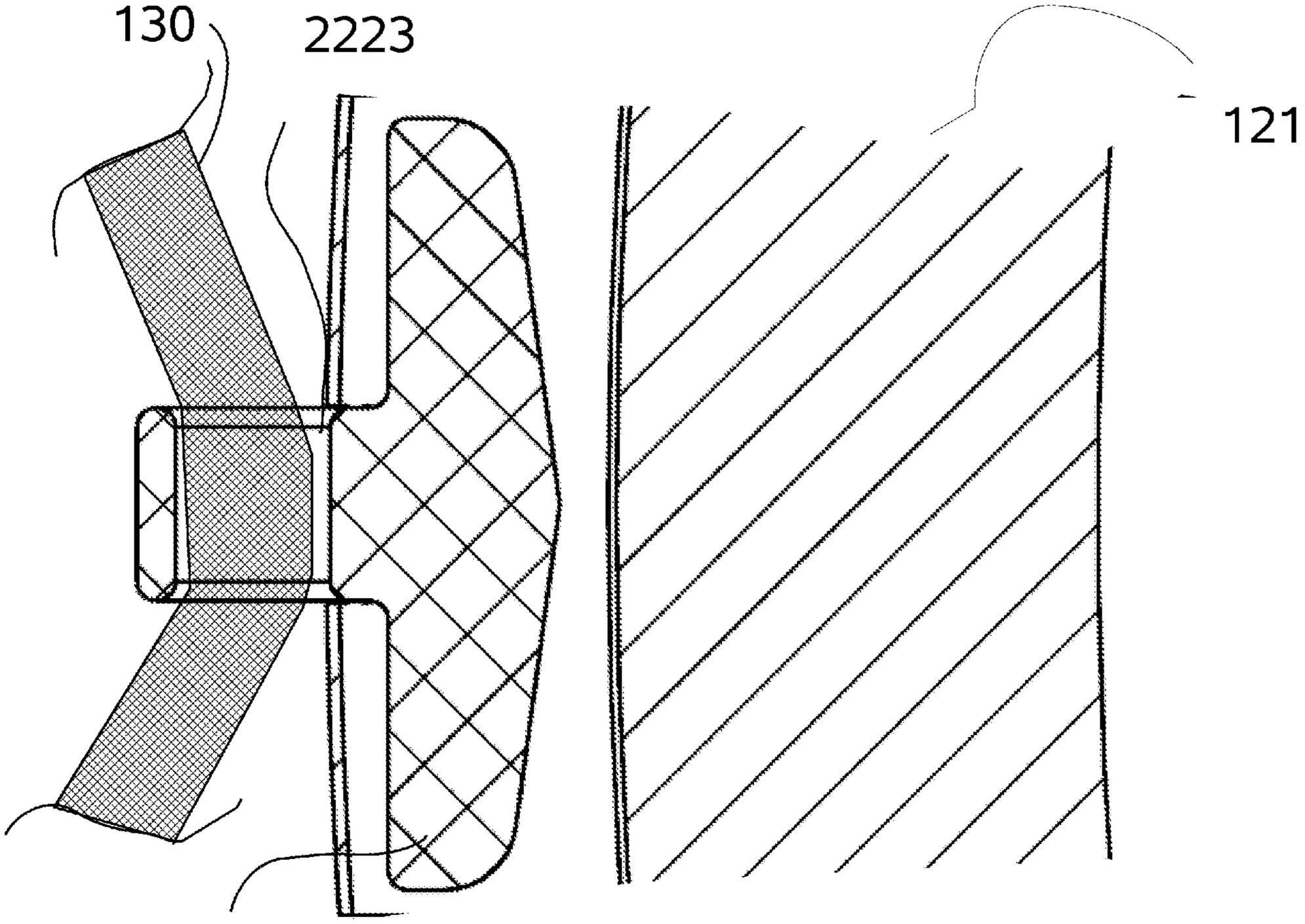


FIG. 26A

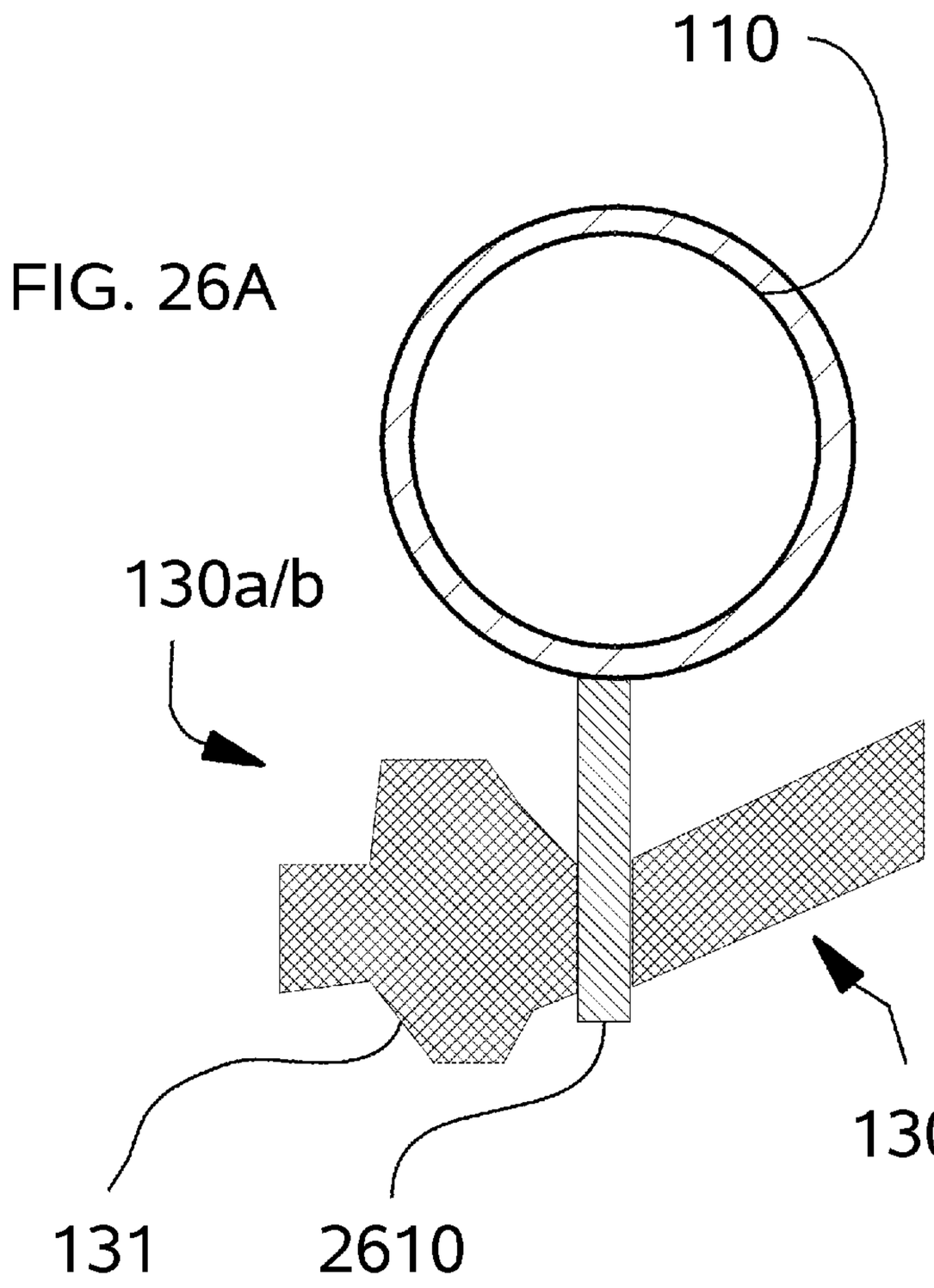


FIG. 26C

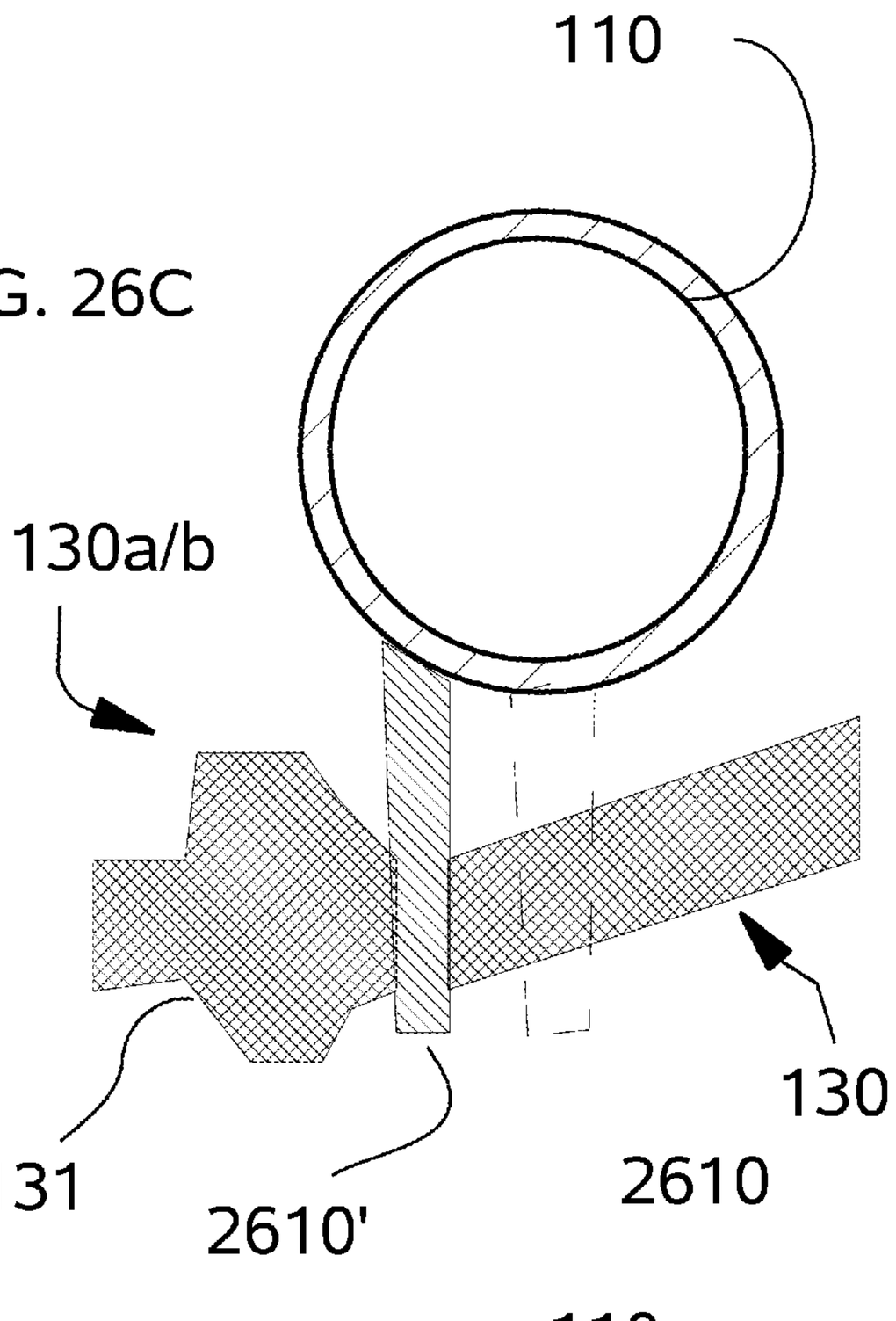
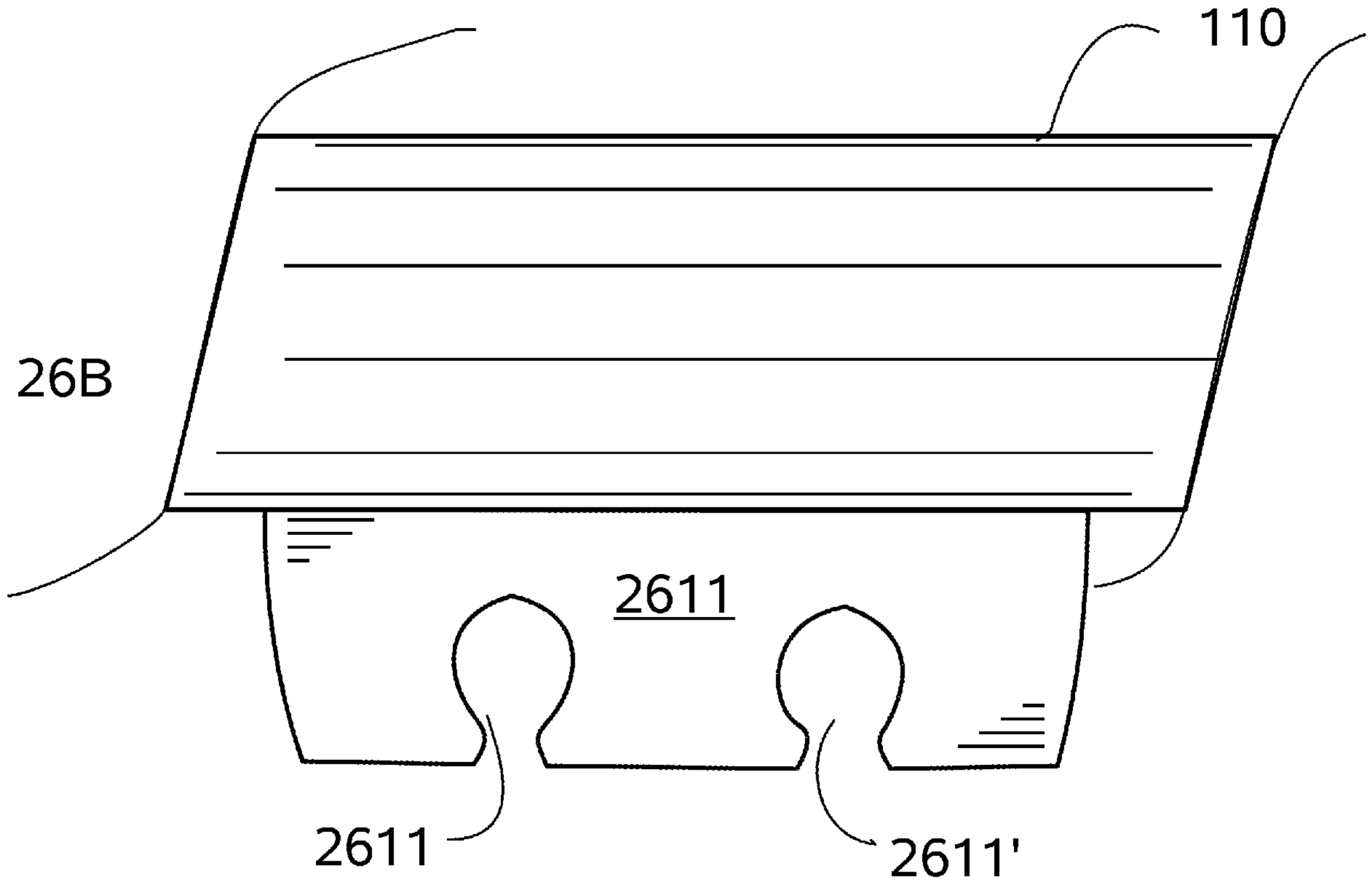


FIG. 26B



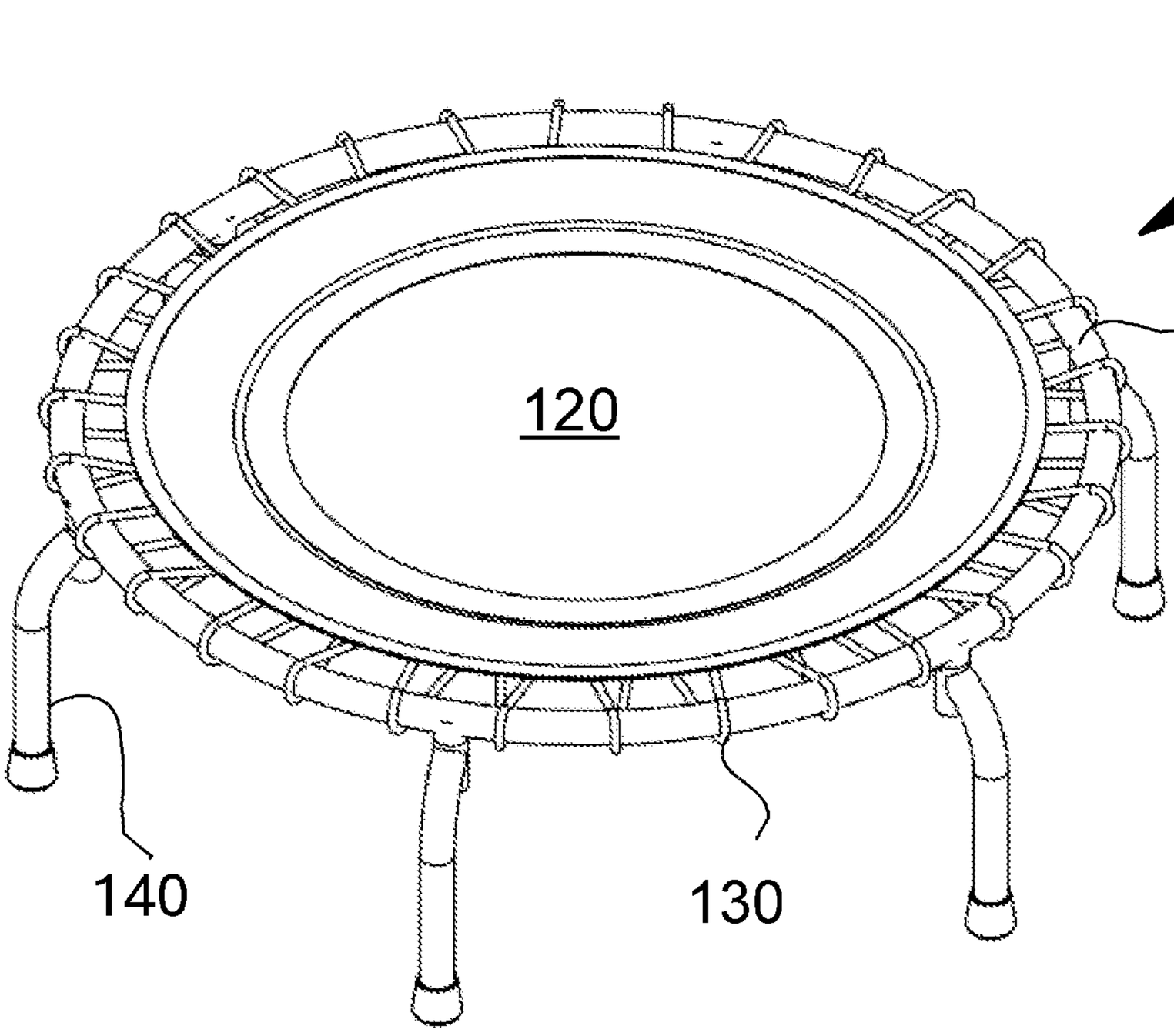
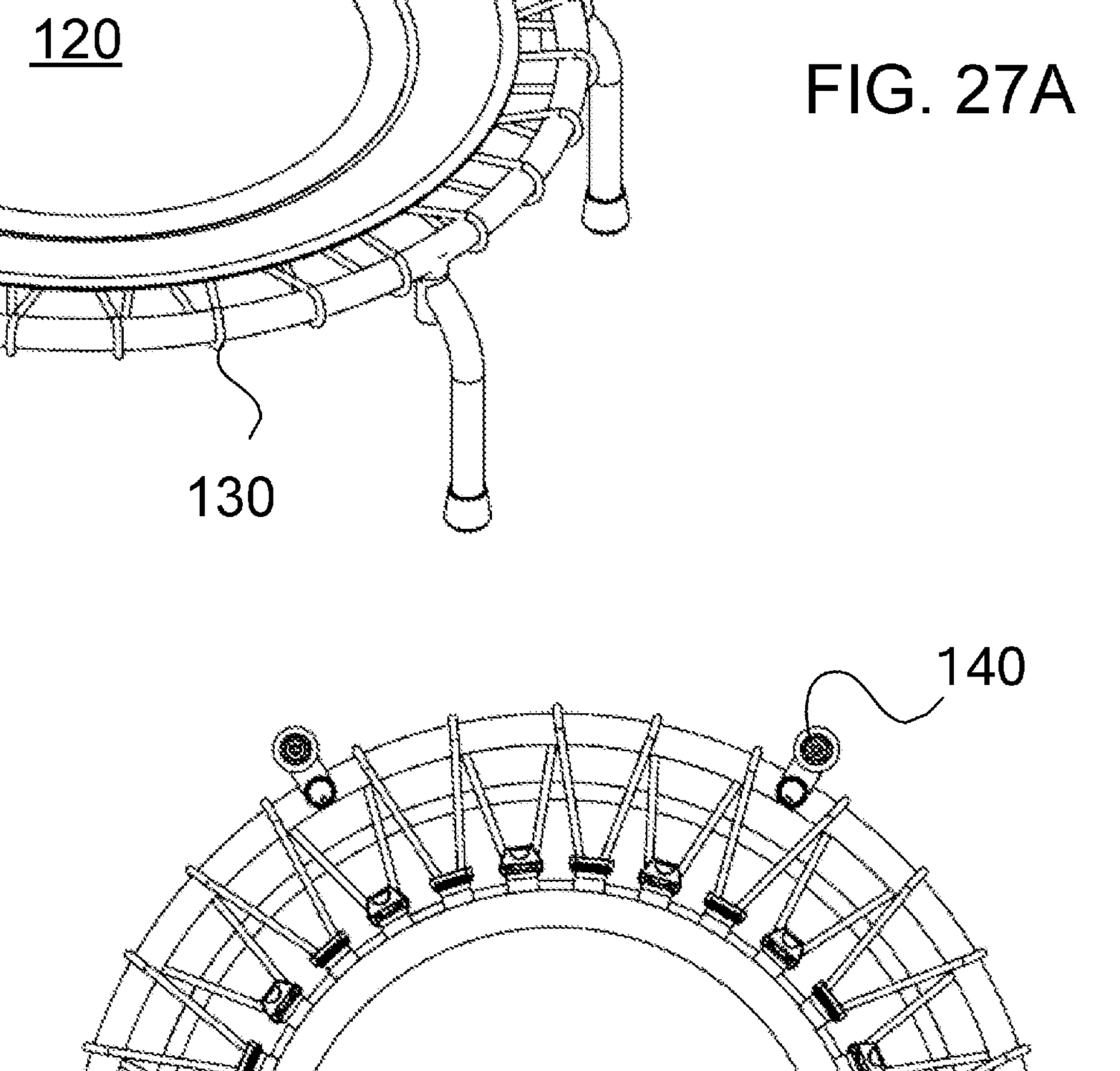


FIG. 27A

FIG. 27B



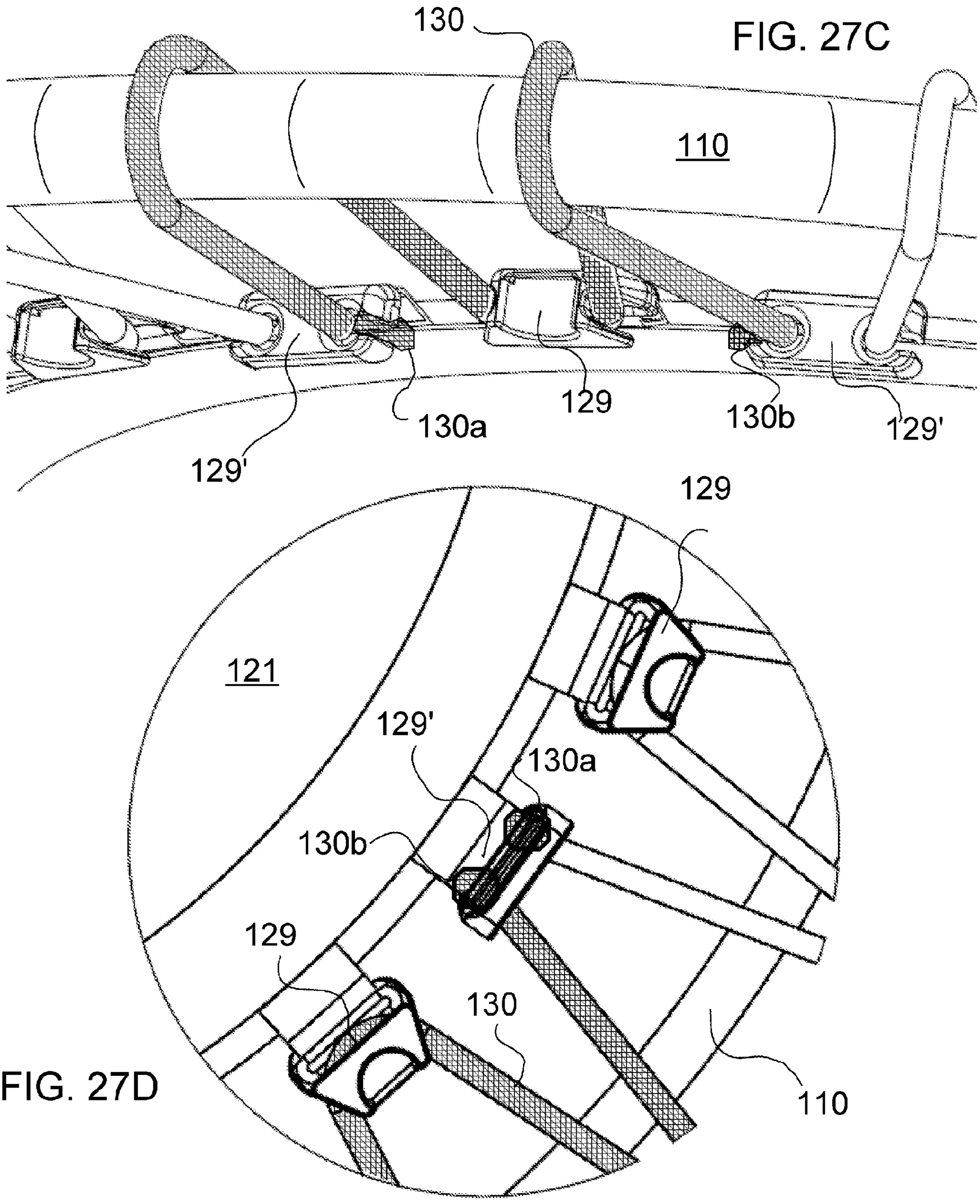


FIG. 27C

FIG. 27D

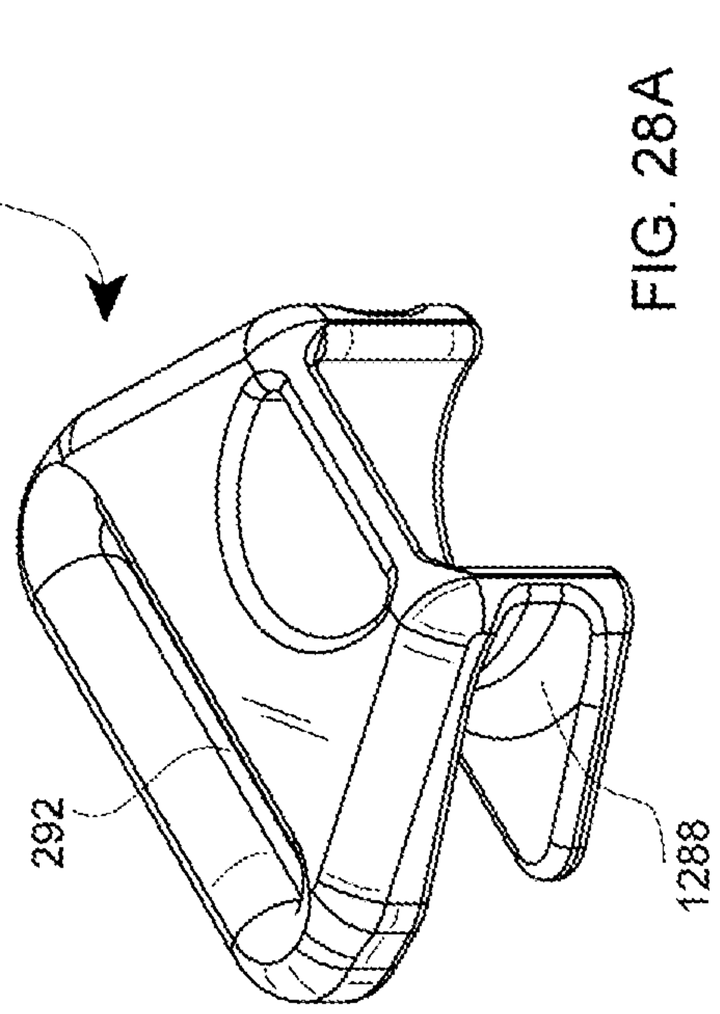


FIG. 28A

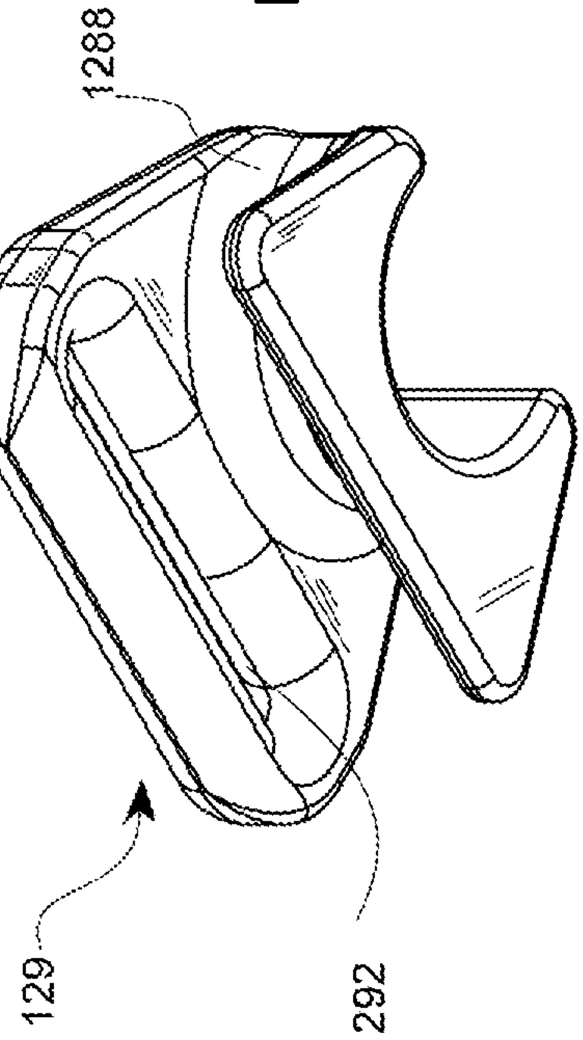


FIG. 28B

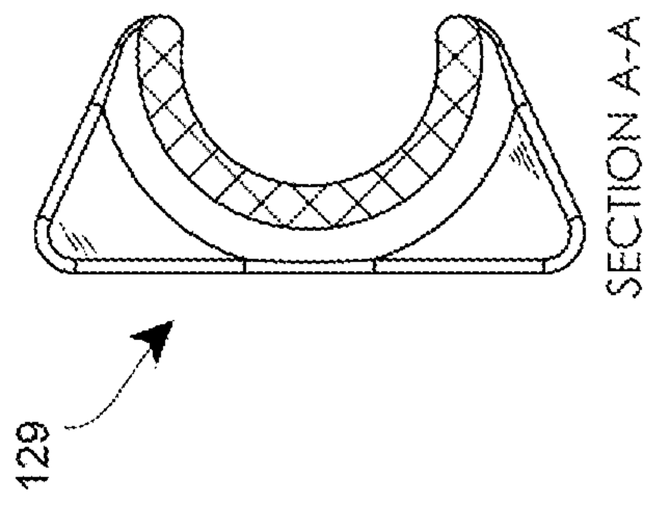


FIG. 28E

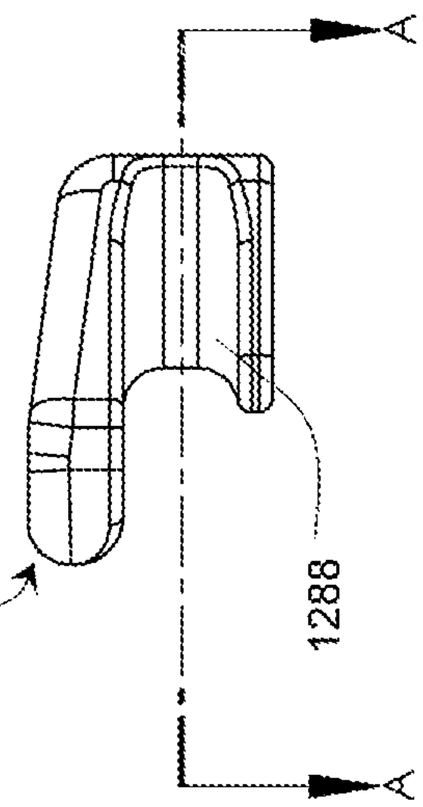


FIG. 28D

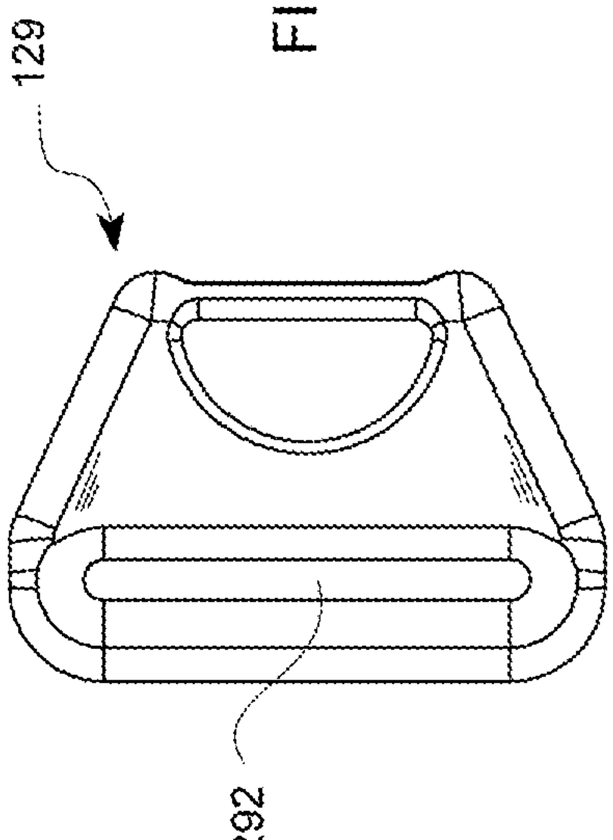


FIG. 28C

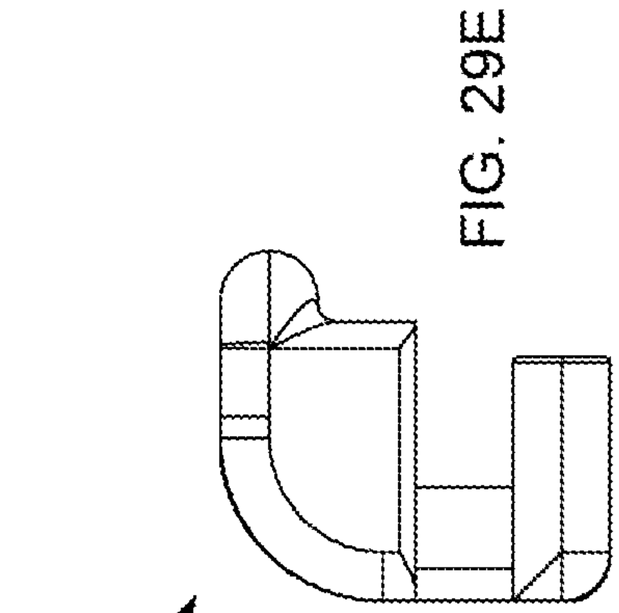


FIG. 29E

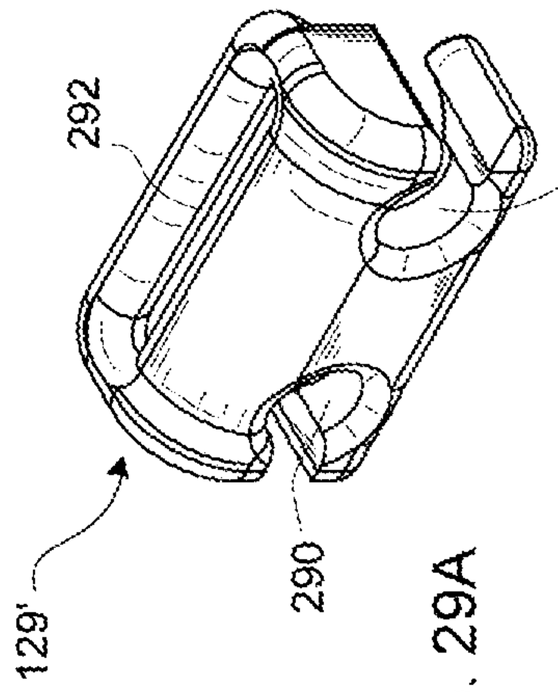


FIG. 29A

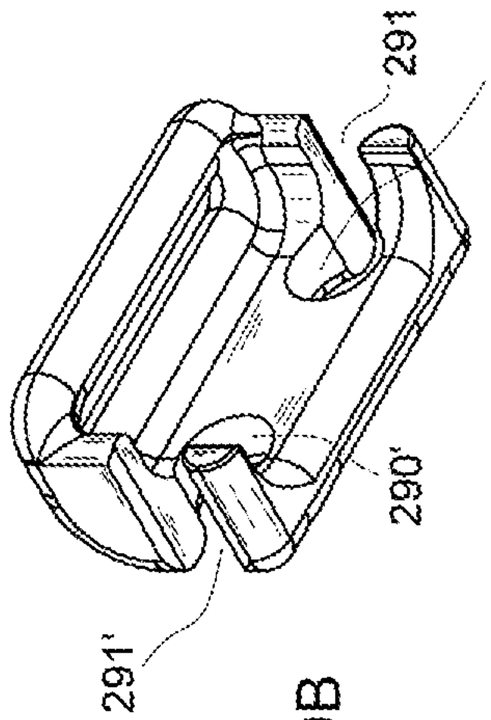


FIG. 29B

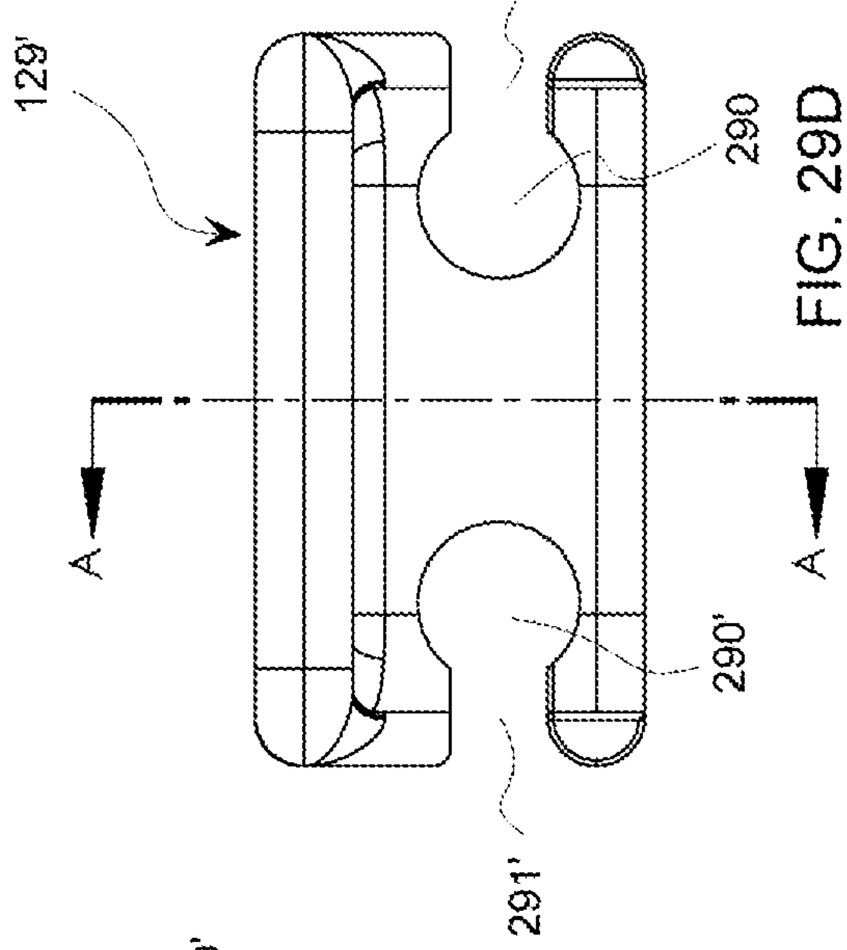


FIG. 29D

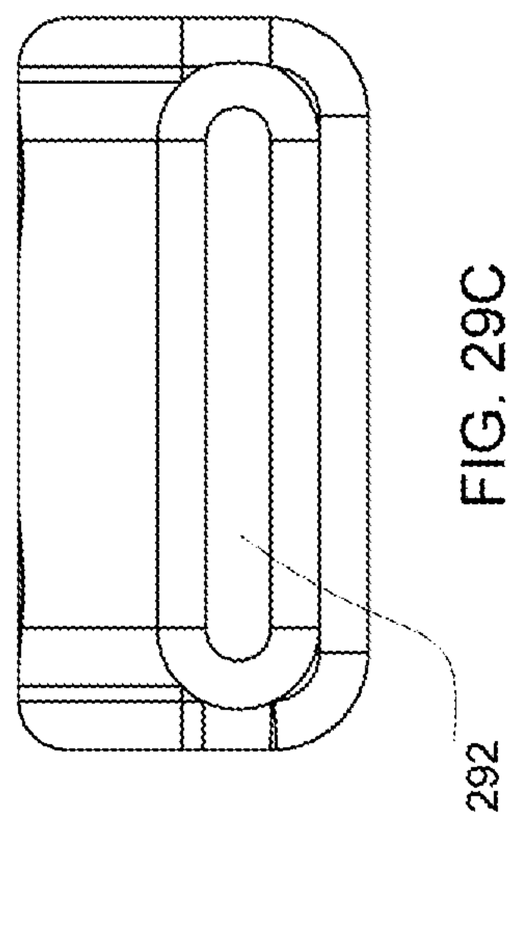


FIG. 29C

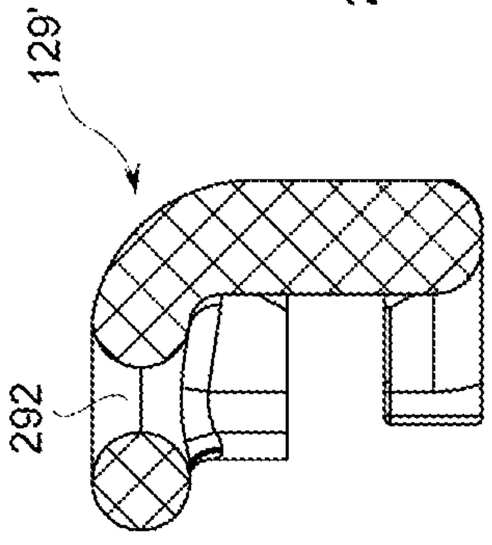


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FIG. 29F

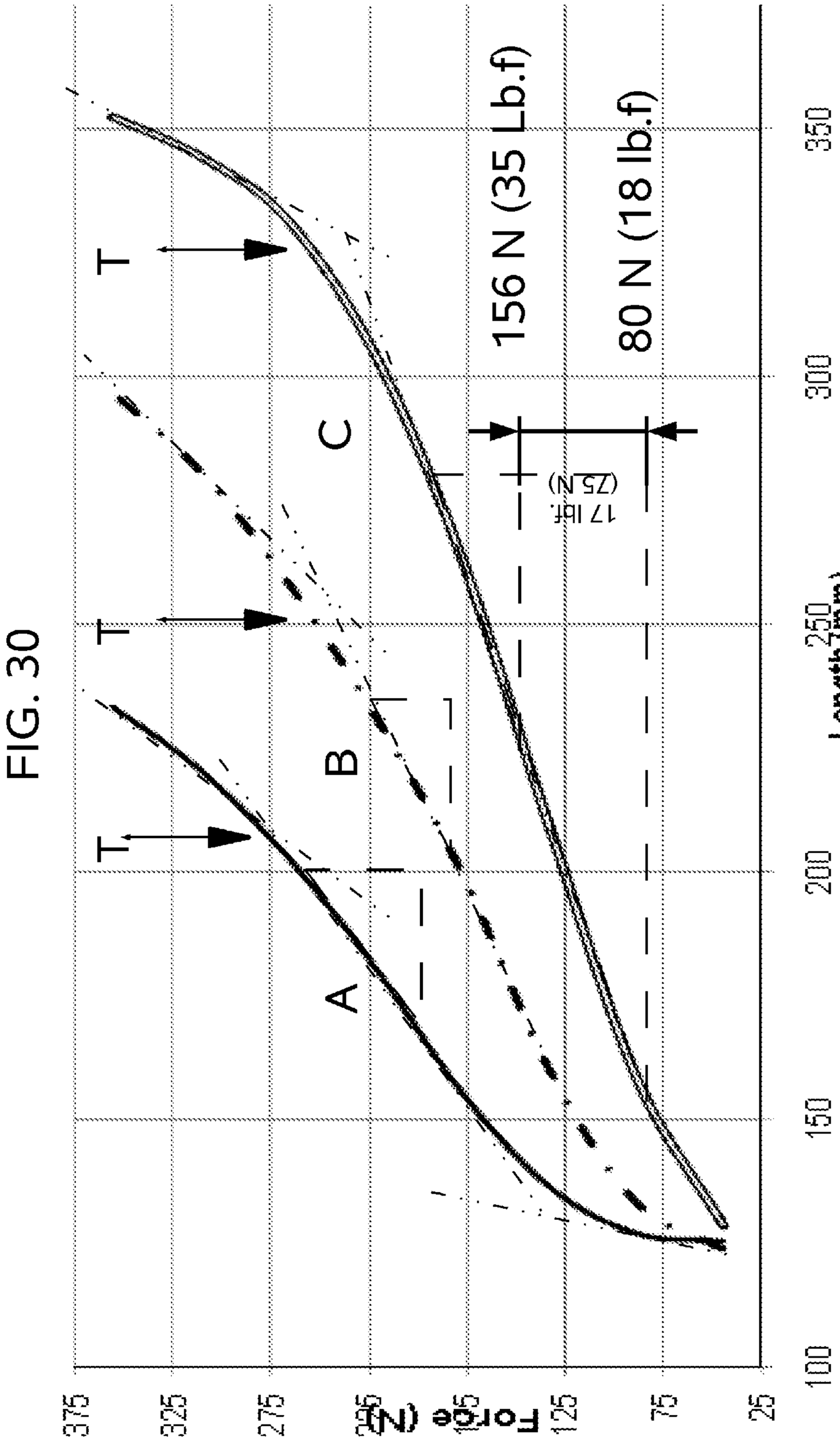

Force (N)
375
325
275
225
175
125
75
25
100
150
200
250
300
350
Length (mm)
T
C
B
A
156 N (35 Lb.f)
80 N (18 lb.f)
17 lbf
(75 N)

FIG. 30

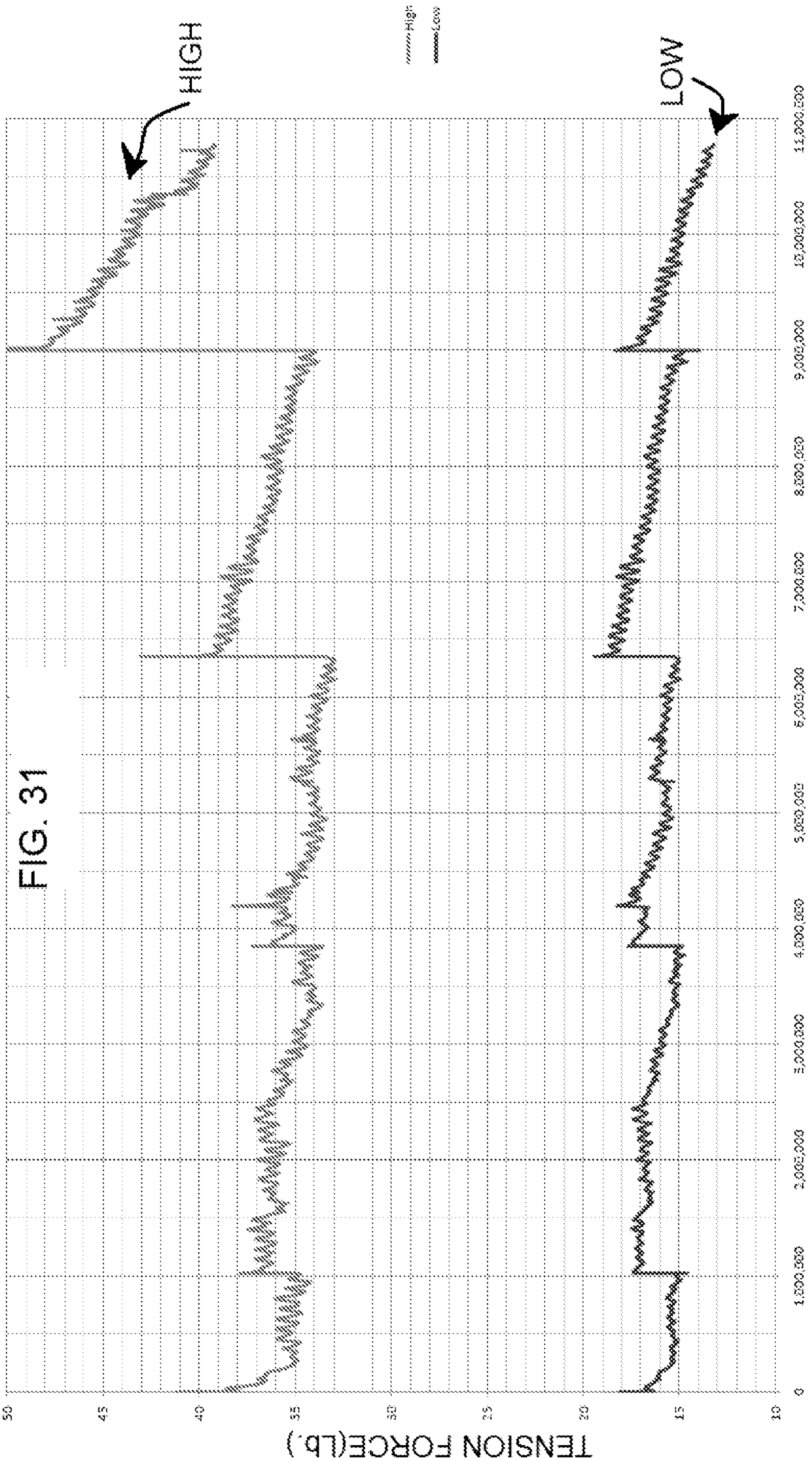
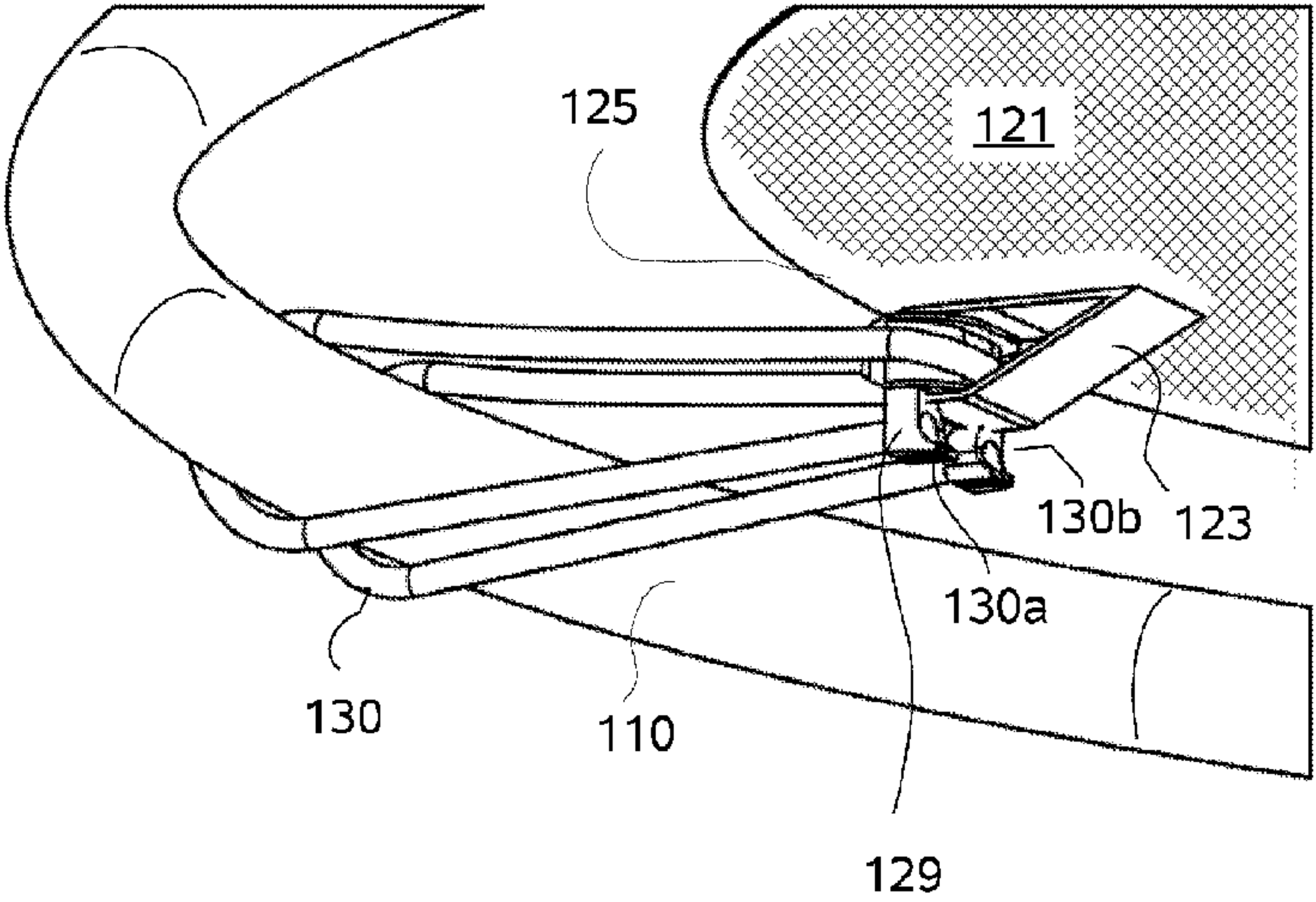

HIGH
LOW
High
Low
50
45
40
35
30
25
20
15
10
0
1,200,000
2,400,000
3,600,000
4,800,000
6,000,000
7,200,000
8,400,000
9,600,000
10,800,000
12,000,000
TENSION FORCE(Lb.)
NUMBER of CYCLES

FIG. 31


125
121
130b
123
130a
130
110
129