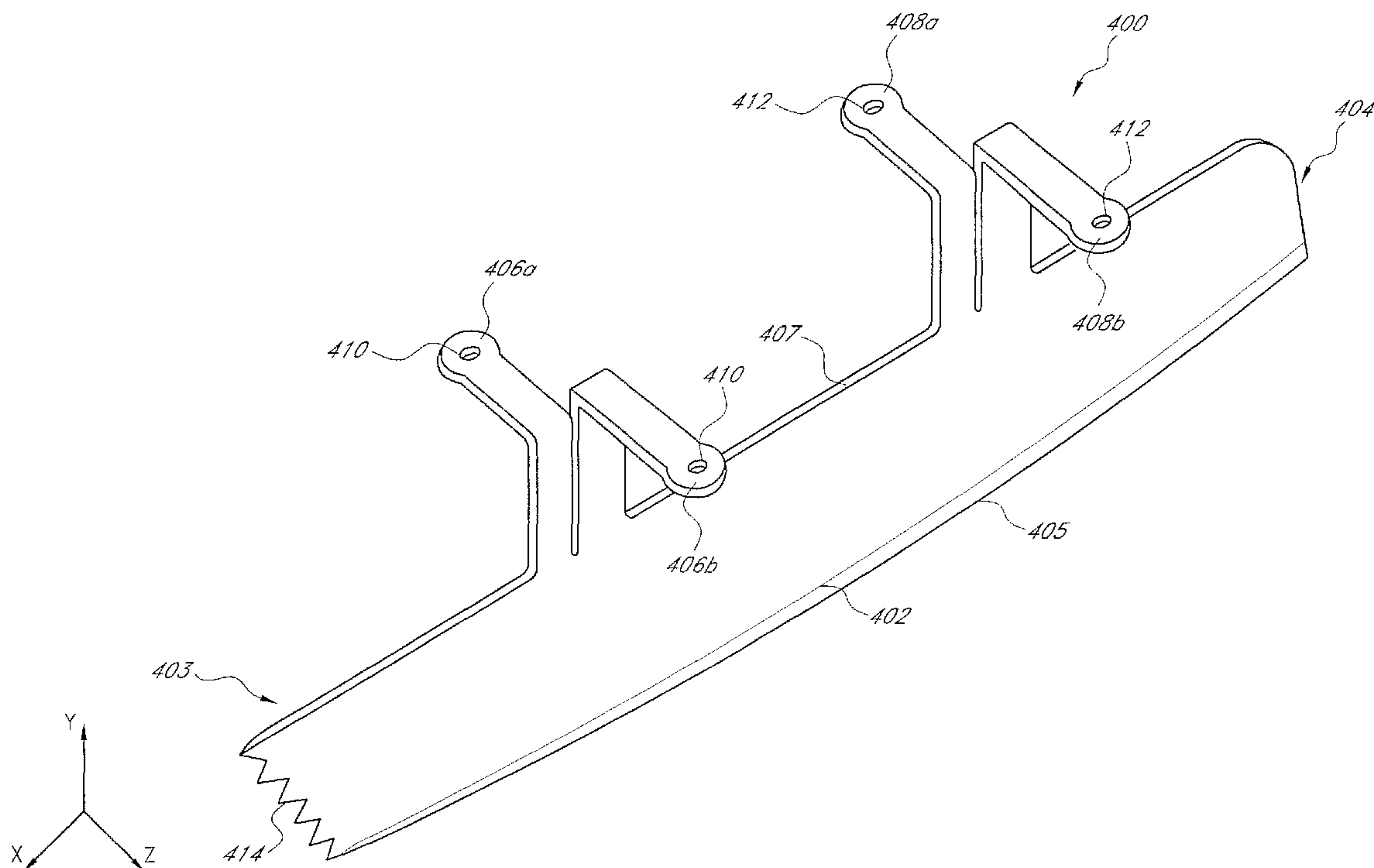




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(57) **Abrégé/Abstract:**

Preferred embodiments of the invention include a skate blade made from a single piece of unitary material. The unitary blade advantageously facilitates the blade manufacturing process and avoids possible weakness introduced by multiple pieces. Certain embodiments of the skate blade may be formed to attach to a skate boot without heating or twisting of the blade. For example, the skate blade may include at least one tab or flange that may be bent to secure the blade to the boot. Certain embodiments of the skate blade preferably comprise a titanium material, such as ASTM-F136 titanium. In certain embodiments, a blade fixation assembly includes locking screws having a threaded body to engage the bottom of a boot and a threaded head to engage grooved portions of the blade.



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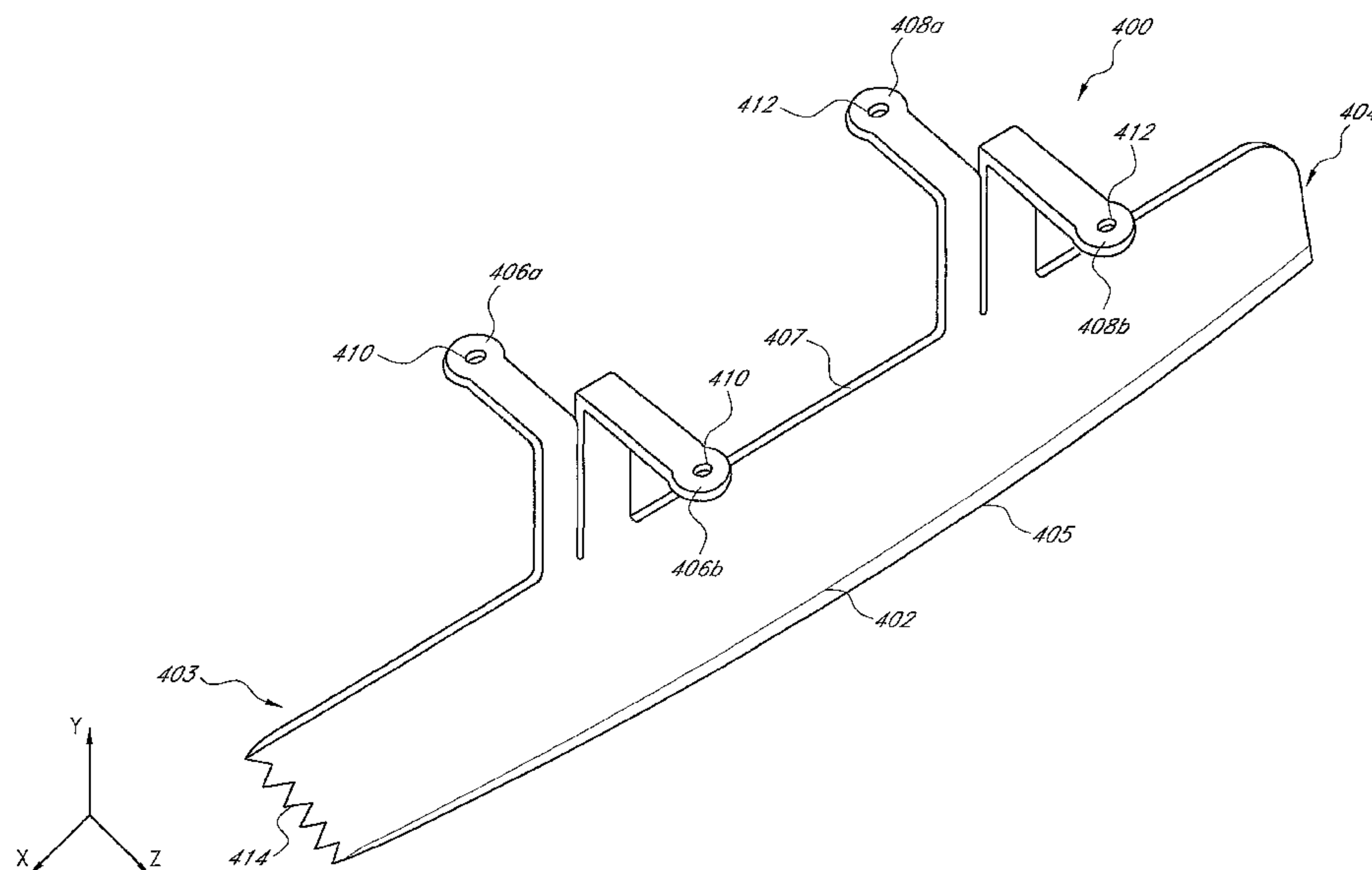
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(54) Title: SKATE BLADES AND METHODS AND APPARATUS FOR AFFIXING SAME



(57) Abstract: Preferred embodiments of the invention include a skate blade made from a single piece of unitary material. The unitary blade advantageously facilitates the blade manufacturing process and avoids possible weakness introduced by multiple pieces. Certain embodiments of the skate blade may be formed to attach to a skate boot without heating or twisting of the blade. For example, the skate blade may include at least one tab or flange that may be bent to secure the blade to the boot. Certain embodiments of the skate blade preferably comprise a titanium material, such as ASTM-F136 titanium. In certain embodiments, a blade fixation assembly includes locking screws having a threaded body to engage the bottom of a boot and a threaded head to engage grooved portions of the blade.

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SKATE BLADES AND METHODS AND APPARATUS FOR AFFIXING SAME

Background of the Invention

5 Field of the Invention

The present disclosure relates generally to ice skate blades for figure skating and to methods and apparatus for securing figure skating blades to a boot.

Description of the Related Art

10 In the art of figure skating, skate blades have retained substantially the same design throughout several decades. Traditional ice skate blades are generally formed by multiple pieces or components that are attached together, such as through welding and/or soldering. For example, Figure 1 depicts a traditional ice skate blade 100 having an elongated blade 102 affixed to a toe plate 104 and a heel plate 106.

15 Several disadvantages accompany the use of multiple-piece skate blades. For instance, the manufacturing of such skate blades can be complicated and involve multiple-step processes to form the blade. For example, the multiple pieces of the skate blade must usually be welded or soldered together. Such welding generally requires the heating of the skate blade to extremely high
20 temperatures, and soldering often requires rehardening and/or tempering of the steel. Each of these additional processes increases the cost of the skate blade and lengthens the manufacturing time. Furthermore, the welding and/or soldering of different blade pieces introduces weakness at the attachment points and can even lead to the breaking of the skate blade and/or potential injury to the skater.

25 In view of the foregoing, there have been attempts to design skate blades that address some of the aforementioned problems. For example, U.S. Patent No. 4,993,725 discloses a skate blade made from a single piece of material. In particular, the skate blade includes a blade portion and two extension portions that connect the skate blade to boot plates. In order to attach the extension portions to
30 a boot, the extension portions are twisted 90 degrees and then bent with respect to the blade portion. This twisting requires the blade material to be heated to a temperature at which the material becomes malleable. Such heating, as

discussed above, complicates the manufacturing process and also introduces weakness into the blade. Furthermore, the substantial amount of steel used in the skate blade of U.S. Patent No. 4,993,725 increases the weight of the skate blade.

With continued reference to Figure 1, the toe plate 104 and heel plate 106
5 of the skate blade 100 are substantially planar and are designed to attach to the bottom of a skate boot. For example, traditional skate blades are commonly affixed to the bottom of a skate boot through the use of standard screws (e.g., wood screws), brackets and/or rivets. With respect to the skate blade 100 of Figure 1, these wood screws, or like devices, would be inserted through a plurality
10 of holes 108 in the toe plate 104 and the heel plate 106 and into the bottom of a skate boot.

Conventional securing devices, however, rely on blade-to-boot compression (or friction) to maintain stability between the blade and the boot. When lateral or axial forces upon the blade exceed the compressive (or frictional) force created by
15 the securing devices, the blade experiences unwanted play, or movement, with respect to the boot. Furthermore, this lateral movement between the skate blade and the boot can cause warping of the skate blade and/or destruction of the boot leather.

Another drawback of several traditional skate blades is that they are
20 generally made of a high carbon steel or stainless steel material. These relatively heavy materials increase the weight of the skate blade, thereby increasing the amount of effort needed by the user during skating.

Steel blades also require substantial maintenance, such as frequent sharpening and cleaning and/or protective treatments to keep the blade in a
25 preferred condition. For example, the edges of skate blades are continually worn down during use, especially when the user makes sharp turns or quick starts and stops. Sharpening steel blades, however, is not a simple process and is generally performed by trained professionals. As can be appreciated, the costs of maintaining skate blades can be substantial.

30 In addition to wear on the sharpness of the blades, ice skate blades are often subjected to severe mechanical stresses and strains caused by rapid accelerations, sharp turns and/or sudden stops. These movements subject the skate blades to extreme bending and torsional stresses. Not only do the skate

blades need to resist mechanical failure, they also need to be corrosion resistant. Skate blades are continually exposed to melted ice, and traditional steel blades require additional care to prevent against rust and to protect the blade from other contaminants.

- 5 Other blade materials, such as ceramics, are light weight and have a high hardness, but have other setbacks. For example, ceramic materials have a fracture toughness much too low for practical use.

Summary of the Invention

10 In view of the foregoing, a need exists for a more straightforward blade manufacturing process and/or a blade design that reduces the introduction of weakness into the blade. For instance, a need exists for a blade that does not require multiple pieces. In certain embodiments of the invention, a unitary blade design is provided that facilitates attachment to a skate boot. In certain
15 embodiments, such a blade may be attached to the boot without the need for substantial heating, such as for twisting and/or rehardening. In certain embodiments, the unitary blade may also have shock absorption features.

There is also a need for an ice skate blade that can operate effectively in a harsh ice skating environment with reduced weight and a high fracture toughness without requiring frequent cleaning and sharpening. Such a skate blade preferably
20 requires less maintenance than the steel blades traditionally used in figure skating.

A need also exists for blade fixation methods and assemblies for securing a skate blade to a boot. In an embodiment, the fixation of the blade to the boot reduces play therebetween and/or decreases warping of the skate blade and/or the boot leather. Such fixation also preferably allows the blade to have a longer
25 life span. In certain embodiments, the skate blade includes temporary fixation holes that allow a user to make minor adjustments to a position of the blade prior to a more permanent securing of the blade to the boot.

In one embodiment, a skate blade formed from a single sheet of material is disclosed. The skate blade includes an elongated portion and a plurality of tabs.
30 The elongated portion has a distal end and a proximal end and occupies a first plane. The elongated portion further includes a top portion and a bottom edge, the bottom edge configured for engagement with a skating surface during use. The plurality of tabs extend from the top portion of the elongated portion, each of the

plurality of tabs being configured to bend at a bend line substantially parallel to the first plane such that a top section of each of the plurality of tabs occupies a second plane substantially perpendicular to the first plane. Each of the top sections of the plurality of tabs comprises at least one hole extending therethrough and usable for
5 securing the tab to a skate boot when the top sections are in the bent positions. In certain embodiments, the elongated portion and the plurality of tabs are formed from a single piece of a unitary material and have substantially the same thickness. In certain embodiments, the skate blade comprises a titanium material, such as Ti_6Al_4V .

10 In an embodiment, an ice skate assembly for improved stability between a skate blade and footwear is disclosed. The ice skate assembly comprises footwear, a blade and a locking screw. The footwear has a sole portion for receiving screw threads having a first pitch. The blade includes at least one portion for securing the blade to the footwear, the at least one portion having a
15 hole with grooves having a second pitch. The locking screw comprises an elongated body having first threads and a head having second threads. The locking screw is further configured to substantially secure the blade to the footwear when inserted into the sole and the hole such that the first threads of the elongated body engage the sole portion and the second threads of the head
20 engage the grooves of the hole. In certain embodiments, the blade comprises a titanium material, such as Ti_6Al_4V .

In an embodiment, a skate blade for improved stability with skate footwear is disclosed. The skate includes an elongated portion configured for engagement with a skating surface during use. The skate blade further includes at least one
25 attachment portion affixed to the elongated portion, wherein the at least one attachment portion includes a threaded hole configured to receive first threads of at least one locking screw such that second threads of at least one locking screw fix the elongated portion in relation to skate footwear. In certain embodiments, the skate blade comprises a titanium material, such as Ti_6Al_4V .

30 In an embodiment, a method of manufacturing a skate blade is disclosed. The method comprises providing a flat, sheet-like member occupying an X-Y plane and having a first thickness. The method further comprises shaping the sheet-like member to form: (1) an elongated blade portion that extends generally in an X

direction within the X-Y plane; and (2) a first tab extending from a top portion of the elongated blade portion and comprising substantially the same thickness as the sheet-like member. The method also includes bending the first tab at a first bend line extending substantially in the X direction such that at least a portion of the first
5 tab generally occupies an X-Z plane. In certain embodiments, the skate blade comprises a titanium material, such as Ti_6Al_4V .

For purposes of summarizing the disclosure, certain aspects, advantages and novel features of the invention have been described herein. It is to be understood that not necessarily all such advantages may be achieved in
10 accordance with any particular embodiment of the invention. Thus, the invention may be embodied or carried out in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

Brief Description of the Drawings

15 Figure 1 illustrates a side perspective view of a traditional skate blade comprising multiple pieces.

Figure 2 illustrates a side view of a skate blade made from a single piece of material, according to an embodiment of the invention.

20 Figures 3A-3F illustrate various embodiments of securing tabs usable with the skate blade of Figure 2.

Figure 4 illustrates a perspective view of a skate blade having bent securing tabs, according to an embodiment of the invention.

Figures 5A-5E illustrate various embodiments of bends usable with the securing tabs depicted in Figures 2-4.

25 Figure 6 illustrates another embodiment of a skate blade made from a single piece of material that further includes shock absorbing slots.

Figure 7A illustrates a perspective view of a blade fixation assembly, according to an embodiment of the invention.

30 Figure 7B illustrates a rear view of a skate blade secured to the bottom of a boot by the fixation assembly illustrated in Figure 7A.

Figure 7C illustrates an embodiment of a locking screw usable with the fixation assemblies depicted in Figures 7A and 7B.

Figure 8 illustrates an embodiment of a securing tab having a provisional hole, according to an embodiment of the invention.

Figure 9 illustrates a side view another embodiment of a skate blade made from a single piece of material.

5 Detailed Description of the Preferred Embodiments

The features of the apparatus and methods will now be described with reference to the drawings summarized above. The drawings, associated descriptions, and specific implementation are provided to illustrate embodiments of the invention and not to limit the scope of the disclosure.

10 In order to simplify the showing of the various embodiments of the invention, the skate boot with which a skate blade is associated will not be shown. It is to be understood, however, that the toe and heel portions of the skate boot are all adapted, in a well known manner, for attachment to, or for engagement with the portions of a skate blade. For example, some skate boots are constructed and
15 arranged such that the toe portion and the heel portion occupy a common horizontal plane. Other skate boots are constructed such that the heel portion is at a higher plane than the toe portion. In addition, bottom portions of the boot may not be flat, but may be shaped to conform to the requirements of the skate blade. It will also be understood from the disclosure herein that skating footwear other
20 than boots may be used with embodiments of the skate blade described hereinafter. All such variations are to be considered as within the spirit and scope of the disclosure.

Figure 2 illustrates a plan view of a flat, unitary, metal member out of which embodiments of the invention may be formed. In particular, a skate blade 200 is
25 formed or cut out of a single, flat, relatively larger, piece of metal (not shown), such as, for example, a sheet of metal. The formation of the skate blade 200 may be performed by the use of any of a number of well known means that produces a flat metal member of generally uniform thickness. For example, the skate blade 200 may be formed through EDM or numerical controlled milling, die cutting, cutting
30 with the use of electric, gas, plasma, water, or laser cutting equipment, die stamping or forging metal material under heat and pressure, casting, injection molding, or employing other conventional means known in the metal working industry and prior art.

As illustrated in Figure 2, the skate blade 200 comprises an elongated portion 202 that is configured for engagement with ice while skating. Extending from a top portion of the elongated portion 202 are multiple sets of securing tabs: a first set 204 of securing tabs is located near a proximal end of the elongated portion 202; a second set 206 of securing tabs is located near the middle of the elongated portion 202; and a third set 208 of securing tabs is located near a distal end of the elongated portion 202. As shown, each of the securing tabs of the sets 204, 206, and 208 includes a fixation hole for securing the skate blade 200 to a boot or a boot plate.

10 In an embodiment, when further forming the skate blade 200 for fixation to a skate boot, at least one of the securing tabs in sets 204, 206, and 208 is bent about a bend axis 212 such that a screw or other fixation device may be inserted through the fixation hole and into the bottom of the boot. For example, half of the securing tabs in sets 204, 206, and 208 may be bent to one side of the skate blade
15 200 while the other half of the tabs may be bent to the opposite side of the skate blade 200.

As will be understood by a skilled artisan from the disclosure herein, various alternative embodiments of securing tabs, including the number and/or configuration of the securing tabs, may be used in securing the skate blade 200 to a boot. Furthermore, an equal number of securing tabs need not be bent to opposing sides of the skate blade 200.

In certain embodiments, the skate blade 200 preferably comprises a stiff metal. In an embodiment, the skate blade 200 advantageously comprises a titanium material. As used herein, "titanium material" refers to any titanium based material, such as, for example, commercially pure titanium, titanium alloys and titanium matrix composites. Such titanium material provides advantages of strength and/or fracture resistance and is also remarkably lightweight. Furthermore, the titanium material provides for a rust resistant material.

In a more preferred embodiment, the skate blade 200 comprises $\text{Ti}_6\text{Al}_4\text{V}$, which is classified by the American Society for Testing and Materials as ASTM-F136 titanium. F136 titanium may advantageously provide a strong crystalline structure and an increased fatigue limit for the skate blade 200.

In certain other embodiments, the unitary metal member 200 comprises a metal alloy, such as, for example, steel or stainless steel.

In certain embodiments, the thickness of the skate blade 200 ranges between about 1.5 millimeters and about 5 millimeters. In a more preferred embodiment, the thickness of the skate blade 200 is approximately 3.5 millimeters. In certain embodiments, the length of the elongated portion ranges between about 10 centimeters to about 31 centimeters and may depend on the size of the associated footwear and/or skater.

Within the spirit and scope of the disclosure, the ice engaging elongated portion 202 may be further coated with a wear resistant material such as diamond, silicon carbide, or the like, in order to reduce the number of times that the blade must be sharpened as a result of use by a skater.

The illustrated skate blade 200 provides for several advantages over traditional skate blades. For example, when forming the skate blade 200, it is not necessary to weld or attach other materials or portions to the skate blade 200. This preferably facilitates the manufacturing process, reduces the cost of the skate blade 200, and/or avoids the introduction of weakness into the blade that occurs with the attaching together of multiple pieces. Furthermore, it is not necessary to twist portions of the skate blade 200 in order to attach the skate blade 200 to a boot. Rather, the user may bend the securing tabs about the bend axis 212.

Figures 3A-3F illustrate certain embodiments of securing tabs usable with a skate blade, according to embodiments of the invention. For example, the securing tab embodiments shown in Figures 3A-3F may be used with the skate blade 200 of Figure 2.

As depicted in Figure 3A, a skate blade 300 has a first set 306 and a second set of 308 of securing tabs wherein each of the sets 306 and 308 includes two securing tabs. As shown, the securing tabs are generally elongated and are substantially the same length. Furthermore, each of the securing tabs has a circular portion near the end of the securing tab that includes a fixation hole.

Figure 3B illustrates a skate blade 310 having a first set 316 of securing tabs and a second set 318 of securing tabs. As illustrated, each of the sets 316 and 318 has two securing tabs, each of a different length. Such an embodiment

advantageously provides for the use of less material to form the skate blade 310 and allows for the securing tabs to be arranged closer together.

Figure 3C illustrates a skate blade 320 having a first set 326 and a second set 328 of securing tabs. As illustrated, each of the sets 326 and 328 includes two
5 securing tabs that are generally elongated and rectangular. Such an embodiment advantageously provides for a simplified manufacturing process of the securing tabs of the skate blade 320. In addition, the rectangular shape of the securing tabs allows for a more efficient use of the material forming the skate blade 320.

Figure 3D illustrates a skate blade 330 having a first securing tab 336 and a
10 second securing tab 338. As illustrated, the securing tabs 336 and 338 are generally larger than the securing tabs shown in Figures 3A-3C. Furthermore, each of the tabs 336 and 338 includes multiple fixation holes toward the top edges of the securing tabs.

Figure 3E illustrates a skate blade 340 having a single securing tab 346.
15 Such an embodiment facilitates an efficient manufacturing process for the skate blade 340. Furthermore, the securing tab 346 includes multiple fixation holes extending therethrough. The single securing tab 346 allows for the bending of a single tab in order to secure the skate blade 340 to the bottom of a boot.

Figure 3F illustrates a skate blade 350 including a first securing tab 356 and
20 a second securing tab 358. As shown, the first securing tab 356 includes a neck portion 360 and a terminal portion 362 usable for attaching the skate blade 350 to the bottom of a boot. The second securing tab 358 includes a neck portion 364 and a terminal portion 366 usable to secure the skate blade 350 to the bottom of the boot. For example, the first securing tab 356 may be used to secure the skate
25 blade 350 to the toe portion of the boot, and the second securing tab 358 may be used to secure the skate blade 350 to the heel portion of the boot. Both of the securing tabs 356 and 358 also include multiple fixation holes usable to accept screws and/or other fixation devices to attach the skate blade 350 to a boot.

Figure 4 illustrates a perspective view of a skate blade 400 having bent
30 securing tabs configured to attach to a skate boot or other footwear. As shown, the skate blade 400 is formed from a single piece of a unitary material, an example of which is described in more detail with respect to Figure 2.

Figure 4 also contains a three orthogonal-axis reference system, made up of axes X, Y and Z, that will be used to explain embodiments of the invention. References to this axis reference system are for illustration purposes only, and a skilled artisan will recognize from the disclosure herein a wide variety of alternative methods for describing the shape and/or design of the skate blade 400.

As shown, the skate blade 400 includes an elongated portion 402 configured for engagement with ice or a ground surface during use. In particular, the elongated portion 402 generally extends in an X direction, within an X-Y plane, between a proximal end 403 (or front) and a distal end 404 (or rear) of the skate blade 400. The elongated portion 402 further includes a blade portion 405 configured to contact the ice or ground surface. In certain embodiments, the blade portion 405 includes two outside edges and an arcuate hollow in between the two edges, as is well known in the art.

The illustrated skate blade 400 further includes two pairs of securing tabs. In particular, securing tabs 406a and 406b are located toward the proximal end 403 of the skate blade 400 and generally extend in a Y direction from a top surface 407 of the elongated portion 402. The illustrated skate blade 400 further includes a second set of securing tabs 408a and 408b located toward the distal end 404 of the skate blade 400 and also generally extending in the Y direction from the top surface 407 of the elongated portion 402.

As shown, each of the securing tabs 406a, 406b, 408a and 408b are bent at approximately a 90-degree angle to facilitate securing the skate blade 400 to the bottom of a boot. In particular, the elongated portion 402 and bottom sections of the securing tabs 406a, 406b, 408a and 408b generally occupy the X-Y plane. Top sections of the securing tabs 406a, 406b, 408a and 408b generally occupy an X-Z plane and are substantially perpendicular to the bottom sections and the elongated portion 402. Furthermore, the illustrated securing tabs 406a and 408a are bent such that the top sections of the securing tabs 406a and 408a extend toward a first side of the skate blade 400 (e.g., in a -Z direction). The top sections of the securing tabs 406b and 408b extend generally in an opposite direction (e.g., in a Z direction) of the securing tabs 406a and 408a. Such an arrangement facilitates balancing of the boot on the skate blade 400.

In certain embodiments, the securing tabs 406a and 406b are configured to attach at or near a toe portion of a skate boot. For example, screws (not shown) may be inserted through fixation holes 410 to secure the securing tabs 406a and 406b to a leather sole of the skate boot. Likewise, the securing tabs 408a and 408b are configured to attach at or near a heel portion of a skate boot such that screws may be inserted through fixation holes 412 to secure the securing tabs 408a and 408b to the leather sole of the skate boot. In other embodiments, other forms or types of fixation devices may be use in place of, or in combination with, screws to secure the skate blade 400 to a boot.

Although described with reference to particular embodiments, the skate blade 400 may include other features in combination with, or in place of, the above-described features. For example, the skate blade 400 optionally includes a toe pick 414 having a plurality of teeth for facilitating skating maneuvers, such as jumps or spins. In other embodiments, the skate blade 400 may include slots or additional devices configured to provide shock absorption during skating. In yet other embodiments, at least one of the securing tabs 406a, 406b, 408a and 408b may be configured for attachment to a metal plate or other surface positioned between the skate blade 400 and the bottom of the boot.

Furthermore, the skate blade 400 may include more or fewer securing tabs, and/or may include at least one securing tab having a different shape, than the securing tabs 406a, 406b, 408a and 408b depicted in Figure 4. For example, the skate blade 400 may include any of the forms or number of securing tabs depicted in Figures 3A–3F.

In other embodiments of the invention, the securing tabs of the skate blade 400 may be bent or formed at angles other than approximately 90 degrees. Figures 5A-5E illustrate various examples of securing tabs and bends thereof for attaching the securing tabs to the bottom of a skate boot.

Figure 5A illustrates a cross-sectional view of a skate blade 500. As shown, the skate blade 500 includes an elongated portion 502, a securing tab 506, and a securing tab 508. The elongated portion 502 also includes a bottom portion 509 that is configured for engagement with an ice surface.

The illustrated securing tab 506 has two substantial bends. The first bend, where the securing tab 506 extends from the elongated portion 502, has an angle

θ . As shown, the angle θ is an obtuse angle and, in certain embodiments, has a value of approximately 135 degrees. The second bend of the securing tab 506 has an angle ϕ . As shown, the angle ϕ is an acute angle and, in certain embodiments, has a value of approximately 45 degrees. Likewise, the illustrated
5 securing tab 508 is bent similarly to the securing tab 506 but in the opposite direction. In certain embodiments, the section of the securing tab 506 between the first and second bends has a hole extending through it to permit a fastening tool, such as, for example, a screwdriver, to be adjust a fastening device (e.g., a screw) for fixing the securing tab, and hence the blade 500, to the boot.

10 Figure 5B illustrates a cross-sectional view of a skate blade 510 according to another embodiment of the invention. In particular, the skate blade 510 includes a single securing tab 516, which is bent similarly to the securing tab 506 shown in Figure 5A. That is, the securing tab 516 has a first bend (angle θ) of approximately 135 degrees and a second bend (angle ϕ) of approximately 45
15 degrees. In certain embodiments, the skate blade 510 is configured to have only a single securing tab. In such embodiments, the securing tab 516 is preferably of a sufficient length and/or width to support the weight of a user.

Figure 5C illustrates a cross-sectional view of a skate blade 520 according to another embodiment of the invention. In particular, the skate blade 520
20 includes a securing tab 526 extending from an elongated portion 522. As shown, the securing tab 526 is bent at an angle θ from the elongated portion 522. In certain embodiments, the angle θ is an obtuse angle and, in preferred embodiments, the angle θ advantageously has a value of approximately 135 degrees. The securing tab 526 further comprises two additional bends at angles
25 ϕ_a and ϕ_b , wherein ϕ_a is an acute angle and ϕ_b is an obtuse angle. In certain embodiments, the sum of the angles of ϕ_a and ϕ_b is approximately 90 degrees more than angle θ . A skilled artisan will also recognize from the disclosure herein other ranges of angles for θ and/or ϕ_a and/or ϕ_b usable with the skate blade 520 for arranging the securing tab 526 to attach to a boot.

30 Figure 5D illustrates a cross-sectional view of a skate blade 530 according to an embodiment of the invention. The skate blade 530 includes an elongated portion 532, a securing tab 536 and a securing tab 538. As shown, the securing

tabs 536 and 538 have a generally arcuate shape such that end portions of the securing tabs 536 and 538 are in a plane approximately perpendicular to the plane comprising the elongated portion 532. In such an embodiment, the securing tabs 536 and 538 may provide for increased cushioning in comparison with skate
5 blades having securing tabs with only a 90-degree bend.

Figure 5E illustrates a cross-sectional view of a skate blade 540 according to an embodiment of the invention. The skate blade 540 includes an elongated portion 542, a securing tab 546 and a securing tab 548. The securing tab 546 includes a first bend having an angle ϕ_a at the connection of the securing tab 546
10 to the elongated portion 542. As illustrated, angle θ_a is an obtuse angle and, in certain embodiments, has a value of approximately 135 degrees. The securing tab 546 also includes a second bend having an angle θ_b . As illustrated, angle θ_b is also an obtuse angle and, in certain embodiments, has a value of approximately 135 degrees. In certain embodiments, the sum of the angles θ_a and θ_b is
15 approximately 270 degrees such that the end portion of the securing tab 546 is in a plane substantially perpendicular to the plane comprising the elongated portion 542.

Although disclosed with reference to particular embodiments, a skilled artisan will recognize from the disclosure herein a wide variety of alternative
20 designs or methods for forming the securing tabs of skate blades. For example, any of the securing tabs illustrated in Figures 5A-5E may be bent in a variety of ways and/or at a variety of angles such that at least a portion of the securing tab is in a plane substantially perpendicular to the plane including the associated elongated portion. In addition, the lengths of the securing tabs may vary to fit
25 certain users or particular sizes and/or shapes of skate boots. Still further, the thickness of the securing tabs in either or both of the two dimensions may be altered to increase or relax stiffness or cushioning between the boot and the ice-engaging blade.

Figure 6 illustrates a side view of another embodiment of a skate blade
30 made from a unitary piece of material. As illustrated, the skate blade 600 includes an elongated portion 602 configured to engage the ground surface or ice during use. The elongated portion 602 generally extends between a proximal end 603 and a distal end 604 of the skate blade 600. The skate blade 600 further

comprises a first set 606 of securing tabs and a second set 608 of securing tabs that generally extend from a top edge of the elongated portion 602. Each of the securing tabs of the sets 606 and 608 also includes a fixation hole 610.

As illustrated in Figure 6, the skate blade 600 further includes a first shock
5 absorption slot 620 near the proximal end 603 and a second shock absorption slot 622 near the distal end 604. As shown, each shock absorption slot 620, 622 is formed by excising one or more portions of the blade 600. One or more of the shock absorption slots advantageously provides for more cushioning to the skater while using the skate blade 600. The shock absorption slots 620 and 622 also
10 decrease the weight of the skate blade 600. Furthermore, unlike traditional skate blades, the shock absorption slots 620 and 622 do not require extra material or devices to provide for cushioning.

As discussed previously with respect to the skate blade 200 depicted in Figure 2, the skate blade 600 may comprise any material, such as a metal,
15 suitable for skate blades. In a preferred embodiment, the skate blade 600 comprises a titanium material, and in particular, ASTM-F136 titanium.

Figure 7A illustrates an embodiment of a blade fixation assembly for securing a skate blade to the bottom of a boot and/or a boot plate. In particular, Figure 7A illustrates a partial perspective view of a skate blade 700 having a bent
20 securing tab 706. The securing tab 706 further includes a grooved fixation hole 710 extending through a terminal portion of the securing tab 706. A locking screw 714 (or fixation screw) is used to affix the securing tab 710 to a boot 715 by extending through the fixation hole 710 into the bottom of the boot 715. For example, the locking screw 714 may be configured to engage a leather sole of the
25 boot 715.

As illustrated, the locking screw 712 includes a threaded head 714 and a threaded body 716. In certain embodiments, the threads of the locking screw 712 advantageously engage grooves of both the securing tab 706 and the hole of the boot 715 when used to secure the blade 700 to the boot 715.

30 In certain embodiments, the threads of the head 714 are of a different pitch than the threads of the body 716. For example, as illustrated in Figure 7A, the threads of the head 714 have less space therebetween (i.e., tighter pitch) than the threads of the body 716. In certain embodiments, the two threaded portions of the

locking screw 712 provide for a more secure attachment between the skate blade 700 and the boot 715. Such stability is due, in part, to portions of the locking screw 712 engaging both the securing tab 706 and the boot 715.

5 In certain embodiments, the locking screw 712 advantageously comprises a titanium material. In yet other embodiments, the locking screw 712 may comprise stainless steel or another like metal, wood, ceramic, alloys, combinations of the same or the like.

Figure 7B illustrates a cross-sectional view of a blade 700 affixed to the bottom of the boot 715. In particular, the skate blade 700 includes an elongated
10 portion 702 and securing tabs 706 and 708. The securing tabs 706 and 708 are affixed to the bottom of the boot 715 through the use of multiple locking screws 712. As shown, each of the locking screws 712 has a threaded head 714 that engages the grooves of the securing tabs 706 and 708. In certain embodiments, the grooves of the securing tabs 706, 708 may comprise a spiral thread matching
15 the pitch of the threaded head 714. Furthermore, each locking screw 712 comprises a threaded body 716 that engages grooves in holes in the bottom of the skate boot 715.

In the illustrated embodiment, the securing tabs 706 and 708 of the skate blade 700 are not substantially flush with the bottom of the skate boot 715.
20 Rather, a gap 724 exists between the skate blade 700 and the boot 715. Because the threads of the locking screw 712 engage both the grooves of the securing tabs 706 and 708 and grooves of the holes in the skate boot 715, the skate blade 700 need not be substantially flush with the bottom of the boot 715. That is, such locking screws 712 need not rely solely upon compression between the skate
25 blade 700 and the boot 715 to withstand lateral forces experienced by the blade 700 and/or boot 715. In certain embodiments, the gap 724 allows for more stability between the blade 700 and the boot 715, such as when the bottom of the boot 715 is not a planar surface. In other embodiments, the securing tabs 706 and 708 may contact at least a portion of the boot 715, and the gap 724 may be
30 reduced or substantially eliminated.

Furthermore, the use of multiple locking screws 712 provides for increased stability between the skate blade 700 and the boot 715. In particular, as lateral forces are experienced by the skate blade 700, such as during skating, the

multiple locking screws 712 jointly counteract the lateral force to decrease movement between the skate blade 700 and the boot 715. Such reduction in play between the skate blade 700 and the boot 715 advantageously preserves the life of the skate blade 700 and/or the boot 715. For example, with the reduced
5 amount of play, the skate blade 700 may be less susceptible to warping, and/or the skate boot 715 may be less susceptible to deterioration of the leather (e.g., such as may be caused by movement of the blade 700 when affixed with conventional screws).

Figure 7C illustrates further details of the locking screw 712. As shown, the
10 locking screw 712 includes the threaded head 714 and the threaded body 716. The threaded head 714 includes multiple threads 730, and the threaded body 716 includes multiple threads 732. As shown, the space between each of the head threads 730 is less (tighter pitch) than the space between the body threads 732. In other embodiments, the body threads 732 may have less space (tighter pitch)
15 therebetween than the head threads 730.

Although described and shown with reference to particular embodiments, a skilled artisan will recognize from the disclosure herein a wide variety of alternative embodiments for the locking screw 712. For example, the locking screw 712 may include a head having a conical, cylindrical, tapered, or customized shape. In
20 certain embodiments, the locking screw 712 may include a shallower thread profile than what is depicted in Figures 7A–7C.

In certain embodiments, the locking screw 712 has a length between about 1 centimeter to about 3 centimeters. For instance, the length of a locking screw used to fasten a skate blade to the front (toe) portion of a boot may be of a shorter
25 length than a locking screw used to fasten the skate blade to the back (heel) portion of the boot.

In certain embodiments, the securing tab 706 may include multiple holes therethrough for affixing the skate blade 700 to the boot 715. For example, the securing tab 706 may include at least one non-grooved hole for a standard screw,
30 bolt, rivet, bracket, clip or other attachment device and at least one grooved hole to receive the locking screw 712. Such embodiments allow for the option of securing the skate blade 700 with one or more types of securing devices.

Figure 8 illustrates a side view of another embodiment of a skate blade 800 having a securing tab 806. In particular, the illustrated securing tab 806 includes a fixation hole 810, such as those described above with respect to Figures 2 and 7. The illustrated securing tab 806 further includes a provisional hole 840 usable, for example, to temporarily affix the securing tab 806 to the underside of a boot. As illustrated, the provisional hole 840 has a smaller circumference than the fixation hole 810.

For example, in certain embodiments, the provisional hole 840 may be used to temporarily affix the skate blade 800 to a boot when the skate blade 800 is being fitted or adjusted. The provisional hole 840 is advantageously of a smaller diameter to allow for the use of smaller securing mechanisms, such as, for example, pins or small screws, that can be inserted through the provisional hole 840 and into the bottom of a boot without requiring substantial alterations or holes in the boot. In other embodiments, the securing tab 806 may include multiple provisional holes 840. Using the provisional holes 840 may advantageously avoid disruption of the integrity of the boot bottom in areas that receive the more permanent fixation device, such as the locking screws 712 illustrated in Figures 7A–7C.

In other embodiments, the skate blade 800 may function without provisional holes. For example, a user may insert temporary fixation devices through the fixation hole 810 when fitting or adjusting the skate.

Figure 9 illustrates a side view of a skate blade 900 according to an embodiment of the invention. In particular, the skate blade 900 includes an elongated portion 902 from which extend a first set 906 of securing tabs and a second set 908 of securing tabs usable to affix the skate blade 900 to the bottom of a boot. As shown, each of the securing tabs includes a fixation hole 910 and a provisional hole 940. The skate blade 900 differs from the skate blades 200, 400 and 600 in Figures 2, 4 and 6, respectively, in that the first set 906 of securing tabs extends from a first common neck portion 907, and the second set 908 of securing tabs extends from a second common neck portion 909. As shown, each of the first neck portion 907 and the second neck portion 909 extends from a top edge of the elongated portion 902.

The illustrated skate blade 900 also includes a toe pick 914, a first shock absorption slot 920 and a second shock absorption slot 922. Furthermore, the skate blade 900 includes an opening 942 positioned within the first neck portion 907 that advantageously provides for a reduction in the weight and/or air
5 resistance of the skate blade 900.

Although described with reference to particular embodiments, a skilled artisan will recognize from the disclosure herein a wide variety of alternative materials usable with the embodiments of skate blades described herein. For example, in certain embodiments, the skate blade may be made of a synthetic
10 non-metallic material or a thermoplastic material, such as, for example, nylon or polyurethane, a hydrophobic material such as an ultra high molecular weight polyethylene (UHMW PE), a fluoropolymer, a silicone material, combinations of the same or the like.

In certain embodiments, the skate blade may comprise a composite
15 material such as a resin or epoxy material including glass, aramide, carbon, boron, or stainless steel fibers, a thermoplastic metal matrix material, a ceramic material, combinations of the same or the like. The skate blade may also include one or more filler materials such as carbon black, graphite, glass fiber, aramide fiber, carbon fiber, boron fiber, stainless steel fiber, microspheres, fluorinated fillers such
20 as fluorinated graphite, silicone, diamond, metal fillers such as titanium carbide or tungsten carbide, titanium coated graphite, diamond films, aluminum-based ceramics, non-oxide ceramics, ceramic, fiber reinforced material, combinations of the same or the like.

As will be appreciated by those of skill in the art, embodiments of the
25 present invention find utility in various types of skates, of which figure skates, roller skates and speed skates are three examples. Since the skating characteristic requirements for these various type skates may vary, the precise material and/or configuration for a given type of skate, or for an individual skater who will use the given type of skate, may also vary.

30 While certain embodiments of the inventions have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the disclosure. Indeed, the novel methods and systems described herein may be embodied in a variety of other forms. Furthermore,

various omissions, substitutions and changes in the form of the methods and systems described herein may be made without departing from the spirit of the disclosure. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the
5 disclosure.

WHAT IS CLAIMED IS:

1. A skate blade comprising:
an elongated portion occupying a first plane and having a distal end,
a proximal end, a top portion and a bottom edge configured for engagement
5 with a skating surface during use; and
a plurality of tabs extending from the top portion of the elongated
portion, each of the plurality of tabs configured to bend at a bend line
substantially parallel to the first plane such that a top section of each of the
plurality of tabs occupies a second plane substantially perpendicular to the
10 first plane, and wherein each of the top sections of the plurality of tabs
comprises at least one hole extending therethrough and usable for securing
the tab to a skate boot when the top sections are in the bent positions,
and wherein the elongated portion and the plurality of tabs are
formed from a single piece of a unitary material and have substantially the
15 same thickness.
2. The skate blade of Claim 1, wherein each of the plurality of tabs
comprises a bottom section extending from the top portion of the elongated portion
and occupying the first plane
3. The skate blade of Claim 1, wherein the bend line occupies the first
20 plane.
4. The skate blade of Claim 1, wherein the distal end of the elongated
portion comprises an elongated slot.
5. The skate blade of Claim 4, wherein the proximal end of the
elongated portion comprises a toe pick.
- 25 6. The skate blade of Claim 1, wherein the at least one hole of at least
one tab comprises a grooved wall for engagement with a threaded portion of a
locking screw.
7. The skate blade of Claim 1, wherein a circumference of the at least
one hole is substantially circular.

8. The skate blade of Claim 1, wherein the at least one hole of at least one tab further comprises:

a first hole for affixing the skate blade to a skate boot; and

5 a second hole for temporarily affixing the skate blade to the skate boot.

9. The skate blade of Claim 1, wherein at least two of the plurality of tabs are located toward a middle portion of the elongated portion and at least two other of the plurality of tabs are located toward the distal end of the elongated portion.

10 10. The skate blade of Claim 1, wherein the unitary material comprises a titanium material.

11. The skate blade of Claim 10, wherein the titanium material comprises Ti_6Al_4V (ASTM-F136 titanium).

12. An ice skate assembly for improved stability between a skate blade
15 and footwear, the ice skate assembly comprising:

footwear having a sole portion for receiving screw threads having a first pitch;

20 a blade comprising at least one portion for securing the blade to the footwear, the at least one portion having a hole with grooves having a second pitch; and

a locking screw comprising an elongated body having first threads and a head having second threads, the locking screw configured to substantially secure the blade to the footwear when inserted into the sole and the hole such that the first threads of the elongated body engage the sole portion and the second threads of the head engage the grooves of the hole.
25

13. The ice skate assembly of Claim 12, wherein the first pitch is different than the second pitch.

14. The ice skate assembly of Claim 13, wherein the second pitch is
30 tighter than the first pitch.

15. The ice skate assembly of Claim 12, wherein the footwear comprises a plate having a threaded hole for receiving threads of the locking screw.

16. The ice skate assembly of Claim 11, wherein the locking screw comprises a titanium material.

17. A skate blade for improved stability with skate footwear, the skate blade comprising:

5 an elongated portion configured for engagement with a skating surface during use; and

at least one attachment portion affixed to the elongated portion, wherein the at least one attachment portion includes a threaded hole configured to receive first threads of at least one locking screw such that
10 second threads of at least one locking screw fix the elongated portion in relation to skate footwear.

18. The skate blade of Claim 17, wherein the elongated portion and the at least one attachment portion are formed from a single piece of a unitary material.

15 19. The skate blade of Claim 17, wherein the at least one attachment portion comprises a plurality of tabs.

20. The skate blade of Claim 17, wherein at least one of the elongated portion and the at least one attachment portion comprises a titanium material.

21. The skate blade of Claim 20, wherein the titanium material comprises
20 $\text{Ti}_6\text{Al}_4\text{V}$ (ASTM-F136 titanium).

22. The skate blade of Claim 17, wherein at least one of the elongated portion and the at least one attachment portion comprises a synthetic non-metallic material.

23. The skate blade of Claim 17, wherein the at least one attachment
25 portion includes a second hole.

24. A method of manufacturing a skate blade, the method comprising:
providing a flat, sheet-like member occupying an X-Y plane and
having a first thickness;

shaping the sheet-like member to form:

5 an elongated blade portion that extends generally in an X
direction within the X-Y plane;

a first tab extending from a top portion of the elongated blade
portion and comprising substantially the same thickness as the
sheet-like member; and

10 bending the first tab at a first bend line extending substantially in the
X direction such that at least a portion of the first tab generally occupies an
X-Z plane.

25. The method of Claim 24, additionally comprising shaping an end of
said elongated blade portion to form an elongated notch within the elongated
15 blade portion.

26. The method of Claim 24, additionally comprising further shaping the
sheet-like member to form a second tab extending from the top portion of the
elongated blade portion, wherein the second tab comprises substantially the same
thickness as the sheet-like member.

20 27. The method of Claim 26, additionally comprising bending the second
tab substantially at a second bend line extending substantially in the X direction,
such that at least a portion of the second tab occupies substantially the X-Z plane.

28. The method of Claim 27, wherein bending the first and second tabs
comprises bending at least a portion of the first tab to a side of the elongated
25 blade portion and bending at least a portion of the second tab to an opposite side
of the elongated blade portion.

29. The method of Claim 28, additionally comprising forming a first hole
in the first tab.

30. The method of Claim 29, wherein said forming comprises forming the
30 first hole with a spiral groove.

31. The method of Claim 29, additionally comprising forming a second
hole having a substantially smaller diameter than the first hole.

FIG. 1

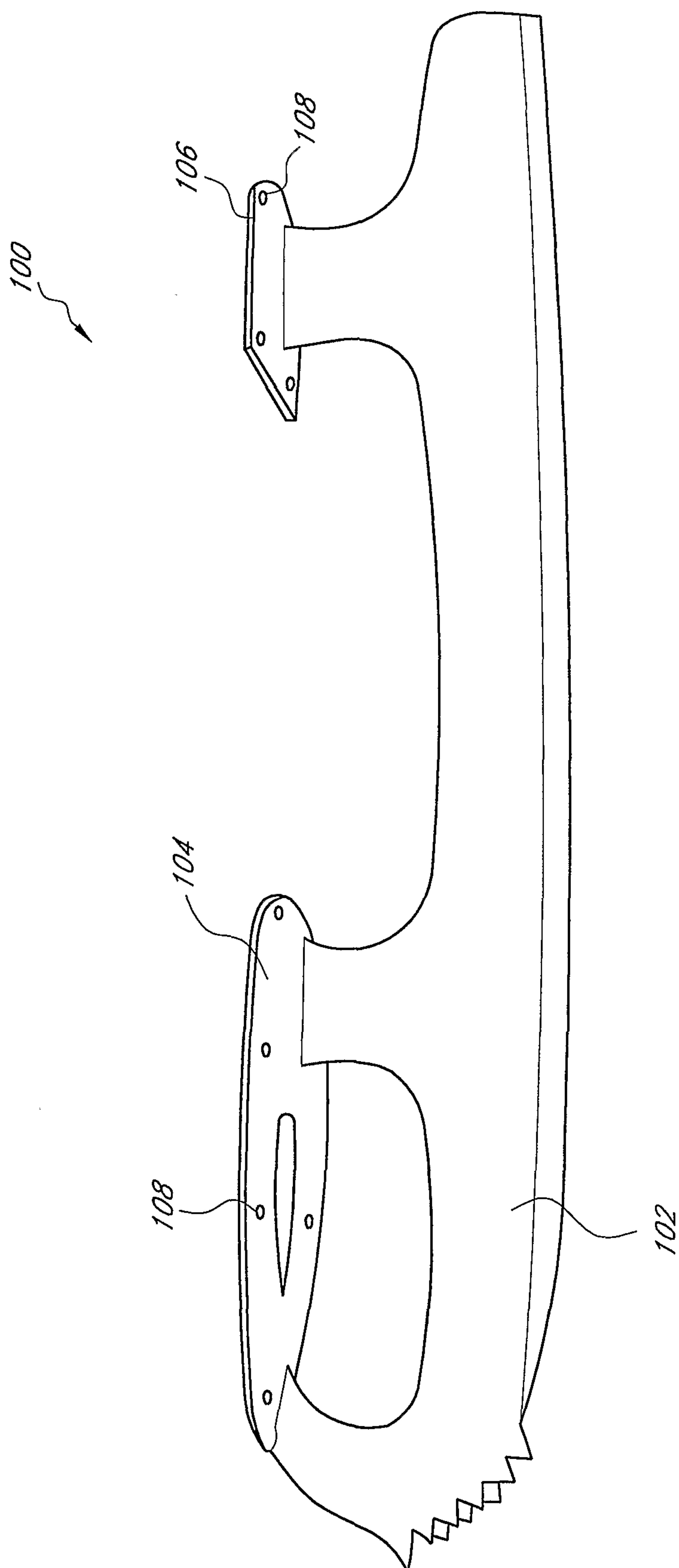
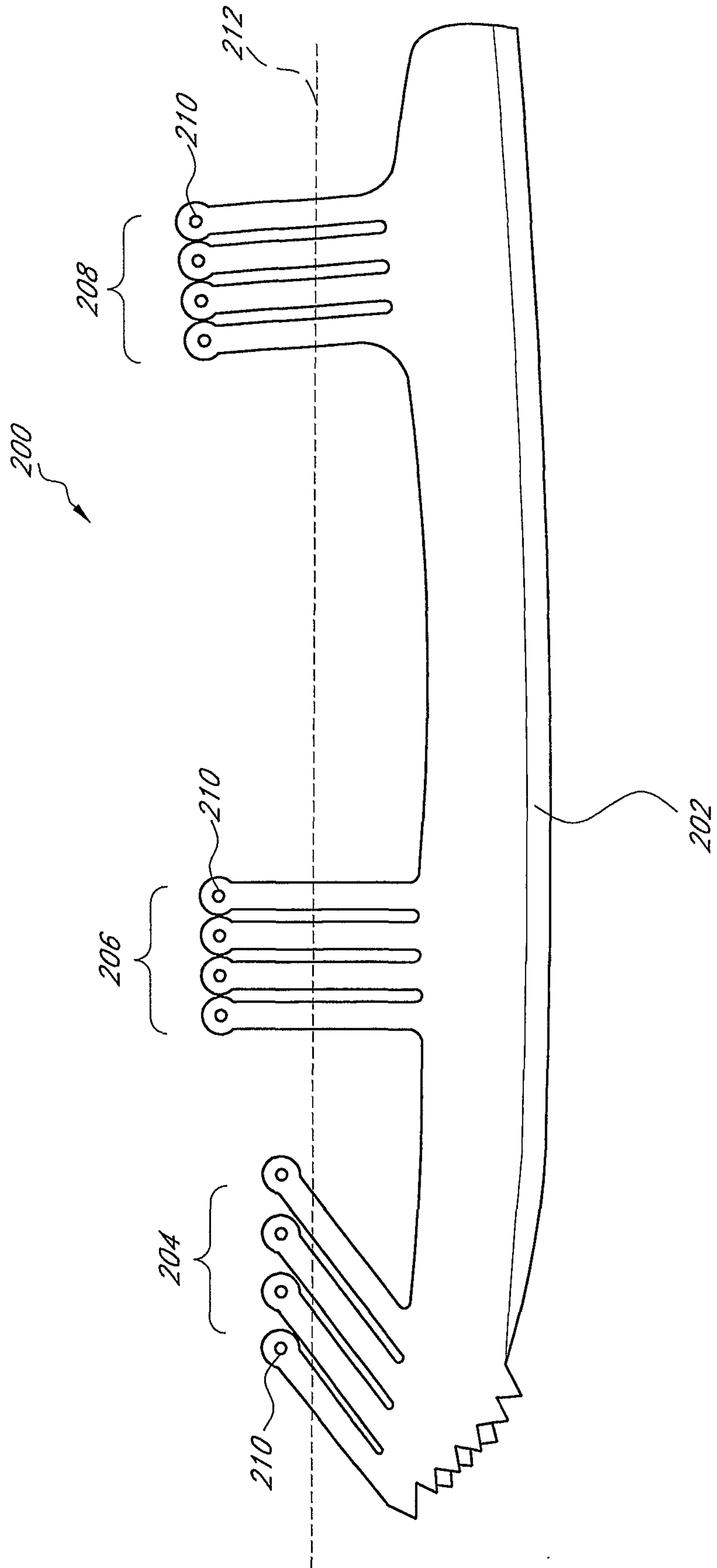
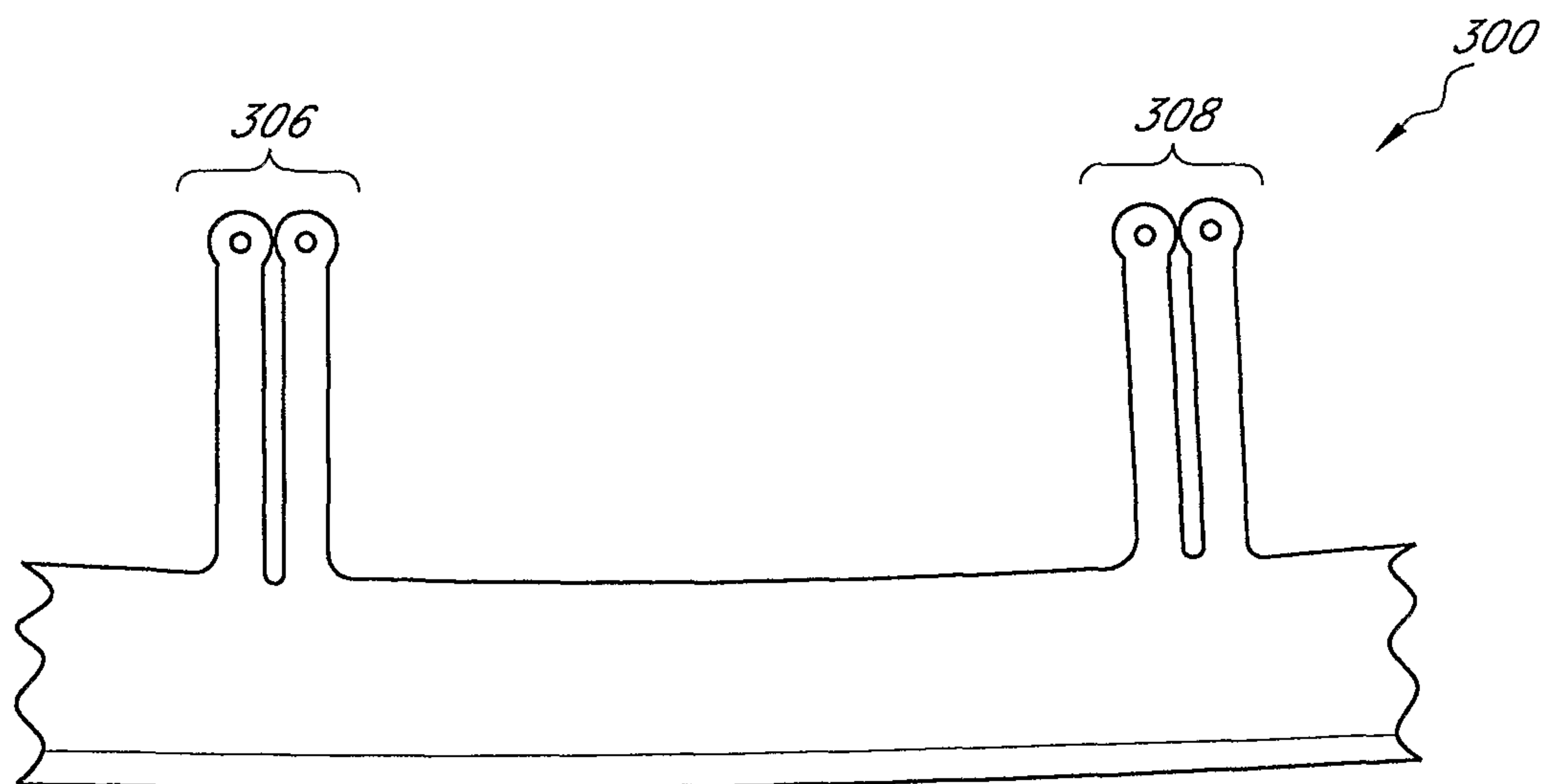
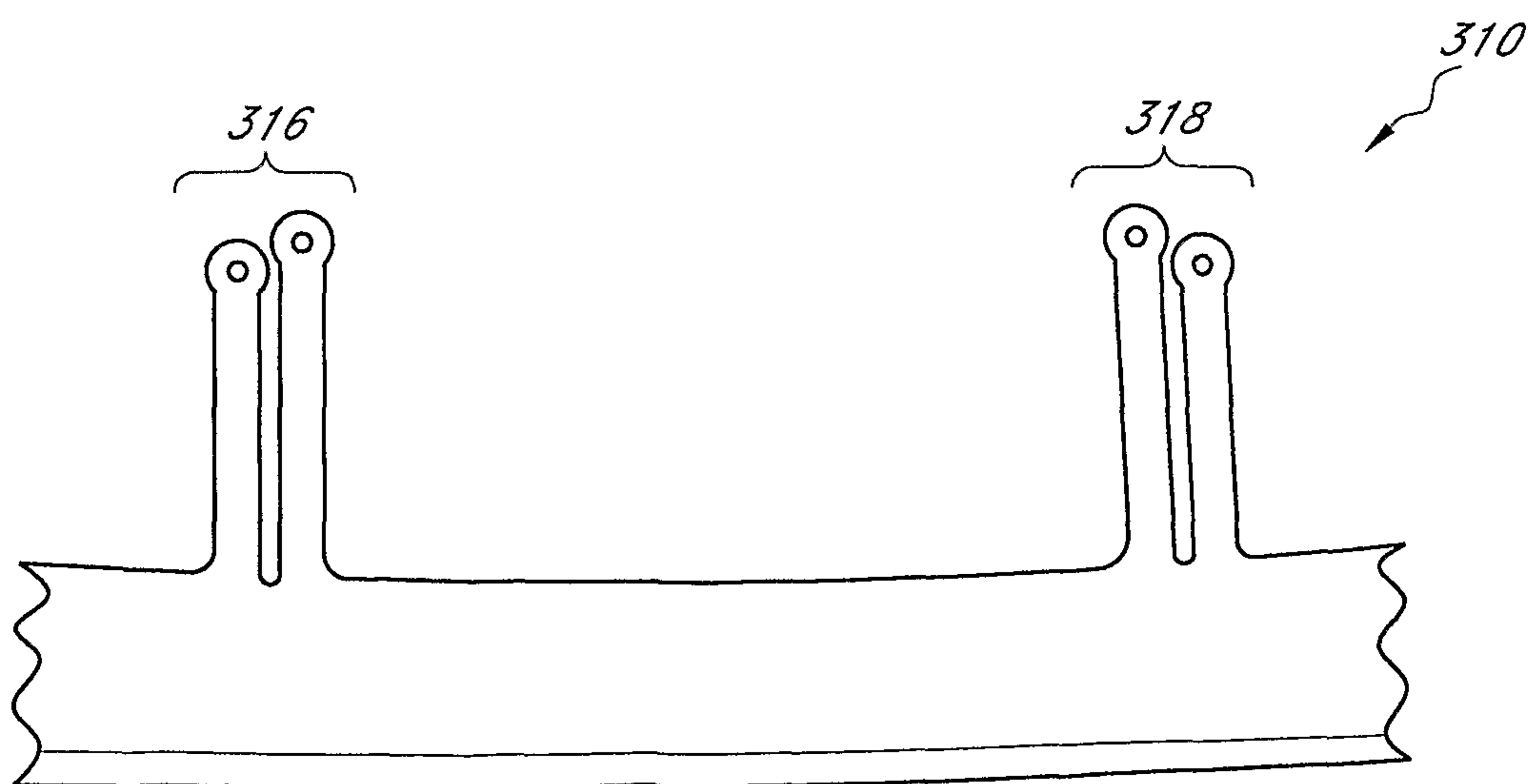
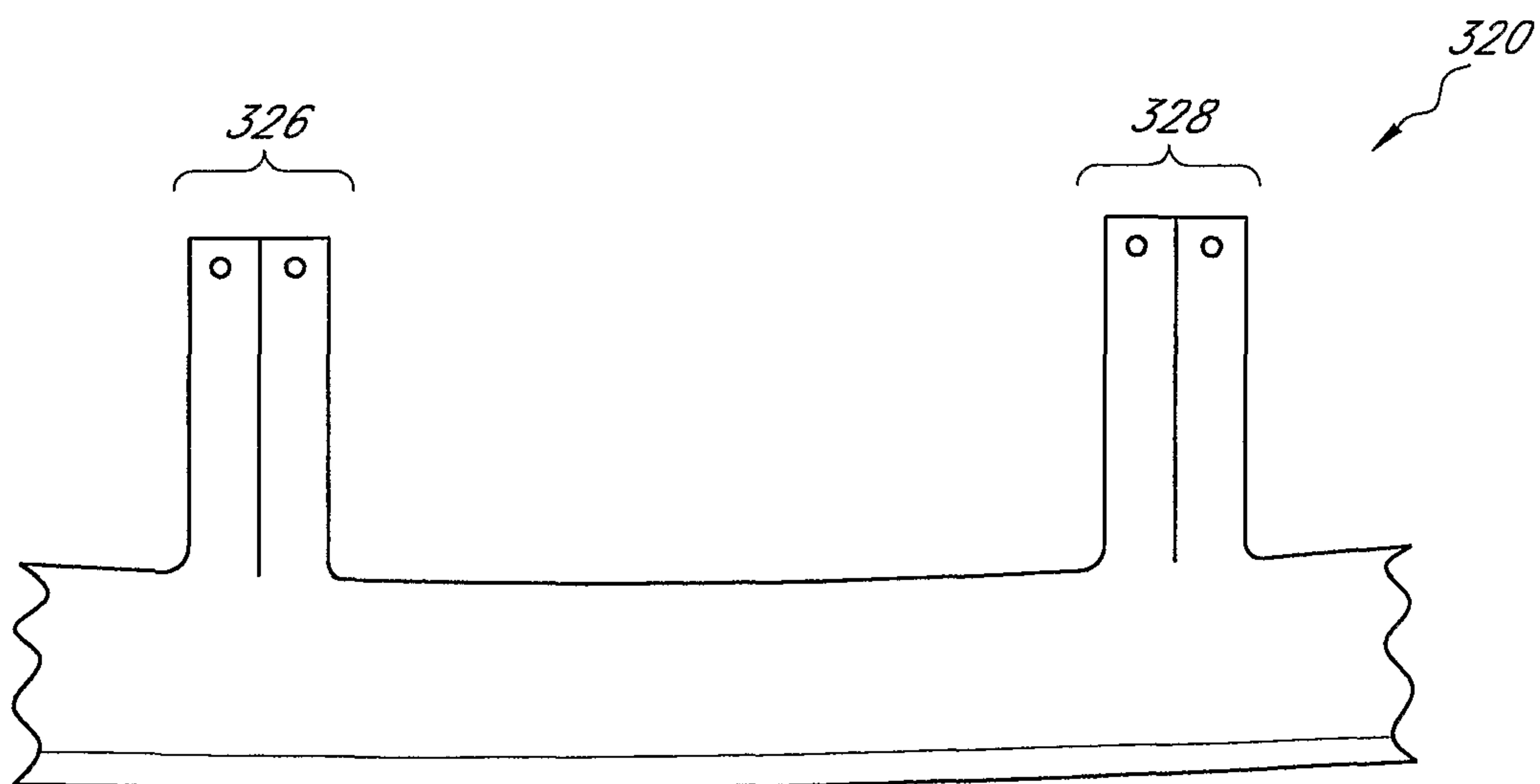
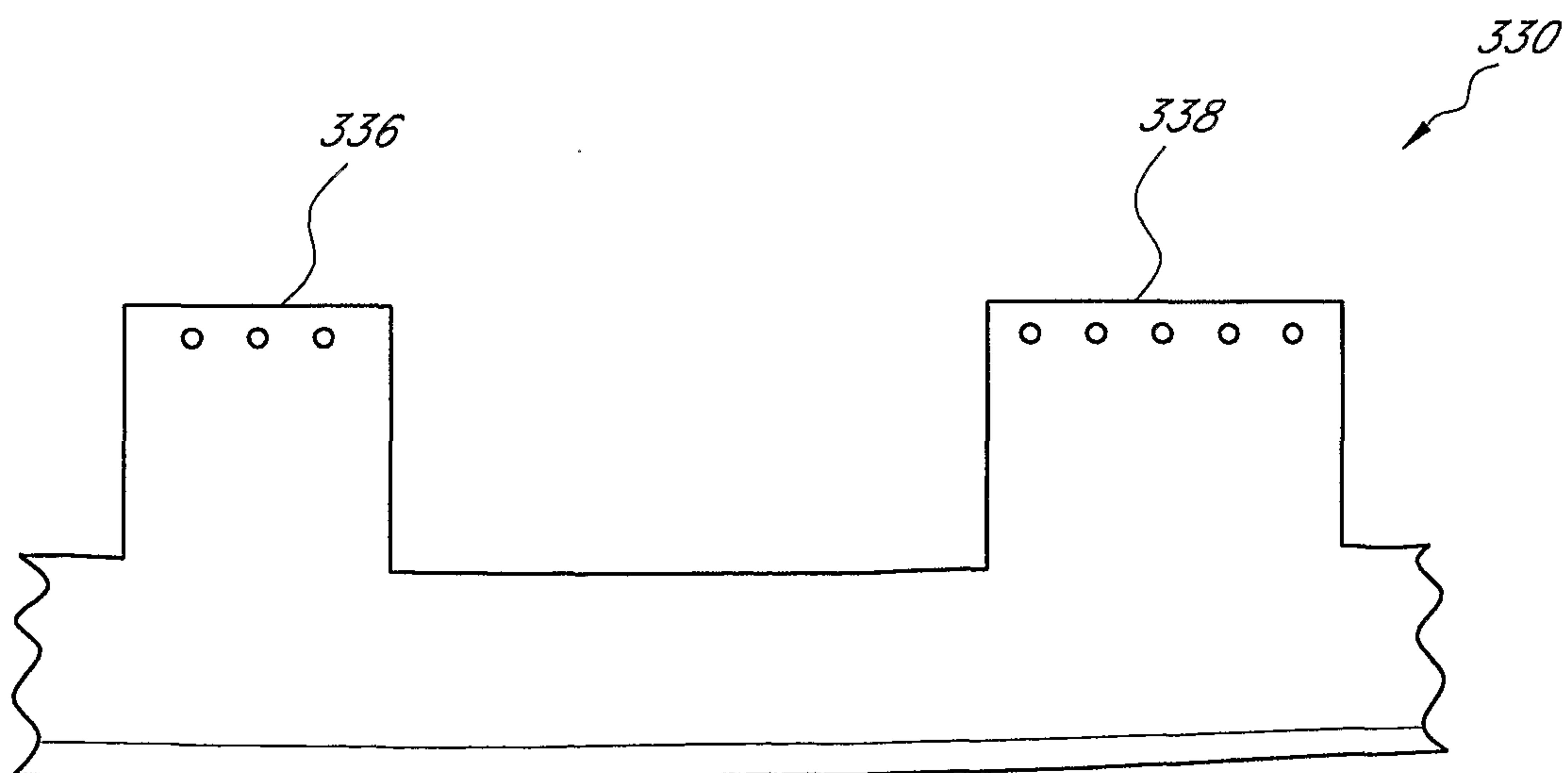


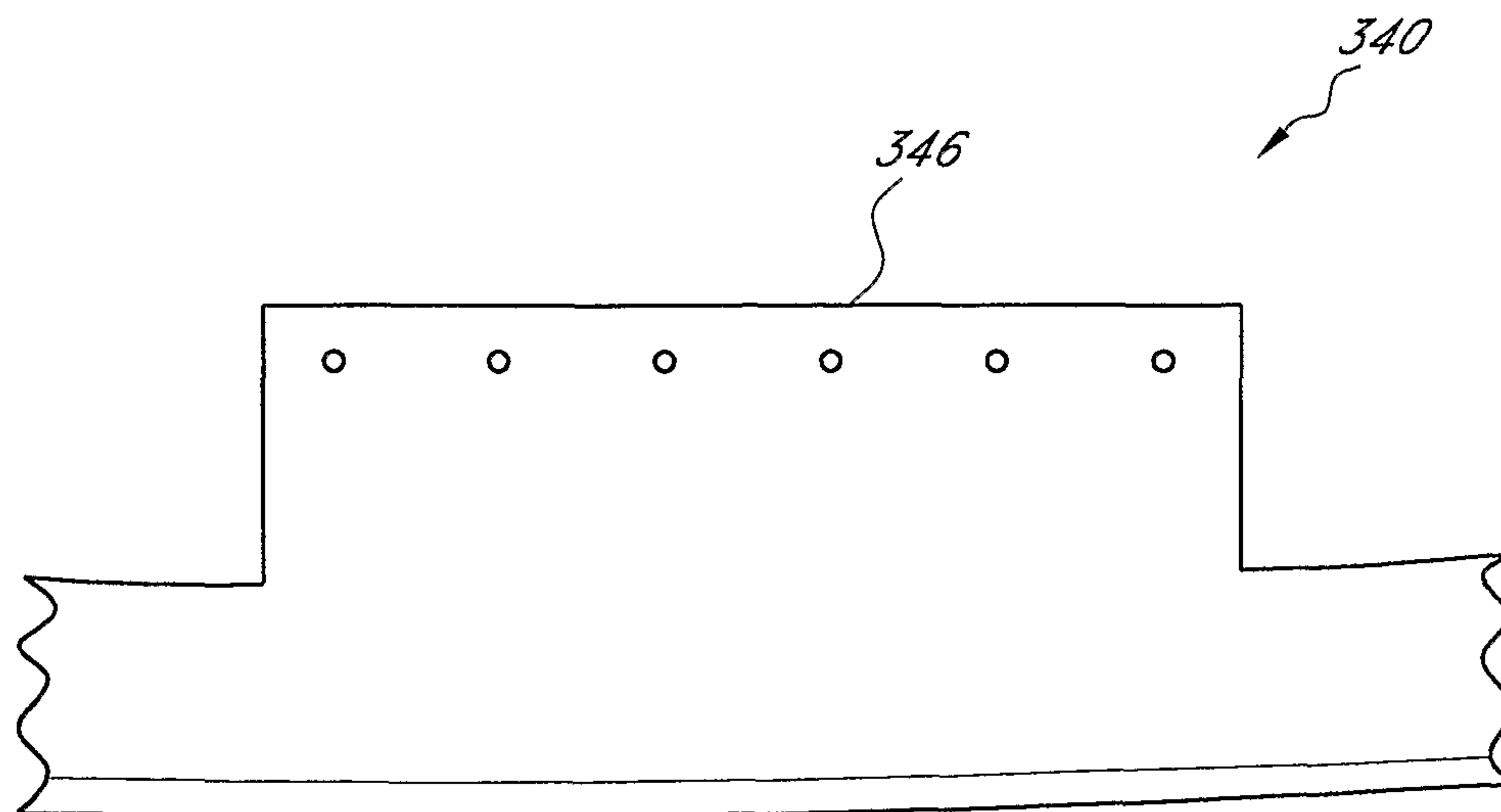
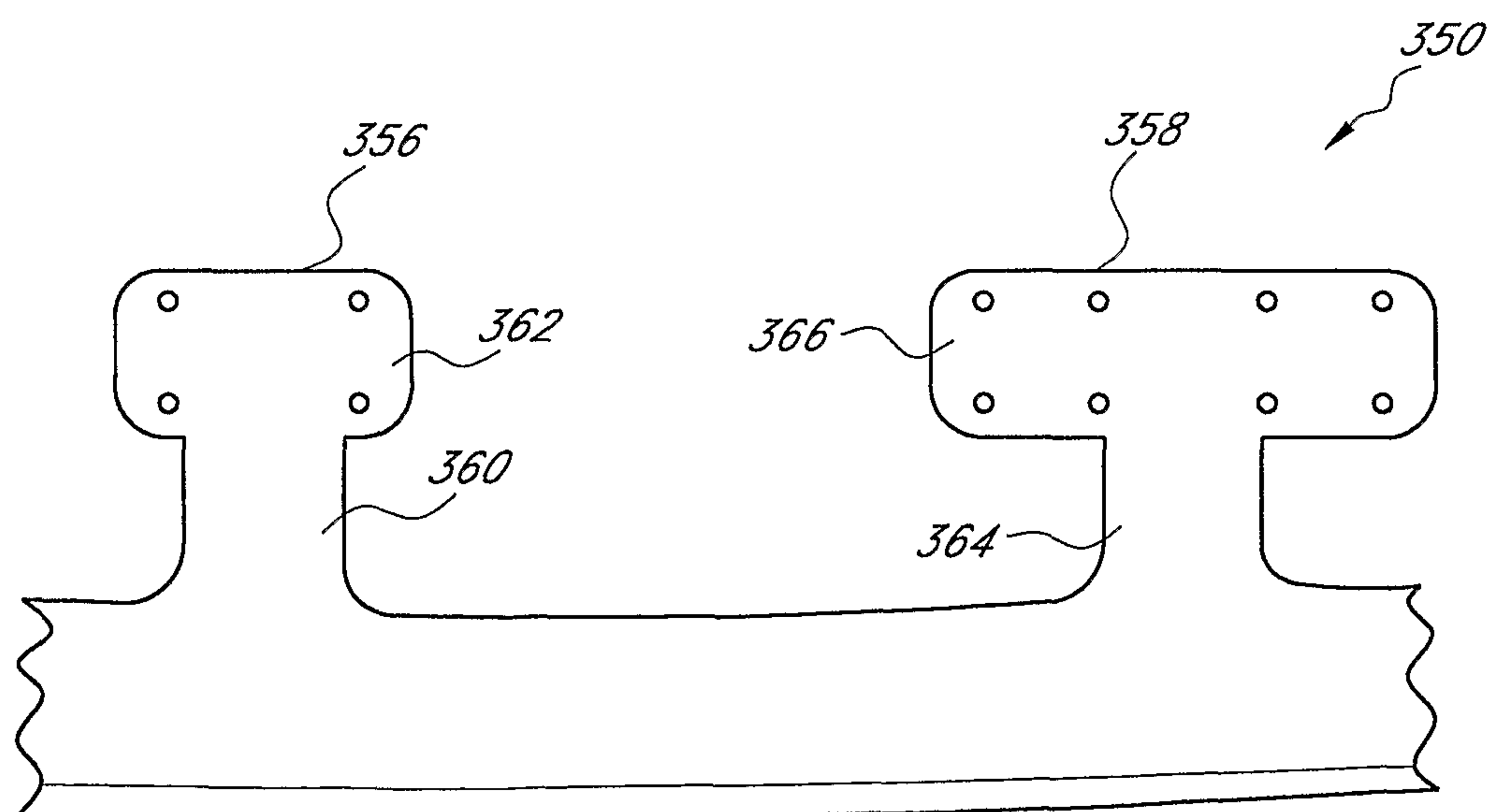
FIG. 2

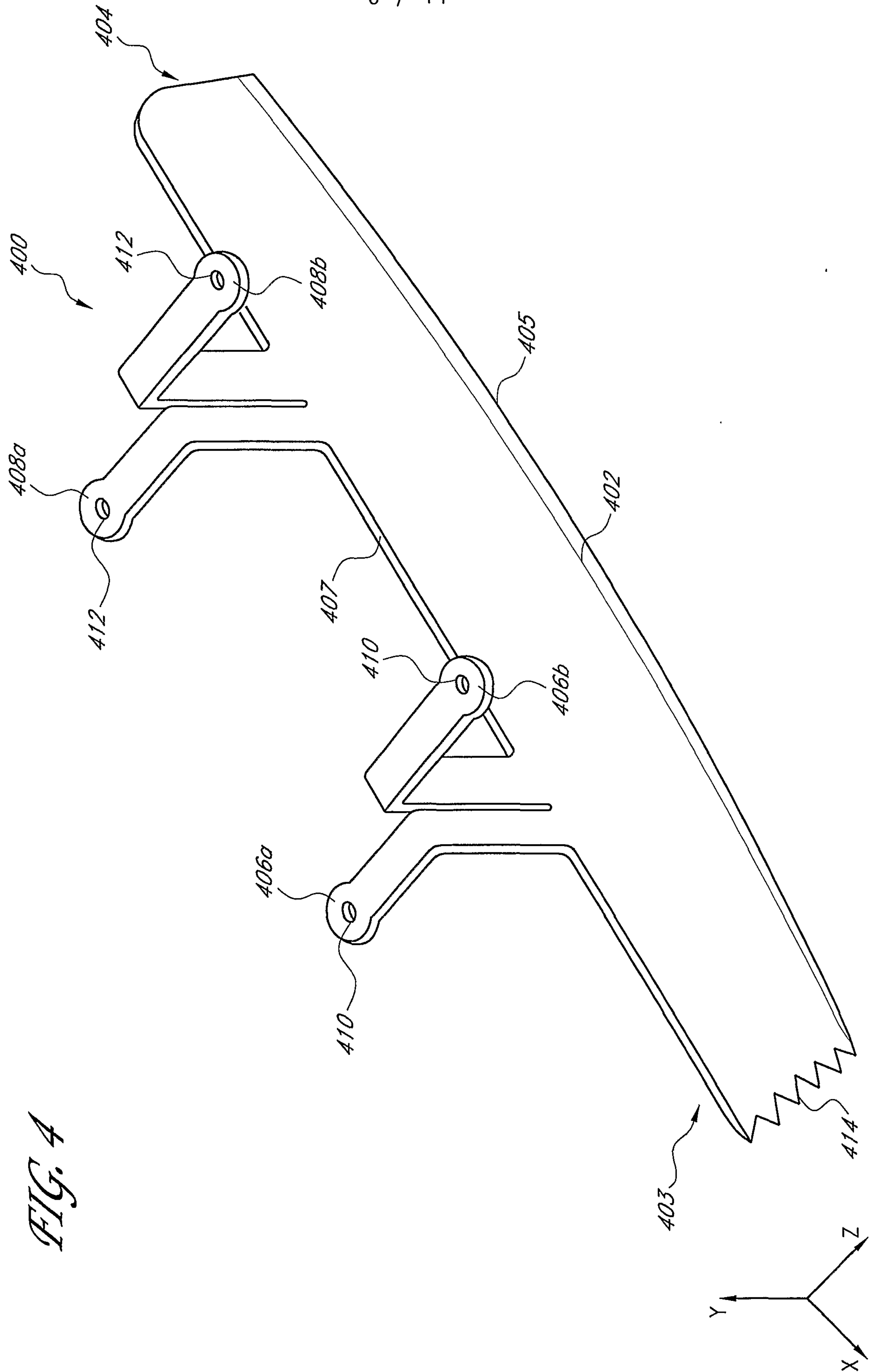


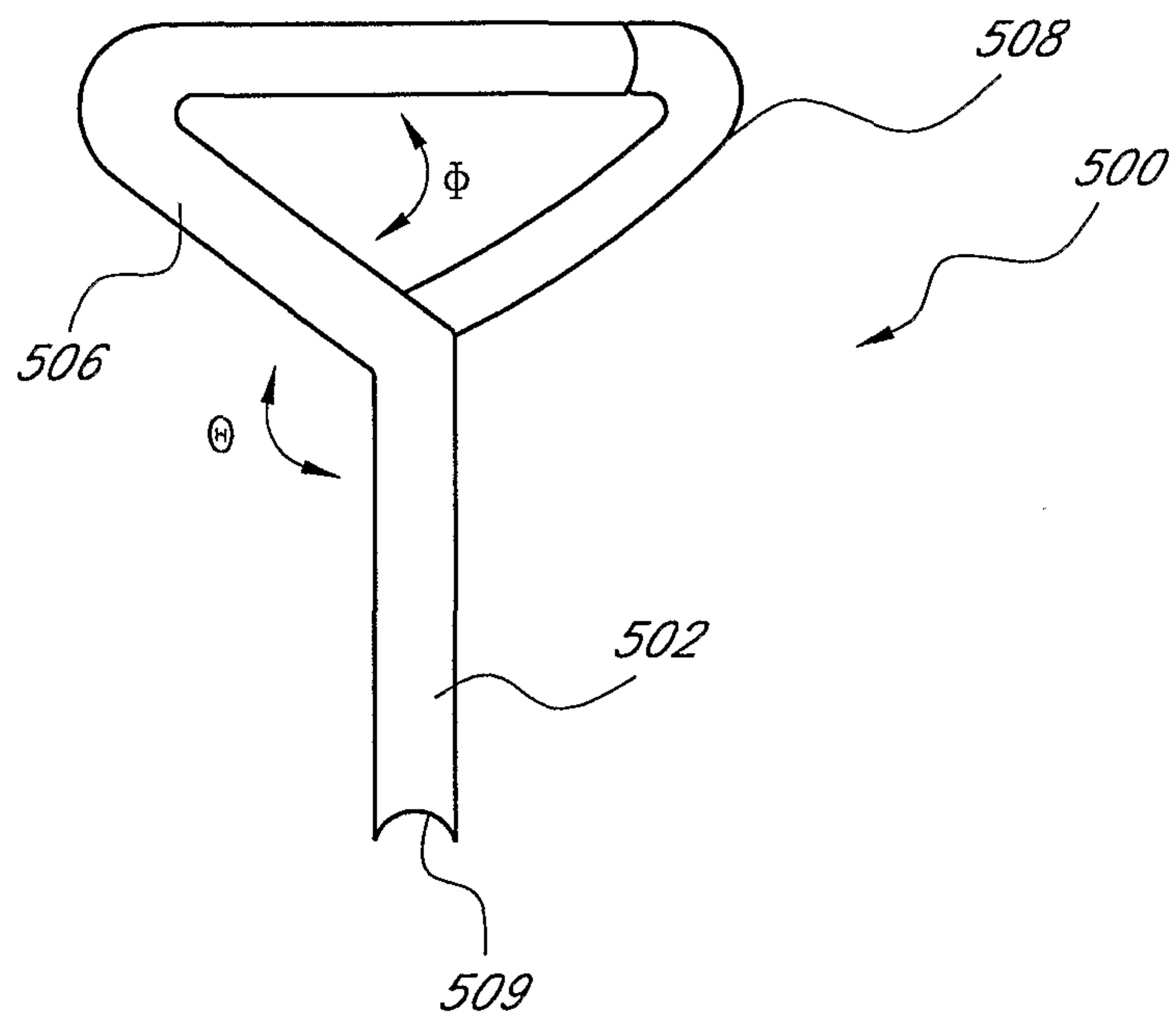
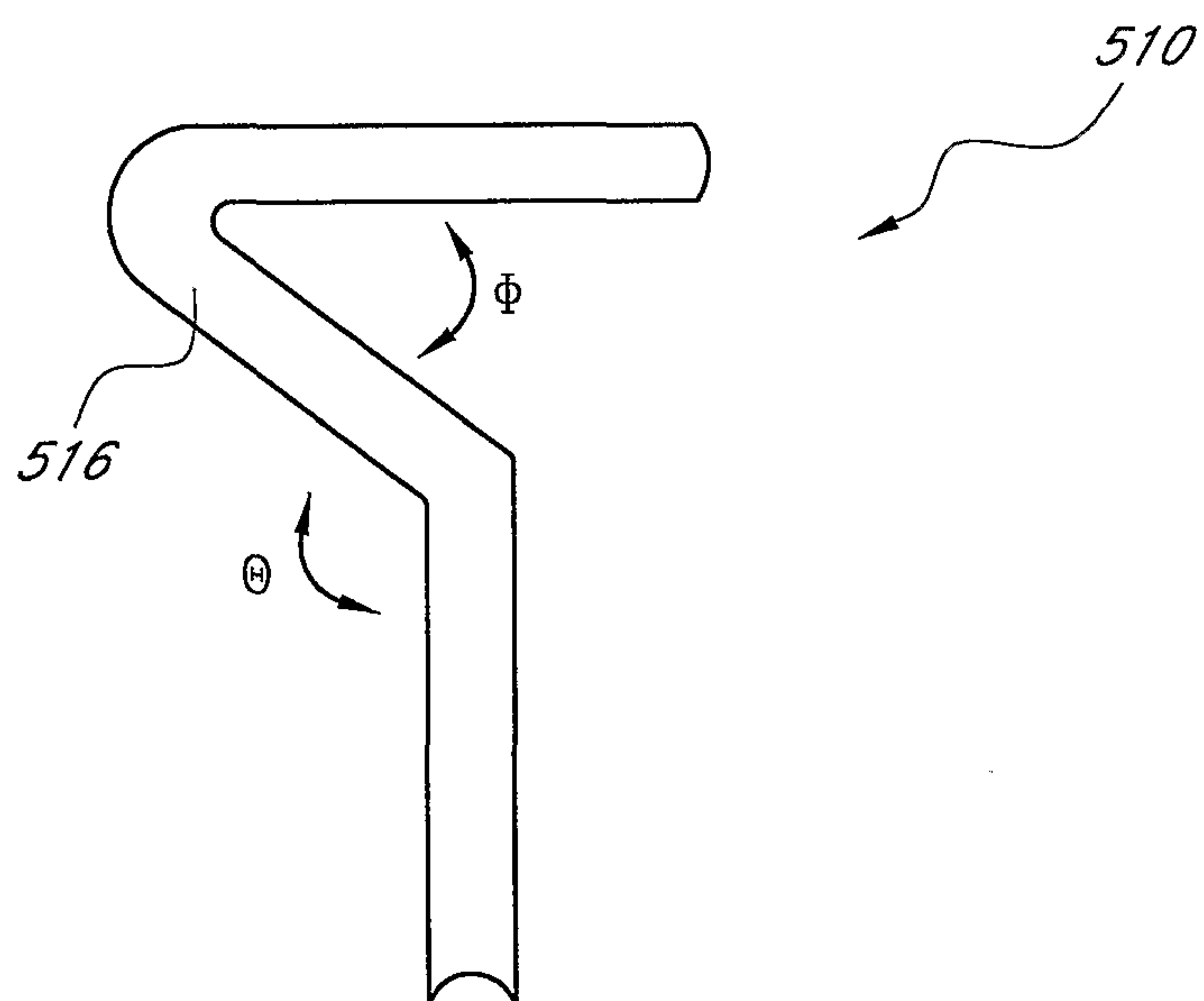
*FIG. 3A**FIG. 3B*

*FIG. 3C**FIG. 3D*

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*FIG. 3E**FIG. 3F*



*FIG. 5A**FIG. 5B*

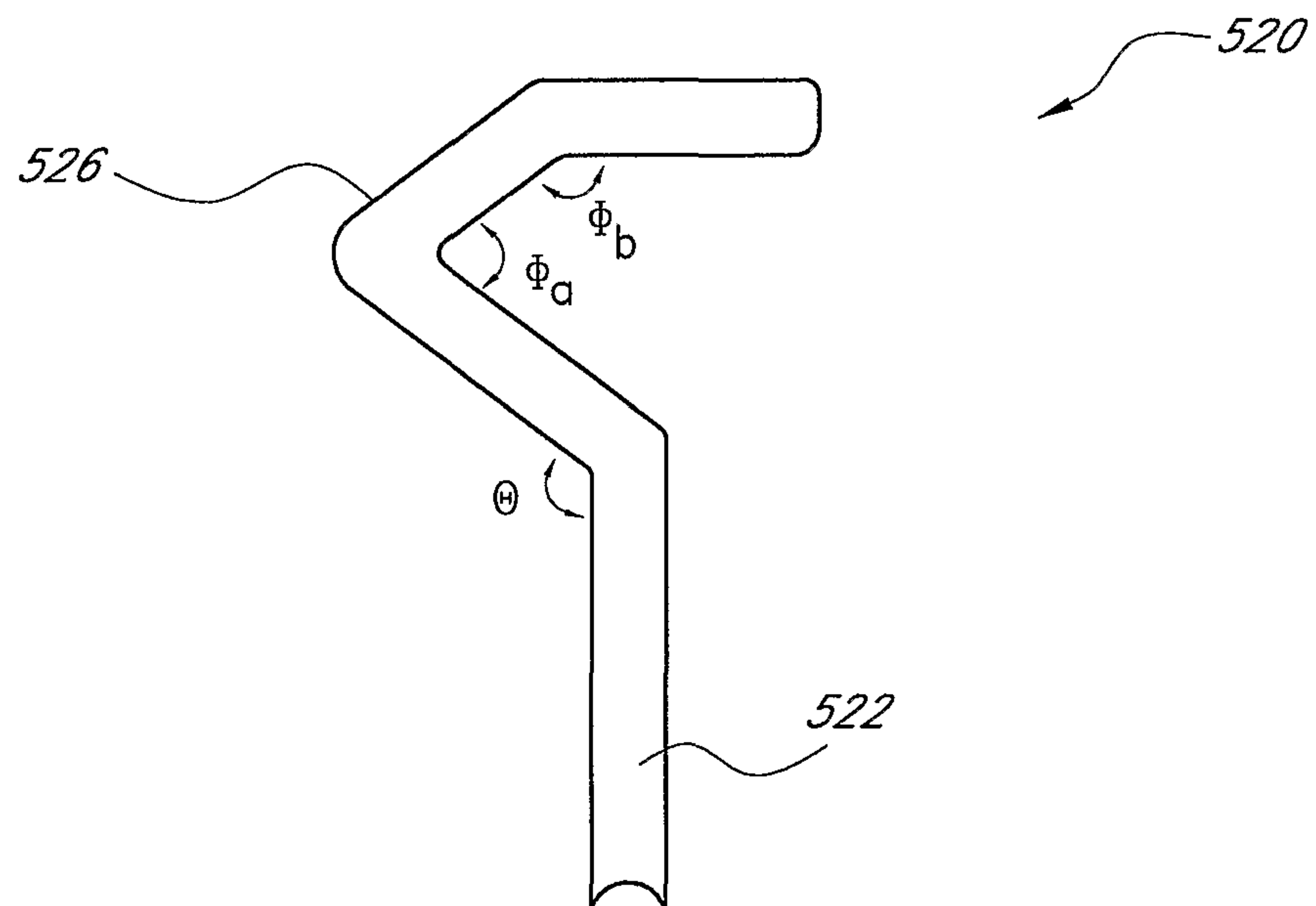
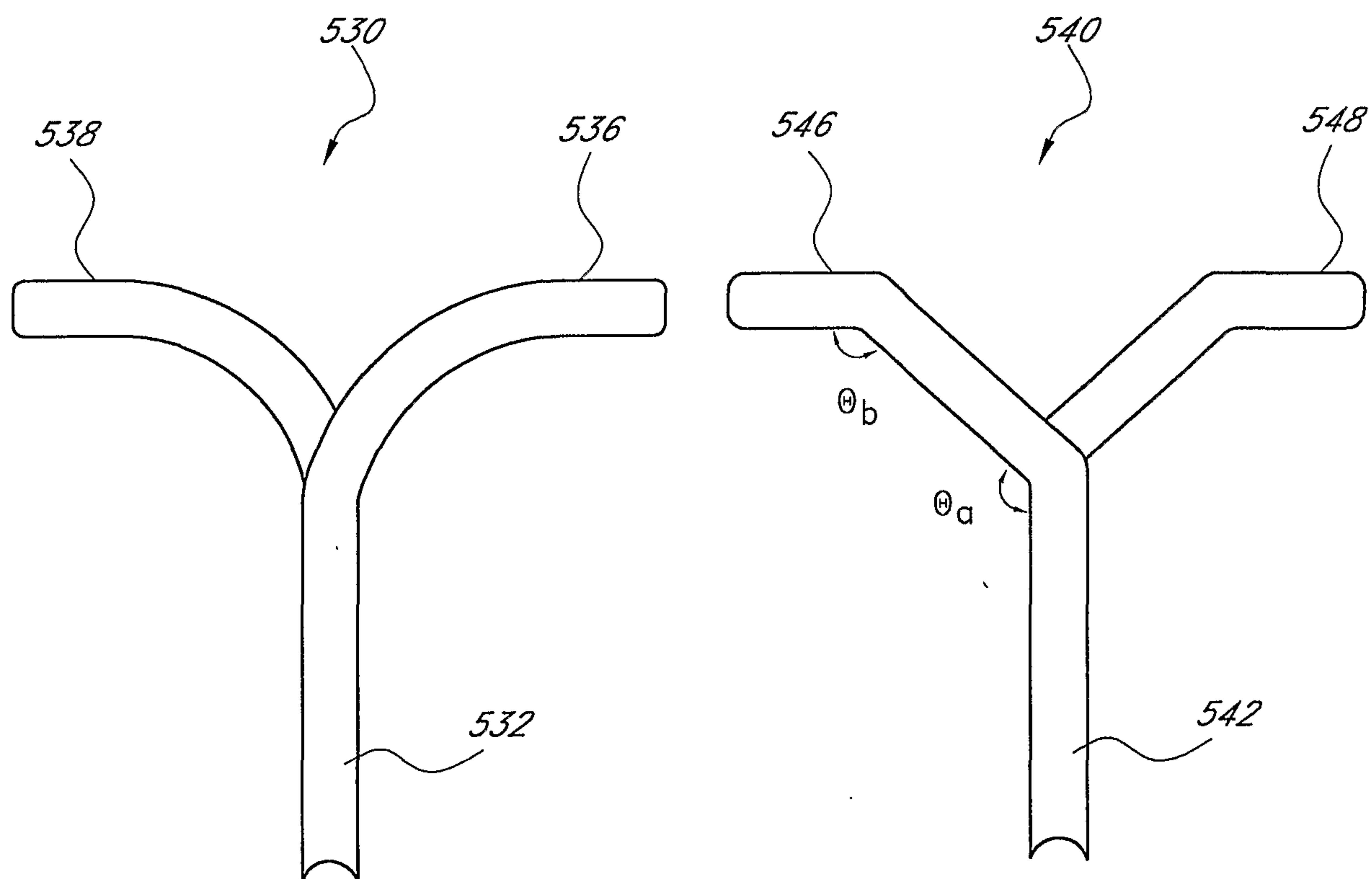
*FIG. 5C**FIG. 5D**FIG. 5E*

FIG. 6

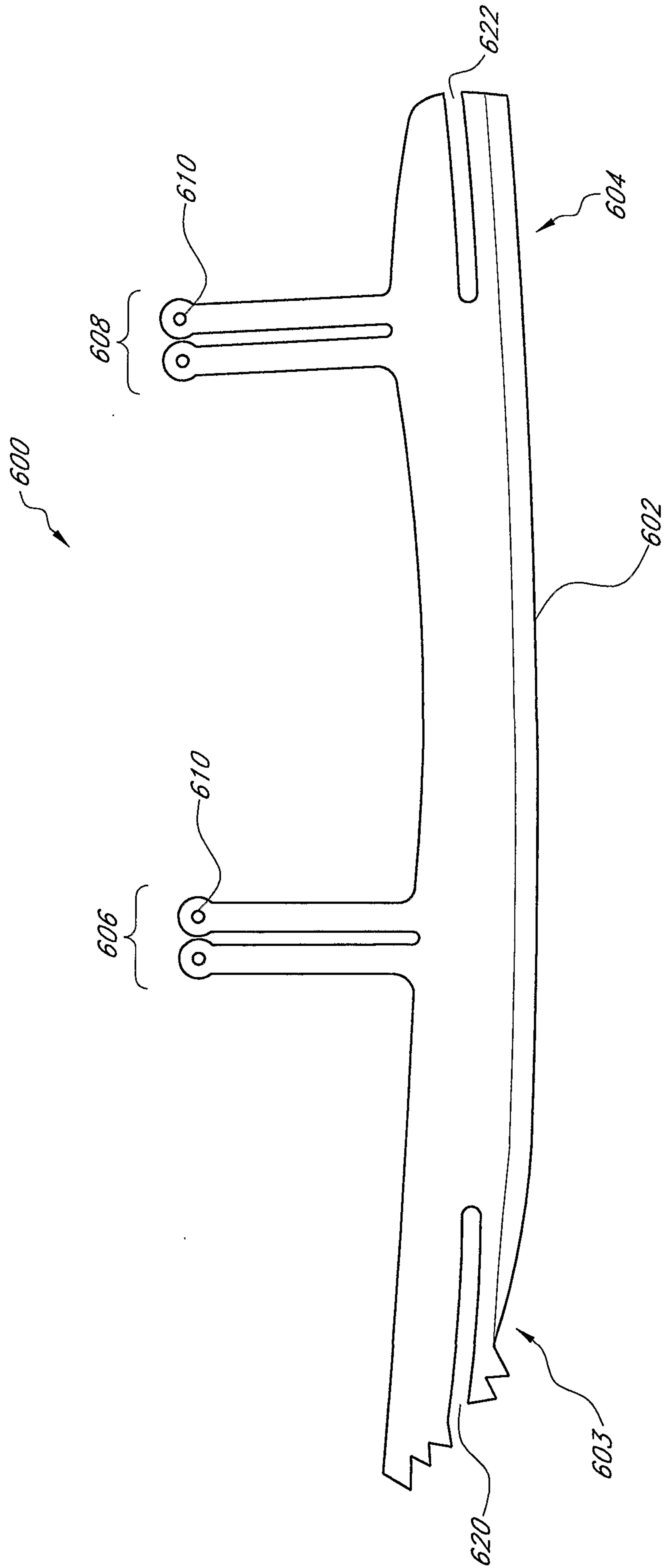


FIG. 7A

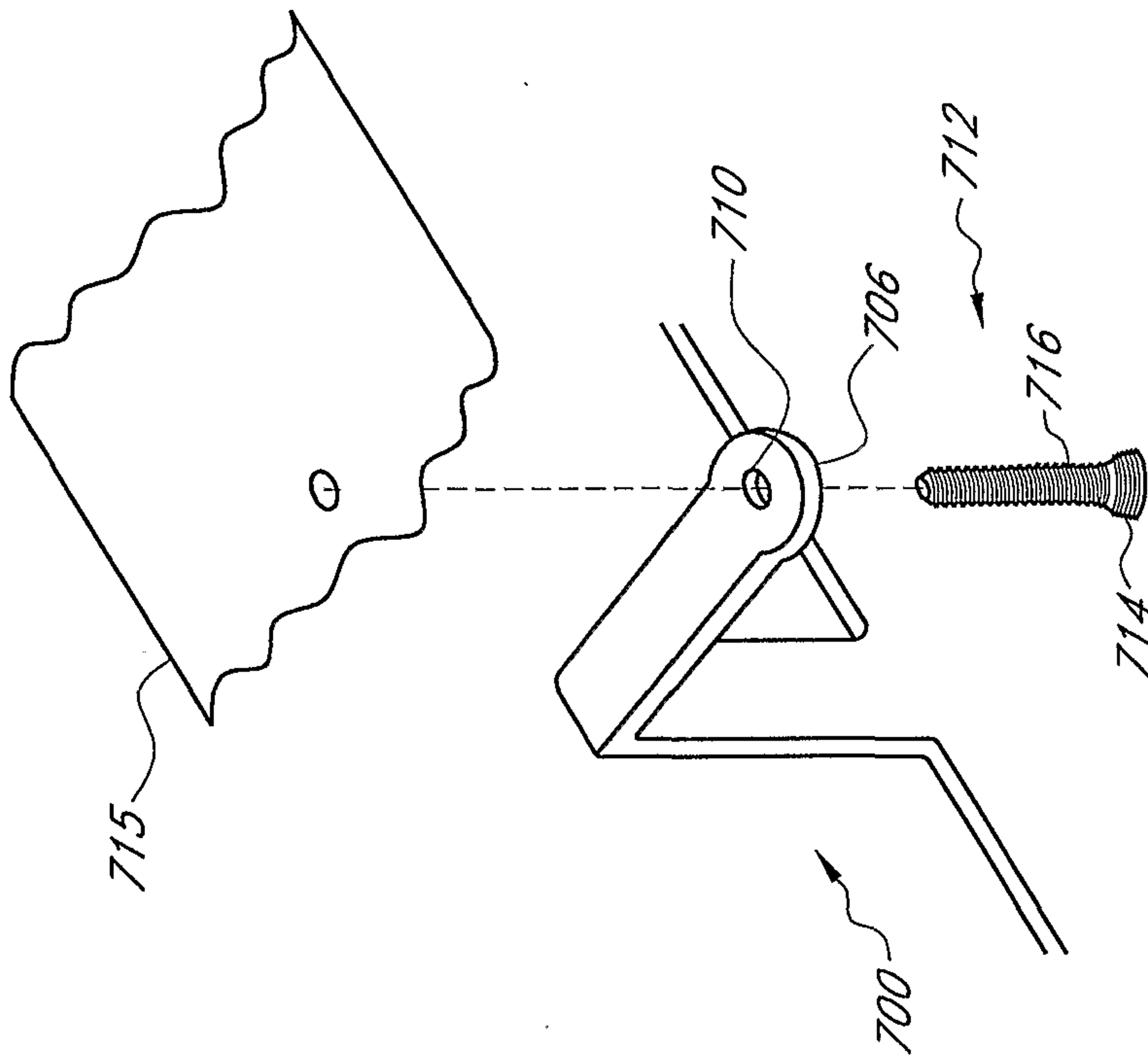


FIG. 7A

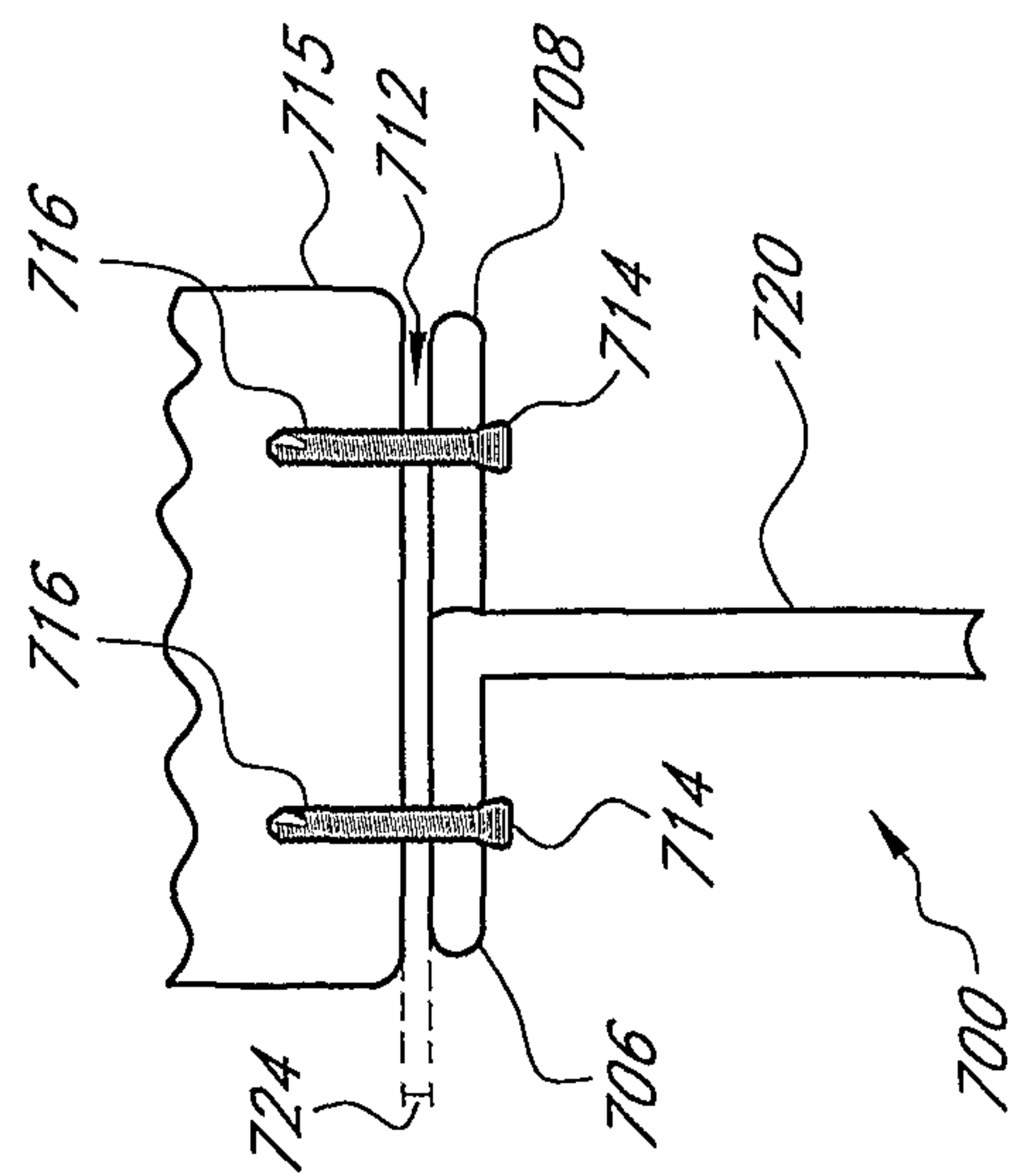


FIG. 7B

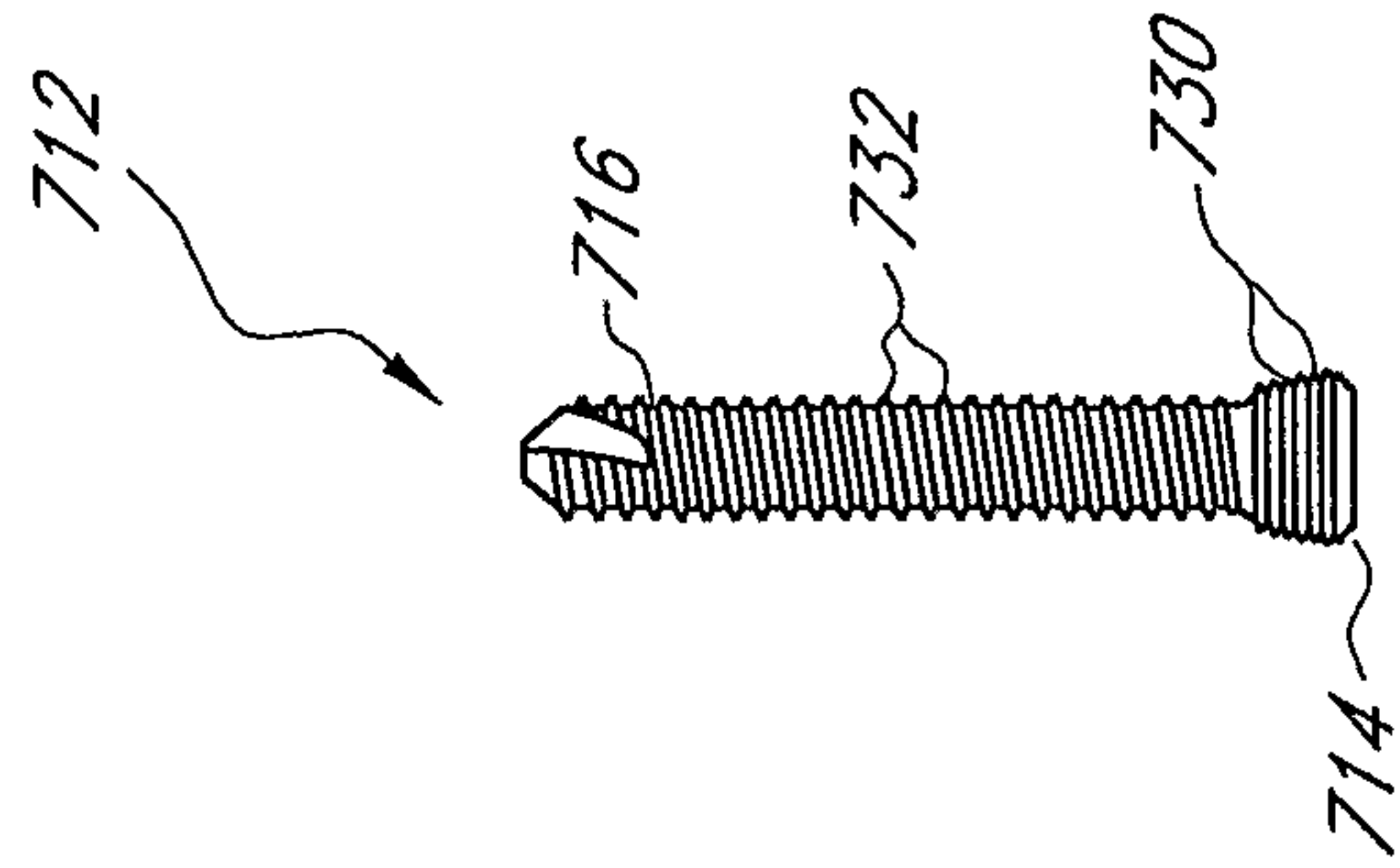
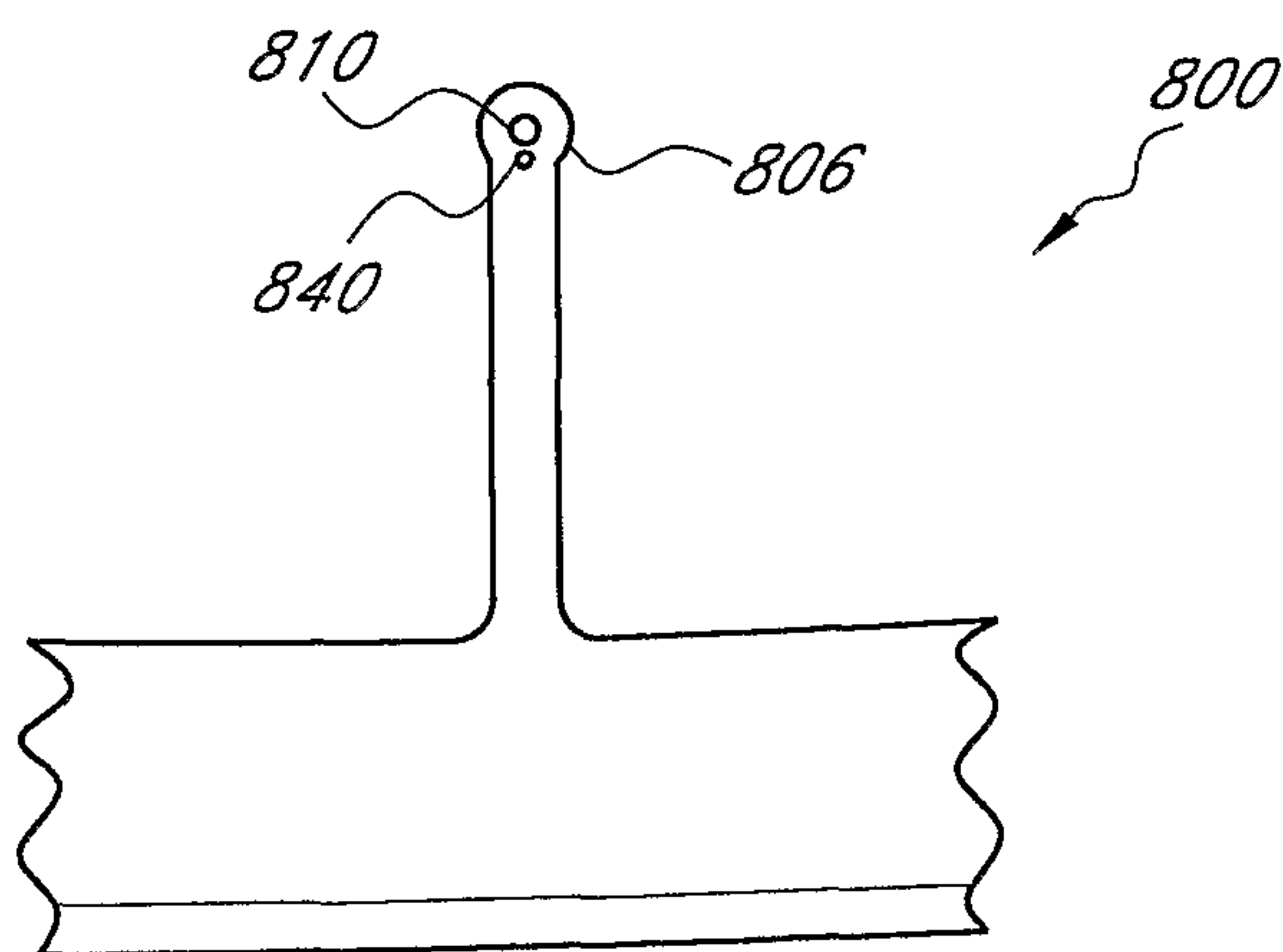
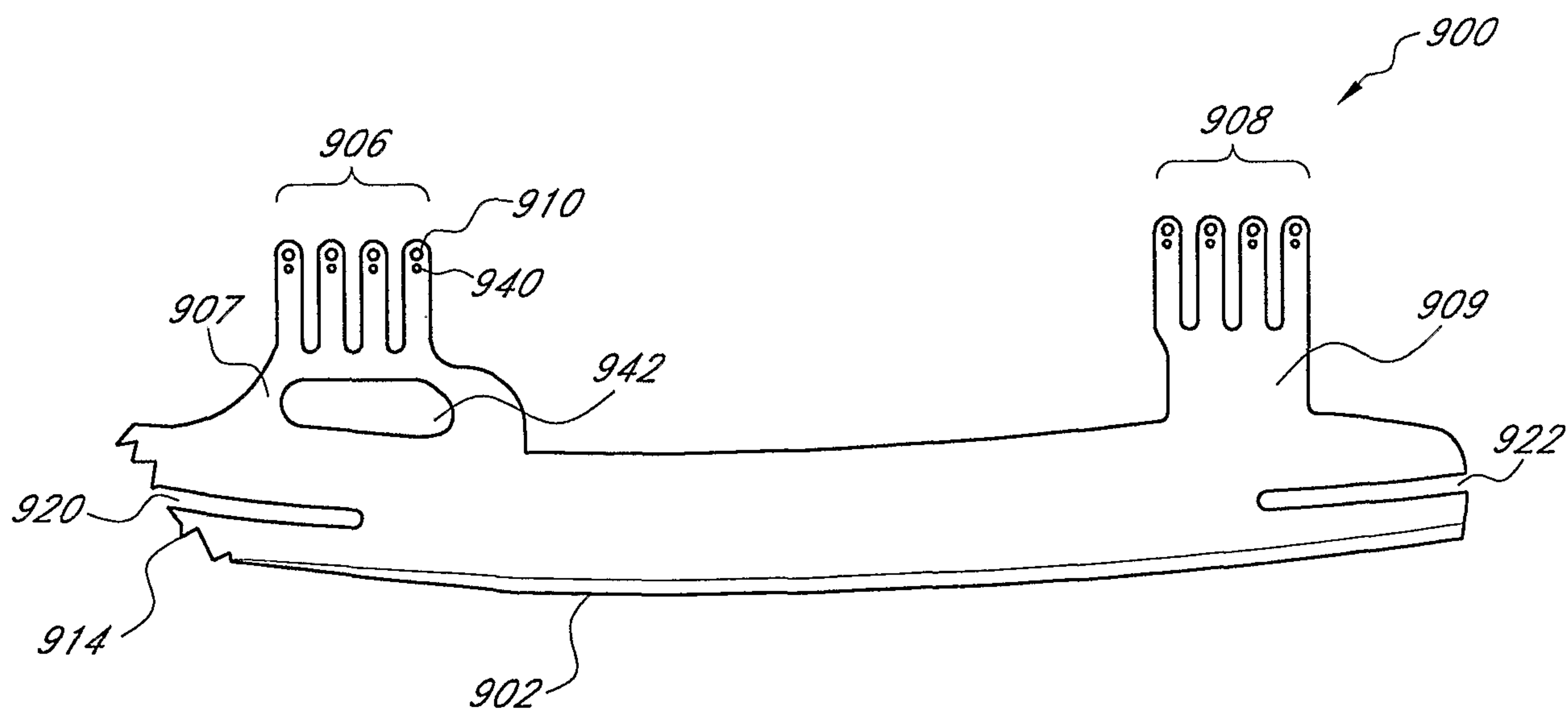


FIG. 7C

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*FIG. 8**FIG. 9*

