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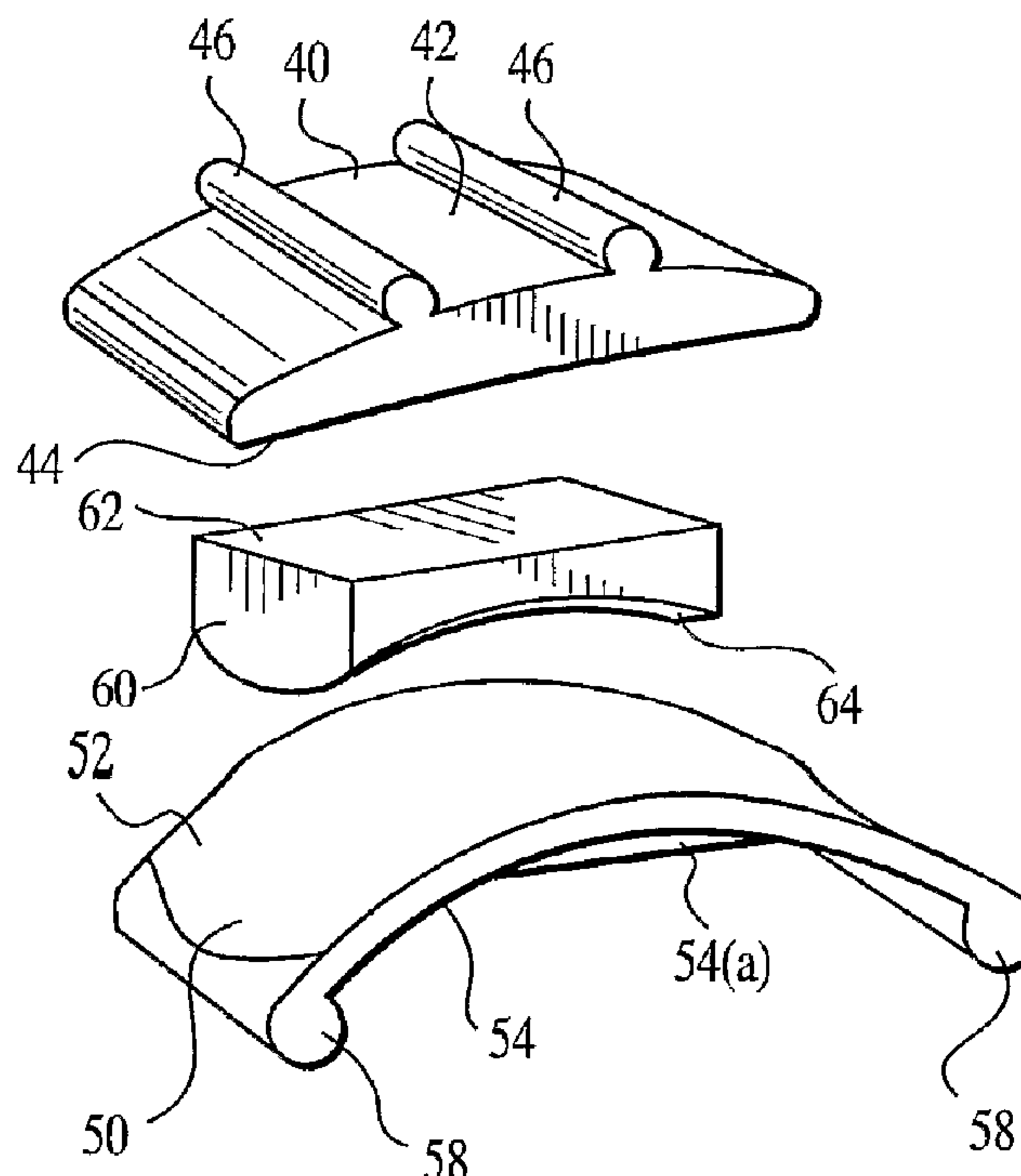
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(54) Title: ANKLE JOINT PROSTHESIS



(57) Abrégé/Abstract:

The ankle joint prosthesis adapted to involve the patient's distal tibia and talus has, according to the present invention, tibial (40, 41), talar (50, 51) and mobile (60) or semi-constrained (61) bearing components that are laterally to medially implanted in the patient. In a preferred embodiment, the tibial component's top surface (42) has convex curvature in its anterior to posterior plane and is configured so as to approximate and match with the curvature of a prepared portion of the distal tibia; its bottom surface (44) being approximately flat. The talar component's top surface (52) has saddle-shaped, convex curvature in its anterior to posterior plane, its bottom surface (54) has concave curvature and is configured so as to approximate and match with the curvature of a prepared portion of the talus. The mobile (60) or semi-constrained (61) bearing components have embodiments that comprise a wide variety of geometric shapes. A method for implanting such a prosthesis is also disclosed.

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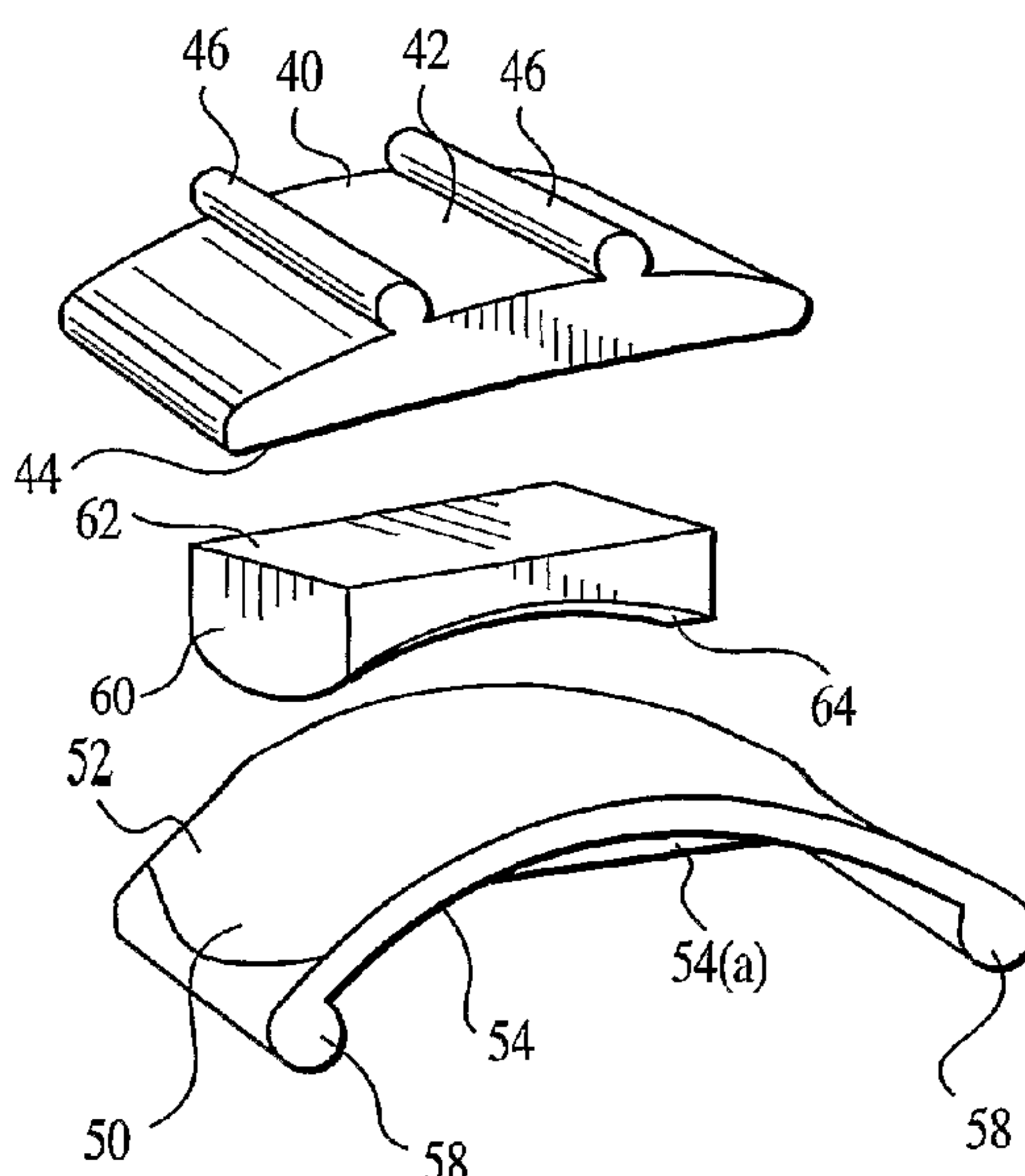
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(54) **Title:** ANKLE JOINT PROSTHESIS



(57) **Abstract:** The ankle joint prosthesis adapted to involve the patient's distal tibia and talus has, according to the present invention, tibial (40, 41), talar (50, 51) and mobile (60) or semi-constrained (61) bearing components that are laterally to medially implanted in the patient. In a preferred embodiment, the tibial component's top surface (42) has convex curvature in its anterior to posterior plane and is configured so as to approximate and match with the curvature of a prepared portion of the distal tibia; its bottom surface (44) being approximately flat. The talar component's top surface (52) has saddle-shaped, convex curvature in its anterior to posterior plane, its bottom surface (54) has concave curvature and is configured so as to approximate and match with the curvature of a prepared portion of the talus. The mobile (60) or semi-constrained (61) bearing components have embodiments that comprise a wide variety of geometric shapes. A method for implanting such a prosthesis is also disclosed.

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ANKLE JOINT PROSTHESIS

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates to ankle prostheses and the surgical procedures for implanting such prostheses.

2. DESCRIPTION OF PRIOR ART

For many years there has been considerable interest and activity with respect to ankle joint replacements, in which the degenerative articular surfaces are removed and replaced with an artificial joint called a prosthesis, as a viable approach to the treatment of diseased or injured ankle joints.

Fusion has long been an alternative to ankle arthroplasty. This approach has its drawbacks. For example, there is a loss of motion in the ankle joint which may cause difficulties with other associated parts of the foot and leg.

Many types of ankle joint prostheses have been developed over the past thirty years. After initial encouraging results, the reputation of ankle arthroplasty was somewhat damaged based on long-term, follow-up clinical studies which revealed the frequent failures of such implants due mainly to the inadequate restoration of the original mobility and the poor stability of the resulting ankle complex. Problems which many have speculated are due to our poor understanding of the relative contribution of the ligamentous structures and articular surfaces in providing passive and active stability for the ankle joint.

The ongoing problems with ankle arthrodesis have encouraged numerous ankle arthroplasty designs. The early designs all feature two-component prostheses having talar and tibial components for respective attachment to the talar and tibia bones of the ankle. For example, see U.S. Patent Nos. 4,156,944,

1 4,069,518, 4,021,864, 3,987,500, 3,975,778, 3,896,503, 3,896, 502, 3,889,300,
2 3,86,599, 3,872, 519, and 3,839,742.

3 Despite the multitude of these designs, none of them yielded clinical
4 results comparable to those achieved with total hip and knee replacement
5 surgeries. Aseptic loosening of the tibial and/or talar components is reportedly the
6 most frequent cause of failure, but complications also included deep infections,
7 dehiscence of the surgical wound, lateral and/or medial subluxation of the floating
8 meniscus and lateral talofibular joint impingement.

9 The most recent prosthesis design feature three components and include a
10 floating, intermediate element that has been introduced to allow full congruence at
11 the articular surfaces in all joint positions in order to minimize wear of the
12 components while coping with the multi-axial nature of the axial rotation of the
13 ankle. These designs all feature a planar and a curved surface for the intermediate
14 element in order to allow a controlled freedom of motion relative to the tibial
15 component, allowing controlled anterior-posterior as well as medial-lateral motion
16 in such a way as to reduce wear of the surfaces and the stress at the interface
17 between the bone and the tibial component of the prosthesis. For example, see
18 U.S. Patent Nos. 4,470,158, 4,755,259 and 5,766,259. These three component
19 designs are also reported to have exhibited problems with aseptic loosening of the
20 tibial and/or talar components, migration of the prosthesis and inadequate motion
21 in the replaced joint.

22 A common characteristic among these previous total ankle prostheses is
23 that they are inserted through incisions made with an anterior approach to the
24 ankle joint. This approach requires making large incisions at the ankle and
25 moving the tendons and other soft tissue aside; thus violating important anterior
26 soft-tissue structures and, more importantly, neurovascular structures that provide
27 blood flow to the talus.

28 Despite the extensive development of ankle joint prostheses, they often
29 continue to exhibit less than desirable performance. Thus, there exists a
30 continuing need for the development of new and improved types of such devices.
31 There is also a need for a less invasive surgical method to install such a prostheses
32 so as to yield improved healing and a decrease in the failure rate of such devices.
33

1 3. OBJECTS AND ADVANTAGES

2 There has been summarized above, rather broadly, the prior art that is
3 related to the present invention in order that the context of the present invention
4 may be better understood and appreciated. In this regard, it is instructive to also
5 consider the objects and advantages of the present invention.

6 It is an object of the present invention to provide an improved ankle joint
7 prosthesis that decreases the failure rate currently being experienced by such
8 devices.

9 It is another object of the present invention to provide a less invasive
10 surgical method for inserting an ankle joint prosthesis so as to yield improved
11 healing and a decrease in the failure rate of such devices.

12 It is yet another object of the present invention to provide a surgical
13 method that utilizes a lateral approach, as opposed to the standard anterior
14 approach, for inserting an ankle joint prosthesis.

15 It is a further object of the present invention to provide a surgical method
16 for implanting ankle joint prostheses that utilizes a lateral approach, as opposed to
17 the standard anterior approach, so as to preserve the blood supply to the talus,
18 thereby avoiding the avascular pathologies known to be caused by damaging the
19 blood supply to the talus.

20 It is an object of the present invention to prepare the ankle joint for the
21 insertion of an ankle joint prosthesis using a crescentic shaped saw, which allows
22 for minimum bone resection that follows the natural contours of the joint and
23 preserves the strongest portion of the distal tibia and talus for implantation of an
24 ankle prosthesis.

25 It is an object of the present invention to provide an ankle joint prosthesis
26 having components that have crescentic shaped surfaces for attachment with the
27 adjoining tibia and talus bones so as to provide more surface area for bony
28 ingrowth or cement fixation than that provided by standard prostheses which use
29 flat surfaces.

30 It is an object of the present invention to present an ankle joint prosthesis
31 with different levels of constraint, ranging from unconstrained to semi-
32 constrained. This provides options for dealing with different clinical situations.

1 Ultimately, the goal will be to use an ankle joint prosthesis, which minimizes wear
2 and enhances the longevity of the implant.

3 It is a still further object of the present invention to provide a device and
4 method that will advance the effectiveness of ankle joint replacements in
5 orthopedic medicine.

6 These and other objects and advantages of the present invention will become
7 readily apparent as the invention is better understood by reference to the
8 accompanying summary, drawings and the detailed description that follows.

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SUMMARY OF THE INVENTION

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18 Recognizing the need for the development of improved ankle joint
19 prostheses and their methods for insertion, the present invention is generally
20 directed to satisfying the needs set forth above and overcoming the disadvantages
21 identified with prior art devices and methods.

22 In accordance with the present invention, the foregoing need can be
23 satisfied by providing an ankle joint prosthesis adapted to involve the patient's
24 distal tibia and talus. This prosthesis may have many embodiments.

25 In a preferred, mobile bearing embodiment, the prosthesis comprises tibial,
26 talar and mobile bearing components that are laterally to medially implanted in the
27 patient. The tibial component's superior (top) surface has convex curvature in the
28 anterior to posterior direction and is configured so as to approximate and match
29 with the curvature of a prepared portion of the distal tibia; its inferior (bottom)
30 surface is approximately flat. The talar component's top surface has one of two
31 forms of curvature. It has only convex curvature in the anterior to posterior
32 direction or it has this curvature plus concave curvature in the lateral to medial
33 direction. Its bottom surface has one of two shaped surfaces. It has concave
34 curvature in the anterior to posterior direction and is configured so as to
35 approximate and match with the curvature of a prepared portion of the talus or it

1 has an approximately flat surface. The mobile bearing component's top surface is
2 approximately flat, and its bottom surface has curvature that is complementary to
3 the curvature of the talar component's top surface.

4 In a preferred, semi-constrained bearing embodiment, the prosthesis
5 comprises tibial, semi-constrained bearing and talar components that are laterally
6 to medially implanted in the patient. In this instance, the tibial component's top
7 surface has convex curvature in the anterior to posterior direction and is
8 configured so as to approximate and match with the curvature of a prepared
9 portion of the distal tibia; its bottom surface has concave curvature in the anterior
10 to posterior direction. The talar component's top surface has curvature that is
11 configured to be complimentary with the curvature of the semi-constrained bearing
12 component's bottom surface so as to allow maximal surface contact. Its bottom
13 surface has concave curvature in the anterior to posterior direction and has
14 protrusions at its anterior and posterior ends that protrude downward or it has a flat
15 surface in the anterior to posterior direction, with or without protrusions at the
16 anterior and posterior ends that protrude downward. The semi-constrained
17 bearing component has a top surface with curvature that is complimentary with the
18 curvature found in the bottom surface of the tibial component so as to lock these
19 surfaces together in various levels of constraint. Polyethylene or another suitable
20 bearing material is used for constructing the semi-constrained bearing component.

21 According to a third embodiment of the present invention, a method is
22 provided for laterally to medially implanting an ankle joint prosthesis so as to
23 replace the diseased bone associated with the articulating surfaces between a
24 patient's distal tibia and talus. The method comprises the steps of: (a) making an
25 incision on the lateral side of the foot and ankle opposite the joint, (b) cutting the
26 patient's fibula at a point above the joint and reflecting the inferior portion of the
27 fibula downward so as to gain access to the ankle joint, (c) distracting the ankle
28 joint so as to improve access to the joint, (d) making a lateral to medial, crescentic
29 cut on the end portion of the distal tibia so as to prepare a portion of the tibia by
30 removing the diseased bone and configuring the prepared portion so that it
31 matches the anterior to posterior, cross-sectional profile of a to-be-inserted tibial
32 component, (e) making a lateral to medial, crescentic (or approximately flat) cut
33 on the dome portion of the talus so as to prepare a portion of the talus by removing

1 the diseased bone and configuring the prepared portion so that it matches the
2 anterior to posterior plane profile of a to-be-inserted talar component, (f) preparing
3 one or more lateral to medial recesses in the cut surfaces of the tibial and talus, (g)
4 laterally to medially inserting the tibial component in the prepared portion of the
5 tibia, (h) laterally to medially inserting the talar component in the prepared portion
6 of the talus, (i) if a mobile bearing prosthesis is being used, laterally to medially
7 inserting a mobile bearing component between the tibial and talar components, or,
8 if a semi constrained bearing prosthesis is being used, laterally to medially
9 inserting a semi constrained bearing component between the tibial and talar
10 components, (j) removing distraction from the ankle joint, (k) replacing the
11 inferior portion of the fibula back into position relative to the upper portion of the
12 fibula and securing the portions in position, and (l) closing the opening incision.

13 Thus, there has been summarized above, rather broadly, the present
14 invention in order that the detailed description that follows may be better
15 understood and appreciated. There are, of course, additional features of the
16 invention that will be described hereinafter and which will form the subject matter
17 of any eventual claims to this invention.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a lateral elevational view of a right, human foot.

FIG. 2 is a similar view of the foot in FIG. 1 and showing the fibula having been cut and moved down to gain lateral access to the ankle joint.

FIG. 3 is a similar view of the foot in FIG. 1 and showing the ankle joint distracted so as to provide better lateral access to the ankle joint.

FIG. 4 is a similar view of the foot in FIG. 1 and showing by dashed lines the shape of the cuts to be made in the surfaces of the distal tibia and talar dome.

FIG. 5 is a perspective, side view of a special cutting guide that is used to make the cuts in the surfaces of the distal tibia and talar dome.

FIG. 6 shows the special cutting guide of FIG. 5 in use for surgically removing a portion of the adjoining tissue between the top of the talus and the bottom of the tibia.

FIG. 7 shows an anterior view of the alignment rod being used with the special cutting guide.

FIG. 8 shows an lateral view of the alignment rod being used with the special cutting guide.

FIG. 9 is a similar view of the foot in FIG. 1 and showing the distal tibia and talar dome after the necessary portions have been removed.

FIG. 10A is an anterior, in-situ view of a talar, lateral surface cutting guide that is used to cut the lateral surface of the talus dome.

FIG. 10B is a close-up view of the cutting guide shown in FIG. 10A.

FIG. 11A is a lateral, in-situ view of the cutting guide shown in FIG. 10A.

FIG. 11B is a close-up view of the cutting guide shown in FIG. 11A.

FIG. 12A is a perspective view of a recess cutting guide that is used to make the recesses in the surfaces of the talar dome and the distal tibia.

FIG. 12B is a lateral view of the recess cutting guide shown in FIG. 12A.

FIG. 12C is a medial view of the recess cutting guide shown in FIG. 12A.

FIG. 13A is an anterior, in-situ view of the recess cutting guide shown in FIG. 12.

FIG. 13B is a close-up view of the recess cutting guide shown in FIG. 13A.

1 FIG. 14A is a lateral, in-situ view of the recess cutting guide shown in FIG.
2 12.

3 FIG. 14B is a close-up view of the recess cutting guide shown in FIG. 14A.

4 FIG. 15 is a perspective, medial side view of a preferred, mobile bearing
5 embodiment of the ankle joint prosthesis of the present invention.

6 FIG. 16 is a similar view of the foot in FIG. 1 and showing the mobile
7 bearing, ankle joint prosthesis that is to be inserted in place of the removed portions
8 of the distal tibia and talar dome.

9 FIGS. 17A-1 and 17A-2 show perspective and cross-sectional views of a
10 preferred embodiment of the mobile bearing component of the present invention in
11 which the component's bottom surface is saddle shaped and has concave curvature
12 in the anterior to posterior direction and convex curvature in the lateral to posterior
13 direction.

14 FIGS. 17B-1 and 17B-2 show perspective and cross-sectional views of a
15 preferred embodiment of the mobile bearing component of the present invention in
16 which the component's bottom surface has concave curvature only in the anterior
17 to posterior direction.

18 FIGS. 18A-1 and 18-2 show perspective and a cross-sectional views of a
19 preferred embodiment of the tibial component in a semi-constrained version of the
20 present invention in which the component's bottom surface is saddle shaped and has
21 concave curvature in the anterior to posterior direction and convex curvature in the
22 lateral to posterior direction.

23 FIGS. 18B-1 and 18B-2 show perspective and a cross-sectional views of a
24 preferred embodiment of the tibial component in a semi-constrained version of the
25 present invention in which the component's bottom surface has concave curvature
26 only in the anterior to posterior direction.

27 FIG. 19A is a perspective, medial side view of a semi-constrained bearing
28 embodiment in which the bearing component's top surface has a dome that
29 partially locks this component into the matching concavity or recess that exists in
30 the tibial component's bottom surface.

31 FIG. 19B shows the bottom view of the tibial component shown in FIG.
32 19A.

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1 FIGS. 20A-1 to 20A-3 show respective lateral, cross-sectional and medial
2 views of a preferred embodiment of the talar components used with the semi-
3 constrained version of the prosthesis of the present invention.

4 FIGS. 20B-1 to 20B-3 show respective lateral, cross-sectional and medial
5 views of a preferred embodiment of the talar components used with the semi-
6 constrained version of the prosthesis of the present invention.

7 FIGS. 20C-1 to 20C-7 show respective lateral, cross-sectional, medial, and
8 bottom views of a preferred embodiment of the talar components used with either
9 the mobile-bearing or the semi-constrained version of the prosthesis of the present
10 invention when a flat cut is required on the talus.

11 FIG. 21 is a similar view of the foot in FIG. 1 and showing the mobile
12 bearing, ankle joint prosthesis components after they have been inserted in place of
13 the removed portions of the distal tibia and talar dome.

14 FIG. 22 is a similar view of the foot in FIG. 1 and showing the mobile
15 bearing, ankle joint prosthesis components inserted, the ankle distraction removed
16 and the fibula placed back in position and plated in place.

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30 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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32 Before explaining at least one embodiment of the present invention in
33 detail, it is to be understood that the invention is not limited in its application to

1 the details of construction and to the arrangements of the components set forth in
2 the following description or illustrated in the drawings. The invention is capable
3 of other embodiments and of being practiced and carried out in various ways.
4 Also, it is to be understood that the phraseology and terminology employed herein
5 are for the purpose of description and should not be regarded as limiting.

6 Referring now to the drawings wherein are shown preferred embodiments
7 and wherein like reference numerals designate like elements throughout, there is
8 shown in FIG. 1 a lateral, elevational view of a right, human foot that illustrates
9 most of the foot bones and the lower ends of the lower leg bones. The present
10 invention involves three of these bones: the fibula 2, the tibia 4 and the talus 6.

11 To gain lateral access to the ankle joint, the fibula 2 is cut at a point above
12 its lower end and this lower end is moved to the side. See FIG. 2. The distal end
13 of the fibula is reflected down hinged on the posterior talofibular and
14 calcaneofibular ligaments. The syndesmosis, anterior talofibular and part of the
15 calcaneofibular ligaments are released from the fibula. The ankle joint is
16 distracted manually or by using an unilateral external fixator applied to the medial
17 aspect. This gives better access to the distal tibia and talar dome surfaces that are
18 to be cut. See FIG. 3.

19 FIG. 4 shows by dashed lines the approximate shape of the cuts that are to be
20 made in the surfaces of the distal tibia and talar dome. The geometry of these cuts
21 is crescentic since it closely follows the natural anatomic contour of the joint and
22 its subchondral bone of the distal tibia and talus.

23 The crescentic cut yields more bony surface area for cement fixation or bony
24 ingrowth. The lateral approach, which exposes the ankle joint surface, allows a
25 reproducible method for minimizing bone loss while performing accurate crescentic
26 cuts. The precision of crescentic cuts that follows the natural anatomic contour of
27 the joint and its subchondral bone, allows for the preservation of the strongest
28 portions of the distal tibia and talus. This is the best bone in which to implant an
29 ankle arthroplasty and may improve survival of ankle joints. An approximately flat
30 cut may be used for the talus in instances of bony deformity which prevent the use of
31 the crescentic saw. Furthermore the tenuous blood supply of the talus, which more
32 typically is compromised with an anterior approach, is left intact with the lateral
33 approach. The distal tibia blood supply is similarly preserved through a lateral

1 approach. The lateral approach minimizes soft tissue compromise as opposed to the
2 anterior approach.

3 Three basic cuts are required to remove the bone necessary to allow for
4 implantation of the prosthesis: One crescentic, approximately flat, cut at the talar
5 dome to remove diseased/damaged cartilage and bone. A second cut in the
6 anterior-posterior direction to free the lateral aspect of the medial wall. A third
7 and final, crescentic cut on the distal end of the tibia in a lateral-medial direction.
8 This third cut will intersect with the second cut on the medial wall of the distal
9 tibia to free the distal segment of tibial bone.

10 These cuts are made with the aid of a special cutting guide 8 that is shown in
11 FIG. 5. It consists of a base 10 which has a plurality of anchoring holes 11 through
12 which one or more anchoring or mounting pins may be extended for anchoring
13 with the patient's tibia. Set screw holes 11a in the side of the base allow set
14 screws to be used to fix the position of the base relative to the pins that extend
15 from the patient's tibia. The slotted hole 12 on the top of the base is placed over a
16 mounting pin in the patient's tibia to provide a preferred initial means for securing
17 the base to the patient's tibia.

18 At the back of the base, a slotted cavity 14 has been provided to allow for
19 the placement of a locking cylinder 16 in the base 10. The locking cylinder fits
20 within this cavity with its distal end generally extending toward the front of the
21 base. This cylinder has a hole that extends from its exterior surface and intersects
22 a threaded bore 18 that extends along the axis of the cylinder from the cylinder's
23 proximate end which is exposed in the entrance to base's rear cavity. The slotted
24 hole 12 on the top of the base extends into the cavity 14 created in the rear of the
25 base and then through the bottom portion of the base, so that this slotted hole 12
26 extends all the way through the base .

27 In use, see FIG. 6, the cylinder 16 is placed such that the pin from the
28 patient's tibia also extends through the hole in the cylinder's exterior surface. The
29 cylinder is secured to the pin by a set screw that fits within the cylinder's threaded,
30 axial bore 18 and can be turned by accessing the set screw's free end which is
31 exposed at the cylinder's proximate end. From each side of the base extend
32 additional threaded bores 20 that project into the sides of the bases' rear cavity 14.
33 These bores contain set screws 22 that can be tighten to lock the cylinder 16 in

1 place relative to the rest of the base 10. The advantage of this configuration is that
2 it provides the surgeon with a means to adjust the location of the base 10 relative
3 to the locking cylinder 16 which is locked to the pin in the patient's tibia. Thus,
4 the locking cylinder 16 can be moved to either side or rotated about a vertical axis
5 defined by the axis of the pin that extends from the patient's tibia.

6 The centerlines of the anchoring holes 11 which are located in the base's
7 top surface and towards its outer edges are slanted towards and at an angle with
8 respect to the base's longitudinal centerline. This angle is provided so as to allow
9 the pins that pass through these holes to approximately contact the tibia
10 perpendicularly to its surface. This allows these pins to be directed towards the
11 tibia's centerline so as to provide the pins with the most secure attachment to the
12 bone.

13 To the front of this base 10 is attached a shelf 24; the front surface of
14 which is shaped so as to have the curvature that is desired to be used in the cut that
15 is made in the surfaces of the distal tibia and talar dome. The surgeon places his
16 curved blade against the shelf's front surface to guide his cutting during the
17 surgical procedure.

18 The shelf 24 is mounted so that it can be pivoted up and down about a
19 pivot joint 26 which is mounted on the back of the shelf. A set screw 27 allows
20 the angular rotation of the pivot joint 26 to be fixed. Additionally, the nature of
21 this connection is such that the shelf can easily be detached from the shaft. This
22 allows for the opportunity to interchange the shelf that is attached to a shaft so that
23 a shelf can be selected from a group of the various surface curvatures, with
24 appropriate protrusions, that will be needed during the surgery.

25 From the shelf's pivot joint, there extends a shaft 28 which can slip into
26 and out of a cavity that exists in the front of the base. On the side of the base there
27 exist two additional bores 32 in which are placed set screws 34 that can be
28 screwed inward so as to contact the exterior surface of the shaft 28 that extends
29 into the base's front cavity. Thus, the distance between the back of the shelf and
30 the front of the base can be set by the use of these set screws to lock the shaft
31 relative to the base. With this configuration, the shelf's position is adjustable in
32 three directions: forward and backward as the shaft moves in and out of the base,
33 rotationally about the axis of the shaft which can rotate within the base's front

1 cavity, and rotationally (i.e., up and down, assuming that the ends of the shelf are
2 extending horizontally) about the hinge joint that connects the front of the shaft
3 and the back of the shelf.

4 After the necessary incisions have been made to expose the ankle joint and
5 the fibula has been cut and peeled back to allow full access to the joint, the cutting
6 guide 8 is placed on the tibia at the location where its shelf 24 can best be utilized
7 in making the necessary cuts on the talus and the tibia. In order to assist in
8 achieving the ideal alignment of the bone cuts and prosthetic components, a
9 modification of the cutting guide 8 may be introduced to facilitate restoration of
10 anatomic, physiologic, and biomechanical alignment.

11 Pre-operative x-rays of the normal contra-lateral ankle are obtained. The
12 normal ankle x-rays are compared to the diseased ankle. The side of the diseased
13 ankle joint, which is the least damaged, is identified in both the anterior-to-
14 posterior and lateral ankle x-rays. These points in the x-rays help to restore the
15 normal architecture and ankle joint level.

16 An alignment rod 36 is attached to the cutting guide 8 and extends
17 proximally to the knee. See FIG. 7. The alignment rod 36 is held in this position
18 and stabilized to the knee proximally with a coiled spring 38, and to the ankle
19 distally with the transfixion pins.

20 A lateral x-ray of the tibia is obtained and the alignment rod 36 is
21 positioned to align centrally down the intramedullary canal of the tibia from the
22 knee, proximally, and the ankle, distally. See FIG. 8.

23 The alignment rod 36 is used as a reference for the alignment of the ankle
24 joint line in the anterior to posterior plane, which is perpendicular to the alignment
25 rod 36.

26 To establish the alignment of the ankle joint in the lateral and medial plane,
27 an anterior-to-posterior ankle x-ray is taken. A narrow wire is passed in the
28 cutting guide 8 from lateral to medial on the anterior aspect of the ankle joint. The
29 height of the crescentic cut is adjusted until the narrow wire is located just
30 proximal to the portion of the ankle joint which has the least amount of damage as
31 determined on the x-rays of the normal ankle joint.

32 The orientation above the tibia of the base's top, slotted hole 12 serves to
33 define the site for the drilling of a hole for the insertion of a primary mounting pin

1 in the tibia. After this pin is inserted, its extended end is fed through the base's
2 top, slotted hole 12 and through the locking cylinder's hole. The cylinder's set
3 screws are then tightened to lock the cutting guide 8 in place.

4 The surgeon next chooses one or more of the side holes 11 for use in
5 anchoring to secondary mounting pins which are passed through these holes 11
6 and into the tibia. For each of these pins, a pilot hole is initially drilled in the bone
7 and a secondary mounting pin is inserted through the hole 11. A set screw 11a is
8 again used to lock the cutting guide to each of these secondary mounting pin.
9 Once the cutting guide is securely locked to the mounting pins, the shelf 24 of the
10 apparatus can be further adjusted and aligned to ensure that it is properly located
11 to most effectively assist the surgeon in making the necessary cuts.

12 The cutting guide 8 may be made of any appropriate material, such as
13 stainless steel, or the like, which is suitable for use in a surgical environment and
14 is capable of being sterilized.

15 FIG. 9 shows the distal tibia and talar dome after the necessary portions have
16 been removed. These portions are removed with the assistance of a talar, lateral
17 surface cutting guide 25. The talar lateral surface cutting guide is used to cut the
18 lateral surface of the talus. This provides a flat mating surface for the inside of the
19 talar component. This surface cutting guide 25 is composed of a curved piece 27
20 which acts as a cutting guide shelf and is adjoined to a vertical element 29 extending
21 superior to inferior on the lateral edge of the cutting shelf. See FIGS. 10A and 10B.
22 The curved piece 27 is narrow so that it can be positioned between the distracted
23 tibia and talus. The curved piece 27 is then held flush against the superior aspect of
24 the talus and pushed medially such that the lateral edge of the talus protrudes lateral
25 to the vertical element of the cutting shelf. An oscillating saw is then used to cut the
26 lateral aspect of the talus. This talar lateral surface cut is not required when using an
27 approximately flat cut on the talus. See FIGS. 11A and 11B. These prepared
28 surfaces correspond to the bone-metal interface surfaces of the prosthetic
29 components.

30 It can be seen that these prepared surfaces have one or more recesses that run
31 from the lateral to the medial edges of the bones. These recesses are configured so
32 as to match with comparably shaped protrusions and/or shoulders that are parts of
33 the prosthesis' components. The protrusions run from lateral to medial on the

1 prosthesis and allow for greater stability to ankle dorsiflexion and plantarflexion,
2 which occur in a plane perpendicular to the protrusions of the prosthesis. These
3 recesses are positioned and created with the assistance of a recess cutting guide 35.
4 See FIGS. 12A and 12B.

5 This recess cutting guide 35 has a curved shelf 37 that is attached to a
6 vertical element 39 that runs both superiorly and inferiorly. In the vertical element
7 are several holes 41 that have alignment tubes 43 extending from them. These
8 holes and their alignment tubes extend parallel to the surface of curved shelf 37.
9 The curved shelf 37 is narrow so that it can be positioned between the distracted
10 tibia and talus. See FIGS. 13A and 13B. With the curved shelf 37 held firmly
11 opposed to the superior surface of the talus, it is pinned to the talus with narrow
12 wires through the alignment tubes positioned near the anterior and posterior
13 aspects of the guide. A narrow wire is passed down the curved shelf 37 for each
14 recess and the orientation and location of each narrow wire is inspected on
15 anterior-to-posterior and lateral x-ray views of the ankle. Once the location of the
16 recesses is determined, one or more stabilization recesses are created in the talus
17 with a tapered drill, which tapers from lateral to medial. See FIGS. 14A and 14B.

18 The ankle joint prosthesis of the present invention can take the form of either
19 a two or a three component embodiment, which may be referred to below as either
20 the mobile bearing or the semi-constrained versions, respectively. These are
21 separately described below.

22 FIG. 15 is a perspective, side view of a preferred, mobile bearing
23 embodiment of the ankle joint prosthesis of the present invention. It consists of
24 tibial 40, talar 50 and mobile bearing 60 components, where the tibial 40 and talar 50
25 components are mounted respectively on the prepared, crescentic-shaped tibial and
26 talar surfaces. The mobile bearing component 60 is located between the tibial 40
27 and talar 50 components. See also FIG. 16.

28 The tibial component 40 has a top surface 42 that has convex curvature in
29 the anterior to posterior direction so as to approximate the curvature of the
30 prepared distal tibia surface. Its bottom surface 44 is flat. The top surface 42 has
31 one or more lateral-to-medially aligned protruding surfaces 46 that are configured
32 to match with the similarly shaped recesses that have been made in the tibia's
33 prepared surface. These protrusions 46 serve to stabilize any motion of the

1 component 40 relative to the prepared distal tibia surface and provide greater
2 surface area for bony ingrowth or cement fixation of the component to the tibia.
3 These protrusions may be tapered, from narrow medial to wide lateral, so as to
4 create a more secure and stable fit as the device is inserted from lateral to medial.
5 The component's top surface 42 may be coated with a substance to enhance bony
6 ingrowth or cement fixation. This material may be sintered beads, plasma sprayed,
7 implex/trabecular metal (implex) or other material that provides an interlocking
8 mechanism.

9 The talar component 50 is a crescentic-shaped structure that is curved on
10 both its top 52 and bottom 54 surfaces. Its the top surface 52 has convex curvature
11 in the anterior to posterior direction and concave curvature in its lateral to medial
12 direction. Its bottom surface 54 has concave curvature in the anterior to posterior
13 direction that approximates the natural curvature found on the prepared talus
14 dome. At some point on the talar component's bottom surface, preferably at its
15 anterior and posterior edges, are protrusions or ridges 58 that extend downward
16 from its bottom surface 54. The shape of these protrusions 58 is configured to
17 match with the similarly shaped recesses or extrusions that have been made in the
18 talar dome's prepared surface. These protrusions 58 serve to stabilize any motion
19 of this component 50 relative to the prepared talar dome surface and provide
20 greater surface area for bony ingrowth or cement fixation of the component 50 to
21 the talar dome.

22 The component's bottom surface 54 may be coated with a substance to
23 enhance bony ingrowth or cement fixation. The medial side of talar component 50
24 has a shoulder 54(a) extending downward from the top surface that coincides with
25 the prepared medial surface of the talus.

26 The talar component of the prosthesis effectively serves to semi-resurface
27 the medial and lateral oblique joint surfaces (the "gutters") of the ankle. It does
28 this by resurfacing the medial facet on the tibial side and the lateral facet on the
29 talar side. Both the tibial and the talar portions of the superior articulating surface
30 are fully resurfaced.

31 The mobile bearing component 60 has a flat top surface 62 and a saddle-
32 shaped bottom surface 64. The bottom surface 64 is configured with a saddle-
33 shaped configuration so as to match with the talar component's top surface 52 and

1 to allow for internal and external rotation motions. This saddle-shaped surface also
2 allows for dorsiflexion and plantar flexion motion. The mobile bearing's top
3 surface 62 is flat so as to match with the shape of the tibia component's flat,
4 bottom surface 44. This flat surface allows for internal and external rotation
5 motions.

6 These components 40, 50, 60 may preferably be made of any appropriate
7 material suitable for the surgical environment. High density, ultra-high molecular
8 weight polyethylene is an excellent plastic material for the bearing surfaces. It is
9 widely used in other surgical devices and characterized by excellent wear
10 resistance and a low coefficient of friction. Titanium or cobalt chrome alloys, or
11 ceramics, are materials commonly used for the components that are rigidly
12 attached to the bony surfaces.

13 The mobile bearing embodiment of ankle joint prosthesis described above
14 can also have various versions. For example, in some application it is preferred to
15 use a talar component 50 having a top surface 52 that has only convex curvature in
16 the anterior to posterior direction. Since the bottom surface 64 of the mobile
17 bearing component 60 must have matching and complimentary curvature, this
18 surface 64 also has only convex curvature in the anterior to posterior direction. See
19 FIGS. 17A-1, 17A-2, 17B-1 and 17B-2 for a comparison of the various types of
20 curvatures that can be used in the mobile bearing component's bottom surface.

21 Due to talar bony deformities, it may also be useful to have a talar
22 component that does not use the crescentic cut, but a flat cut. For example, the talar
23 dome may be depressed or collapsed and there is not room to perform the crescentic
24 cut. A talar component 70, again with various bearing surface curvatures 71 and 72,
25 may have a flat surface 73 on the inferior or bottom surface. Again a medial to
26 lateral directed protrusion 74 provides great surface area for fixation and additional
27 stability. See FIGS. 20C-1 through 20C-7 for possible talar component
28 configurations with a flat cut on the bottom surface.

29 In a preferred, semi-constrained bearing embodiment, the prosthesis consists
30 of a tibial 41, semi-constrained bearing 61 and talar 51 components, where the tibial
31 41 and talar 51 components are mounted respectively on the prepared, crescentic-
32 shaped tibial and talar surfaces. See FIG. 19A.

1 In this embodiment, the tibial component 41 has a top surface 43 that has
2 convex curvature in the anterior to posterior direction so as to approximate the
3 curvature of the prepared distal tibia surface. This top surface 43 has one or more
4 lateral-to-medially aligned protruding surfaces 47 that are configured to match
5 with the similarly shaped recesses that have been made in the tibia's prepared
6 surface. These protrusions 47 serve to stabilize any motion of the component 41
7 relative to the prepared distal tibia surface and provide greater surface area for
8 bony ingrowth or cement fixation of the component to the tibia. These protrusions
9 47 may be tapered, from narrow medial to wide lateral, so as to create a more
10 secure and stable fit as the device is inserted from lateral to medial. The
11 component's top surface 43 may be coated with a substance to enhance bony
12 ingrowth or cement fixation. This material may be sintered beads, plasma sprayed,
13 implex/trabecular metal (implex) or other material that provides an interlocking
14 mechanism.

15 The tibial component's bottom surface 45 has one of a variety of forms of
16 curvature that are designed to yield various degrees of constraint for the underlying
17 semi-constrained bearing component 61. This bearing component 61 is preferably
18 made from polyethylene or other suitable bearing material, whereas, the tibial and
19 talar components are made from one of a variety of suitable metals. See FIGS.
20 18A-1, 18A-2, 18B-1 and 18B-2 for a comparison of the various types of curvatures
21 that can be used in the tibial component's bottom surface.

22 The semi-constrained bearing component's top surface may be bonded or
23 mechanically attached to the bottom surface of the tibial component 41. The semi-
24 constrained bearing component 61 may also be partially locked into the tibial
25 component 41. For example, its superior aspect 63 may be slightly convex to
26 match a slightly concave curvature that is placed in the bottom surface of the tibial
27 component 41. See FIG. 19A which shows a semi-constrained bearing
28 embodiment in which the bearing component's top surface has a dome that
29 partially locks this component into the matching concavity or recess 49 that exists
30 in the tibial component's bottom surface. See FIG. 19B for the bottom view of the
31 tibial component shown in FIG. 19A. In locked and unlocked versions, the
32 inferior aspect 65 of the semi-constrained bearing component 61 will have
33 different configurations depending on the constraint required.

1 In this semi-constrained bearing embodiment, the talar component **51** has a
2 top surface **53** with curvature that matches and is complementary to the curvature
3 found in the semi-constrained bearing component's bottom surface **65**. The talar
4 component's bottom **55** surface has concave curvature or is approximately flat in
5 the anterior to posterior direction that approximates the natural curvature or flat
6 saw cut found on the prepared talus dome. At some point on the talar
7 component's bottom surface, preferably at its anterior and posterior edges, are
8 protrusions or ridges **59** that extend downward from its bottom surface **57**. See
9 FIG. 20A-1 to 20A-3 and 20B-1 to 20B-3. The shape of these protrusions **59** is
10 configured to match with the similarly shaped recesses or extrusions that have
11 been made in the talar dome's prepared surface. These protrusions **59** serve to
12 stabilize any motion of this component **51** relative to the prepared talar dome
13 surface and provide greater surface area for bony ingrowth of the component **51** to
14 the talar dome. The lateral side of talar component **51** has a shoulder **55(a)**
15 extending downward from the top surface that coincides with the prepared lateral
16 surface of the talus. The component's bottom surface **55** may be coated with a
17 substance to enhance bony ingrowth or cement fixation.

18 In the semi-constrained bearing embodiment, the tibial and talar
19 components may be wider medially than laterally so as to approximate the native
20 truncated cone shape of the talus.

21 To mount the tibial **40** and talar **50** components in place, the protrusions **46**
22 and/or shoulders **56** of these component are carefully aligned with the matching
23 recesses or groves that have been prepared in the respective distal tibia and talar
24 dome surfaces. The medial edges of these components are abutted against the
25 lateral edges of the grooves. A surgical mallet may be used to apply light blows to
26 the lateral edges of the components to drive the medial edges of their protrusions
27 and/or shoulders into the matching grooves until the components are fully seated
28 in the respective tibial and talar dome surfaces. These components become
29 adhered to tibial and talar dome cut surfaces by cement fixation or by press fitting
30 and later bony ingrowth.

31 The mobile bearing component **60** may be properly located and seated
32 within the ankle joint, between the tibial component **40** and the talar component
33 **50**, by hand. The mobile bearing component is inserted into the ankle joint with

1 the foot in distracted position. FIG. 21 illustrates the completed ankle joint for the
2 mobile bearing embodiment of the prosthesis with all of the prosthesis'
3 components in place. FIG. 22 illustrates the ankle prosthesis components inserted,
4 the ankle distraction removed and the fibula placed back in position and plated in
5 place.

6 If the completed ankle joint is too lax, a mobile bearing component 60 of
7 greater thickness may be chosen. Similarly, if the completed ankle joint is too
8 tight, a mobile bearing 60 of lesser thickness can be used. Selection of the mobile
9 bearing component 60 of proper thickness permits adjustment of the overall height
10 of the prosthesis.

11 For the semi-constrained bearing embodiment of the prosthesis, different
12 thickness of the tibial or talar components are used to accomplish the same fitting
13 objectives discussed above.

14 Although the foregoing disclosure relates to preferred embodiments of the
15 invention, it is understood that these details have been given for the purposes of
16 clarification only. Various changes and modifications of the invention will be
17 apparent, to one having ordinary skill in the art, without departing from the spirit
18 and scope of the invention as hereinafter set forth in the claims.

THE EMBODIMENTS OF THE INVENTION FOR WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An ankle joint prosthesis adapted to involve the patient's distal tibia and talus, said prosthesis comprising:

a tibial component (40) for lateral to medial implanting on a prepared portion of said distal tibia, said tibial component having a top (42) and a bottom (44) surface, said top surface having convex curvature in the anterior to posterior direction and configured so as to compliment and match with the curvature of said prepared portion of said distal tibia, said bottom surface being approximately flat,

a talar component (50) for lateral to medial implanting on a prepared portion of said talus, said talar component having a top (52) and a bottom (54) surface, said top surface (52) having convex curvature in the anterior to posterior direction, said bottom surface (54) having a shape chosen from the group consisting of either concave curvature in the anterior to posterior direction or an approximately flat surface in the anterior to posterior direction, said bottom surface configured so as to compliment and match with said prepared portion of said talus, and

a mobile bearing component (60) for lateral to medial implanting between said tibial (40) and talar components (50), said bearing component having a top (62) and a bottom (64) surface, said top surface (62) being approximately flat, said bottom surface (64) having concave curvature in the anterior to posterior direction that is complementary to the curvature of said talar component's top surface (52).

2. The ankle joint prosthesis as recited in claim 1, wherein:

said tibial component top surface (42) having a lateral-to-medially aligned protrusion (46) that is configured to match with a similarly shaped recess that has been made in the prepared portion of said distal tibia.

3. The ankle joint prosthesis as recited in claim 1, wherein:

said talar component bottom surface (54) having a lateral-to-medially aligned protrusion (58) that extends downward from said surface, said protrusion (58)

configured to match with a similarly shaped recess that has been made in the prepared portion of said talus.

4. The ankle joint prosthesis as recited in claim 2, wherein:

said talar component bottom surface (54) having a lateral-to-medially aligned protrusion (58) that extends downward from said surface, said protrusion (58) configured to match with a similarly shaped recess that has been made in the prepared portion of said talus.

5. The ankle joint prosthesis as recited in claim 1, wherein:

said talar component having an anterior-to-posterior aligned shoulder (54(a)) that extends downward from a lateral edge of said talar component top surface.

6. The ankle joint prosthesis as recited in claim 2, wherein:

said talar component (50) having an anterior-to-posterior aligned shoulder (54(a)) that extends downward from a lateral edge of said talar component top surface (52).

7. The ankle joint prosthesis as recited in claim 3, wherein:

said talar component (50) having an anterior-to-posterior aligned shoulder (54(a)) that extends downward from a lateral edge of said talar component top surface (52).

8. The ankle joint prosthesis as recited in claim 4, wherein:

said talar component (50) having an anterior-to-posterior aligned shoulder (54(a)) that extends downward from a lateral edge of said talar component top surface (52).

9. The ankle joint prosthesis as recited in claim 1, wherein:

said talar component top surface (52) having concave curvature in the lateral to medial direction, and

said mobile bearing component bottom surface (64) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (52) in the lateral to medial direction.

10. The ankle joint prosthesis as recited in claim 2, wherein:

said talar component top surface (52) having concave curvature in the lateral to medial direction, and

said mobile bearing component bottom surface (64) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (52) in the lateral to medial direction.

11. The ankle joint prosthesis as recited in claim 3, wherein:

said talar component top surface (52) having concave curvature in the lateral to medial direction, and

said mobile bearing component bottom surface (64) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (52) in the lateral to medial direction.

12. The ankle joint prosthesis as recited in claim 4, wherein:

said talar component top surface (52) having concave curvature in the lateral to medial direction, and

said mobile bearing component bottom surface (64) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (52) in the lateral to medial direction.

13. The ankle joint prosthesis as recited in claim 5, wherein:

said talar component top surface (52) having concave curvature in the lateral to medial direction, and

said mobile bearing component bottom surface (64) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (52) in the lateral to medial direction.

14. The ankle joint prosthesis as recited in claim 2, wherein:
said tibial protrusion (46) being tapered, from narrow medial to wide lateral, so as to create a more secure and stable fit for said tibial component.
15. The ankle joint prosthesis as recited in claim 4, wherein:
said tibial protrusion (46) being tapered, from narrow medial to wide lateral, so as to create a more secure and stable fit for said tibial component.
16. The ankle joint prosthesis as recited in claim 8, wherein:
said tibial protrusion (46) being tapered, from narrow medial to wide lateral, so as to create a more secure and stable fit for said tibial component.
17. The ankle joint prosthesis as recited in claim 1, wherein:
said tibial component top surface (42) being coated with a substance to enhance adhesion between said component and prepared, distal tibia surface.
18. The ankle joint prosthesis as recited in claim 1, wherein:
said talar component bottom surface (42) being coated with a substance to enhance adhesion between said component and prepared, talar surface.
19. The ankle joint prosthesis as recited in claim 17, wherein:
said coating substance being chosen from the group consisting of sintered beads, plasma sprayed, implex/trabecular metal or other material that provides an interlocking mechanism for better adhesion between said tibial component (40) and prepared, distal tibia surface.
20. The ankle joint prosthesis as recited in claim 18, wherein:
said coating substance being chosen from the group consisting of sintered beads, plasma sprayed, implex/trabecular metal or other material that provides an

interlocking mechanism for better adhesion between said talar component (40) and prepared, talar surface.

21. The ankle joint prosthesis as recited in claim 1, wherein:

said components (40, 50, 60) being fabricated from materials chosen from the group consisting of an ultra-high, molecular weight polyethylene, titanium or cobalt chrome alloys, or a ceramic, or other suitable surgically implantable material.

22. An ankle joint prosthesis adapted to involve the patient's distal tibia and talus, said prosthesis comprising:

a tibial component (41) for lateral to medial implanting on a prepared portion of said distal tibia, said tibial component having a top (43) and a bottom (45) surface, said top surface (43) having convex curvature in the anterior to posterior direction,

a talar component (51) for lateral to medial implanting on a prepared portion of said talus, said talar component having a top (53) and a bottom (55) surface, said top surface (53) having convex curvature in the anterior to posterior direction, said bottom surface (55) having a shape chosen from the group consisting of either concave curvature in the anterior to posterior direction or an approximately flat surface in the anterior to posterior direction, said bottom surface configured so as to compliment and match with said prepared portion of said talus, and

a semi-constrained bearing component (61) for lateral to medial implanting between said tibial (41) and talar (51) components, said semi-constrained bearing component having a top (63) and a bottom (65) surface, said bottom surface (65) having concave curvature in the anterior to posterior direction that is complimentary to the curvature of said talar component's top surface, and

wherein said semi-constrained bearing component top surface (63) and said tibial component bottom surface (45) having complimentary curvature that is configured to aid in providing a defined level of constraint of movement and interaction between said semi-constrained bearing component top surface (63) and said tibial component bottom surface (45).

23. The ankle joint prosthesis as recited in claim 22, wherein:
said tibial component bottom surface (45) having concave curvature in the anterior to posterior direction, and
said semi-constrained bearing component top surface (63) having complimentary convex curvature in the anterior to posterior direction.
24. The ankle joint prosthesis as recited in claim 22, wherein:
a portion of said tibial component bottom surface (45) having a recess (49),
and
a portion of said semi-constrained bearing component top surface (63) having a convex protrusion that is configured and located on said surface so as to be complimentary to said recess (49) in said tibial component bottom surface (45) and so as to partially constrain the relative motion between said surfaces.
25. The ankle joint prosthesis as recited in claim 23, wherein:
a portion of said tibial component bottom surface (45) having a recess (49),
and
a portion of said semi-constrained bearing component top surface (63) having a convex protrusion that is configured and located on said surface so as to be complimentary to said recess (49) in said tibial component bottom surface (45) and so as to partially constrain the relative motion between said surfaces.
26. The ankle joint prosthesis as recited in claim 22, wherein:
said tibial component top surface (43) having a lateral-to-medially aligned protrusion (47) that is configured to match with a similarly shaped recess that has been made in the prepared portion of said distal tibia.
27. The ankle joint prosthesis as recited in claim 22, wherein:
said talar component bottom surface (55) having a lateral-to-medially aligned protrusion (59) that extends downward from said surface, said protrusion configured

to match with a similarly shaped recess that has been made in the prepared portion of said talus.

28. The ankle joint prosthesis as recited in claim 23, wherein:

said talar component bottom surface (55) having a lateral-to-medially aligned protrusion (59) that extends downward from said surface, said protrusion configured to match with a similarly shaped recess that has been made in the prepared portion of said talus.

29. The ankle joint prosthesis as recited in claim 22, wherein:

said talar component (51) having an anterior-to-posterior aligned shoulder (55(a)) that extends downward from the lateral edge of said talar component top surface.

30. The ankle joint prosthesis as recited in claim 23, wherein:

said talar component (51) having an anterior-to-posterior aligned shoulder (55(a)) that extends downward from the lateral edge of said talar component top surface.

31. The ankle joint prosthesis as recited in claim 24, wherein:

said talar component (51) having an anterior-to-posterior aligned shoulder (55(a)) that extends downward from the lateral edge of said talar component top surface.

32. The ankle joint prosthesis as recited in claim 25, wherein:

said talar component (51) having an anterior-to-posterior aligned shoulder (55(a)) that extends downward from the lateral edge of said talar component top surface.

33. The ankle joint prosthesis as recited in claim 22, wherein:
said talar component top surface (53) having concave curvature in the lateral to medial direction, and
said bearing component bottom surface (65) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (53) in the lateral to medial direction.
34. The ankle joint prosthesis as recited in claim 23 wherein:
said talar component top surface (53) having concave curvature in the lateral to medial direction, and
said bearing component bottom surface (65) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (53) in the lateral to medial direction.
35. The ankle joint prosthesis as recited in claim 24, wherein:
said talar component top surface (53) having concave curvature in the lateral to medial direction, and
said bearing component bottom surface (65) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (53) in the lateral to medial direction.
36. The ankle joint prosthesis as recited in claim 25, wherein:
said talar component top surface (53) having concave curvature in the lateral to medial direction, and
said bearing component bottom surface (65) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (53) in the lateral to medial direction.
37. The ankle joint prosthesis as recited in claim 26, wherein:
said talar component top surface (53) having concave curvature in the lateral to medial direction, and

said bearing component bottom surface (65) having convex curvature in the lateral to medial direction that is complementary to the curvature of said talar component's top surface (53) in the lateral to medial direction.

38. The ankle joint prosthesis as recited in claim 26, wherein:

said tibial protrusion (47) being tapered, from narrow medial to wide lateral, so as to create a more secure and stable fit for said tibial component.

39. The ankle joint prosthesis as recited in claim 37, wherein:

said tibial protrusion (47) being tapered, from narrow medial to wide lateral, so as to create a more secure and stable fit for said tibial component.

40. The ankle joint prosthesis as recited in claim 22, wherein:

said tibial component top surface (43) being coated with a substance to enhance adhesion between said component and prepared, distal tibia surface.

41. The ankle joint prosthesis as recited in claim 22, wherein:

said talar component bottom surface (55) being coated with a substance to enhance adhesion between said component and prepared, talar surface.

42. The ankle joint prosthesis as recited in claim 40, wherein:

said coating substance being chosen from the group consisting of sintered beads, plasma sprayed, implex/trabecular metal or other material that provides an interlocking mechanism for better adhesion between said tibial component and prepared, distal tibia surface.

43. The ankle joint prosthesis as recited in claim 41, wherein:

said coating substance being chosen from the group consisting of sintered beads, plasma sprayed, implex/trabecular metal or other material that provides an interlocking mechanism for better adhesion between said tibial component and prepared, talar surface.

44. The ankle joint prosthesis as recited in claim 22, wherein:
said components (41, 51, 61) being fabricated from materials chosen from the group consisting of an ultra-high, molecular weight polyethylene, titanium or cobalt chrome alloys, or a ceramic, or other suitable surgically implantable material.
45. Use of the ankle joint prosthesis according to any one of claims 1 to 44 to replace diseased bone associated with articulating surfaces between a patient's distal tibia and talus.

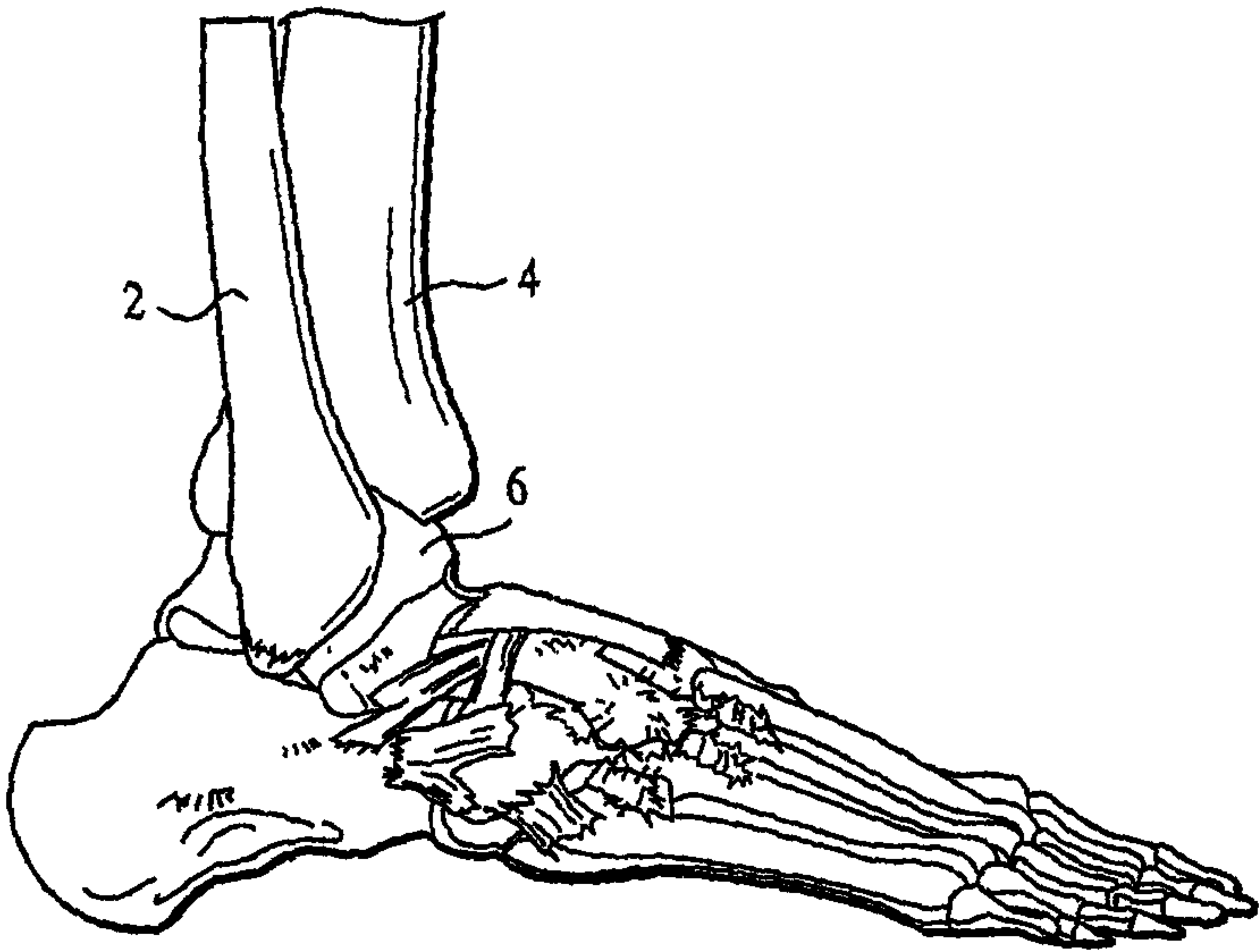


FIG. 1

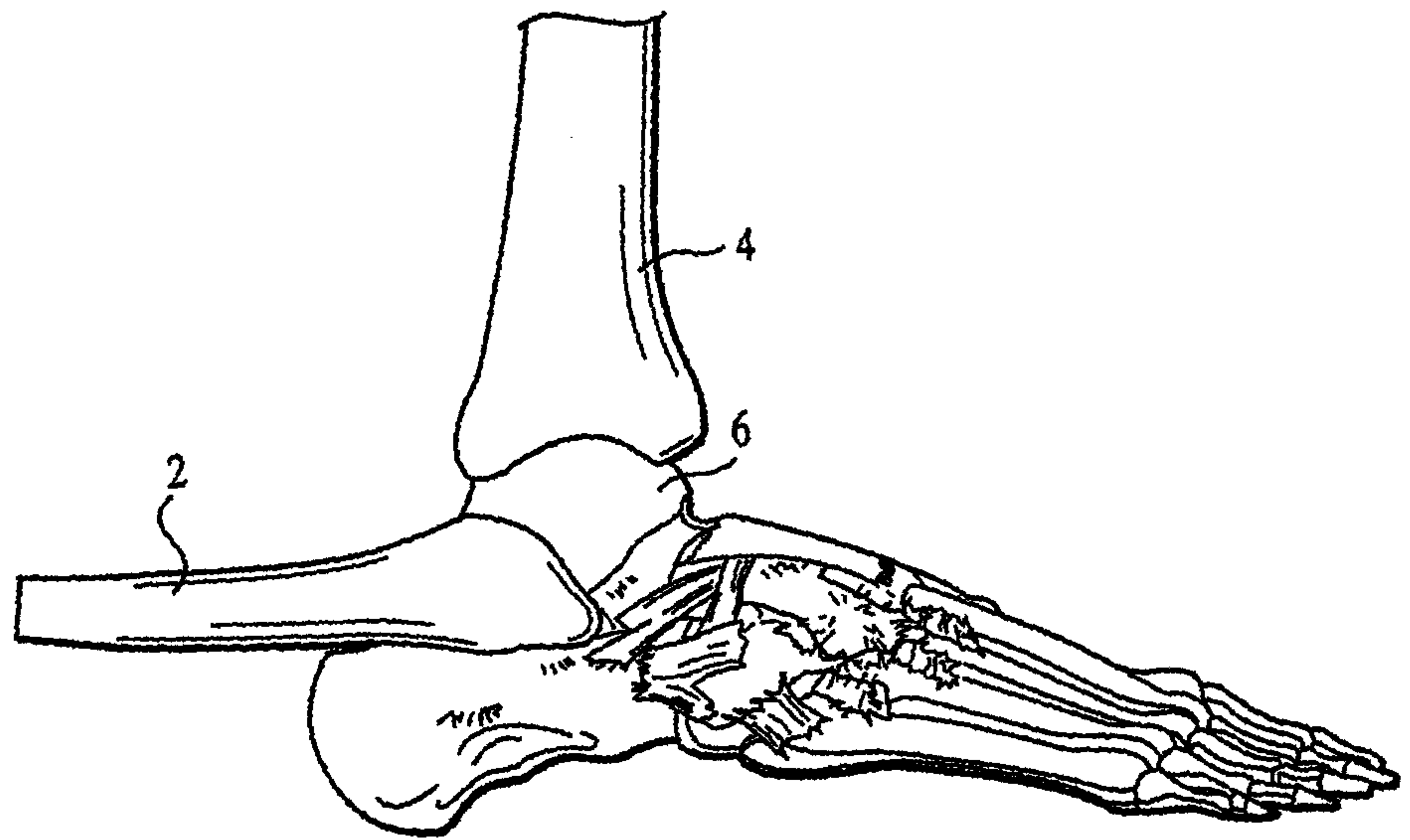


FIG. 2

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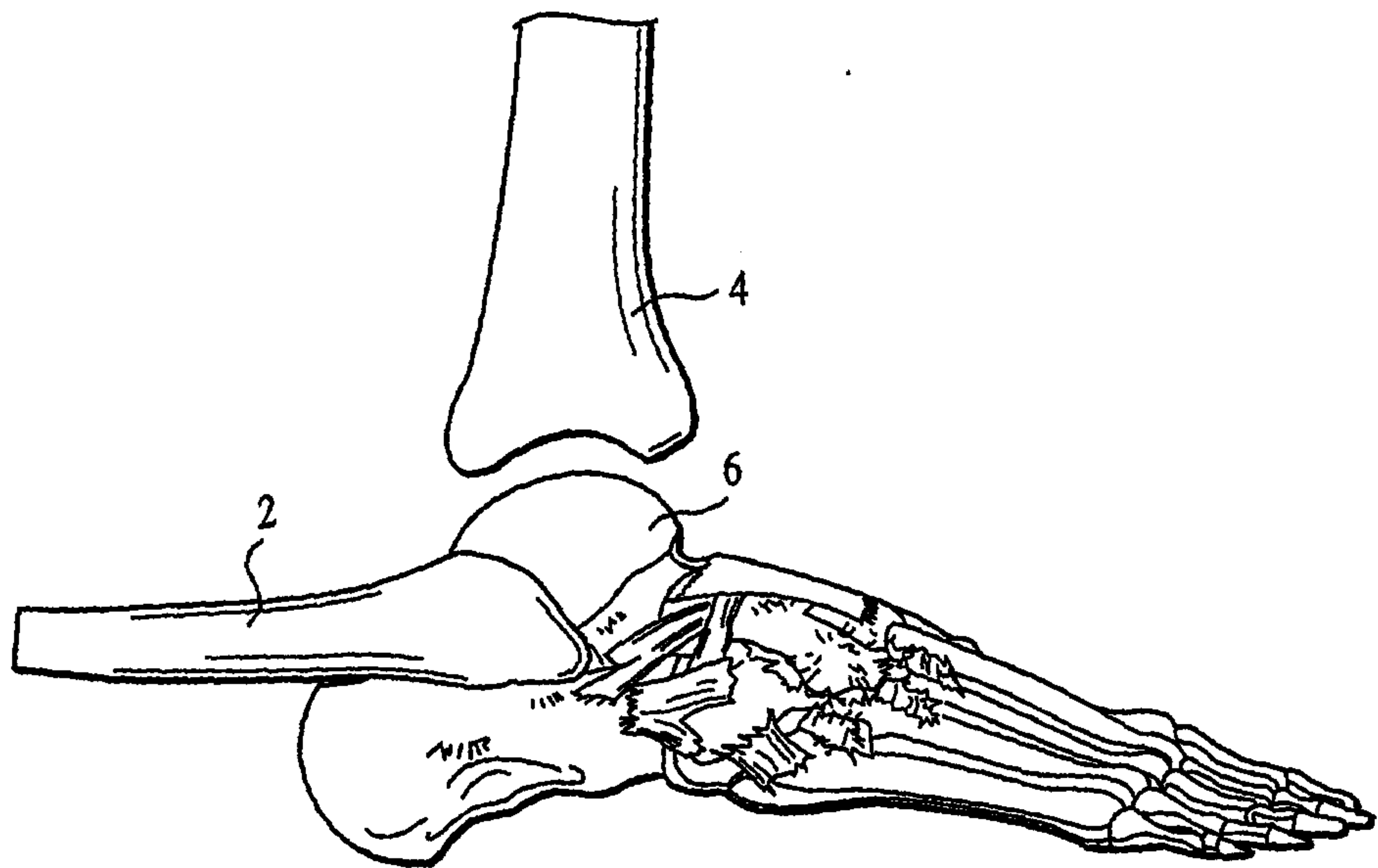


FIG. 3

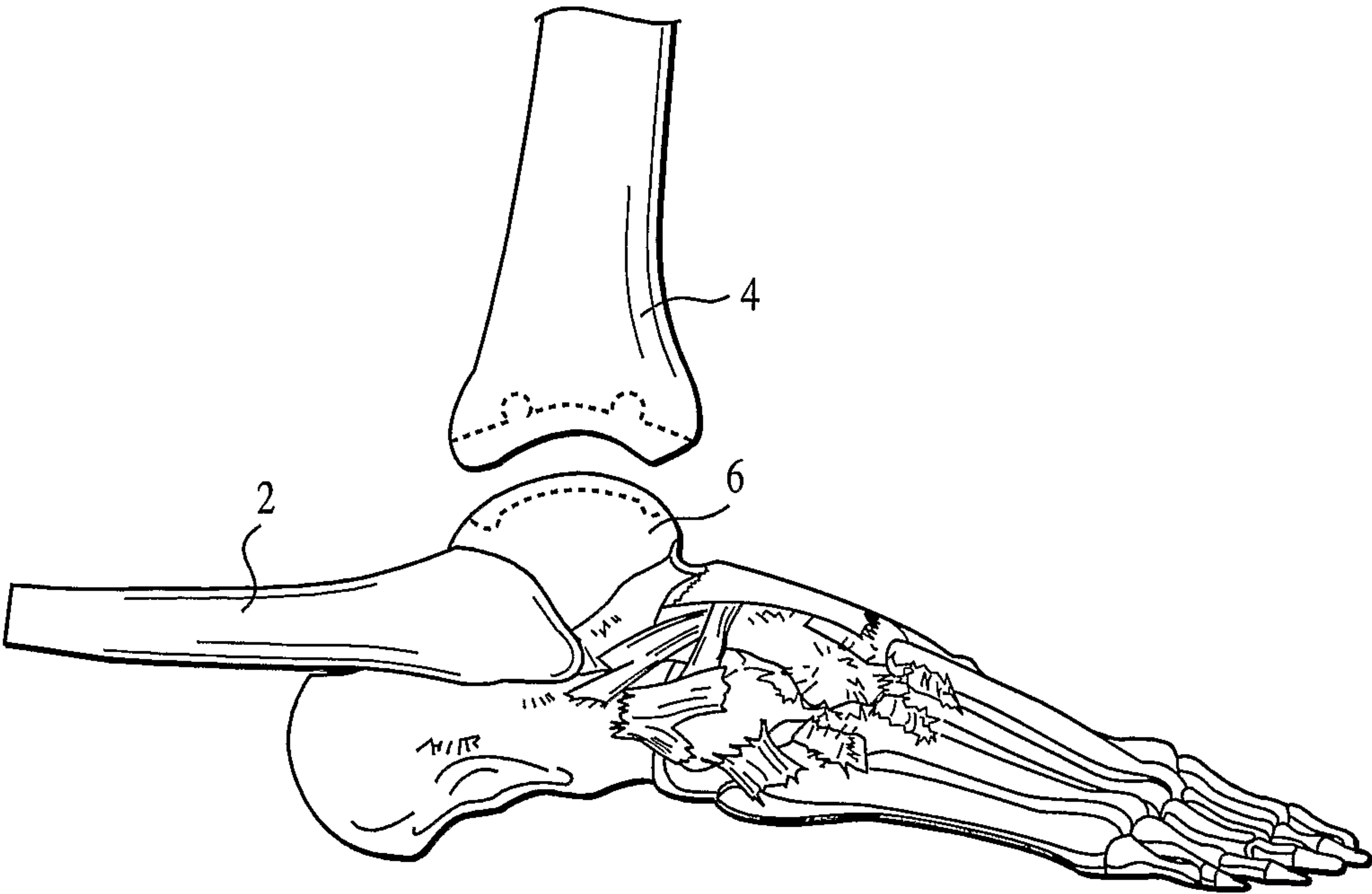


FIG. 4

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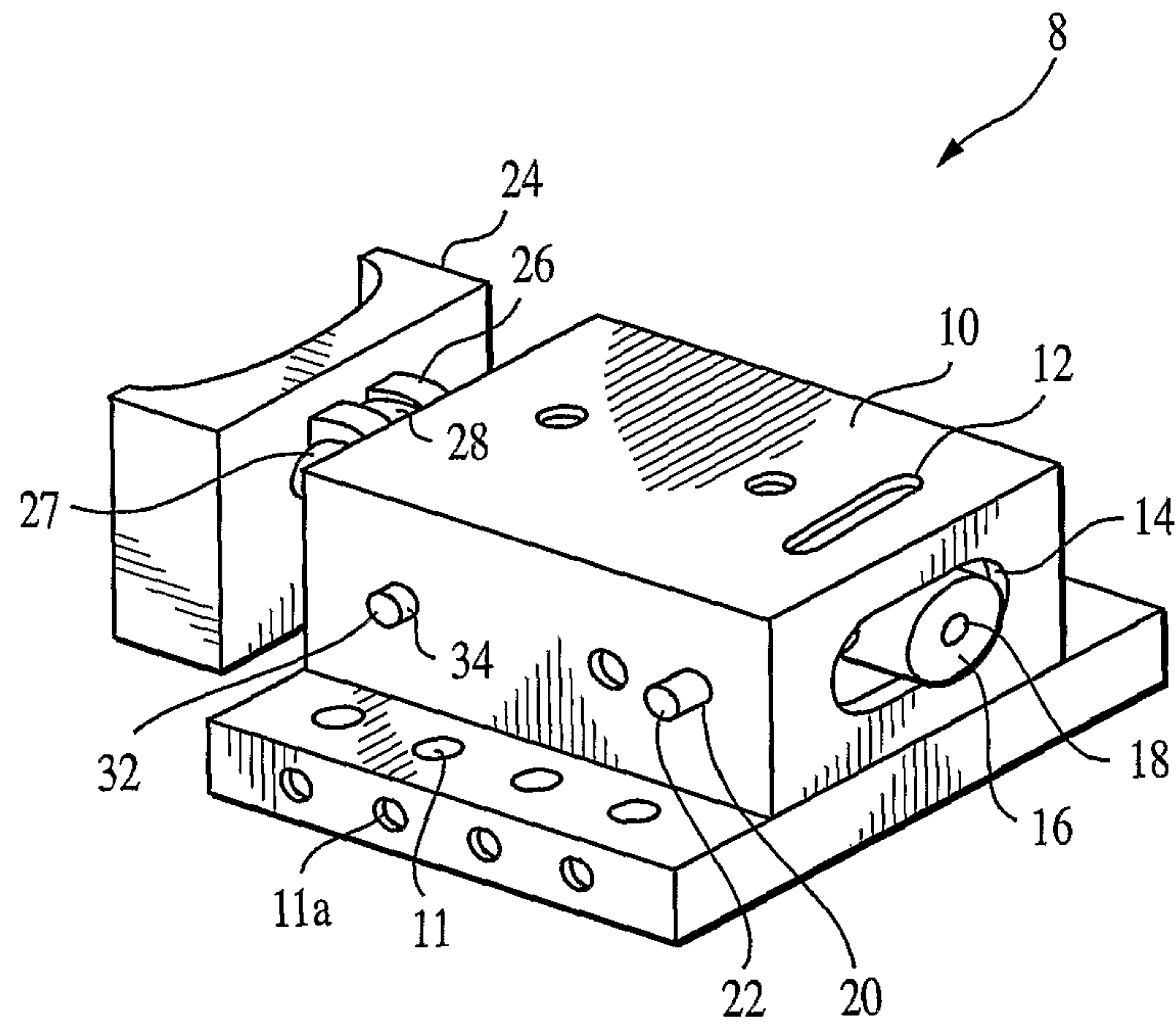


FIG. 5

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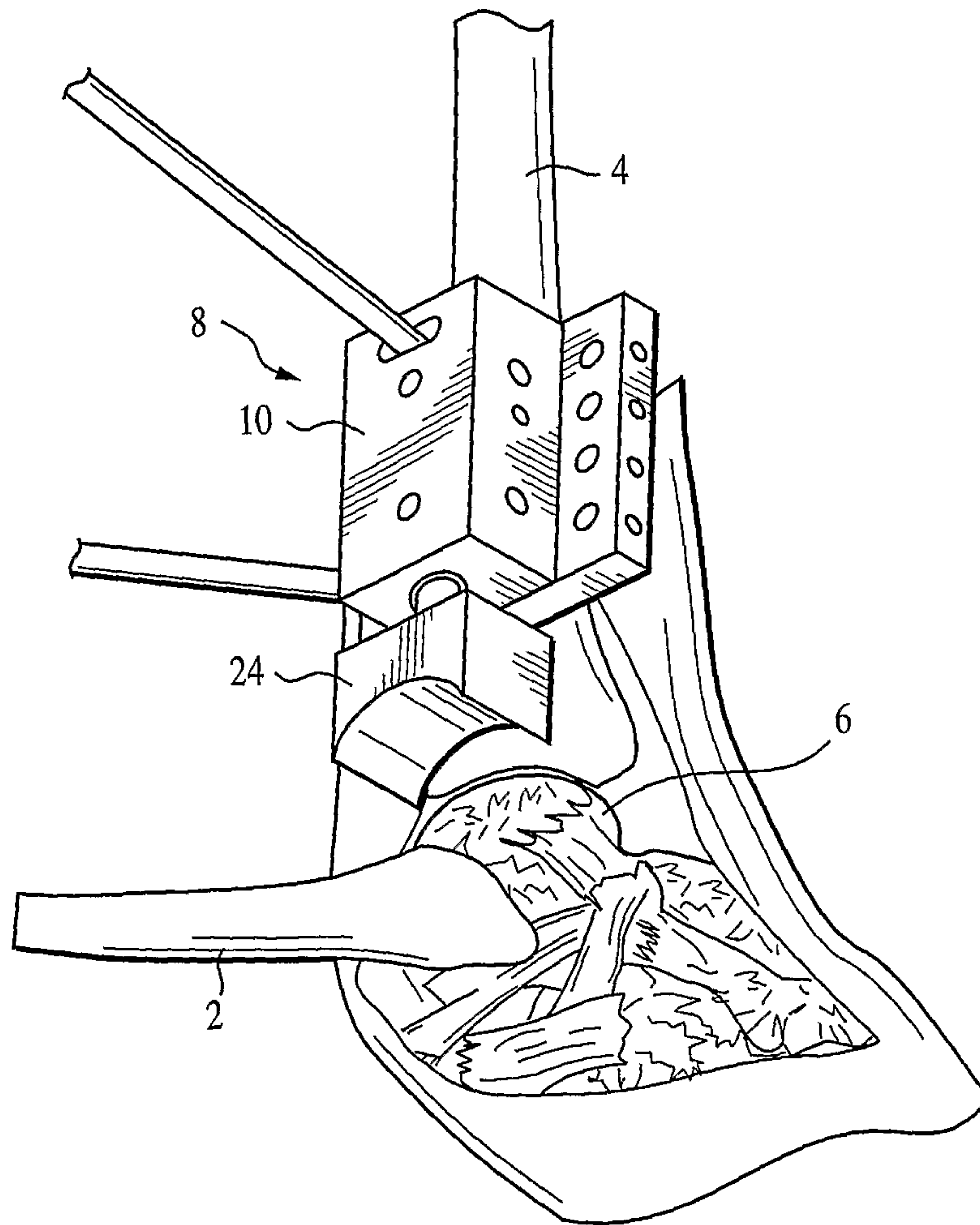


FIG. 6

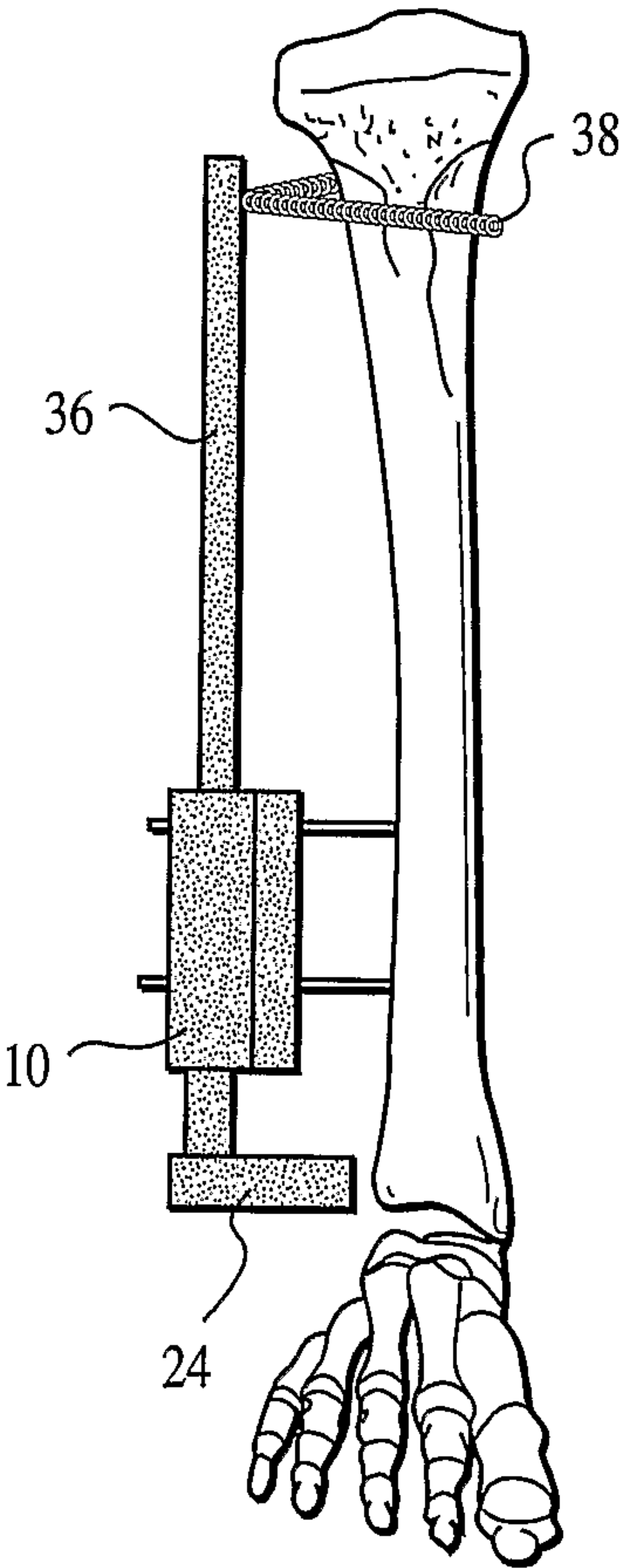


FIG. 7

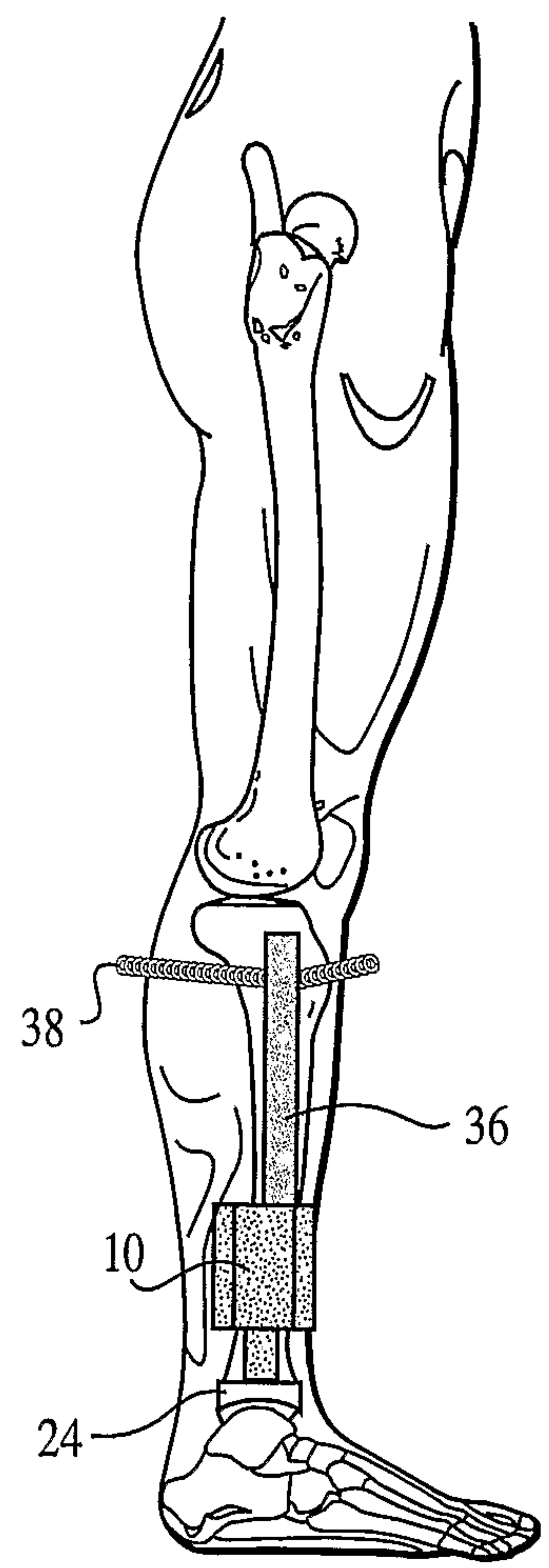


FIG. 8

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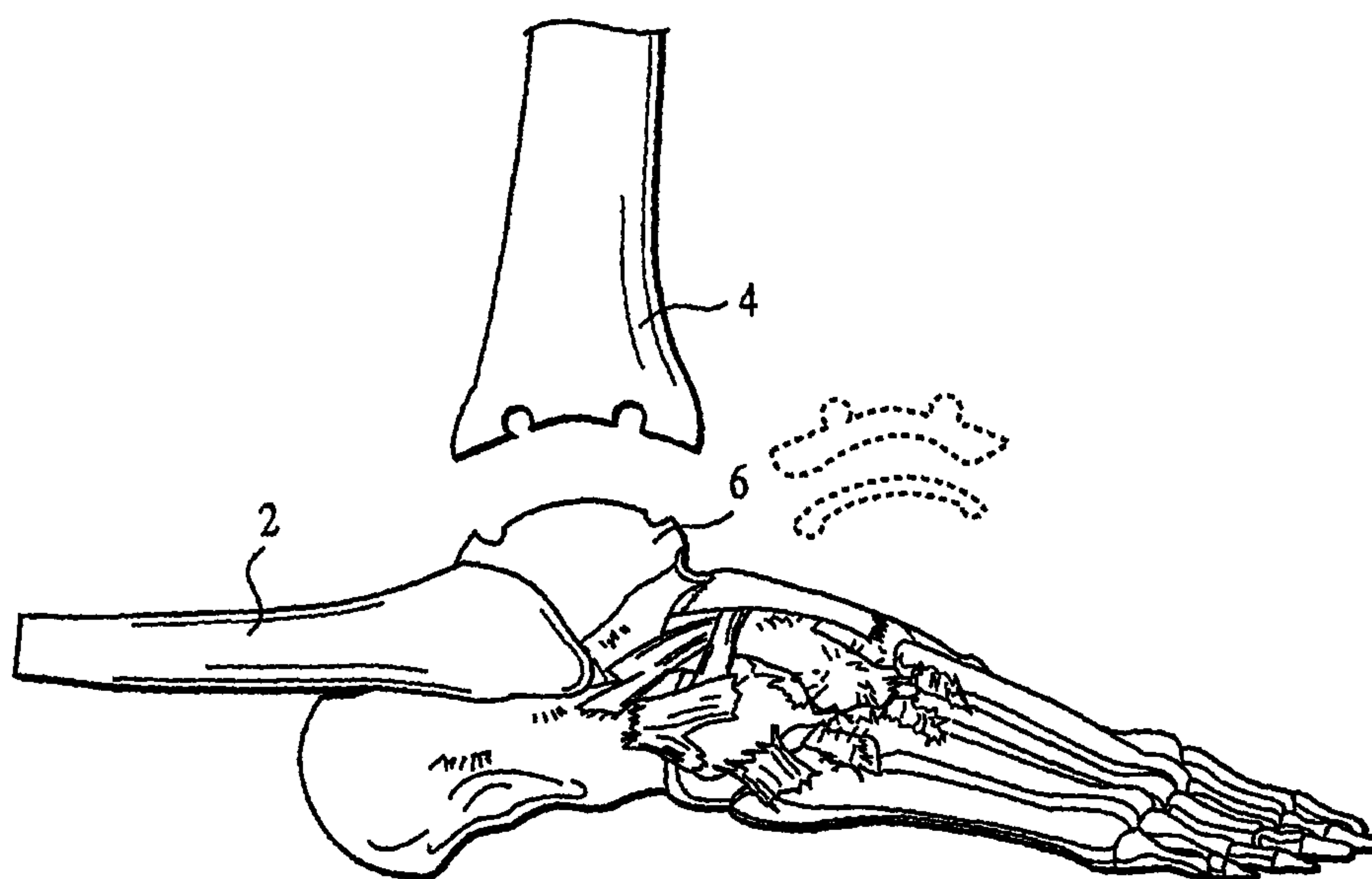


FIG. 9

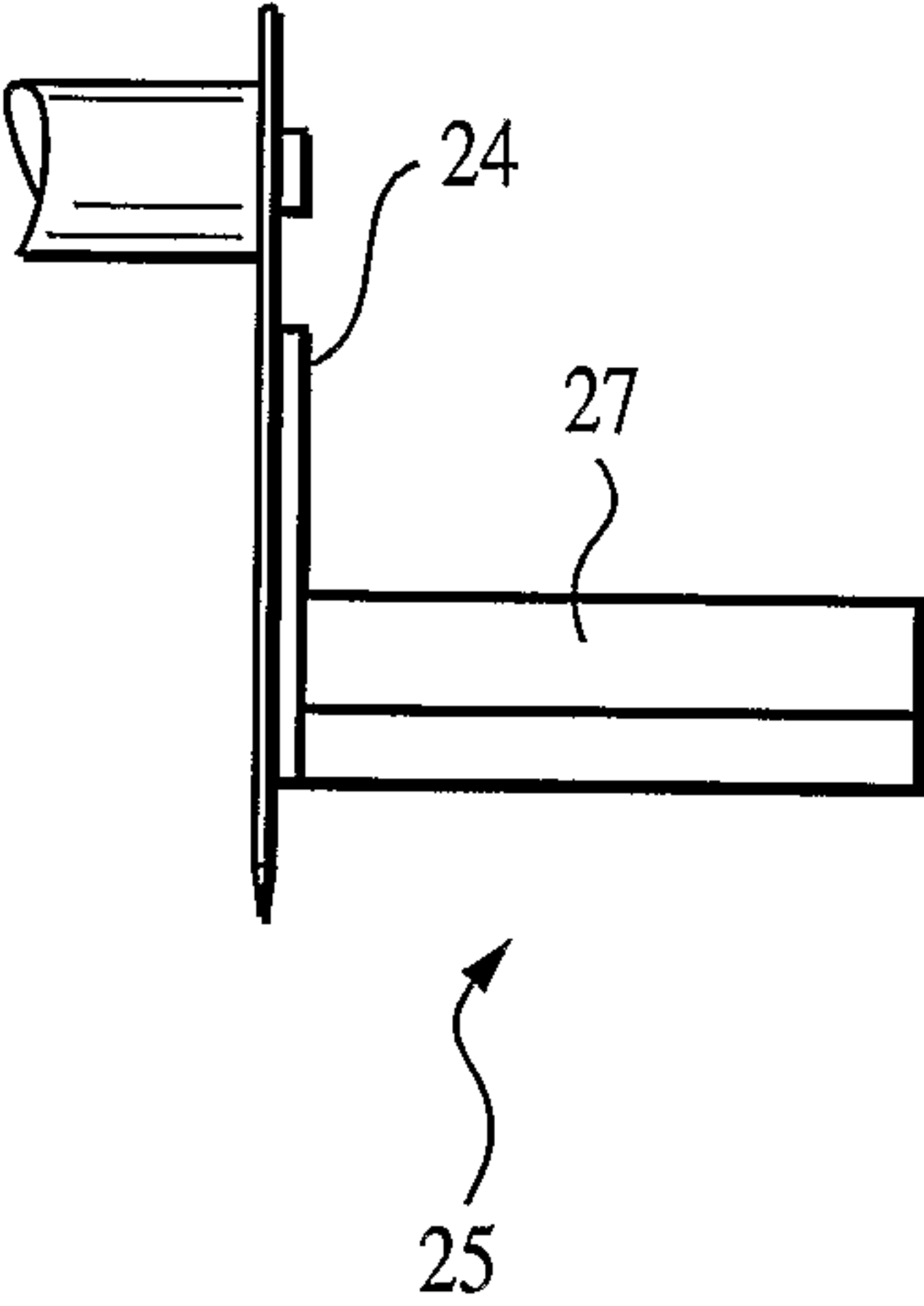
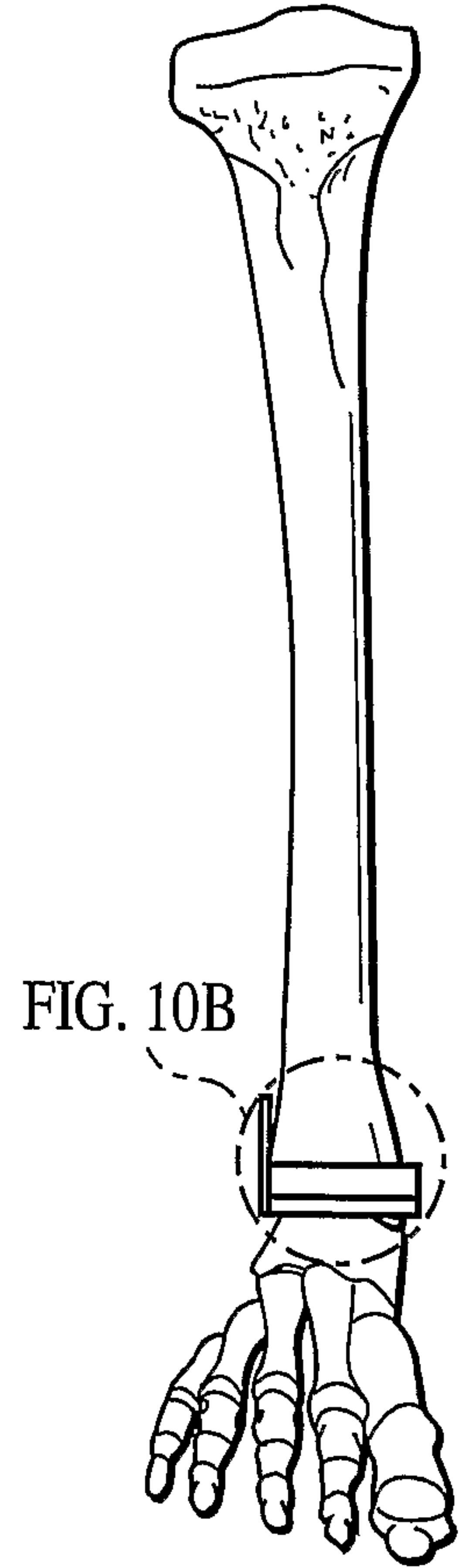


FIG. 10B

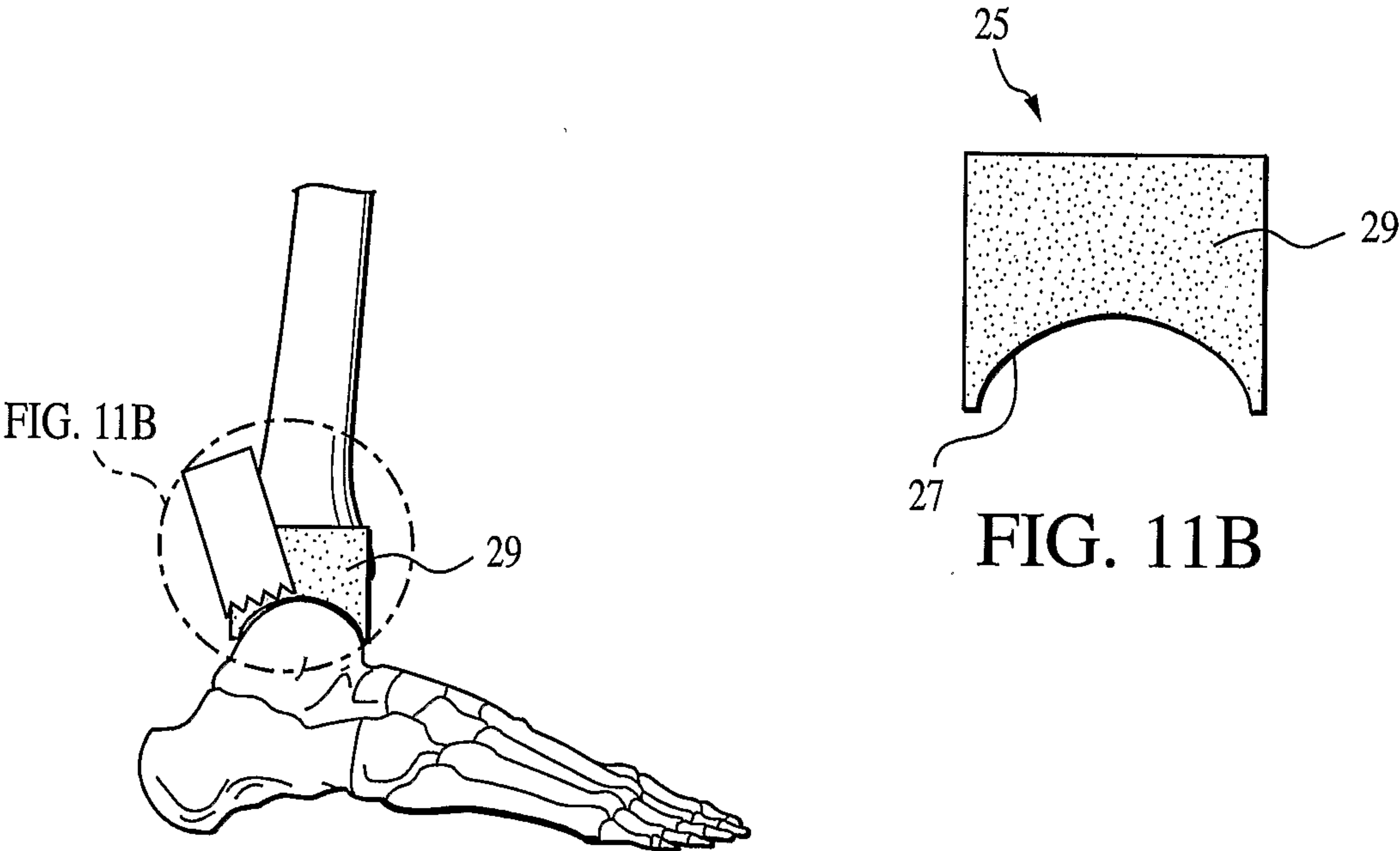


FIG. 11A

FIG. 11B

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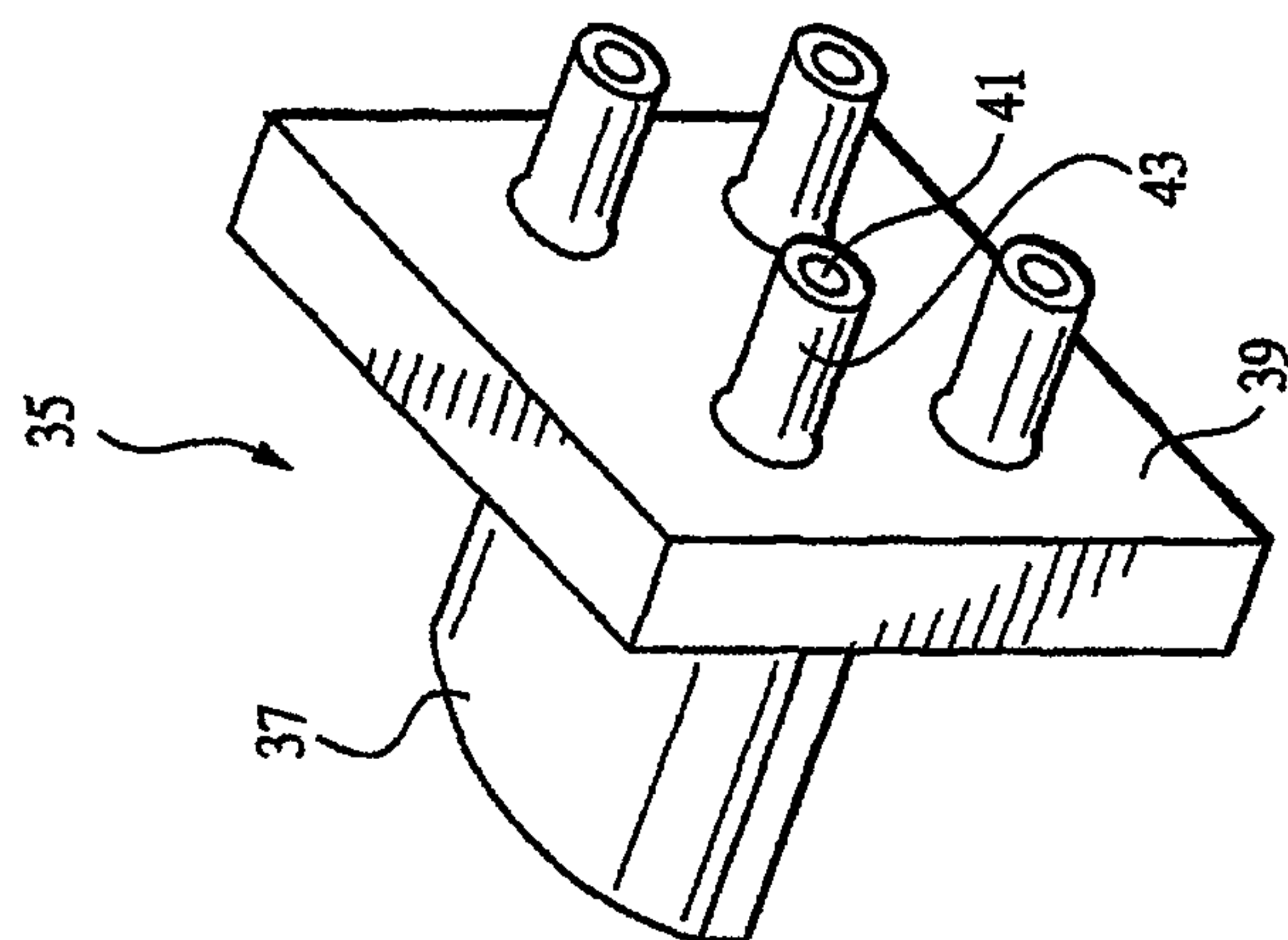
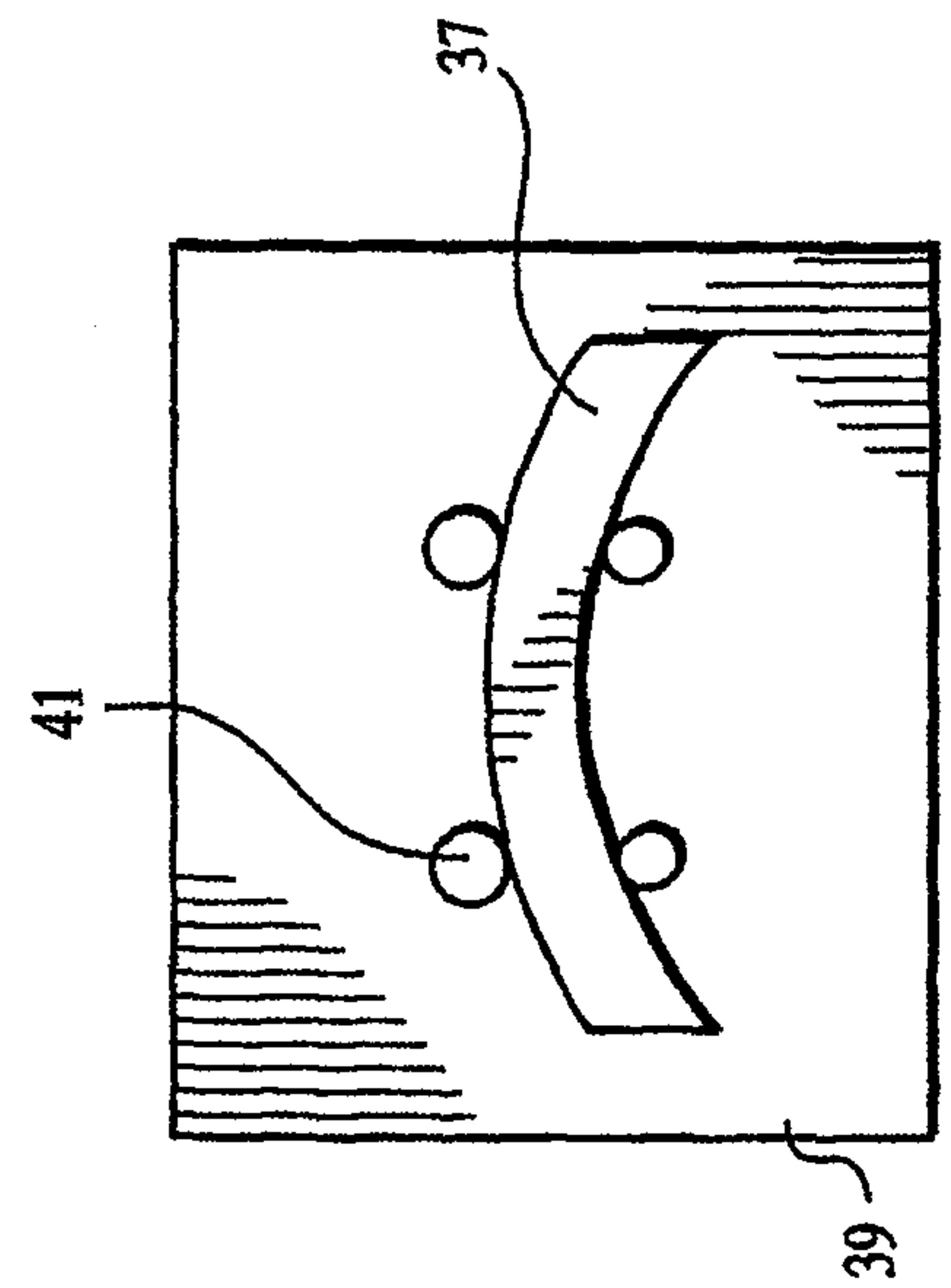
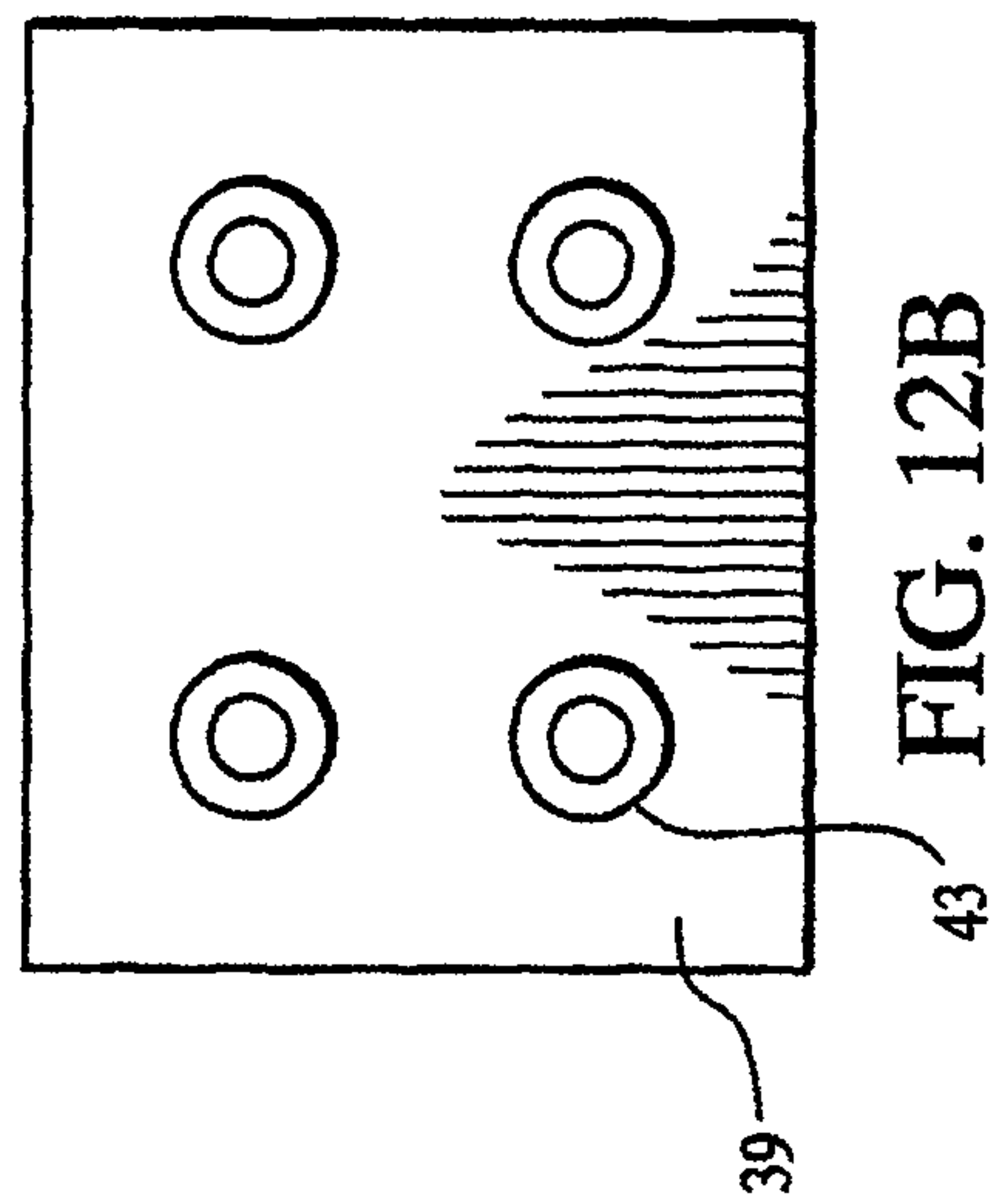


FIG. 12A

FIG. 12C

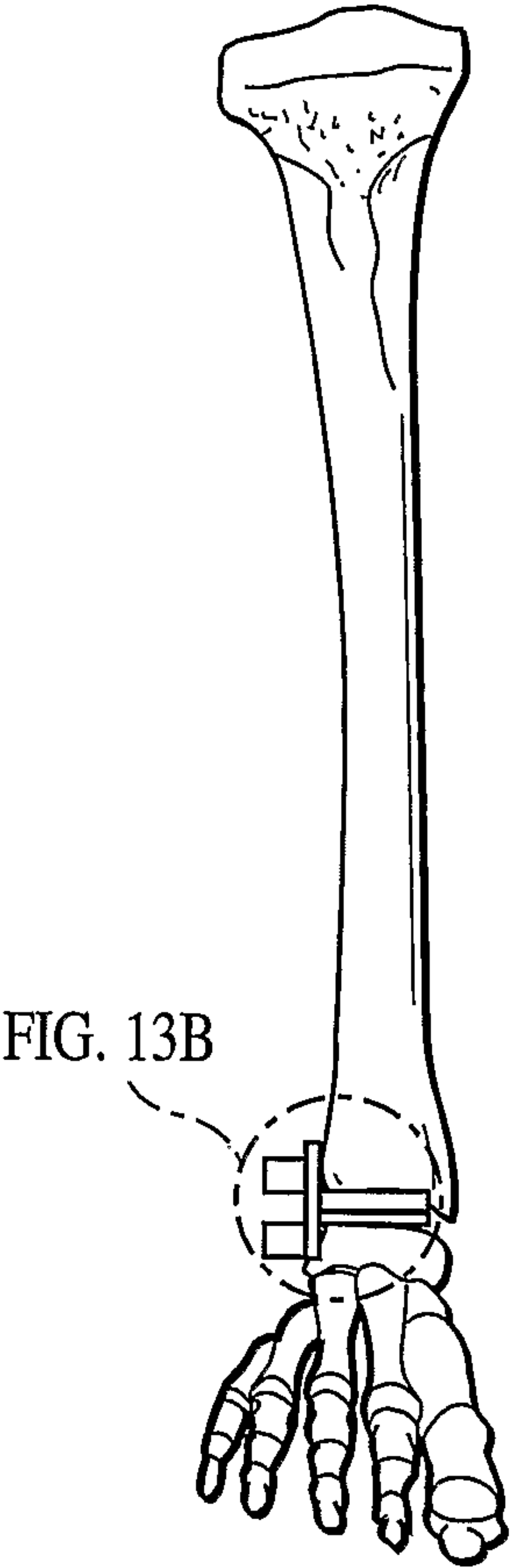


FIG. 13A

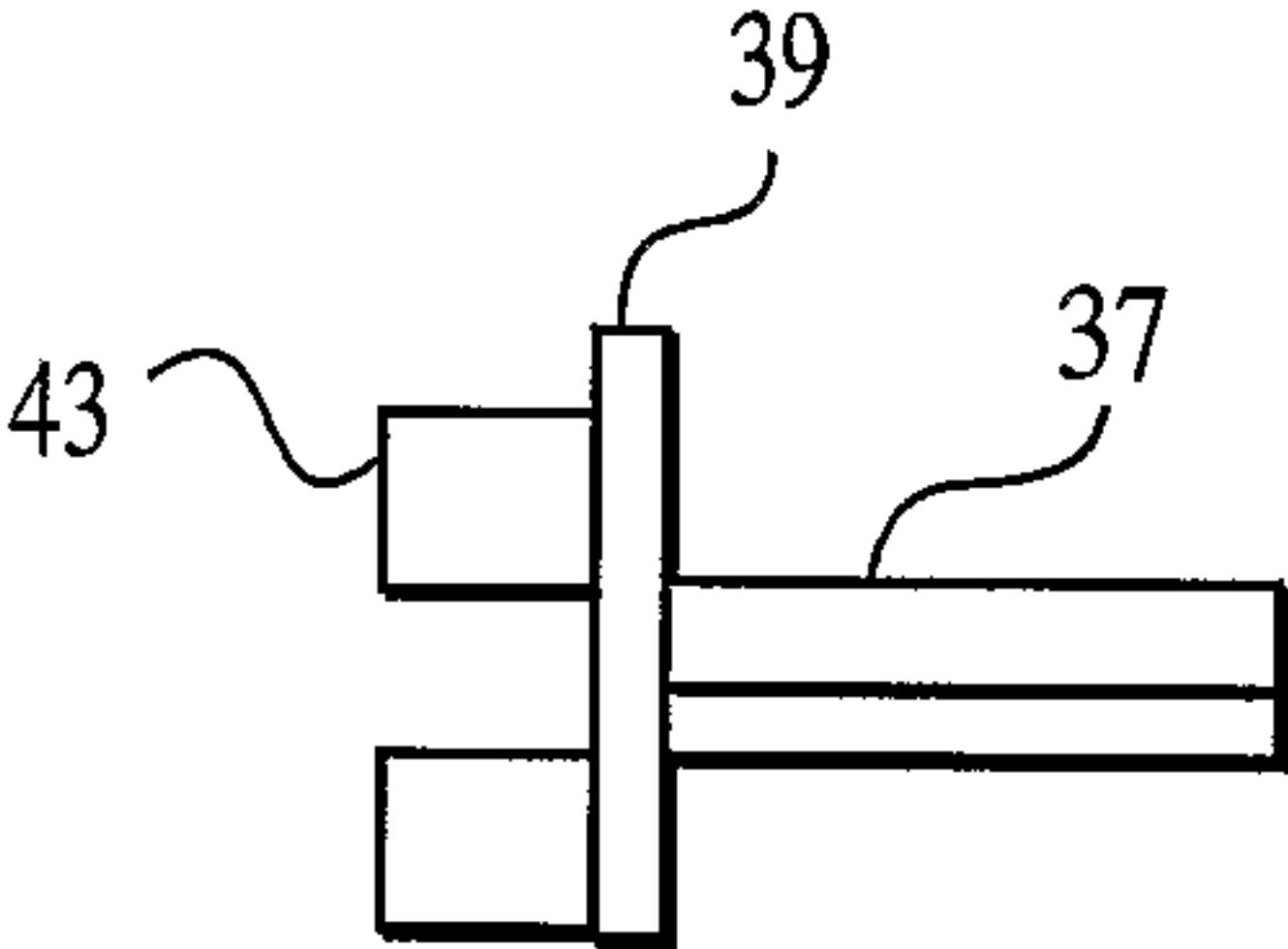


FIG. 13B

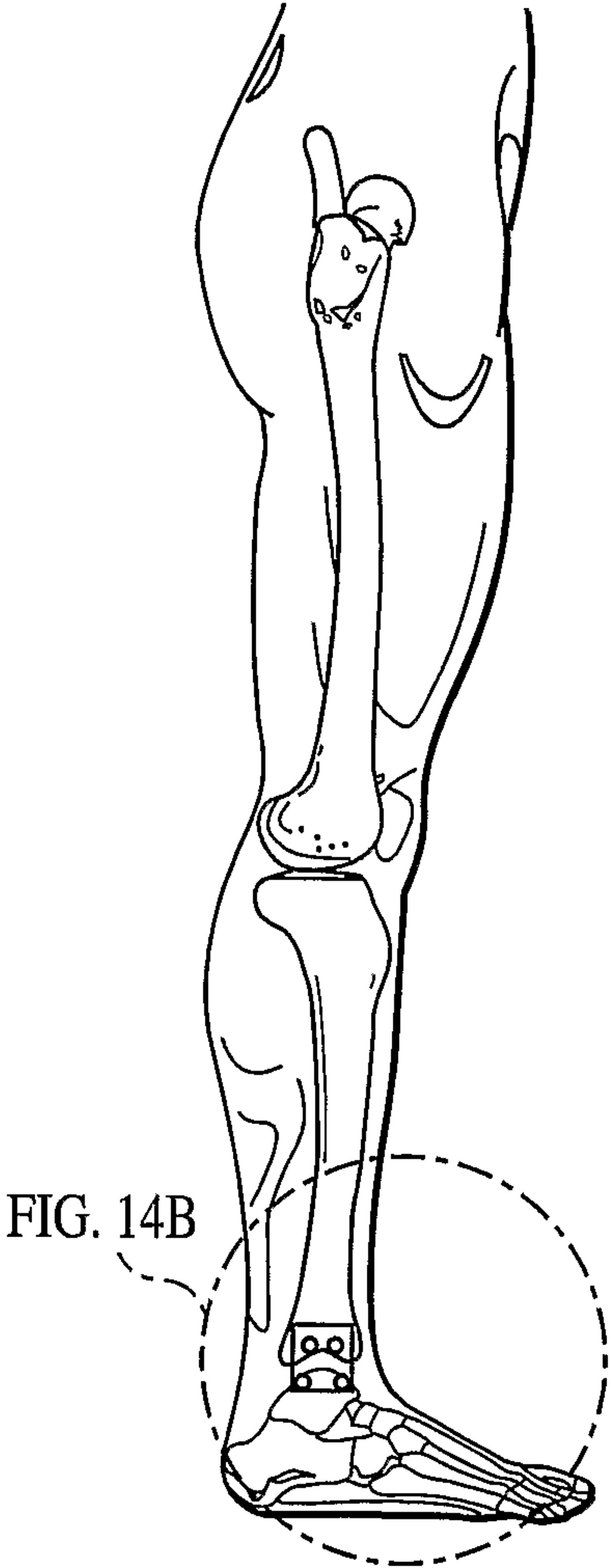


FIG. 14A

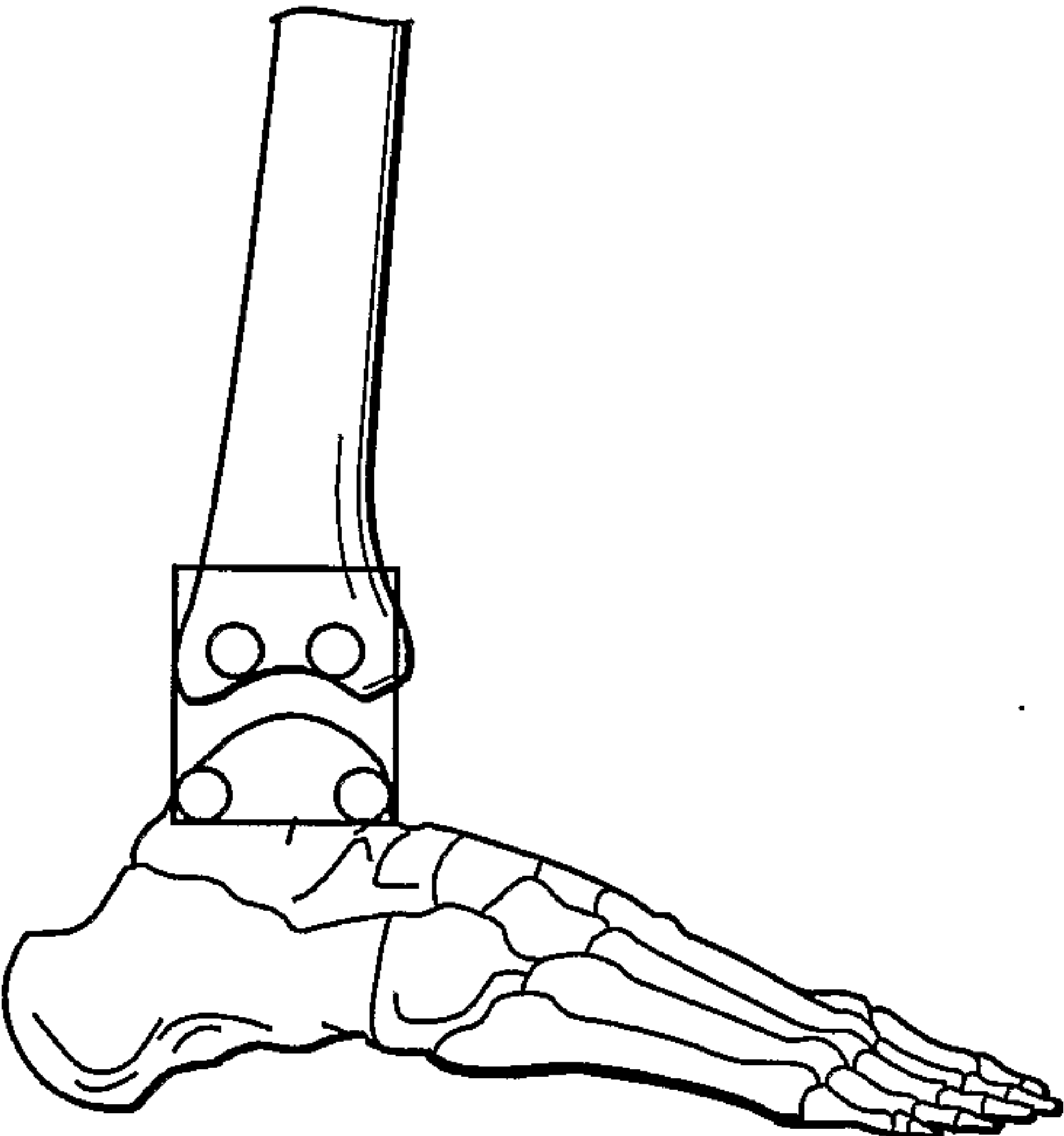


FIG. 14B

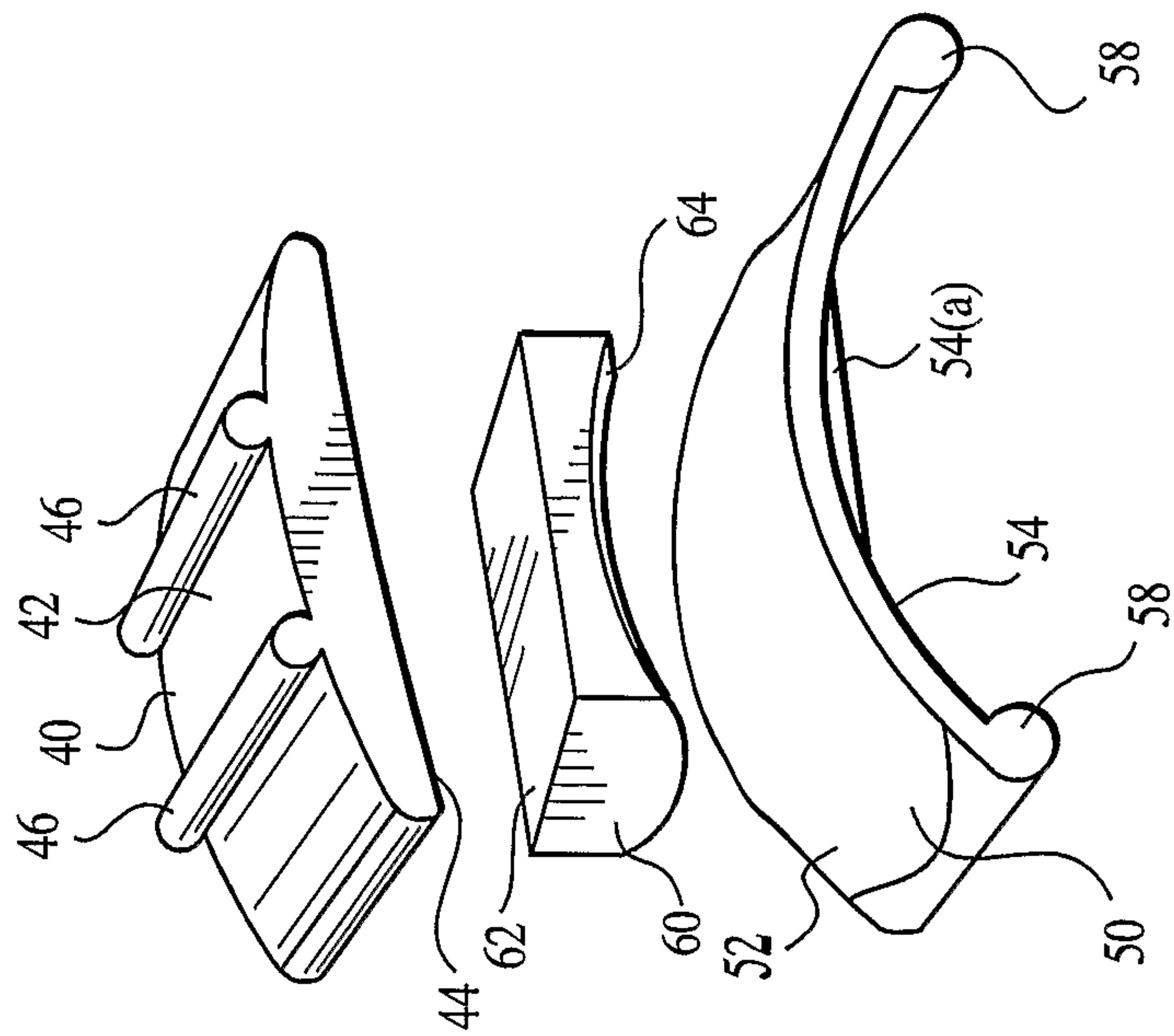


FIG. 15

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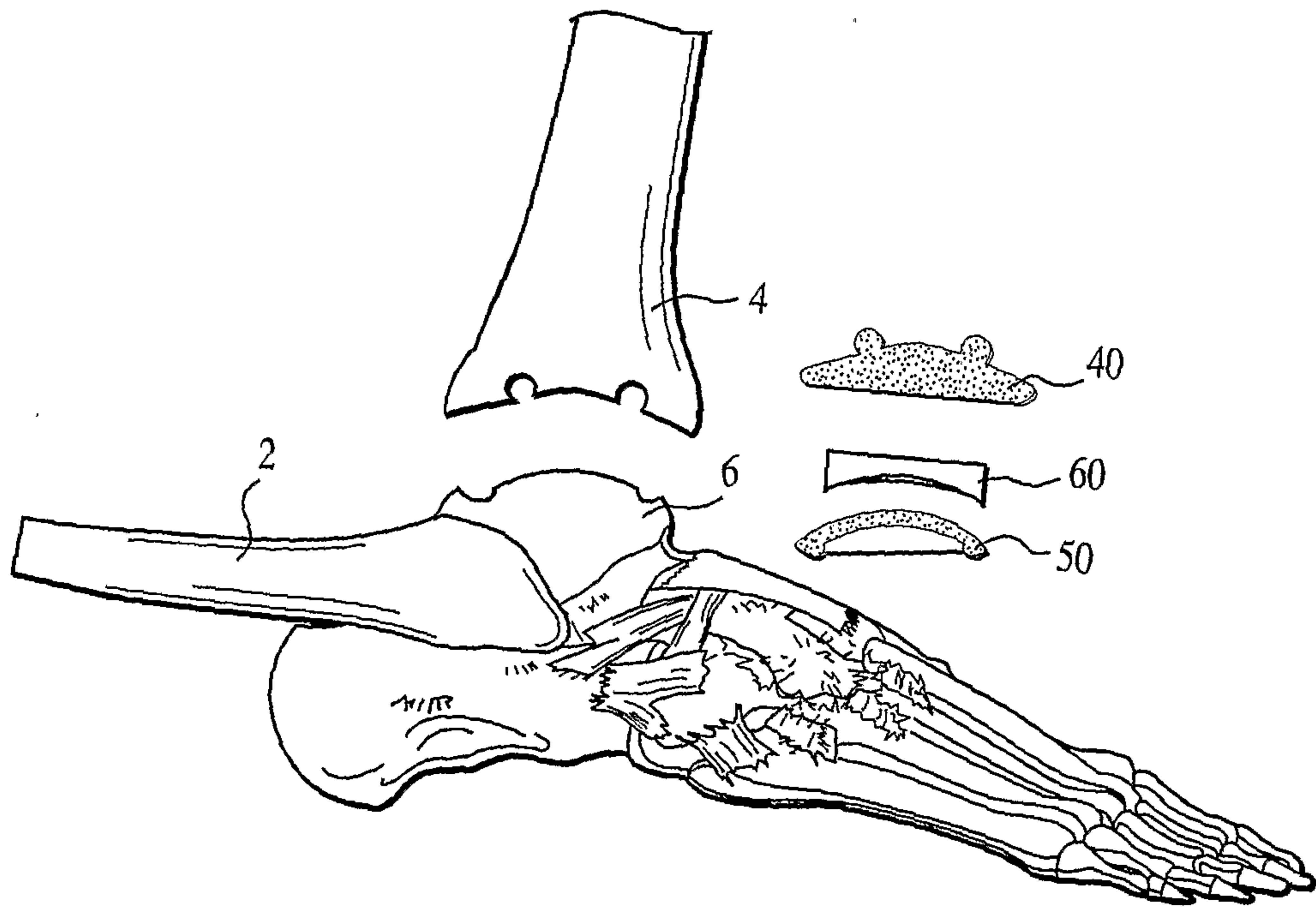


FIG. 16

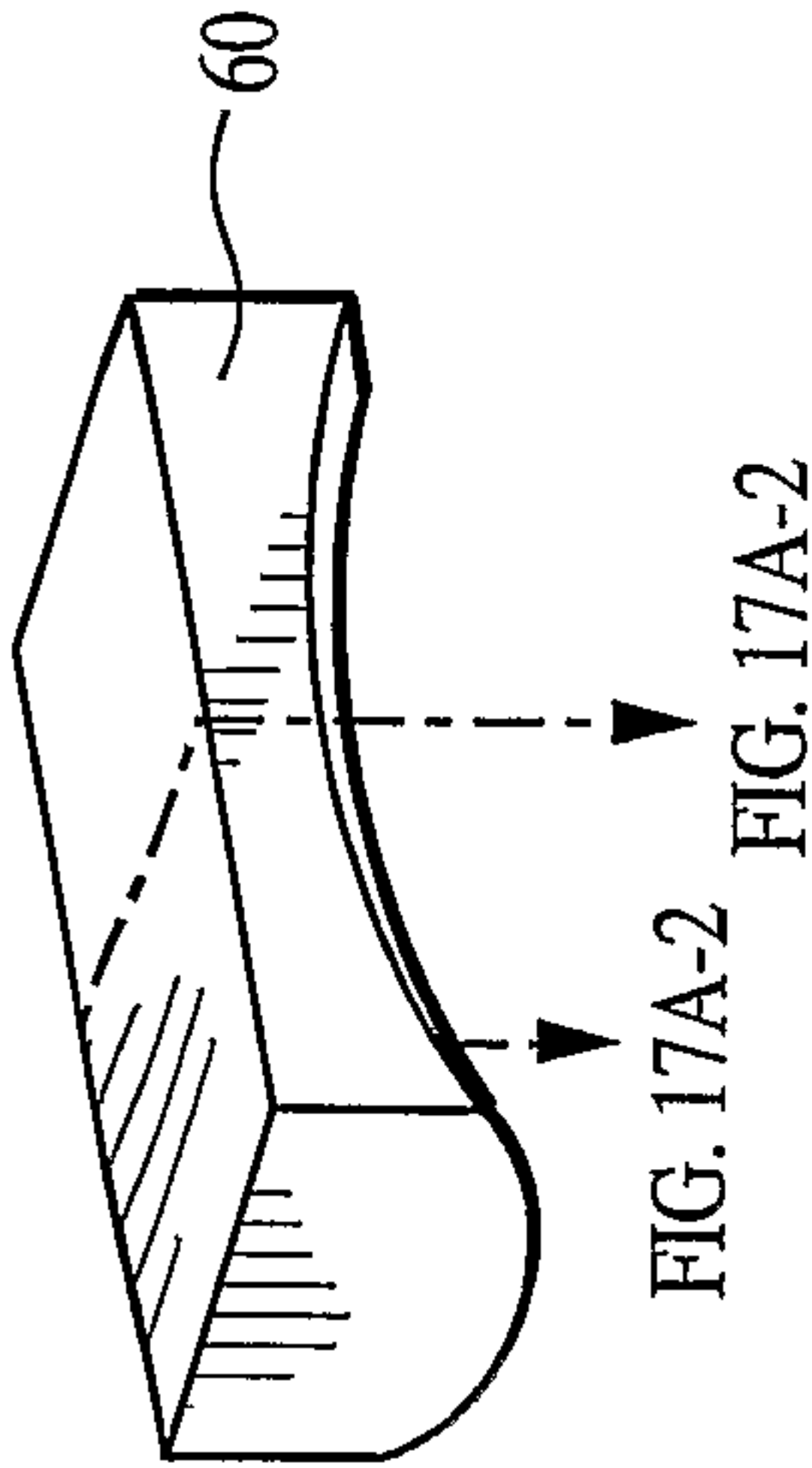


FIG. 17A-1

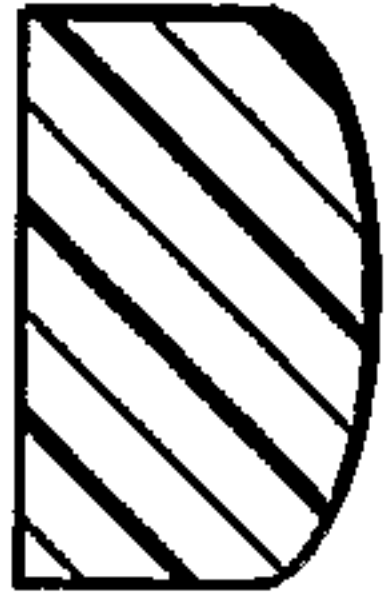


FIG. 17A-2

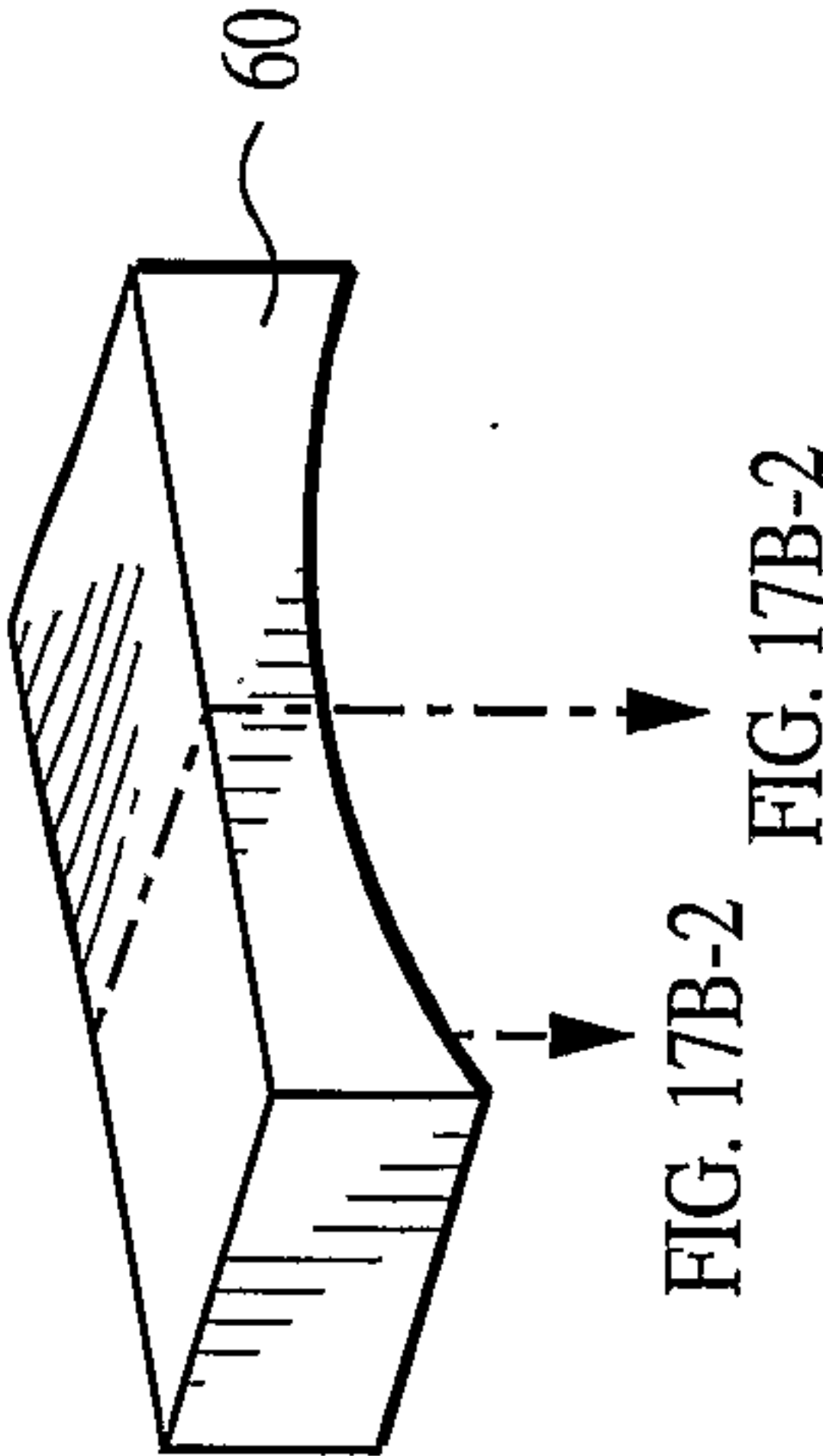


FIG. 17B-1



FIG. 17B-2

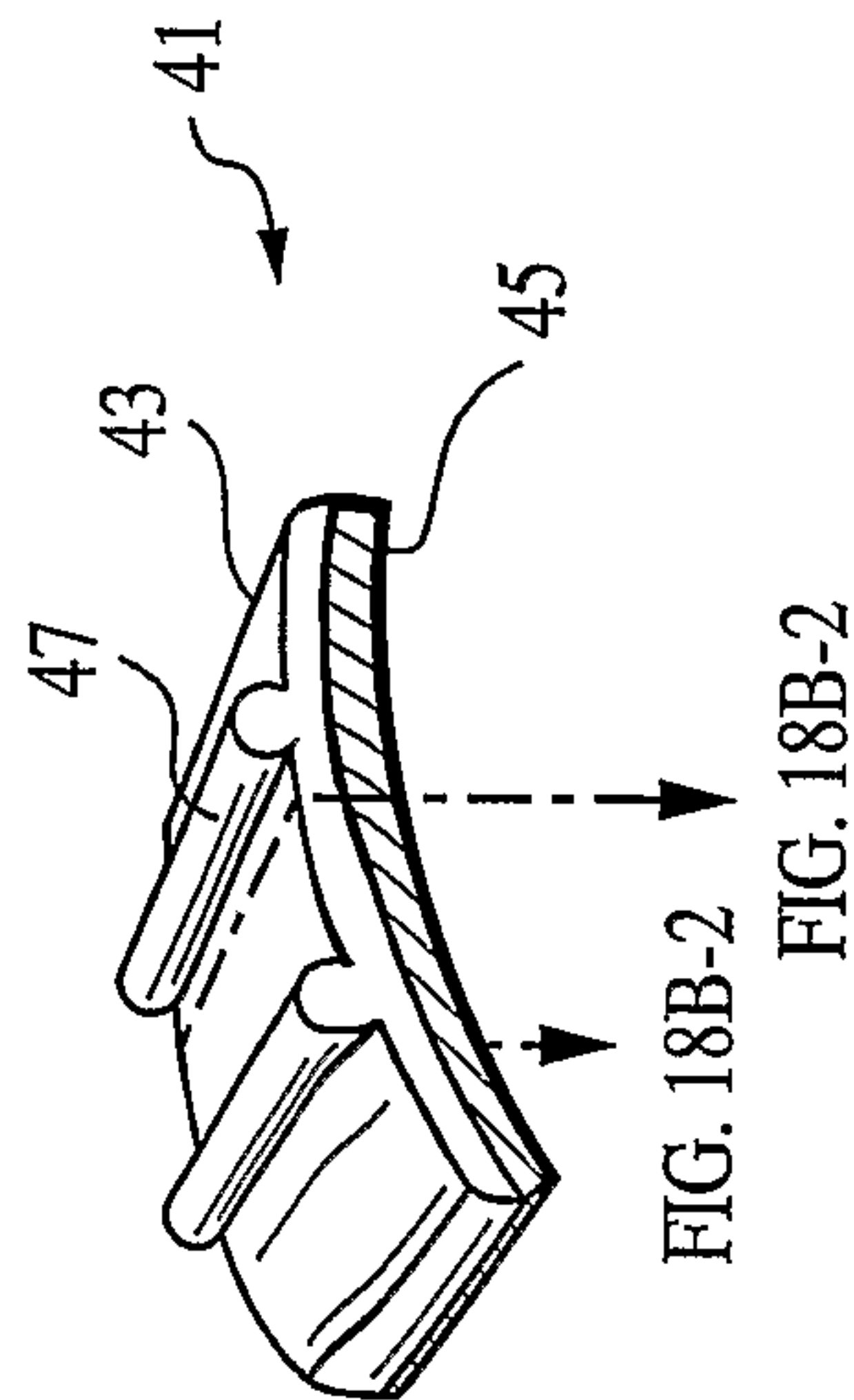


FIG. 18B-1

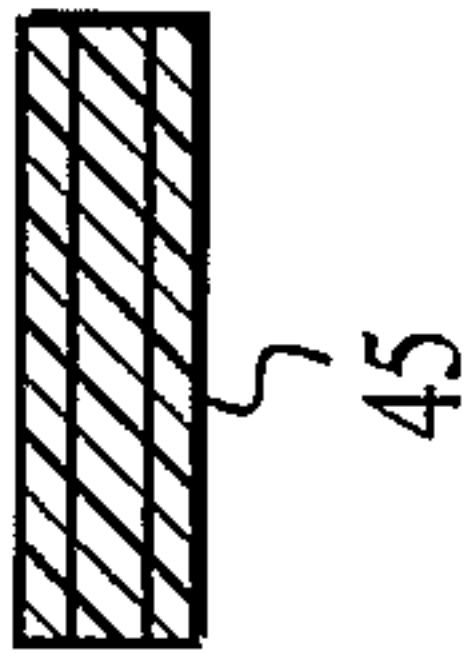


FIG. 18B-2

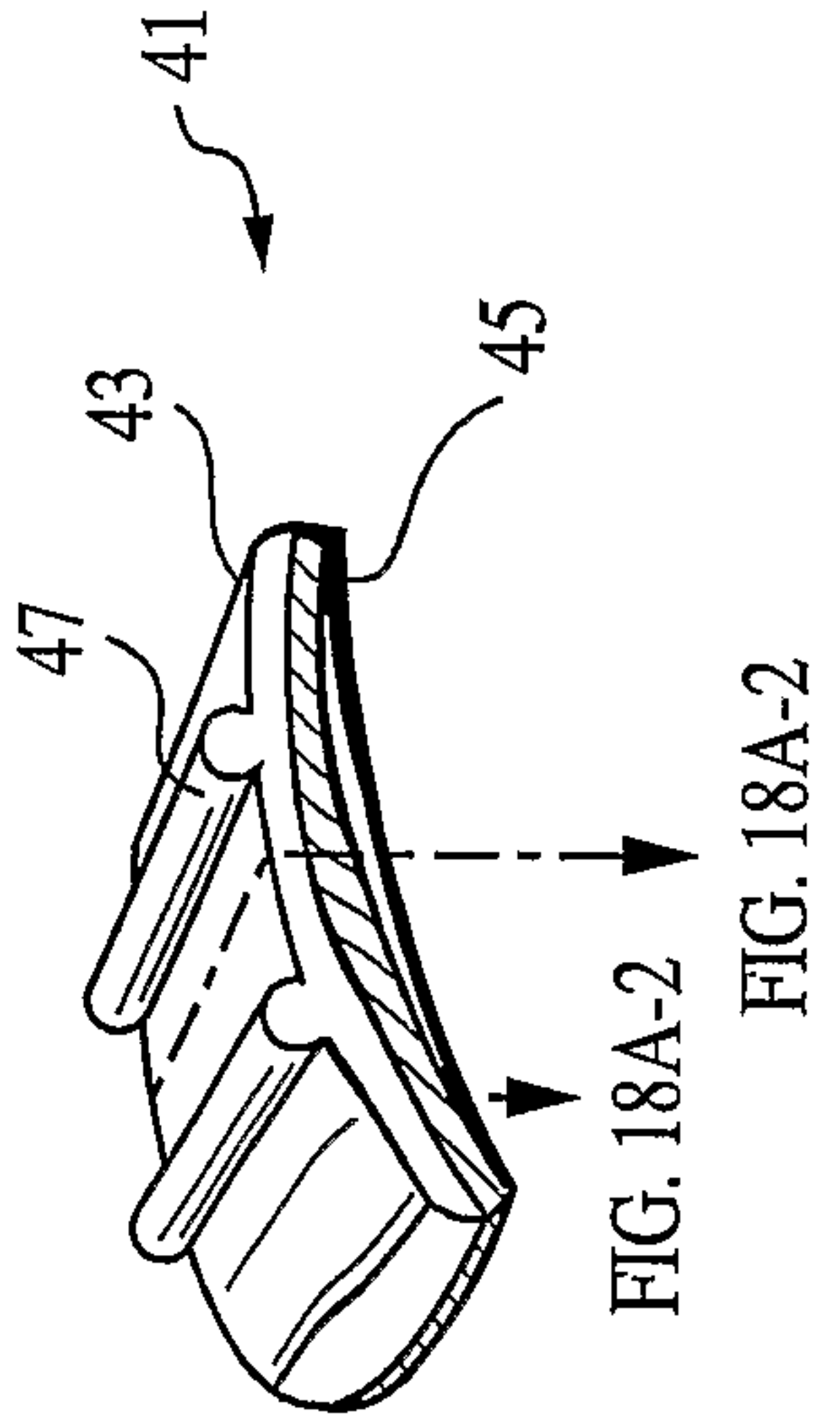


FIG. 18A-1

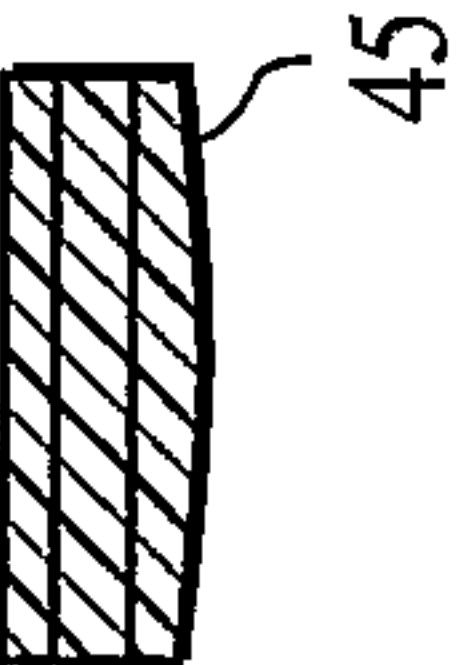


FIG. 18A-2

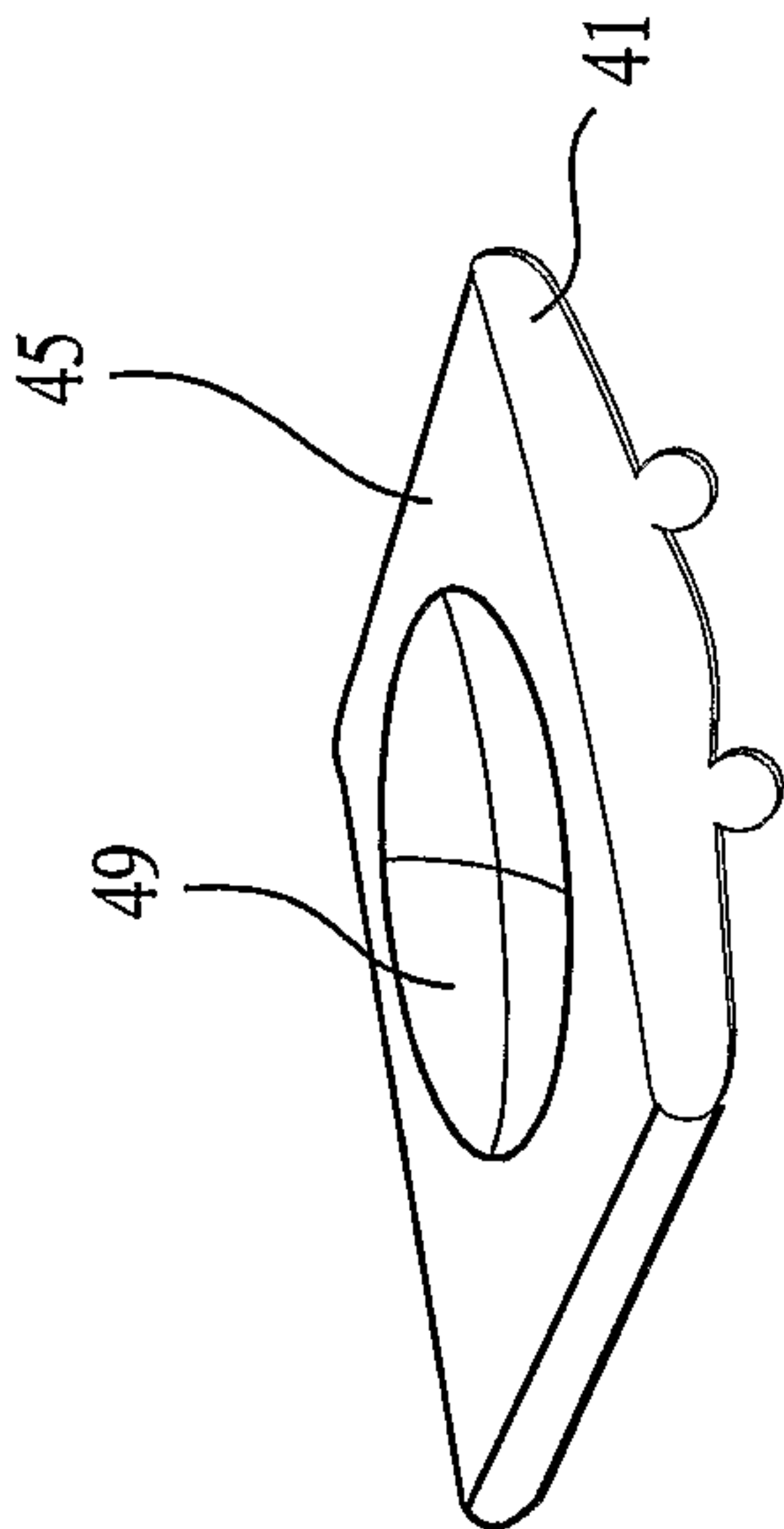


FIG. 19B

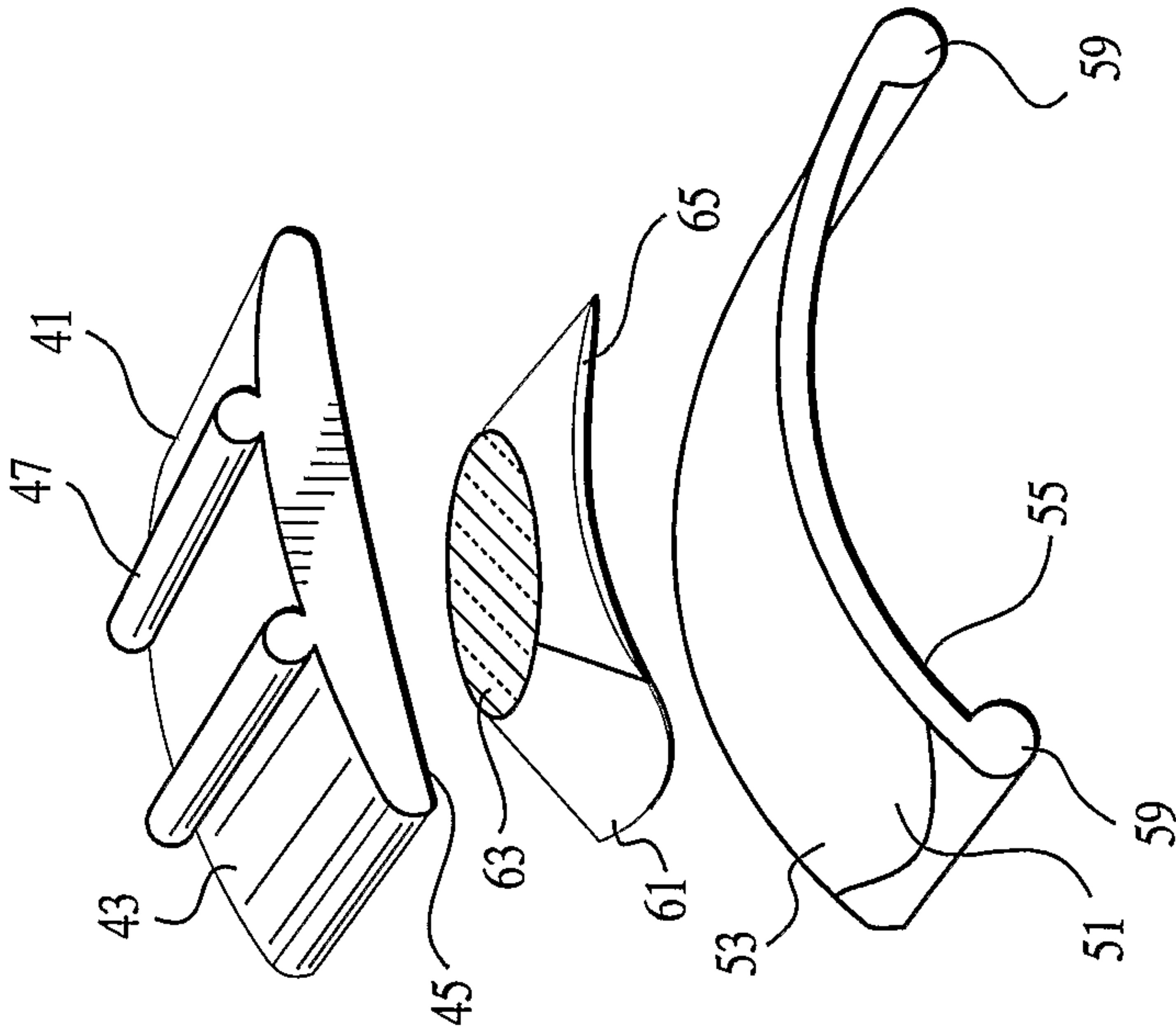


FIG. 19A

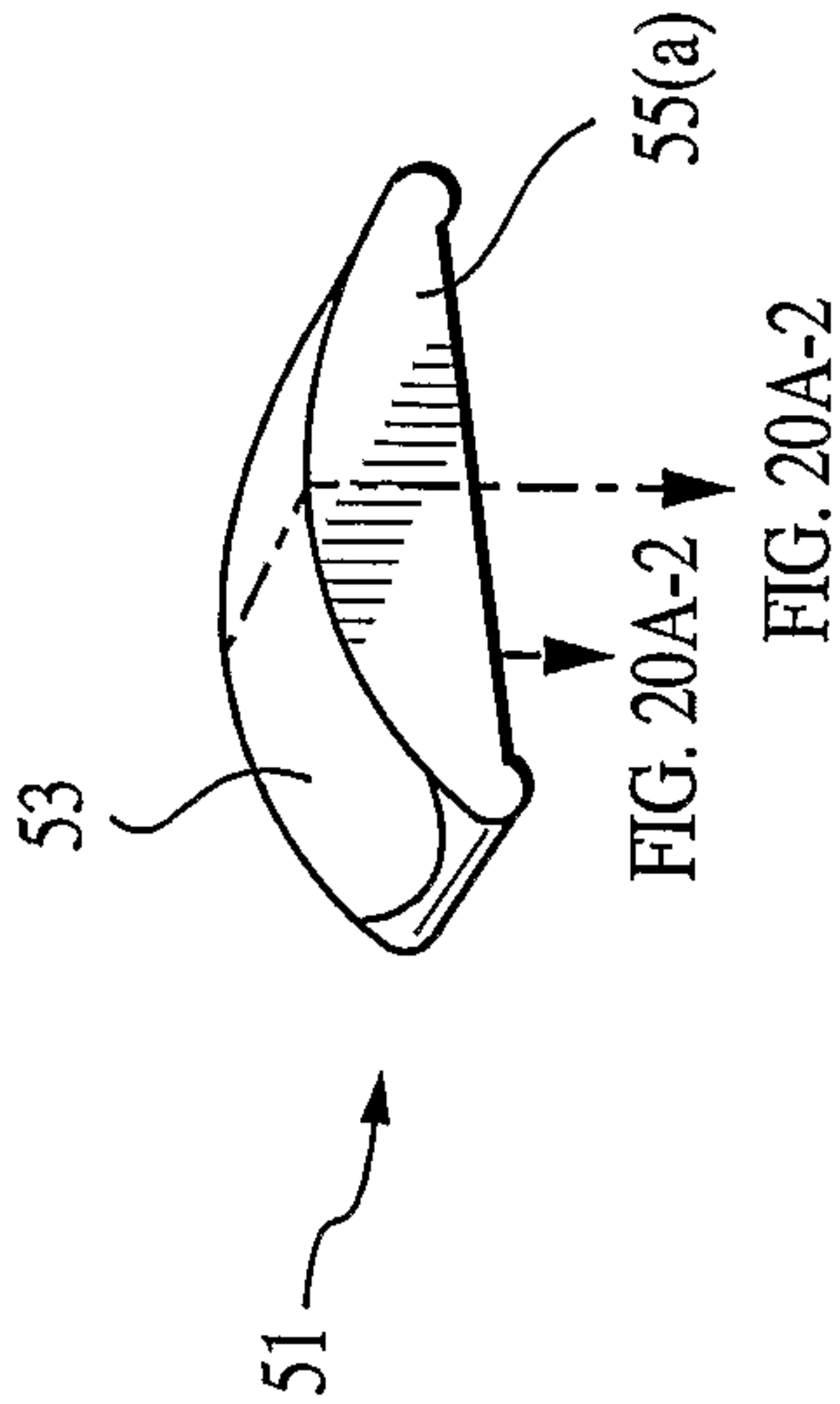


FIG. 20A-2

FIG. 20A-1



FIG. 20A-1

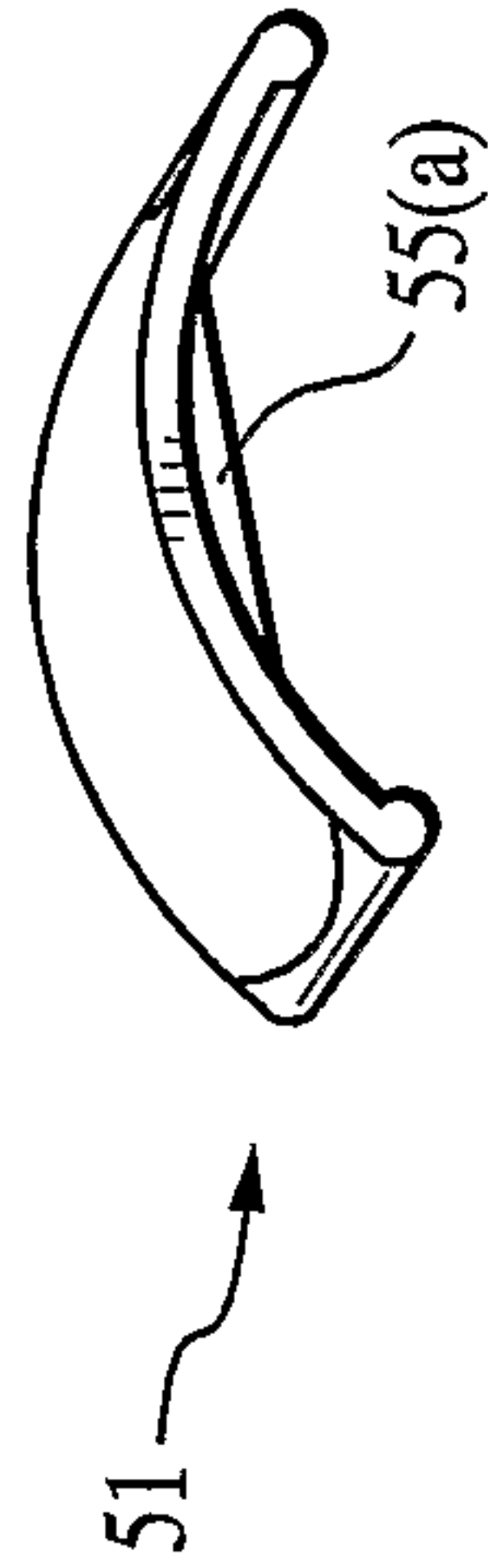


FIG. 20A-1

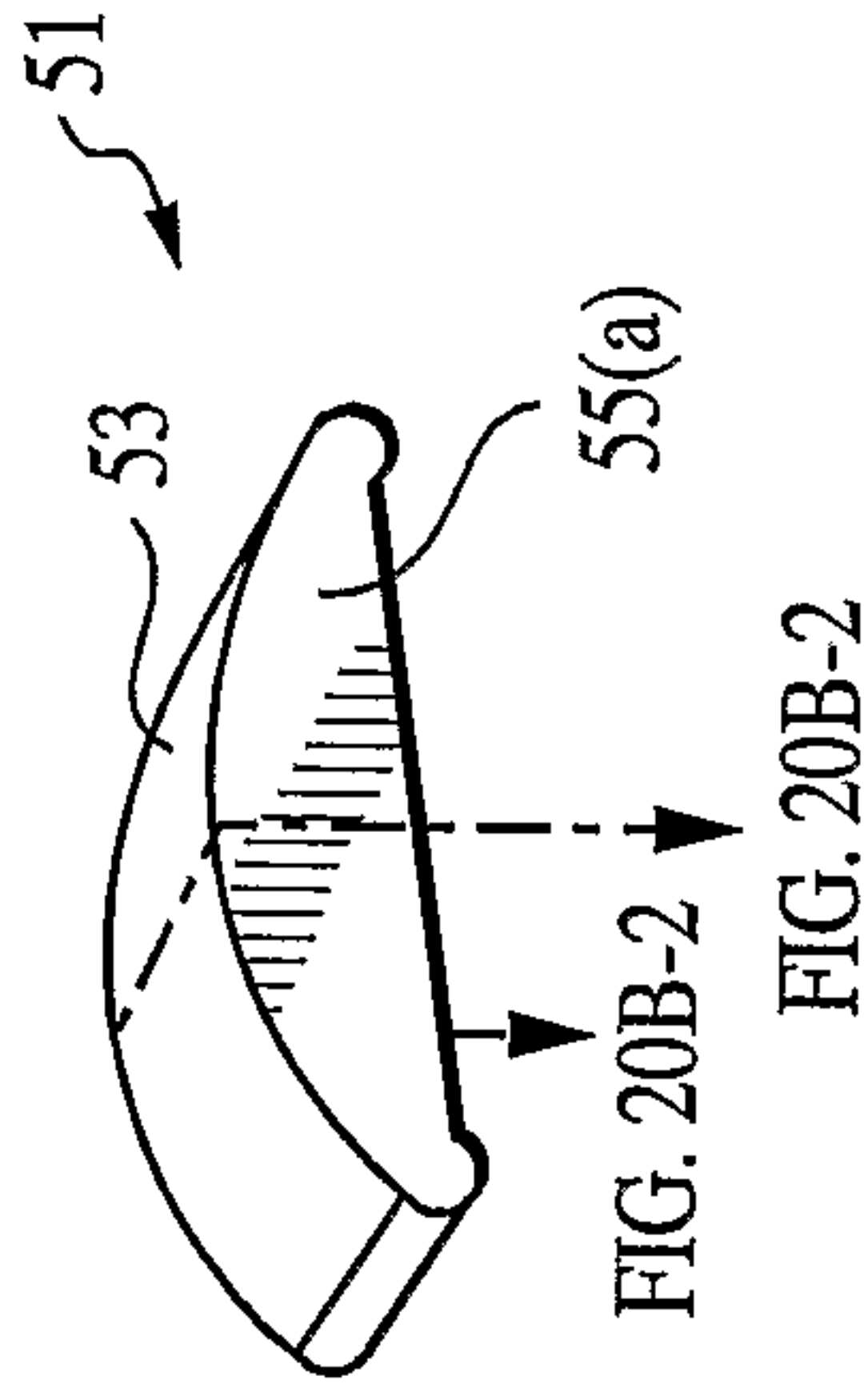


FIG. 20B-2

FIG. 20B-1



FIG. 20B-1

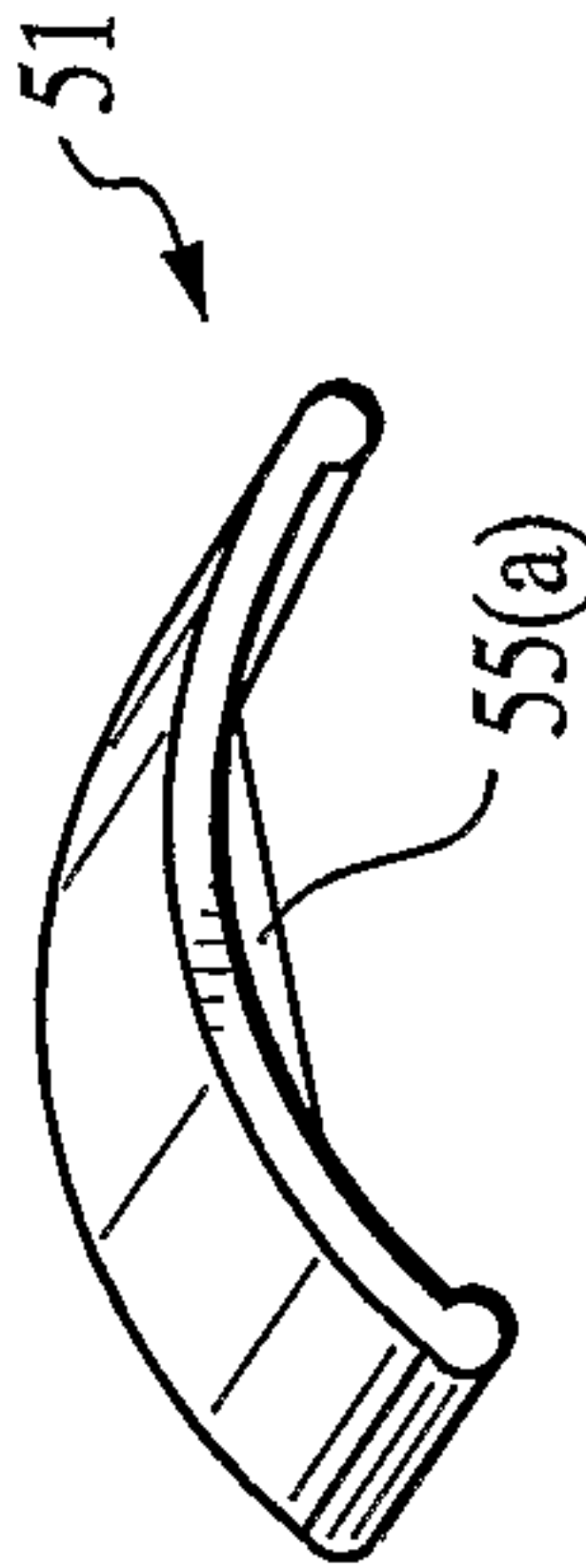


FIG. 20B-1

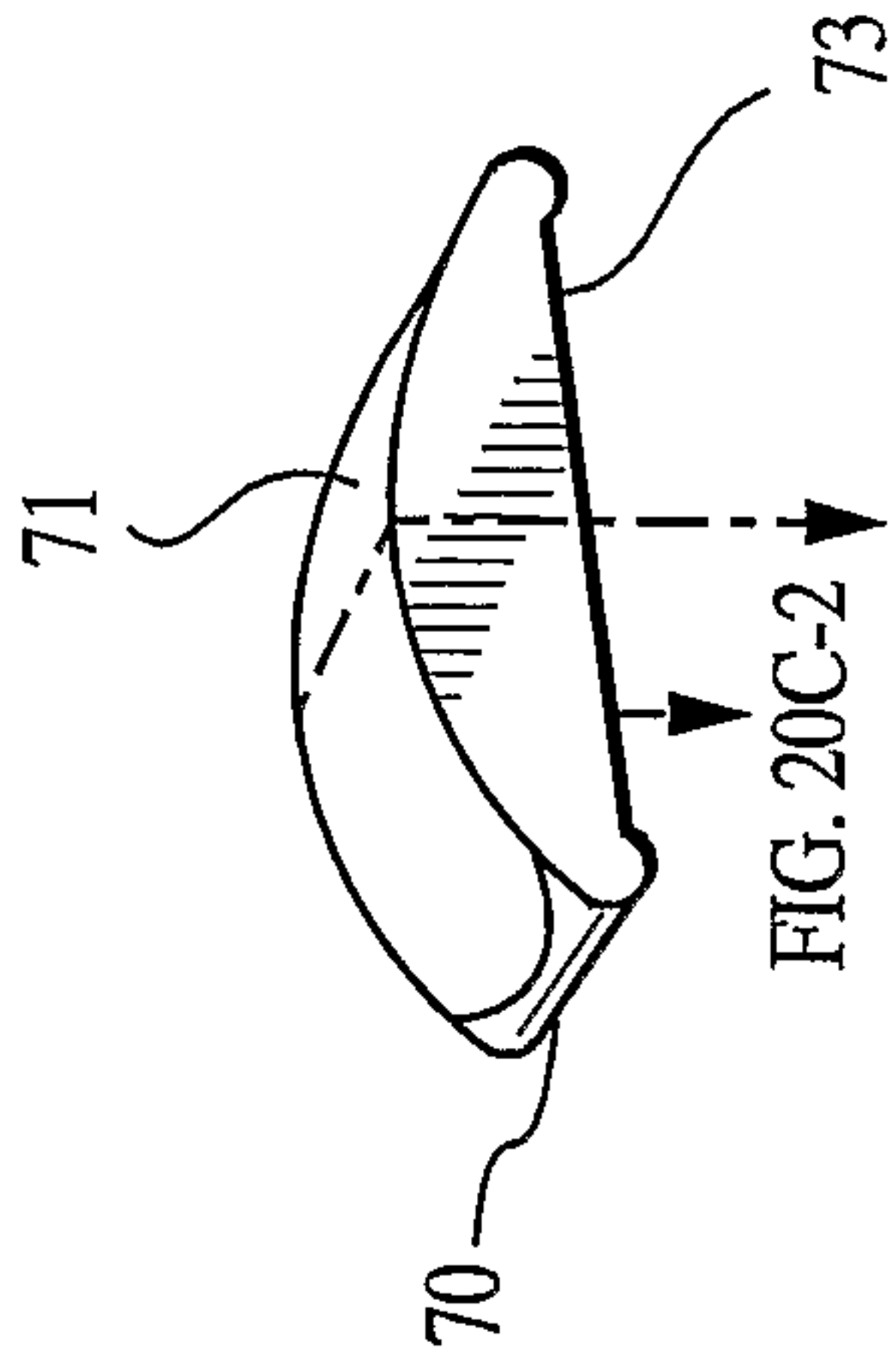


FIG. 20C-1



FIG. 20C-2

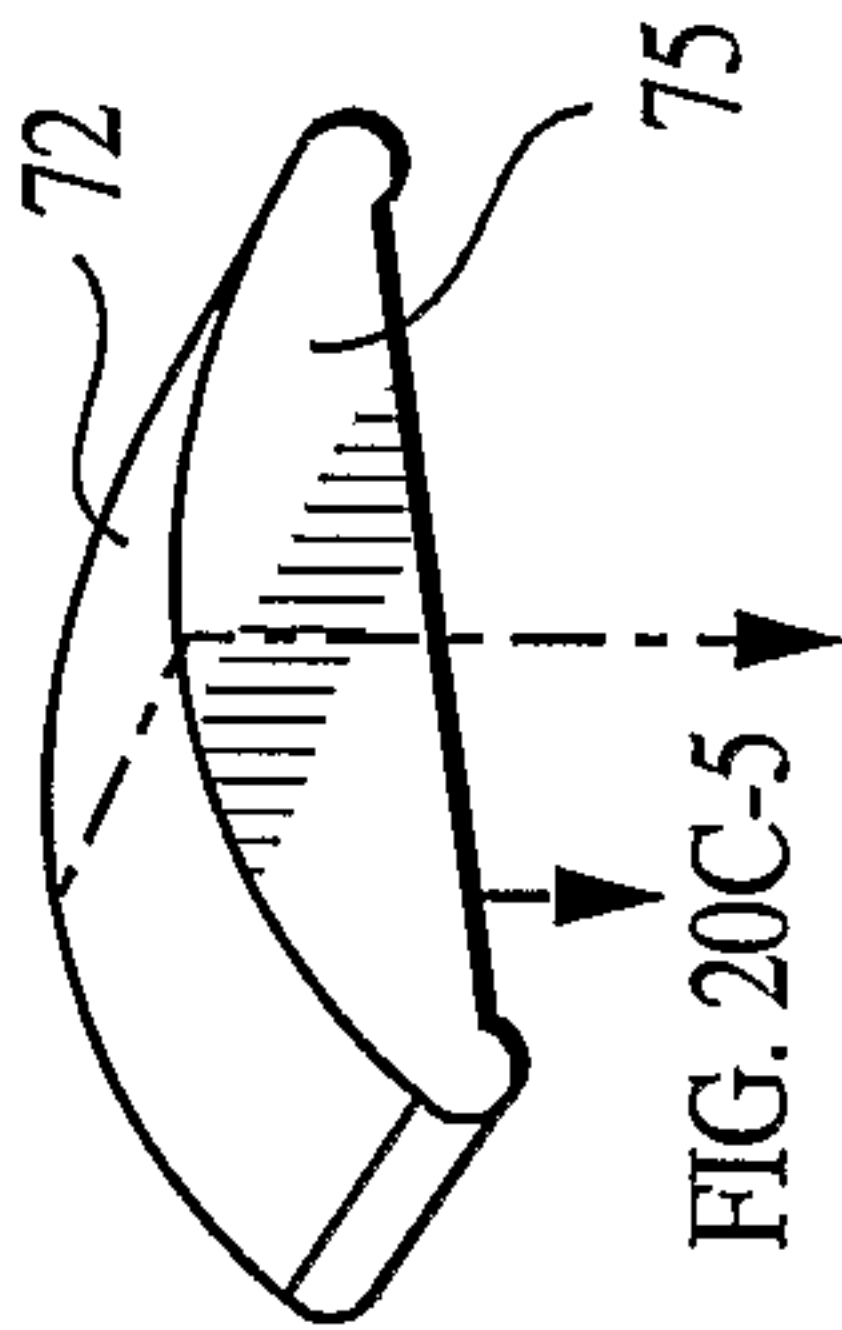


FIG. 20C-3



FIG. 20C-4

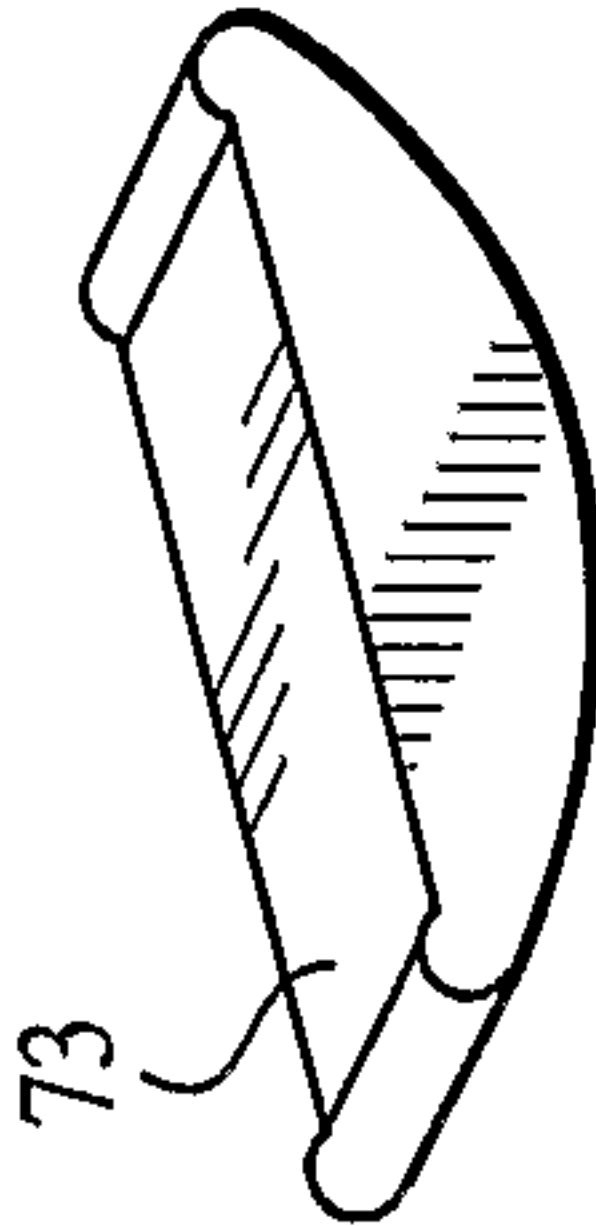


FIG. 20C-5

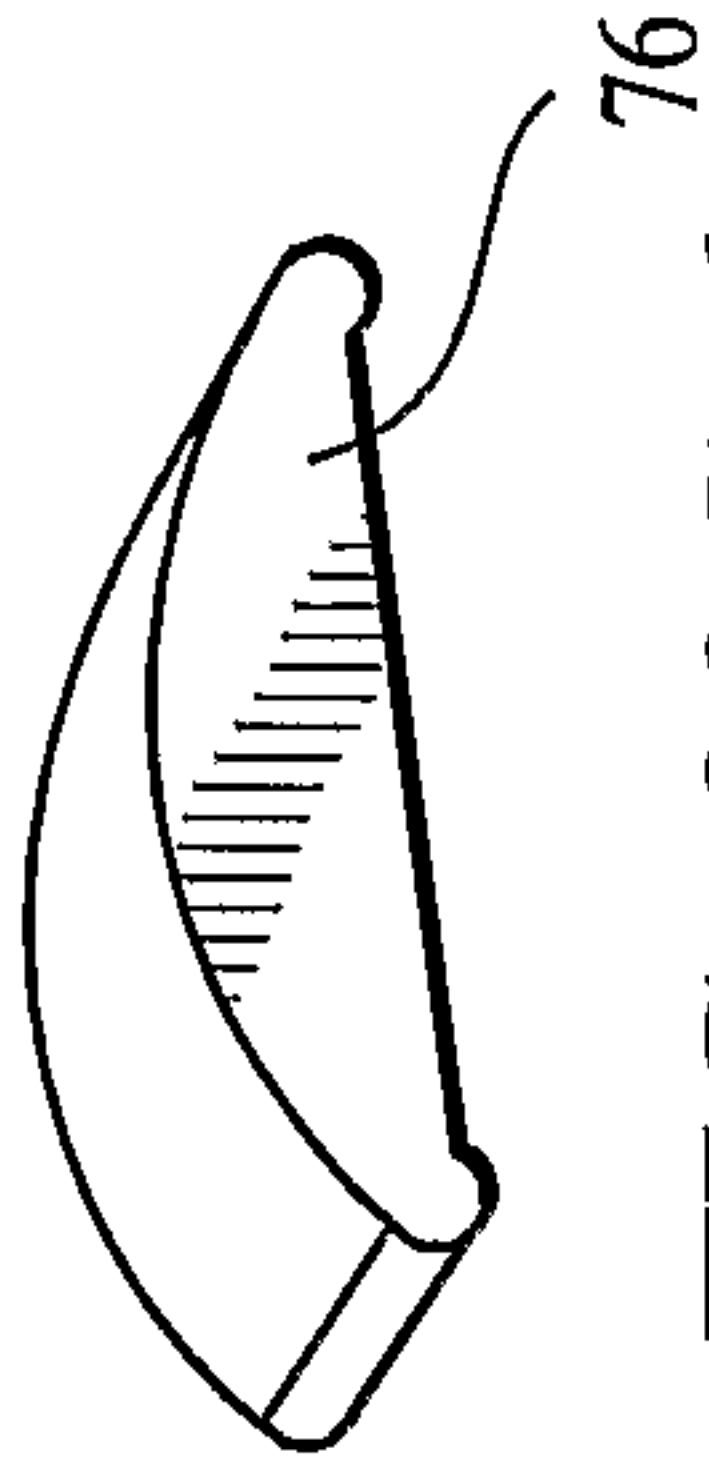


FIG. 20C-6



FIG. 20C-7

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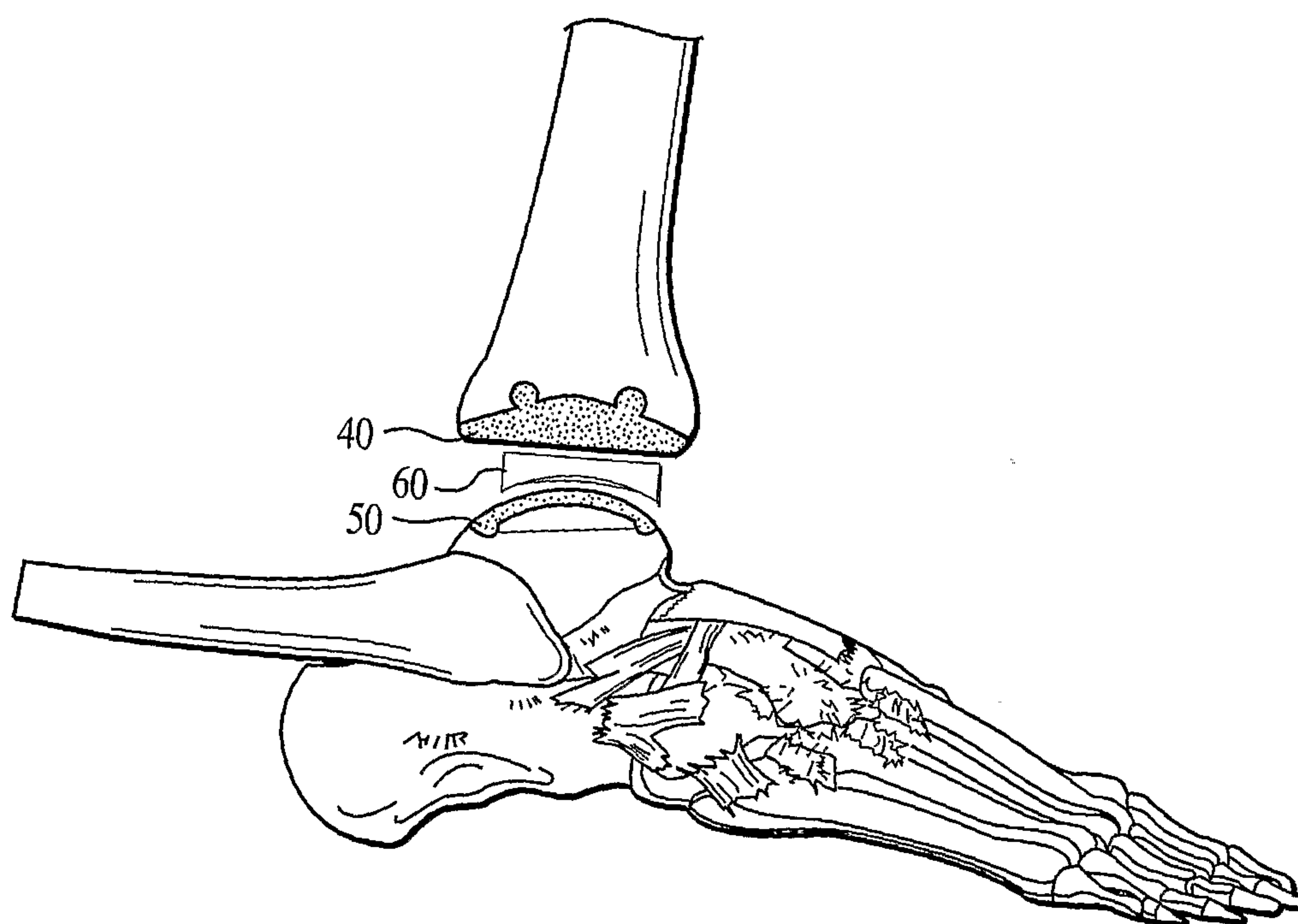


FIG. 21

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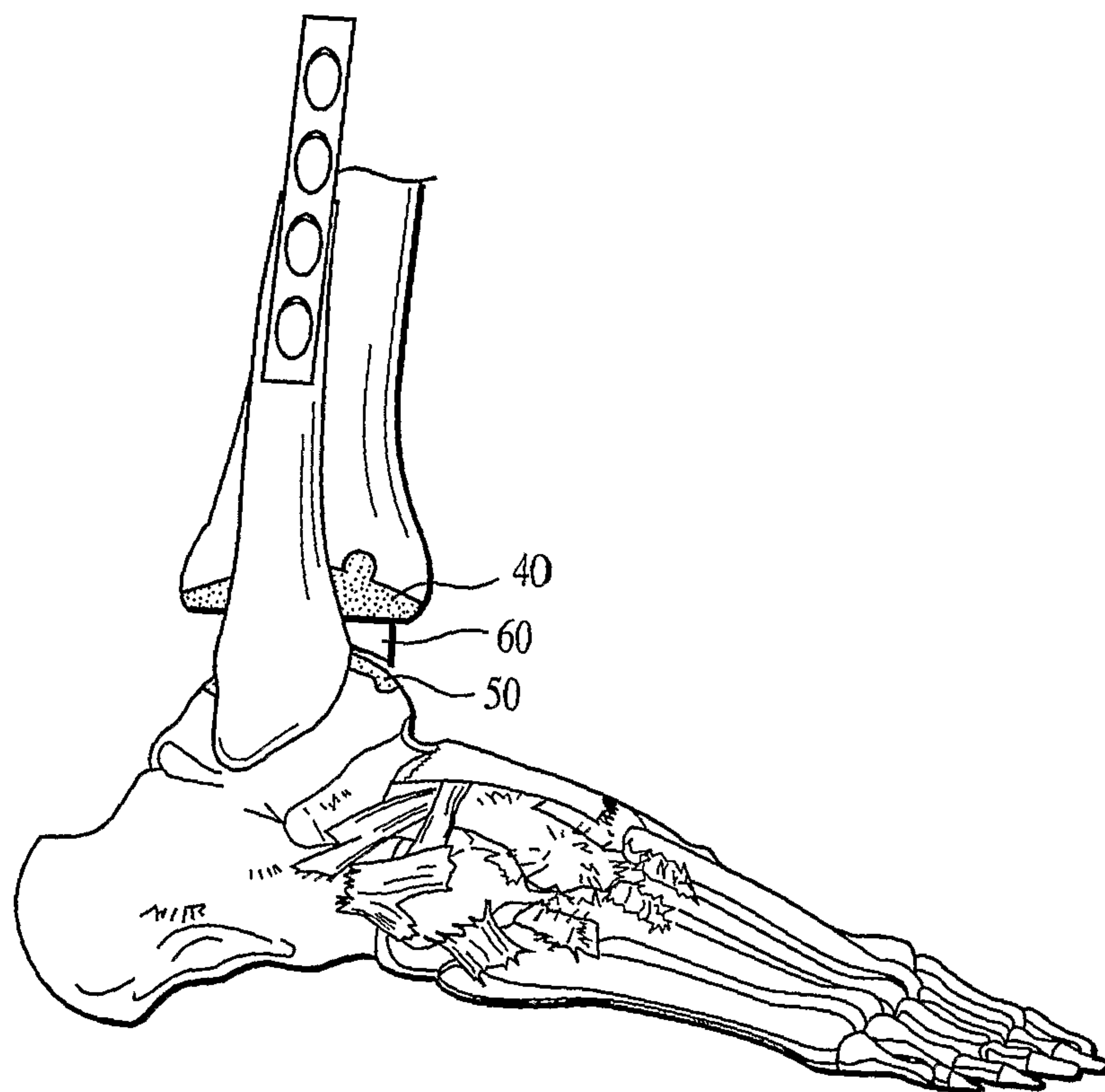


FIG. 22

