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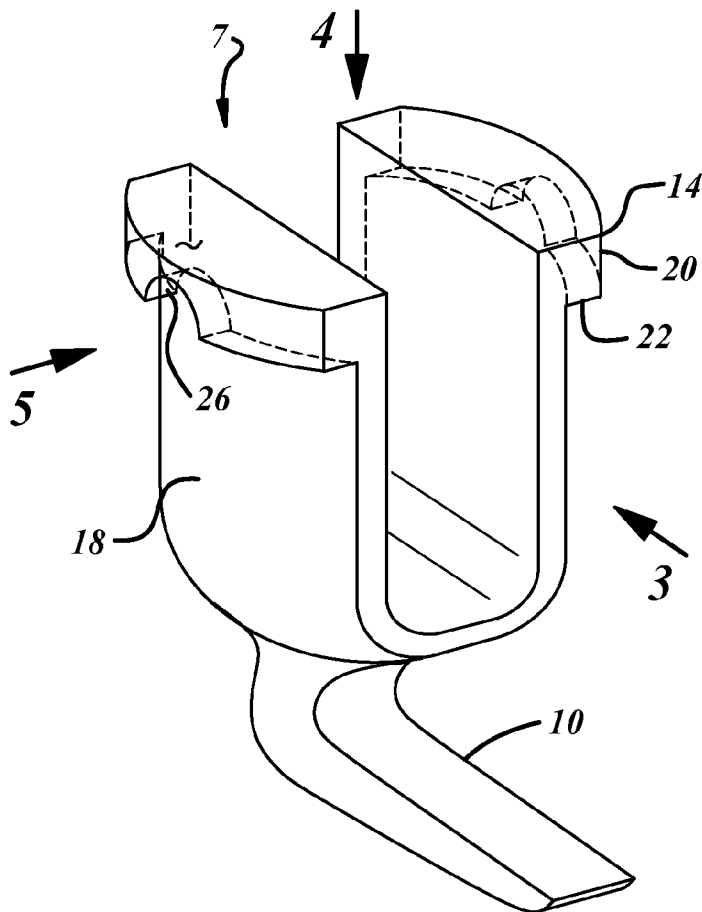
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(54) Title: OPEN AXLE SURGICAL IMPLANT



(57) Abstract: A surgical implant engageable by a surgical tool having spaced apart jaws with inward facing tubular protrusions, is provided. The implant includes a body for interfacing with a bone structure. The implant also includes a head connected with the body having spaced apart posts juxtaposed by a stabilization member receiving area. Each post has an outward side face that includes an upper generally vertical surface intersecting with a generally inward directed under surface that in turn intersects with a lower generally vertical surface. The side face has a generally tubular cylindrical indentation intersecting the upper vertical surface and the inward directed under surface.

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OPEN AXLE SURGICAL IMPLANT

FIELD OF THE INVENTION

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The present invention provides a surgical implant that is connectable with a spinal stabilization member such as a cable, rod or plate.

BACKGROUND OF THE INVENTION

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Spinal surgeons often treat spinal disorders with spinal fusion augmented with stabilization members such as plates or elongated spinal rods. The stabilization members are connected to the spine with implants such as pedicle screws or lamina hooks. Such "stabilization assemblies" often comprise one or two spinal rods or plates and a plurality of implants engaging the pedicles of their respective vertebral bodies. The implants are provided with U-shaped heads that can be capped to couple the stabilization members to the implants. The heads of the implants are relatively small and are often concealed within the flesh of a patient during a surgical procedure. It is desirable to provide and implant that be torqued or manipulated easily with a surgical tool without making the head of the implant excessively large.

SUMMARY OF THE INVENTION

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To make manifest the above noted and other manifold desires, a revelation of the present invention is brought forth. In a preferred embodiment, the present invention provides a surgical implant with an "open axle recess". The implant is engageable by a surgical tool having spaced apart jaws with inward facing tubular protrusions. The implant includes a body for interfacing with a bone structure. The implant also includes a head connected with the body having spaced apart posts juxtaposed by a stabilization member receiving area. Each post has an outward side face that includes an upper generally vertical surface intersecting with a generally inward directed under surface that in turn intersects with a lower generally vertical surface. The side face has a generally

cylindrical recess or indentation intersecting the upper vertical surface and the inward directed under surface, forming the open axle.

5 Other features of the invention will become more apparent to those skilled in the art as the invention is further revealed in the accompanying drawings and Detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a perspective view of a preferred embodiment lamina hook implant of the present invention.

Figure 2 is a perspective view of a preferred embodiment pedicle screw implant of the present invention.

15 Figure 2A is a front elevation view of a preferred embodiment multiple axis pedicle screw implant of the present invention.

Figure 3 is a front elevation view of the implant shown in Figure 1.

20 Figure 4 is a top plan view of the implant shown in Figure 1.

Figures 5A-5C are partial side elevational views of the implant shown in Figure 1.

25 Figure 6 is a partial perspective view of an alternate preferred embodiment implant of the present invention.

Figure 7 is a top plan view of the implant shown in Figure 6.

30 Figure 8 is a front elevation view of the implant shown in Figure 1.

Figure 8A is a partial front elevation view of another alternate preferred embodiment implant of the present invention.

Figure 8B is a partial perspective view of a surgical tool and accompanying protrusion which can be used in a particular method of the present invention providing locking between the tool, and implant shown in Figures 5C and 9C.

Figures 9A-9C are partial side elevational views of the implant shown in Figure 6.

Figures 10 and 11 are views similar to that of Figure 4 of other alternate preferred embodiment implants of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figures 1, 3 and 4, a lamina hook implant 7 of the present invention is provided. The implant 7 has a body 10 for interfacing with a bone structure of a patient. The body 10 is connected with a head 12. The head 12 has spaced apart posts 14. A stabilization member or rod receiving area 16 juxtaposes the posts 14. Each post 14 has an outward side face 18. The outward side face 18 has an upper generally vertical surface 20. The surface 20 intersects a generally inward directed under surface 22. The under surface 22 intersects a lower generally vertical surface 24.

The side face 18 has a generally cylindrical recess or indentation 26 penetrating the upper vertical surface 20 and the under surface 22. The indentation 26 is torsionally engageable with an inward facing tubular protrusion 28 (Figure 8) of a surgical tool.

As shown in Figure 4, the vertical surface 20 has a generally conic curvilinear shape. Figure 10 is a top view of an alternative embodiment implant 30 having cylindrical indentions 26 wherein the upper generally vertical surface 32 is flat. The body of the implant 30 is substantially identical to the body 10 previously described.

Figure 5A-5C illustrate three possible partial side views of the implant 7 shown in Figure 1. In Figure 5A, the indentation 26 projects on the surface 20 180° . In Figure 5B and 5C the indentation 26 projects on the surface 20 for less than 180° and more than 180° respectively. It is usually preferable that the indentation project on the surface 20 between 80° and 240° .

Referring to Figures 6, 7, 8, 9A-9C an alternative embodiment implant 57 is provided. The implant 57 is essentially identical to the implant 7 with the exception that the indentation 62 of the surface 20 further extends into the lower vertical surface 24 terminating in a blind end 64. Figures 9A-9C illustrate the invention 62 projecting onto the surface 20 180° , less than 180° , and more than 180° . It is usually preferable that the indentation project on the surface 20 between 80° and 240° .

Referring to Figure 8, a distance between the two surfaces 24 is D1. The distance between the two surfaces 20 is D2. The distance between the two surfaces 64 is D3. Often during a surgical operation, the implant 57 is concealed within the patient's flesh. A stabilization member such as a cable, plate or an elongated rod extends through the rod receiving area 16. A surgeon uses the stabilization member to aid locating the implant 57. A surgical tool (only partially shown) has the protrusions 28 set at a separation distance closely approximating D1. The surgeon then aligns the protrusions 28 along the lower vertical surface 24. The surgical tool is pulled upward without separating the protrusions 28 a significant distance beyond D1. The protrusions 28 are then pulled up to contact the under surface 24. The protrusions 28 are then turned until they seat into the indentions 62. If the projection of the indentation 62 is equal to 180° or less (Figure 9A and 9B) the protrusions 28 slides into the indentation 62 without requiring an extension of the protrusions outward to a distance D2. After the protrusions 28 are aligned with the indentation 62, the protrusions 28 can be moved inward for contact with the blind end 64. The inward extension of the protrusions 28 to the blind ends 64 served as a confirming indicator to the surgeon that the protrusions 28 are now ready for torsional engagement with the invention 62. Torsional contact of the protrusions with the indentions occurs from a distance of D2-D3.

In a surgical operation often the rod is very close to the implant 57 and a relatively small force is required to reduce the rod into the rod receiving area 16. In such a case a rod introduction forceps as described in commonly assigned U.S. Patent 6,036,692 Burel et al. (hereinafter referred to as Burel) can be used. In such cases the protrusions of the forceps need only engage with the arcuate portions of the indentions 62 from D1 to D2. In some rod reducing applications, a rod reducing instrument as described in Beale et al. U.S. Patent 6,790,290 (hereinafter referred to as Beale) is more appropriate. The instrument of Beale supplies a large holding force on the implant head. Beale can be modified for its protrusions to initially only engage the indentions in the same area as Burel. Then upon further closure of the arms of Burel's actuator assembly the protrusions will move inwardly to seat in the area of the indentions between D2 and D3.

A further modification can be made to the implant 67 as shown in Figure 8A so that the indentation 62 will have a conic end 69 to mate with a conic end 71 of the protrusion 71 similar to that described in Beale.

Figures 5C, 9C and 8B illustrate a further advantage of the present invention. A surgical tool 96 can be provided with protrusions 92 (only one shown) having a radius 93 closely approximating that of the indentation 62. The protrusions 92 have a flat 94. The protrusion has a height H1. H1 can be less in length than radius 93. The projection of the indentation 62 has a window 97 (the width of the indentation 62 at the intersection of the under surface 22 with the upper vertical surface 20) with a width D4. The width of the flat 94 is greater than that of D4. To place the protrusion 92 within the indentation the protrusion 92 has a flat contact face 95. The contact face 95 is mated against the surface 24 in a manner similar to that previously described in relation to the protrusion 28. The surgical tool 96 is angled (tilted) to allow the protrusions 92 to enter into the indentation windows 97. After the surgical tool 96 is raised back to an upright position the protrusions 92 are essentially locked within the indentation 62 since the width of the flat is greater than D4. To remove the tool 96 from the implant 67 the tool 96 is tilted and the protrusions 92 are pushed downward out of the windows 97. The separation distance between the protrusions 92 remain constant. Accordingly, the protrusions 92 can be provided by a connecting rigid non-folding rigid structural member (not shown).

5 Figure 2 is pedicle screw 107 embodiment of the present invention having a body 109 for interfacing with a patient's pedicle by threaded insertion. Figure 2A is multiple axis pedicle screw 127 embodiment of the present invention having a body 129. Figure 11 illustrates an implant 147 of the present invention having multiple indentions 62 on each side face 18.

10 While preferred embodiments of the present invention have been disclosed, it is to be understood it has been described by way of example only, and various modifications can be made without departing from the spirit and scope of the invention as it is encompassed in the following claims.

What is claimed:

- 5 1. A stabilization member connectable surgical implant engageable by a surgical tool having spaced apart jaws with inward facing tubular protrusions, said implant comprising:
a body for interfacing with a bone structure; and
a head connected with said body having spaced apart posts juxtaposed by a stabilization member receiving area, each said post having an outward side face, said outward side face having an upper generally vertical surface intersecting with a generally inward directed under surface intersecting with a lower generally vertical surface, said side face having a generally tubular cylindrical indentation intersecting said upper vertical surface and said inward directed under surface.
- 10 2. A surgical implant as described in claim 1 wherein said body is a screw.
- 15 3. A surgical implant as described in claim 1 wherein said multiple axis screw.
4. A surgical implant as described in claim 1 wherein said body is a hook.
- 20 5. A surgical implant as described in claim 1 wherein said indentation on said upper generally vertical surface projects approximately 180° .
6. A surgical implant as described in claim 1 wherein said indentation on said upper generally vertical surface projects less than 180° .
- 25 7. A surgical implant as described in claim 6 wherein said indentation on said upper generally vertical surface projects at least 80° .
8. A surgical implant as described in claim 1 wherein said indentation on said upper generally vertical surfaces projects more than 180° .
- 30

9. A surgical implant as described in claim 8 wherein said indentation on said upper generally vertical surfaces projects 240° or less.

10. A surgical implant as described in claim 1 wherein said upper vertical surface is generally flat.

11. A surgical implant as described in claim 1 wherein said upper vertical surface is generally curvilinear.

12. A surgical implant as described in claim 1 wherein said indentation penetrates said lower generally vertical surface.

13. A surgical implant as described in claim 12 wherein said indentation has a blind end.

14. A surgical implant as described in claim 12 wherein said indentation has a conic end.

15. A surgical implant as described in claim 1 wherein each said post side face has multiple indentions.

16. An elongated stabilization member connectable surgical implant engageable by a surgical tool having spaced apart jaws with inward facing tubular protrusions, said implant comprising:

a body for interfacing with a bone structure; and

a head connected with said body having spaced apart posts juxtaposed by a stabilization member receiving area, each said post having an outward side face, said outward side face having an upper generally vertical surface intersecting with a generally inward directed under surface intersecting with a lower generally vertical surface, said side face having a generally cylindrical indentation intersecting said upper and lower vertical surfaces and said inward directed under surface, said indentation having a blind end and said indentation projects on said upper generally vertical surface 180° or less.

17. A method of engaging a surgical tool having spaced apart jaws with inward facing tubular protrusions with a stabilization member connectable bone interfacing implant, said method comprising:

5 providing a head for said body having spaced apart posts juxtaposed by a stabilization member receiving area, each said post having an outward side face, said outward side face having an upper generally vertical surface intersecting with a generally inward directed under surface intersecting with a lower generally vertical surface, said side face having a generally cylindrical indentation intersecting said upper vertical surface and said inward directed under surface, said side face lower generally vertical surfaces of said posts being spaced apart a distance D1 and said upper generally vertical surfaces being spaced apart a greater distance D2;

10 separating said tubular protrusions a space closely approximating D1;

aligning said tubular protrusions with said generally lower vertical surface of said implant head;

15 pulling said tubular protrusions into said indentions without separating said tubular protrusions a significant distance beyond D1; and

torsionally engaging said tubular protrusions in said cylindrical indentions at a distance of D2.

20 18. A method as described in claim 16 further including providing said cylindrical indentation in each said side face at a distance D3 less than D2 and providing confirmation of entry of said tubular protrusions into said cylindrical indentions by allowing said protrusions to come to a separation distance closely approximating D3.

25 19. A method as described in claim 16 further including providing said indentions projecting on said side faces with upper vertical surfaces over 180° with a window width of D4 and providing said tubular protrusions with a radius closely approximating said radius of said indentions, said protrusions having a flat with a width greater than said D4, and angling said surgical tool to allow said protrusions to enter said indentation widows and
30 straightening out said surgical tool to lock said protrusions within said indentions.

20. A method of engaging a surgical tool having spaced apart jaws with inward facing tubular protrusions with a stabilization member connectable bone interfacing implant, said method comprising:

5 providing a head for said body having spaced apart posts juxtaposed by a stabilization member receiving area, each said post having an outward side face, said outward side face having an upper generally vertical surface intersecting with a generally inward directed under surface intersecting with a lower generally vertical surface, said side face having a generally cylindrical indentation intersecting said upper vertical surface and penetrating said lower vertical surface, said side face lower generally vertical surfaces of
10 said posts being spaced apart a distance D1 and said upper generally vertical surfaces being spaced apart a greater distance D2 and said cylindrical indentions penetrating said lower vertical surface to a distance D3;

engaging said tubular protrusions in said cylindrical indentions at a distance of D1-D2; and

15 engaging said tubular protrusions in said cylindrical indentions at a distance of D2-D3.

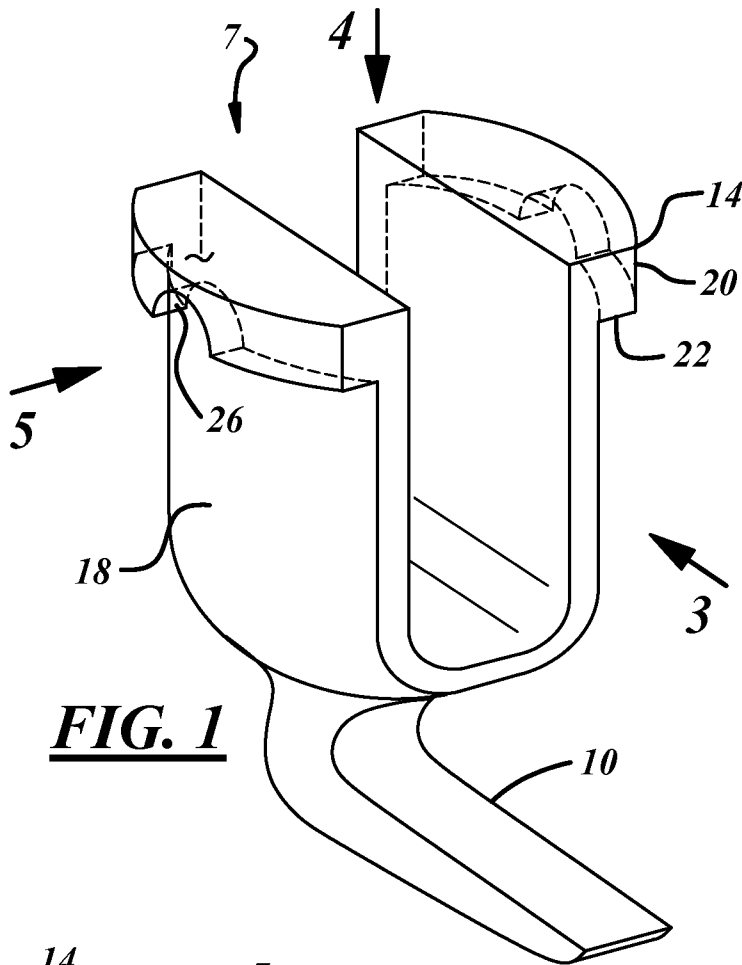


FIG. 1

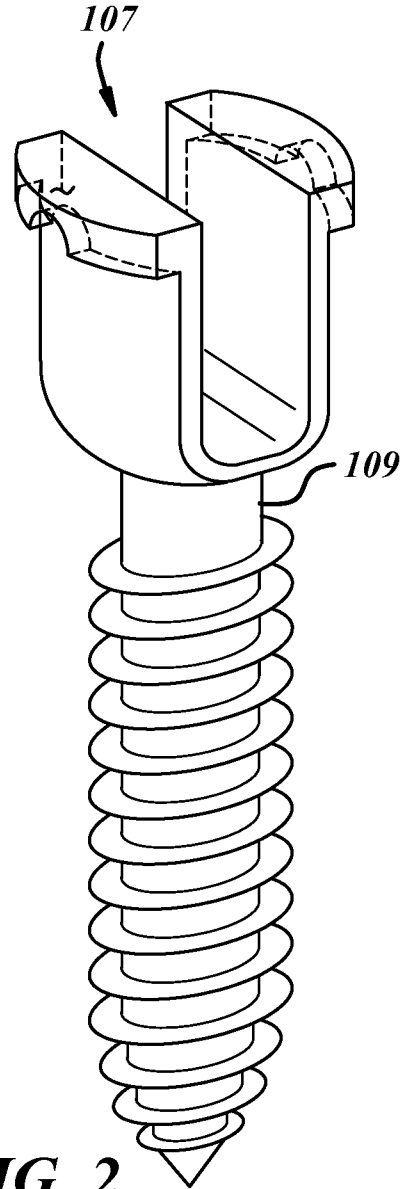


FIG. 2

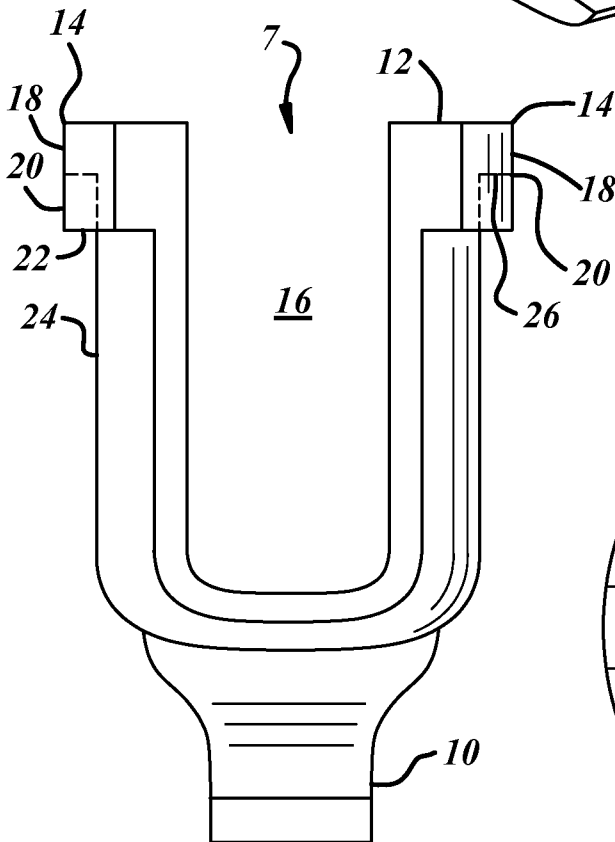


FIG. 3

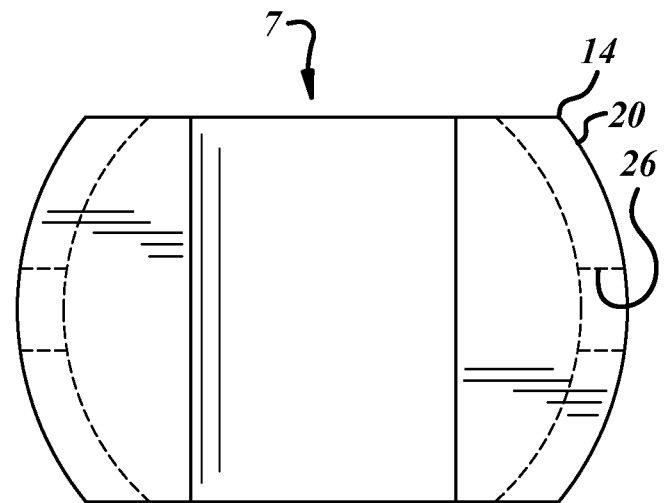
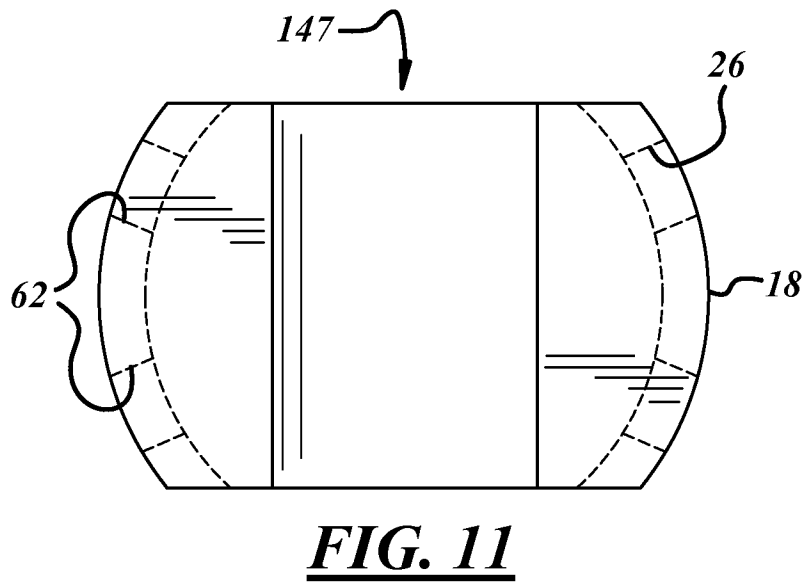
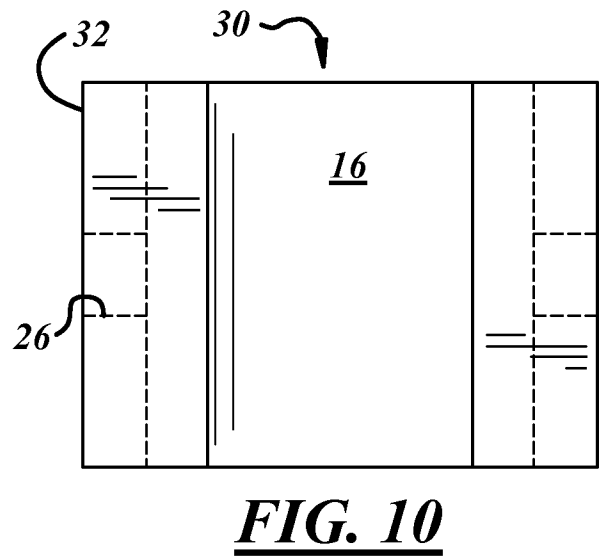
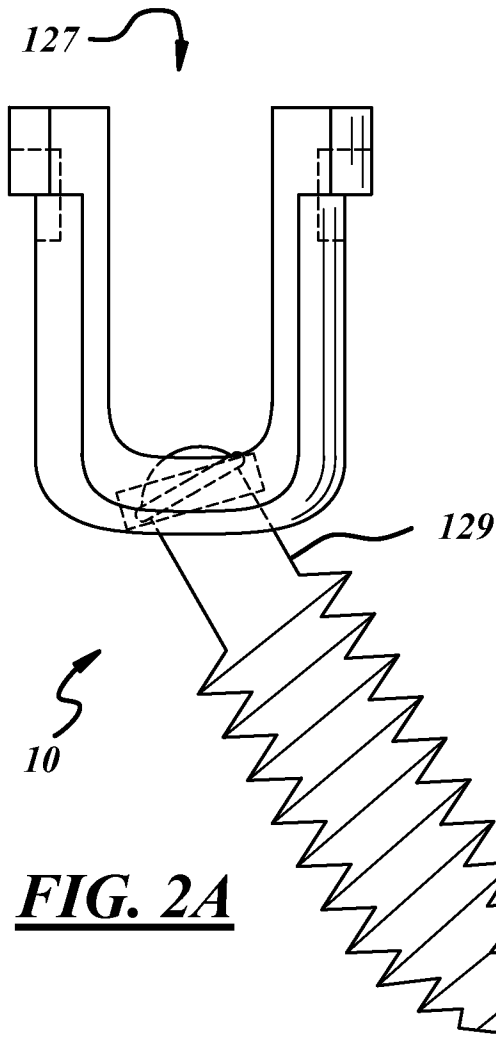


FIG. 4



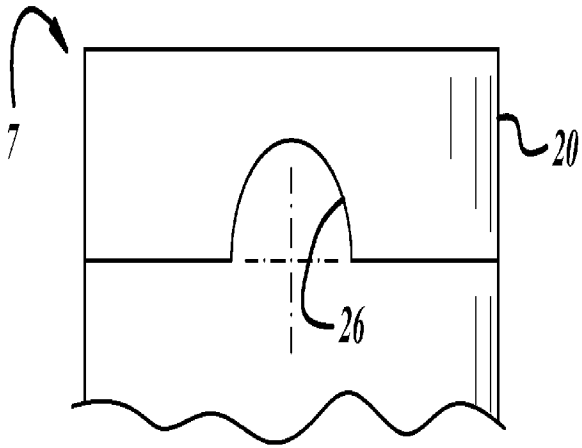


FIG. 5A

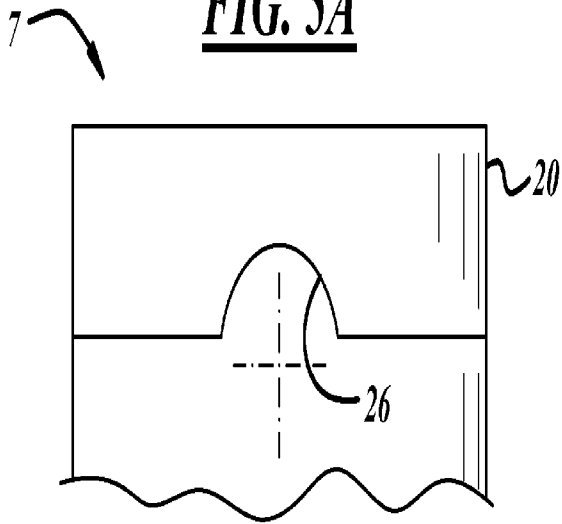


FIG. 5B

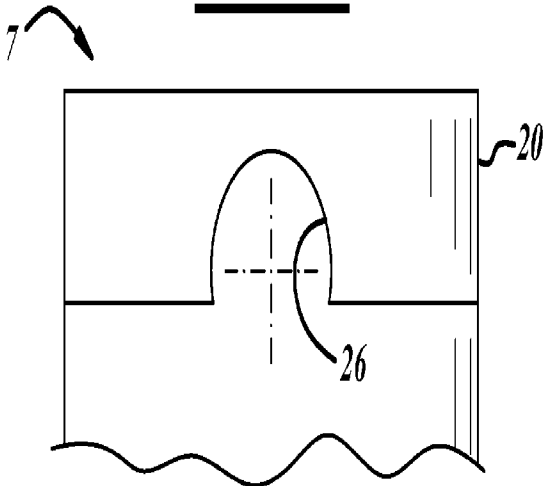


FIG. 5C

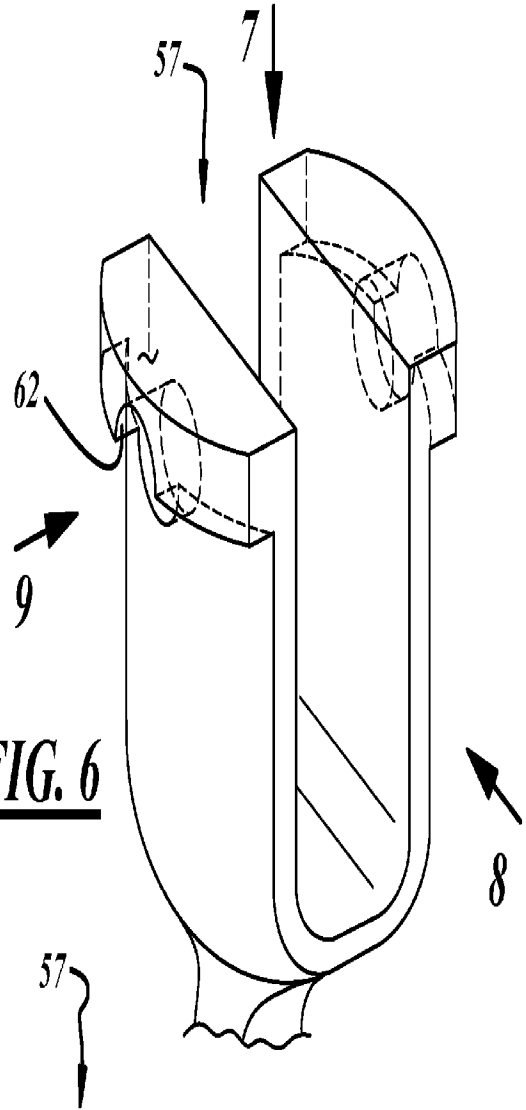


FIG. 6

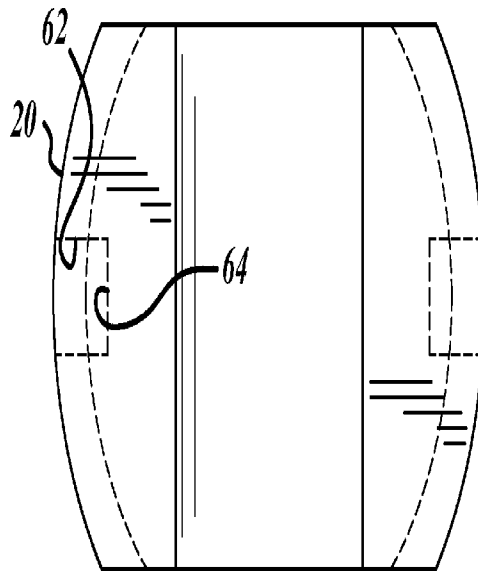


FIG. 7

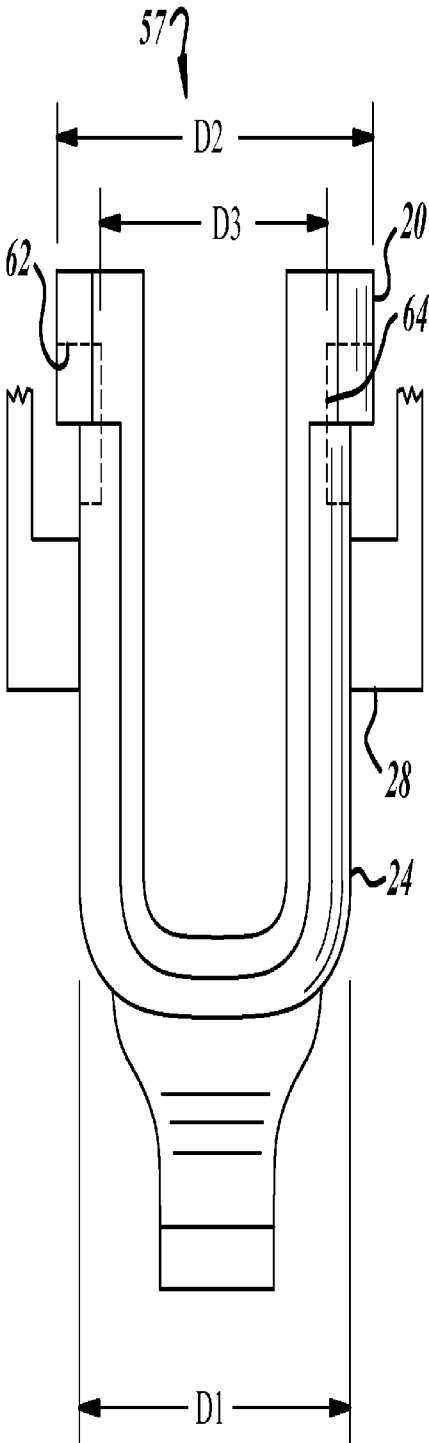


FIG. 8

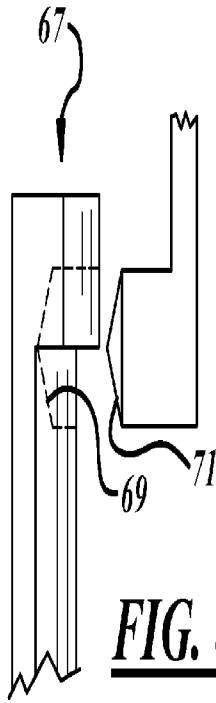


FIG. 8A

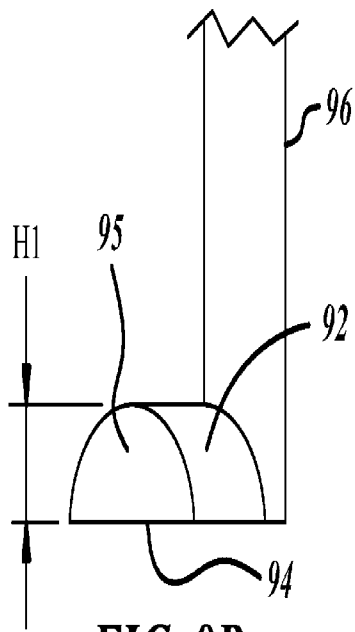


FIG. 8B

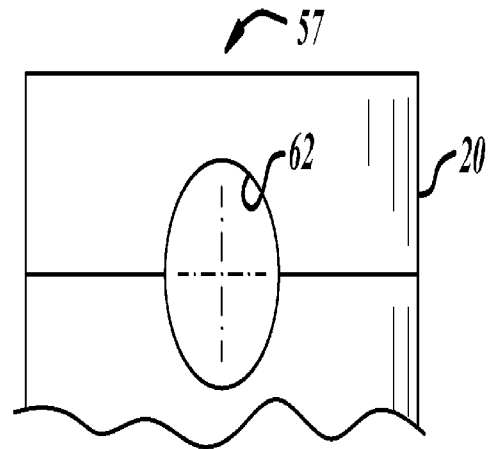


FIG. 9A

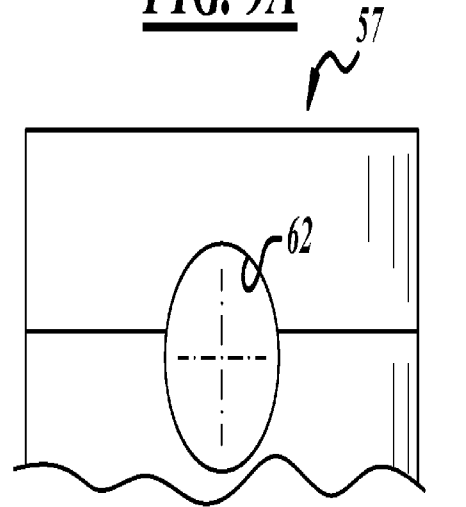


FIG. 9B

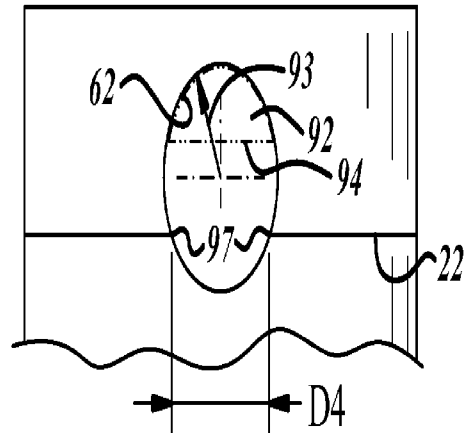


FIG. 9C