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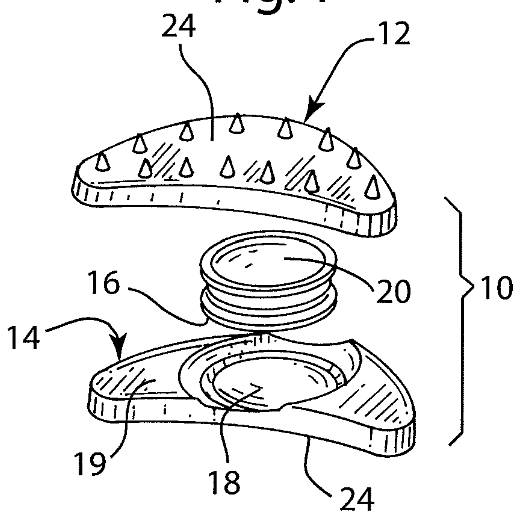
(54) **Title:** INTERVERTEBRAL IMPLANT COMPONENT WITH THREE POINTS OF CONTACT

Fig. 1



(57) Abstract: An intervertebral implant is made up of components which each have an inner surface and an outer surface which engages an adjacent vertebra and presents only three distinct points of contact with a cortical rim of the vertebra. Preferably, the outer surface has a footprint which is sized to be within that of the cortical rim. In disclosed embodiments, the footprint can be convexo-concave shaped, D shaped, or kidney shaped. The intervertebral implant can be provided with upper and lower (or first and second) components which engage adjacent first and second vertebrae and which move relative to one another. The implant has both the first and second outer surfaces sized to present a respective footprint sufficient for two lateral-anterior and one posterior points of contact with an adjacent cortical rim of the respective first and second vertebra.

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INTERVERTEBRAL IMPLANT COMPONENT WITH THREE POINTS OF CONTACT

BACKGROUND OF THE INVENTION

[0001] Historically, when it was necessary to completely remove a disc from between adjacent vertebrae, the conventional procedure is to fuse the adjacent vertebrae together. This “spinal fusion” procedure, which is still in use today, is a widely accepted surgical treatment for symptomatic lumbar degenerative disc disease. However, reported clinical results vary considerably, and complication rates are considered by some to be unacceptably high.

[0002] More recently, there have been important developments in the field of disc replacement, namely disc arthoplasty, which involves the insertion of an artificial intervertebral disc implant into the intervertebral space between adjacent vertebrae, and which allows limited universal movement of the adjacent vertebrae with respect to each other. The aim of total disc replacement is to remove pain generation (caused by a bad disc), restore anatomy (disc height), and maintain mobility in the functional spinal unit so that the spine remains in an adapted sagittal balance. Sagittal balance is defined as the equilibrium of the trunk with the legs and pelvis to maintain harmonious sagittal curves. In contrast with fusion techniques, total disc replacement preserves mobility in the motion segment and mimics physiologic conditions.

[0003] One such intervertebral implant includes an upper part that can communicate with an adjacent vertebrae, a lower part that can communicate with an adjacent vertebrae, and an insert located between these two parts. An example of this type of implant is disclosed in U.S. Patent No. 5,314,477 (Marnay).

[0004] While this and other known implants represent improvements in the art of artificial intervertebral implants, there exists a continuing need for improvements in this field.

BRIEF SUMMARY OF THE INVENTION

[0005] In accordance with the present invention, a component of an intervertebral implant is provided with an inner surface and an outer surface. The outer surface engages an adjacent vertebra and presents only three distinct points of contact with a cortical rim of the adjacent vertebra. Preferably, the outer surface has a footprint which is sized to be within that of the cortical rim. In disclosed embodiments, the footprint of the outer surface has a major convex side and can be convexo-concave shaped, D shaped, or kidney shaped.

[0006] Preferably, the three points of contact of the footprint of the outer surface with the cortical rim are two lateral-anterior points and one posterior point. In addition, the footprint of the outer surface includes opposed ends which provide the two lateral-anterior points of contact.

[0007] In a preferred embodiment, the outer surface of the component includes at least one vertebra engaging protrusion. The protrusion can include a protruding keel located adjacent an opposed or longitudinal end, which keel may be curved.

[0008] Also in a preferred embodiment, the inner surface includes a pair of cutouts extending to an adjacent outer edge thereof. The cutouts are preferably angled centrally inwardly and dovetail shaped in cross section.

[0009] Also in accordance with the present invention, an intervertebral implant can be provided with upper and lower (or first and second) components, each as described above and each of which engages an adjacent first and second vertebrae.

The implant also includes a means for allowing the first and second components to move relative to one another. The implant would have the outer surfaces of both the first and second components sized to present a respective footprint sufficient for only three points of contact with an adjacent cortical rim of the respective first and second vertebra.

[0010] It is an advantage of the present invention that a minimally sized intervertebral implant is provided.

[0011] It is also an advantage of the present invention that the intervertebral implant has only three points of contact made at the cortical rim of the adjacent vertebrae.

[0012] It is a further advantage of the present invention that a major convex-sided shape of the intervertebral implant presents a small insertion size which can be inserted along an arc shaped path.

[0013] Other features and advantages of the present invention are stated in or apparent from detailed descriptions of presently preferred embodiments of the invention found hereinbelow.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0014] Figure 1 is a perspective exploded view of an implant in accordance with the present invention.

[0015] Figure 2 is a top plan view of the implant depicted in Figure 1 adjacent a vertebra.

[0016] Figure 3 is a top plan view of the implant depicted in Figure 2 partially inserted into an intervertebral space.

[0017] Figure 4 is a top plan view of the implant depicted in Figure 2 fully inserted into an intervertebral space.

[0018] Figure 5 is a left side view of the implant depicted in Figure 2 inserted into an intervertebral space.

[0019] Figure 6 is an anterior view of the implant depicted in Figure 5.

[0020] Figure 7 is a perspective exploded view of an alternatively shaped implant of the present invention.

[0021] Figure 8 is a perspective exploded view of an implant similar to Figure 1 but showing a modification of the invention.

[0022] Figure 9 is a perspective view of a component of an alternatively shaped implant of the present invention showing a modification of the invention.

[0023] Figure 10 shows the operative portion of an instrument used for insertion of an implant according to the present invention.

[0024] Figure 11 shows an implant having components as in Figure 9 being engaged by the instrument depicted in figure 10.

DETAILED DESCRIPTION OF THE INVENTION

[0025] With reference now to the drawings in which like numerals represent like elements throughout the views, an intervertebral implant 10 according to the present invention is depicted in Figures 1-6. Broadly and as best shown in Figure 1, implant 10 is formed of three components or parts, an upper part 12, a lower part 14 and a movable insert 16 allowing upper part 12 to move relative to lower part 14. An opposed pair of convexities 18 are provided on respective inner surfaces 19 of upper and lower parts 12 and 14 (though only convexity 18 for lower part 16 is shown), and concavities 20 (only upper concavity 20 is shown) on opposite sides of insert 16 which concavities 20 mate with adjacent convexities 18. Such parts 12, 14 and 16 in general and the motions provided thereof are well known in the art, such as in USPA 2006/0116769 (Marnay et al.) which is herein incorporated by reference, and thus need not be discussed further. It will be noted that it is also known in the art that insert 16 could be a convexity extending integrally from one part which mates with a concavity integrally in the other part, so the separate depiction of an insert 16 for the present invention is only exemplary of one type of movable insert means known in the art.

[0026] Both upper and lower parts 12 and 14 each have an outer surface 24. As known in the art, outer surfaces 24 are each designed to contact an adjacent vertebrae, such as upper and lower vertebrae 26 and 28 depicted in Figures 2-6. As shown in Figures 2-4, vertebra 28 (and similar vertebrae in general) includes a relatively rigid cortical rim 30 of bone which surrounds less rigid cancellous bone 32. Prior art vertebral implants were designed to cover cortical rim 30. However, such coverage results in multiple points (or areas) of contact which are not needed. Thus, implant 10 of the present invention provides a more compact and hence easier to insert implant which still has a good and sufficient contact with the adjacent vertebrae.

[0027] It is thus a feature of the present invention that outer surfaces 24 are designed or sized to provide three distinct points (or small areas) of contact 34a, 34b and 34c (or collectively, points 34) with the adjacent cortical rim 30 as shown in Figure 4. It will be appreciated that points of contact 34 shown in Figure 4 are those of outer surface 24 of upper part 12 which would contact upper vertebra 26 (not shown) but in the same manner as the underlying points of contact 34 of lower part 14 (which are not seen because they are covered by upper part 12) contact lower vertebra 28 which is shown. It will be noted that outer surface 24 also includes a series of small teeth or spikes 36 or other such protrusions upstanding therefrom which serve to anchor upper and lower parts 12 and 14 in place after implantation as well known in the art.

[0028] As noted above, outer surface 24 is shaped with a major convex side according to the present invention to present a footprint so that only three points of contact 34 are provided thereby. As the size of vertebrae vary depending on location and on the individual user, implant 10 will be tailored to the individual so that only three points of contact 34 are made. This sizing of the footprint of outer surface 24 is conveniently determined by choosing the footprint of outer surface 24 to be located within the footprint of cortical rim 30 as shown. The points of contact 34 are left and right lateral-anterior points 34a and 34c which are preferably symmetrically located as shown, and a posterior point 34b. Conveniently, the footprint of the outer surface 24 includes opposed ends which provide the left and right lateral-anterior points 34a and 34c. Suitable footprints to provide the three points 34 of contact include: a) a convexo-concave footprint as shown by implant 10 in Figures 1-4 (and by implant 210 in Figure 8); b) a D-shaped footprint as shown by implant 110 in Figure 7; or c) a kidney shaped footprint as shown by implant 310 in Figures 9 and 11.

[0029] The use of such a small footprint and only three points of contact 34 with one being posterior or anterior also makes it possible for implants 10, 110, 210 and 310 to have a relatively narrow or small maximum width between left and right points 34a and 34c as evident from the three footprints discussed above. This narrow maximum width, particularly where augmented by a longitudinal concavity or inward bowing as with implants 10, 210 and 310, permits implants 10, 110, 210 and 310 to be inserted between adjacent vertebrae 26 and 28 through a smaller incision than if the implant spanned cortical rim 30 in all directions. In Figures 2-4, it will also be appreciated that the size and shape of implant 10 also makes the implanting of implant 10 from the angle shown and along the path depicted easy to accomplish.

[0030] Implant 110 depicted in Figure 7 discloses upper and lower parts 112 and 114 having outer surfaces 124 which present a D shaped footprint. As with Figure 1, as noted above, insert 116 shows the upper concavity thereof (opposite the similar lower concavity thereof).

[0031] Depicted in Figure 8 is an implant 210 which is also convexo-concave shaped like implant 10. However, implant 210 includes a keel 262 extending from each of outer surfaces 224 adjacent an opposed or longitudinal end thereof, and preferably the opposed end which is inserted last between vertebrae 26 and 28 (see Figure 3) with the opposite longitudinal end then preferably having a slight chamfer to ease insertion. Each keel 262 serves to anchor the associated upper and lower parts 212 and 214 of implant 210 in place in a provided cutout or slot in adjacent vertebrae 26 and 28 after implantation as known in the art, in addition to the anchoring provided by the small spikes 236 also shown in Figure 8. Keel 262 is depicted as curved or arced to match arced insertion path along which implant 210 would be implanted between the vertebrae (as shown by the three positions of implant 10 shown in Figures 2-4); though if implant 262 is implanted along a straight direction, keel 262 would instead be straight. If desired, two or more keels positioned along an arc or straight line could also be provided. The cutout required for keel 262 could be made in advance of implantation, or keel 262 could be self-cutting having chisel-like cutting edges at the introduction end as known in the art.

[0032] In Figure 9, an entire implant is identified by the numeral 310, although only lower part 314 thereof is shown in detail. The upper part 312 is a mirror image thereof, and the insert the same as the above described insert 16. Lower part 314 has an outer surface 324 which presents a kidney shaped footprint as shown. Also shown on lower part 314 are an opposed pair of cutouts 372 in inner surface 319. Cutouts 372 are dovetail shaped, that is, the vertical walls thereof are angled inwardly (or each toward the other cutout 372), and cutouts 372 are also preferably are longitudinally angled centrally inwardly or converging toward one another (or toward convexity 318) as they extend from the adjacent opposed end. Cutouts 372 are provided so that an instrument with a pair of matingly shaped engaging members can securely grasp lower part 314 (and similarly upper part 312) in order to insert implant 310 between vertebrae 26 and 28 as generally known in the art; and the added security of having both the dovetails shape and convergence allows cutouts 372 to be usable as well to reposition or even remove implant 310 as required. Of course, cutouts 372 could also be parallel to one another rather than converging if desired if less holding power is needed with the instrument.

[0033] Depicted in Figures 10 and 11 is a portion of an insertion instrument 400 which can be used for insertion of implant 310 (or the other disclosed implants if they are provided with cutouts 372). Instrument 400 includes a base 402 attached to an inserter shaft 403. Extending distally from base 402 (away from inserter shaft 403) is a longitudinal fixed arm 404. Fixed arm 404 is shaped with top and bottom laterally-inwardly directed projections 406a and 406b. Projections 406 are designed to fit matingly in cutouts 372, and thus have a mating dovetail design. Laterally opposite to fixed arm 404 is a movable arm 408 having top and bottom laterally-inwardly directed projections 410a and 410b which are similarly shaped as projections 406 but oppositely directed. Like projections 406, projections 410 are designed to fit matingly in cutouts 372 but on the opposite side of implant 310. As known in the art, movable arm 408 is movable about a pivot 412 provided in base 402 toward fixed arm 404, and this movement is accomplished by a rod 414 guided in inserter shaft 403 which is forced against a pin 416 integral with movable arm 408 and trapped in slot 418 of base 402.

[0034] In use, instrument 400 is used to grasp implant 310 by placing projections 406 and 410 on either sides of implant 310 and adjacent respective cutouts 372. Then, by manipulation of rod 414, movable arm 408 is moved towards fixed arm 404 so that projections 406 and 410 are received in and then locked in cutouts 372. Once projections 406 and 410 are locked in place in cutouts 372, implant 310 is securely attached to base 402 so that implant 310 can be inserted between vertebrae by manipulation of inserter shaft 403 as known in the art.

[0035] While the present invention has been described with respect to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that variations and modifications can be effected within the scope and spirit of the invention.

We Claim:

1. An intervertebral implant component comprising:

an outer surface for engaging an adjacent vertebra and an inner surface;

wherein said outer surface presents only three distinct points of contact with a cortical rim of the adjacent vertebra.

2. An intervertebral implant component as claimed in claim 1, wherein said outer surface has a footprint which is sized to be within that of the cortical rim.

3. An intervertebral implant component as claimed in claim 2, wherein said footprint of said outer surface is convexo-concave shaped.

4. An intervertebral implant component as claimed in claim 2, wherein said footprint of said outer surface is D shaped.

5. An intervertebral implant component as claimed in claim 2, wherein said footprint of said outer surface is kidney shaped.

6. An intervertebral implant component as claimed in claim 1, wherein said three points of contact of said footprint of said outer surface with the cortical rim are two lateral-anterior points and one posterior point.

7. An intervertebral implant component as claimed in claim 6, wherein a footprint of said outer surface includes opposed ends which provide the two lateral-anterior points of contact.

8. An intervertebral implant component as claimed in claim 1, wherein said outer surface includes at least one vertebra engaging protrusion.

9. An intervertebral implant component as claimed in claim 8, wherein said at least one vertebra engaging protrusion includes a protruding keel located adjacent a longitudinal end of said outer surface.

10. An intervertebral implant component as claimed in claim 9, wherein said keel is curved.

11. An intervertebral implant component as claimed in claim 1, wherein said inner surface includes a pair of instrument receiving cutouts extending to an adjacent outer edge thereof.

12. An intervertebral implant component as claimed in claim 11, wherein said cutouts are angled centrally inwardly.

13. An intervertebral implant component as claimed in claim 12, wherein said cutouts are dovetail shaped in cross section.

14. An intervertebral implant comprising:

a first part which has a first outer surface for engaging a first vertebra and a first inner surface;

a second part which has a second outer surface for engaging a second vertebrae and a second inner surface; and

said first and second parts being moveable relative to one another;

wherein said first and second outer surfaces are sized to present a respective footprint sufficient for only three points of contact with an adjacent cortical rim of the respective first and second vertebra.

15. An intervertebral implant as claimed in claim 14, wherein said footprints of said outer surfaces of said first and second parts are sized to be within a footprint of the adjacent cortical rim.

16. An intervertebral implant as claimed in claim 15, wherein said footprints of said outer surfaces are convexo-concave shaped.

17. An intervertebral implant as claimed in claim 15, wherein said footprints of said outer surfaces are D shaped.

18. An intervertebral implant as claimed in claim 15, wherein said footprints of said outer surfaces are kidney shaped.

19. An intervertebral implant as claimed in claim 14, wherein said three points of contact of each of said footprints of said outer surfaces with the adjacent cortical rims are two lateral-anterior points and one posterior point.

20. An intervertebral implant as claimed in claim 19, wherein each of said footprints of said outer surfaces include opposed ends which provide the two lateral-anterior points of contact.

21. An intervertebral implant as claimed in claim 14, wherein each of said outer surfaces includes at least one vertebra engaging protrusion.

22. An intervertebral implant as claimed in claim 21, wherein each said at least one vertebra engaging protrusion includes a protruding keel located adjacent a longitudinal end of the respective said outer surface.

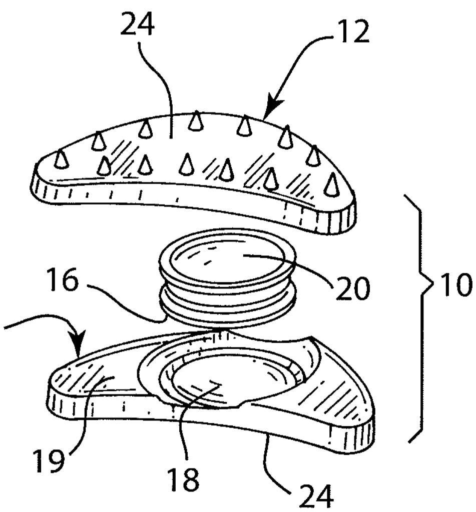
23. An intervertebral implant as claimed in claim 22, wherein each said keel is curved.

24. An intervertebral implant as claimed in claim 14, wherein each of said inner surfaces includes a pair of instrument receiving cutouts extending to an adjacent outer edge thereof.

25. An intervertebral implant as claimed in claim 24, wherein each of said cutouts is angled centrally inwardly.

26. An intervertebral implant as claimed in claim 25, wherein each of said cutouts is dovetail shaped in cross section.

Fig. 1



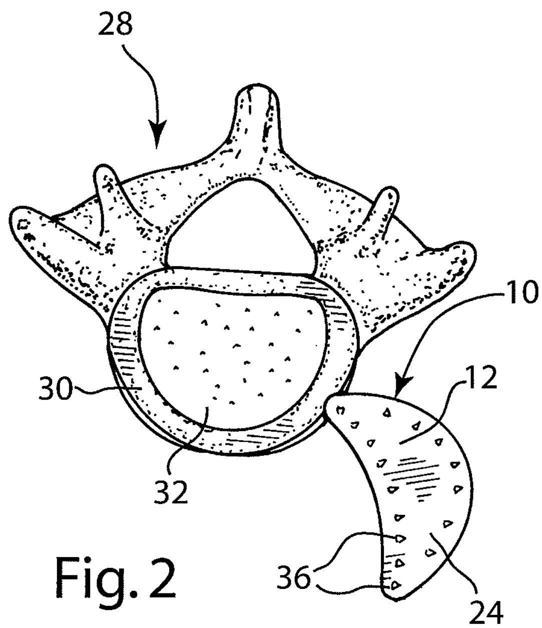
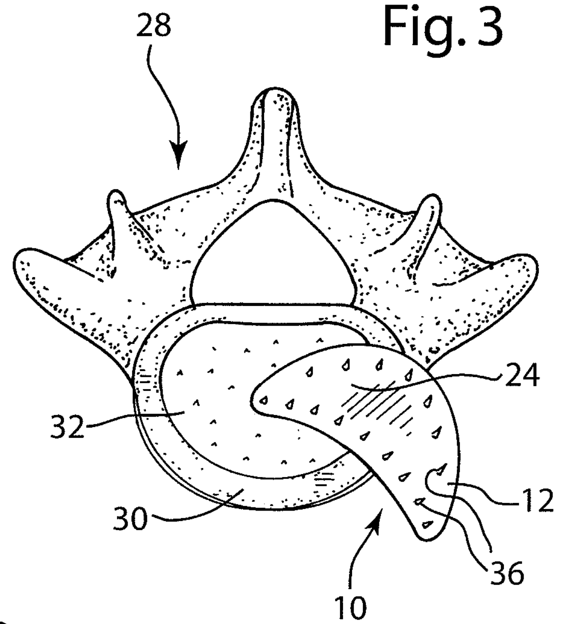


Fig. 2

Fig. 3



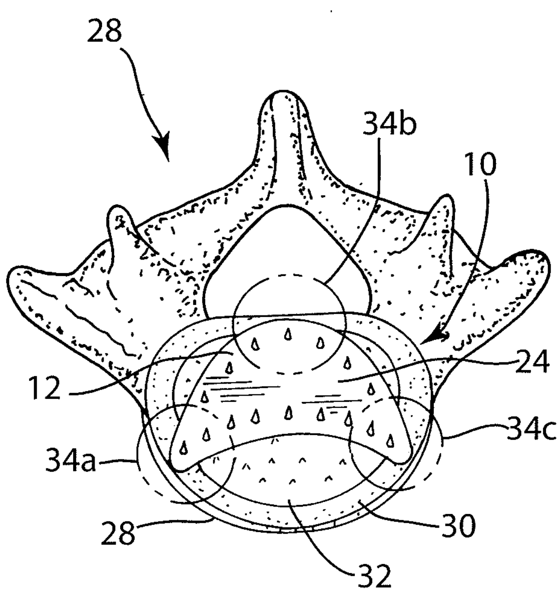


Fig. 4

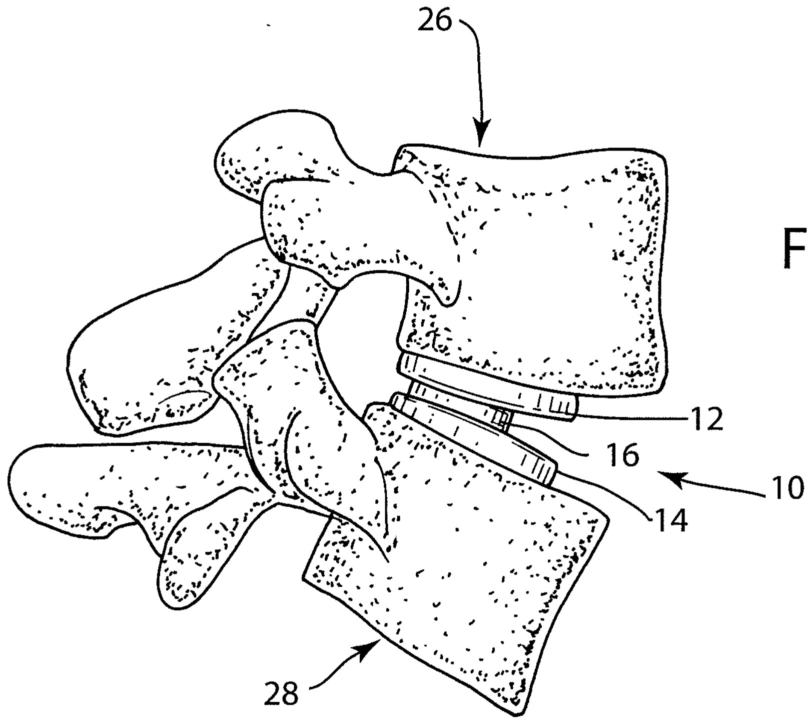


Fig. 5

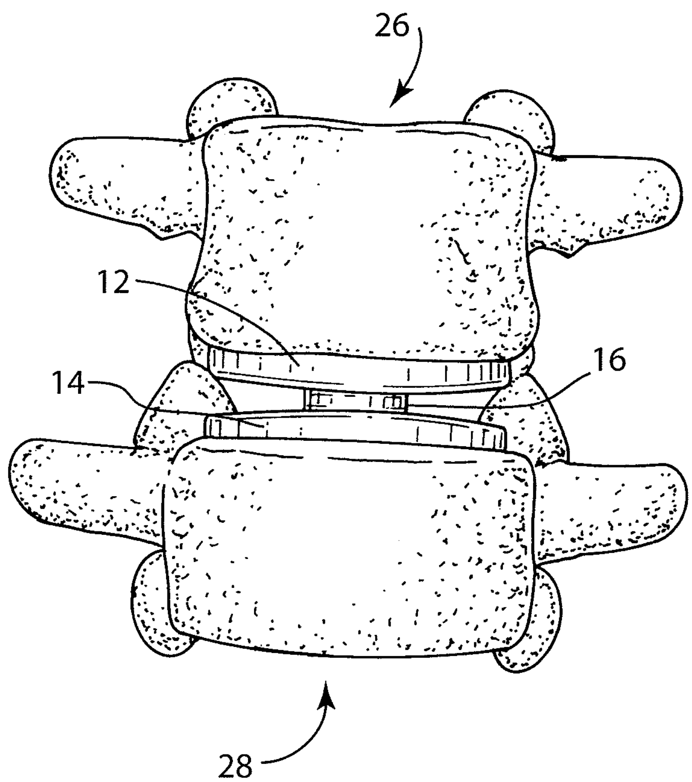


Fig. 6

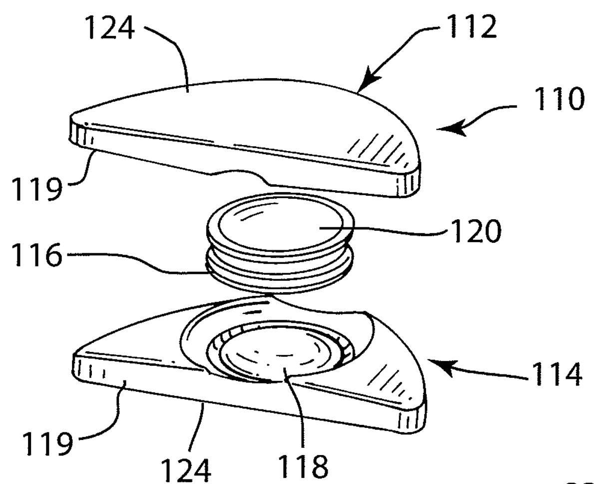


Fig. 7

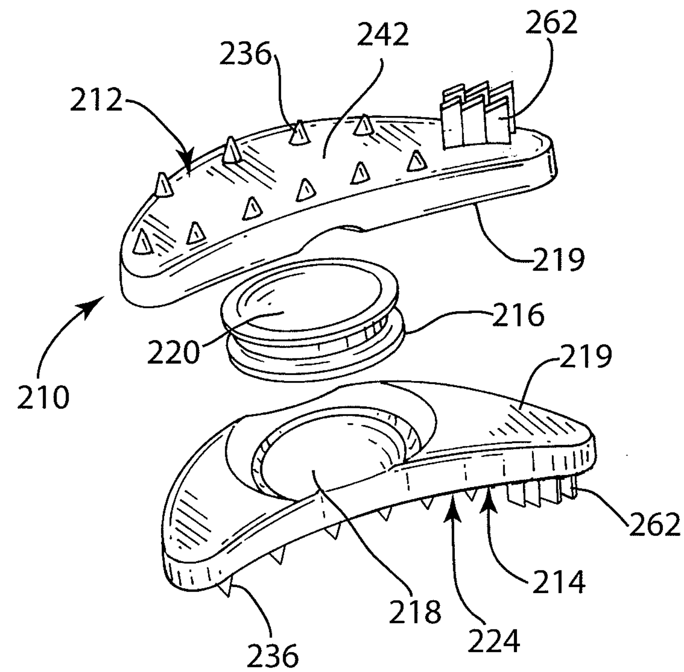


Fig. 8

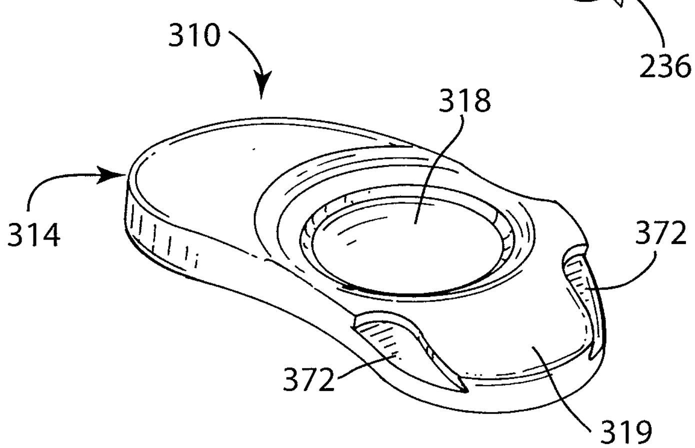


Fig. 9

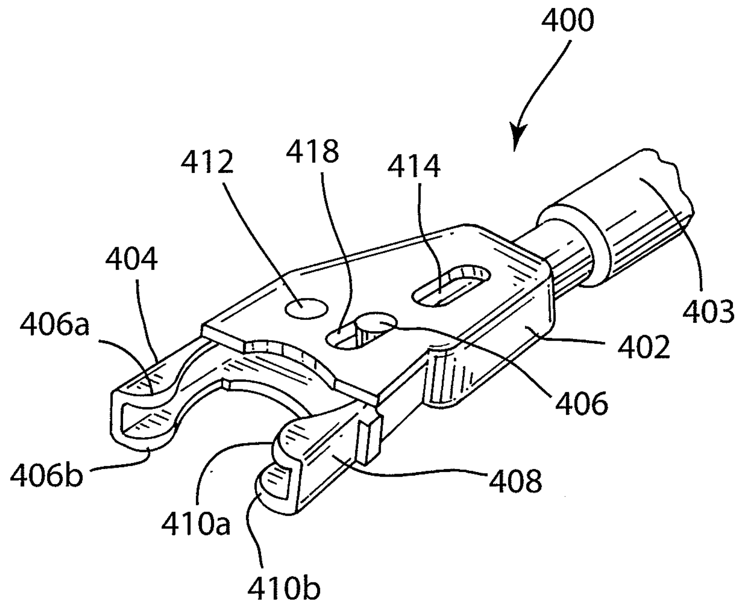

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Fig. 10

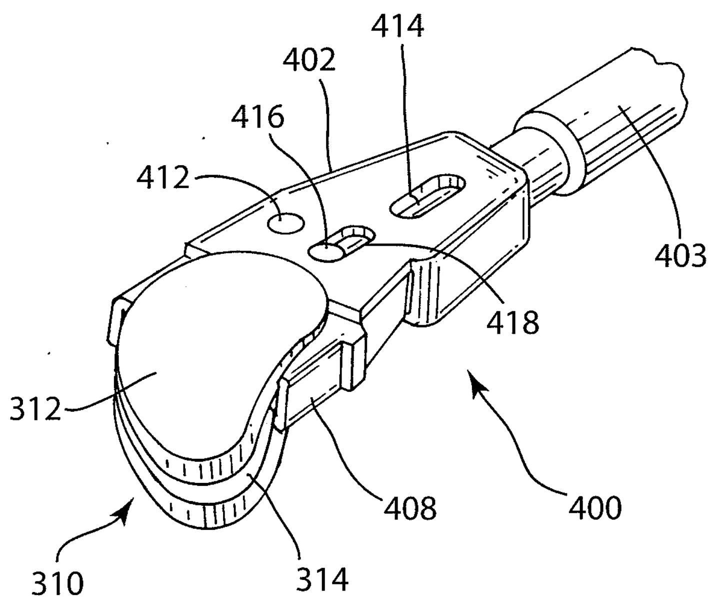
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Fig. 11