

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
9 August 2007 (09.08.2007)

PCT

(10) International Publication Number  
**WO 2007/089975 A1**

(51) International Patent Classification:  
**A61B 17/70** (2006.01)

(21) International Application Number:  
PCT/US2007/060571

(22) International Filing Date: 16 January 2007 (16.01.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
11/341,178 27 January 2006 (27.01.2006) US

(71) Applicant (for all designated States except US): **WARSAW ORTHOPEDIC, INC.** [US/US]; 2500 Silveus Crossing, Warsaw, Indiana 46581 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **ANDERSON, Kent A.** [US/US]; 1310 Bocage Cove, Number 201, Memphis, Tennessee 38103 (US). **LANGE, Eric C.** [US/US]; 1990 Brooks Bluff Cive, Collierville, Tennessee 38017 (US). **CARLS, Thomas A.** [US/US]; 848 River Park, Memphis, Tennessee 38103 (US). **BRUNEAU, Aurelien** [US/US]; 8301 Crimson Creek Drive, Memphis, Tennessee 38016 (US). **TAYLOR, Jean** [FR/FR]; Villa Poralto, 25 avenue Poralto, F-06400 Cannes (FR).

(74) Agents: **HAINES, Warren M.** et al.; 710 Medtronic Parkway MS LC340, Minneapolis, Minnesota 55432 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

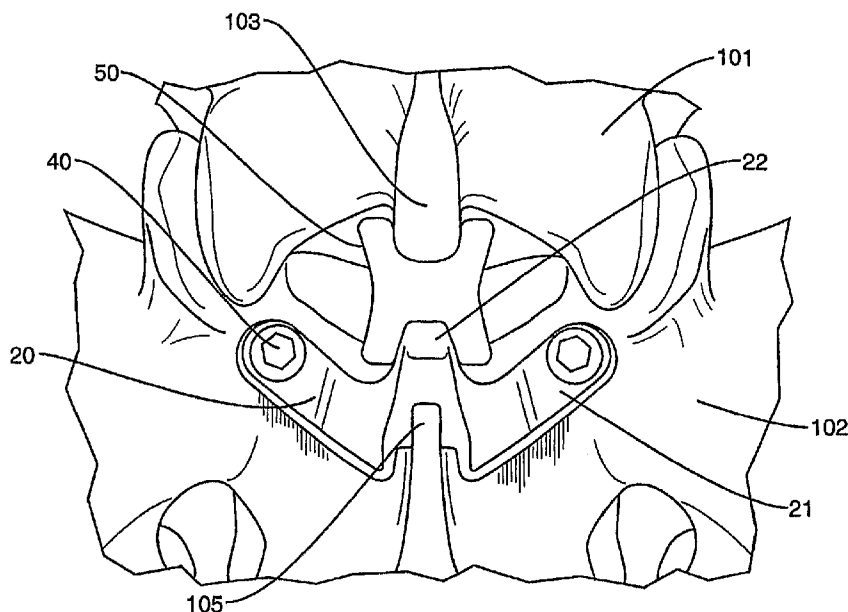
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: ARTIFICIAL SPINOUS PROCESS FOR THE SACRUM AND METHODS OF USE



(57) Abstract: Devices and methods for attaching a support to the sacrum. One device may include first and second anchors (40) that mount to the sacrum, and first and second lateral extensions (21) coupled to the anchors to secure the device to the sacrum. A bearing face (26) having a width (W) is positioned between the lateral extensions. The face may have a height (H) in an anterior-posterior direction greater than the spinous process of the sacrum. Further, the bearing face may be oriented in a superior direction when the device is mounted to the sacrum. An implant (50) may be supported by the device to space the sacrum and L5 vertebrae. The implant may be an interspinous device and positioned between the L5 spinous process and the bearing face. The implant is supported at least in part by the bearing face.

WO 2007/089975 A1



- 
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## ARTIFICIAL SPINOUS PROCESS FOR THE SACRUM AND METHODS OF USE

### Background

The present application is directed to devices to mount with the sacrum, and more specifically to devices that attach to the sacrum and provide a support for positioning an implant between the sacrum and fifth lumbar vertebrae.

The spine is divided into regions that include the cervical, thoracic, lumbar, and sacrococcygeal regions. The cervical region includes the top seven vertebrae identified as C1-C7. The thoracic region includes the next twelve vertebrae identified as T1-T12. The lumbar region includes five vertebrae L1-L5. The sacrococcygeal region includes nine fused vertebrae comprising the sacrum comprising S1-S5 vertebrae and four or five rudimentary members that form the coccyx.

The sacrum is shaped like an inverted triangle with the base at the top. The sacrum acts as a wedge between the two iliac bones of the pelvis and transmits the axial loading forces of the spine to the pelvis and lower extremities. The sacrum is rotated anteriorly with the superior endplate of the S1 vertebrae angled from about 30 to about 60 degrees in the horizontal plane.

The S1 vertebrae includes a spinous process aligned along a ridge called the medial sacral crest. However, the spinous process on the S1 vertebrae may not be well defined and therefore not adequate for supporting an implant. One example of this dilemma is the inability of the spinous process to adequately support an interspinous process implant positioned between the L5 and S1 spinous processes.

## Summary

The present application is directed to devices that mount to the sacrum and methods of use. One embodiment of the device may include first and second anchors that mount to the sacrum, and first and second lateral extensions coupled to the anchors to secure the device to the sacrum. A bearing face having a width is positioned between the lateral extensions. The face may have a height in an anterior-posterior direction greater than the spinous process of the sacrum. Further, the bearing face may be oriented in a superior direction when the device is mounted to the sacrum. An implant may be supported by the device to space the sacrum and L5 vertebrae. The implant may be an interspinous device and positioned between the L5 spinous process and the bearing face. The implant is supported at least in part on the bearing face.

## Brief Description of the Drawings

Figure 1 is a rear view of a system having a base and an implant according to one embodiment.

Figure 2 is a top view of the base fastened to the sacrum according to one embodiment.

Figure 3 is a perspective view illustrating an inferior portion of a base according to one embodiment.

Figure 4 is a perspective view illustrating a superior portion of a base according to one embodiment.

Figure 5 is a perspective view of a base fastened to the sacrum by a pair of anchors according to one embodiment.

Figure 6 is a perspective view illustrating a superior portion of a base according to one embodiment.

Figure 7 is a perspective view of an implant according to one embodiment.

Figure 8 is a side view of a mount according to one embodiment.

Figure 9 is a perspective view of a base according to one embodiment.

Figure 10 is a top view of a base according to one embodiment.

Figure 11 is a perspective view of a base according to one embodiment.

### Detailed Description

The present application is directed to a base that attaches to the sacrum and includes a bearing face to support an implant. Figure 1 illustrates one embodiment having a base 20 that attaches to the sacrum 102. A mount 22 extends posteriorly outward from the base 20 and is sized to contact an inferior portion of an implant 50. The implant 50 extends between the mount 22 and the spinous process 103 of the L5 vertebrae 101. The base 20 includes the mount 22 and one or more extensions 21 as illustrated in Figures 2, 3, and 4. Mount 22 includes a bearing face 26 that faces in a superior direction when the base 20 is mounted to the sacrum 102. Bearing face 26 has a height H and width W to support the implant 50. The bearing face 26 has a height H in an anterior-posterior direction to extend posteriorly outward from the sacrum 102 a distance to support the implant 50. In one embodiment, the height H is greater than a height of the sacral spinous process 105. In one embodiment, the width W of the bearing face 26 is substantially constant along the height H. In another embodiment, the width W varies along the height H. Bearing face 26 may extend outward from the sacrum 102 at a variety of angles. In one embodiment, the width W of the bearing face 26 is substantially equal to a width of the L5 spinous process 103. Bearing surface 26 may be substantially planar, substantially curved, or include a combination having planar and curved sections.

Mount 22 further includes first and second sections 24, 25 that extend from the bearing face 26. Sections 24, 25 are positioned along lateral sides of the sacral spinous process 105 when the base 20 is mounted to the sacrum 102. Sections 24, 26 may have a length to extend outward and contact the sacrum 102, or may have a lesser length and be spaced from the sacrum 102 when the base 20 is mounted. An intermediate section 49 may extend inferiorly from the bearing face 26. Intermediate section 49 may have a width to extend between the first and second sections 24, 25. A recess 31 is formed on an underside of the mount 22 and is sized to extend over the entirety or a portion of the sacral spinous process 105. The embodiments of Figures 2, 3, and 4 illustrate the sections 24, 25, 26, 49 being substantially flat and connected together along ridges. Another embodiment features the sections 24, 25, 26, 49 formed of a continuous curved member with the sections not clearly definable by ridge lines. Apertures 30 may extend through

the first and second sections 24, 25 for receiving a tether as will be described in more detail below. Apertures 30 may also be used for grasping the base 20 during insertion and positioning into the patient.

A superior edge of the bearing face 26 may include a lip 28 as illustrated in Figure 2. Lip 28 aligns the mount 22 on the sacrum 102, and specifically aligns the mount 22 on the sacral lamina. In one embodiment, the height H of the bearing surface includes the lip 28. In one embodiment, the height H excludes the lip 28. Lip 28 may have the same width as the bearing face width W, or a different width. As illustrated in Figures 1 and 3, a notch 29 may be formed in an inferior edge of the intermediate section 49. Notch 29 is sized to accommodate the S1 spinous process 105 of the sacrum 102. In one embodiment, the lip 28 and notch 29 are centered about a centerline of the bearing face 26. In one embodiment, the centerline of the bearing face 26 is aligned with the medial sacral crest. One or more extensions 21 extend outward from the mount 22 to contact the face of the sacrum 102. Extensions 21 may include one or more apertures 23 to receive an anchor 40 to connect the base 20 to the sacrum. In one embodiment as illustrated in Figure 2, extensions 21 have a length to position the apertures 23 at the sacrum pedicles for good fastener fixation. In one embodiment, anchors 40 comprise a head 41 that contacts the edges of the aperture 23 and a shaft 42 that extends into the sacrum 102. In one embodiment as illustrated in Figure 1, extensions 21 have a superior edge that is substantially aligned with the superior edge of the bearing face 26.

Figures 5 and 6 illustrate another embodiment of a base 20 comprising a mount 22 and extensions 21. For clarity, Figure 5 does not include an implant 50 mounted between the L5 spinous process 103 and the mount 22. Mount 22 comprises first and second sections 24, 25 that connect together at a superior face that forms the bearing face 26. Bearing face 26 is positioned at the apex of the sections 24, 25 and is positioned on the superior face of the sacral spinous process 105. Bearing face 26 has a height H to extend outward from the sacrum 102 beyond the posterior edge of the sacral spinous process 105. Sections 24, 25 extend inferiorly outward from the bearing face 26 and are positioned along lateral edges of the spinous process 105. The sections 24, 25 further angle laterally outward in an inferior direction giving the mount 22 a substantially V-shape. In one embodiment, a height of the sections 24, 25 may be substantially equal to the height of the bearing face 26 as illustrated in Figure 5. Bearing face 26 and sections 24, 25 form a

recess 31 sized to fit over the spinous process 105. One or more apertures 30 may extend through the one or both sections 24, 25 to receive a tether.

Extensions 21 extend outward from the first and second sections 24, 25. In the embodiments illustrated, the extensions 21 extend from an inferior portion of the sections 24, 25, although other positions along the sections 24, 25 are also contemplated. Extensions 21 may be fixedly attached to the sections 24, 25 such that rotation of the extensions causes the mount 22 to also rotate. In another embodiment, the extensions 21 are movably connected to the sections 24, 25 and rotate independently from the sections. One or more anchors 40 attach the extensions 21 to the sacrum 102. In this embodiment, anchors 40 are multi-axial devices comprising a saddle 43 that includes a channel 44 for receiving extensions 21. A threaded fastener (not illustrated) extends into an opening in the bottom of the channel 44. The connection between the fastener and saddle 43 provides for rotational movement of the saddle 43 to accommodate the extensions 21 at a variety of orientations. In one embodiment, extensions 21 have a circular cross-sectional shape that movably fits within the channel 44. The inner edges of the saddle 43 are threaded to receive a locking fastener (not illustrated) that extends over and locks the extensions 21 within the channel 44. A similar type of rotatable saddle connection is disclosed in U.S.

Patent Application Serial No. 10/870,504 titled "Orthopedic Fixation System and Method of Use" filed on June 17, 2004, the relevant sections herein incorporated by reference.

Implant 50 is an interspinous device sized to extend between the L5 spinous process 103 and the mount 22. One embodiment is illustrated in Figure 7 and includes an interspinous section 51 and outwardly-extending arms 52. Inlets 53 are formed by the extensions 52 on each side of the interspinous section 51. In one embodiment, an inferior surface of the interspinous section 51 contacts the bearing face 26 and a superior surface contacts the L5 spinous process 103. The inner edges of arms 52 may contact the first and second sections 24, 25 providing lateral support to the implant 50. In one embodiment, the height  $H$  of the bearing face 26 is greater than a height  $h$  of the implant 50. Implant 50 is constructed of a flexible material to dampen the relative movements during flexion and extension. Implant embodiments are disclosed in U.S. Patent Application Publication 2005/0261768 and U.S. Patent No. 6,626,944 both herein incorporated by reference in

their entirety. Another implant embodiment is the DIAM spinal stabilization device available from Medtronic Sofamor Danek of Memphis, Tennessee.

In use, the base 20 is mounted to the sacrum 102. Initially, an incision is made to access the sacrum 102 and L5 vertebrae 101. In one embodiment, the surface of the sacrum 102 including the sacral spinous process 105 is contoured such that the base 20 can be securely positioned on the sacrum 102. This may include contouring the superior surface of the spinous process 105 to reduce the height, or contouring a section of the medial sacral crest. In another embodiment, base 20 is positioned on the sacrum 102 without contouring.

The base 20 is positioned with the mount 22 extending outward in a posterior direction from the sacrum 102. The recess 31 is positioned to extend at least partially over the sacral spinous process 105. The bearing face 26 is positioned superiorly of the spinous process 105 and adjacent to the L5 spinous process 103. The mount 22 has a height H to extend beyond the spinous process 103 to provide a support for the implant 50. As illustrated in Figures 1 and 2, the notch 29 on the inferior edge of the mount 22 may extend over the spinous process 105 and the lip 28 aligns with the sacral lamina. Once the mount 22 is situated over the sacral spinous process 105, anchors 40 connect the extensions 21 to the sacrum 102. One or more fasteners extend into the sacrum 102 to securely connect the base 20. In some embodiments, extensions 21 have a length to position the shaft 42 within the lamina, pedicles, sacral ala, or iliac crest of the sacrum 102.

Once the base 20 is mounted to the sacrum 102, interspinous implant 50 is inserted between the mount 22 and L5 spinous process 103. The inferior surface of the interspinous section 51 contacts the bearing face 26 and a superior surface faces the L5 spinous process 103. In one embodiment, the superior surface contacts the L5 spinous process 103. The inner edges of arms 52 may contact the first and second sections 24, 25 and the lateral edges of the spinous process 103 providing lateral support to the implant 50. A tether (not illustrated) may be used to more securely attach the implant 50 in position. Tether is attached to one or more of the apertures 30 within the mount 22, and may further extend around the spinous process 103 to maintain the implant within the interspinous space formed between the mount and L5 spinous process 103.



In one embodiment, the superior surface contacts the L5 spinous process 103. In another embodiment, the L5 spinous process 103 has been replaced with an implant. In this embodiment, the superior surface contacts the implant.

The embodiments of the base 20 discussed above disclose the mount 22 and extensions 21 constructed in a unitary manner. Another embodiment features a modular design as illustrated in Figures 8 and 9 having a mount 22 that is detachable from the extensions 21. Mount 22 includes a hook 32 extending from an inferior section that forms a receiving area 33 sized to accommodate the extensions 21. Mount 22 further includes a superior bearing face 26 and lateral first and second sections 24, 25. Mount 22 may further extend outward from a base 34. Extension 21 has a shape to fit within the receiving area 33. The mount 22 may be movable along the extension 21 in the direction indicated by arrows A to position the mount 22 and accommodate differing anatomies between patients. A lock mechanism (not illustrated) may be associated with the mount 22 and/or extension 21 to prevent further movement once proper positioning is obtained. Anchors 40 attach the extension 21 to sacrum 102 as previously discussed.

Figures 10 and 11 illustrate another embodiment of the base 20 having a mount 22 positioned between extensions 21. Mount 22 includes a superior bearing face 26 having a width to support the implant 50. A slot 38 extends through the mount 22 between first and second sections 24, 25. Each extension 21 includes a platform 36 having an enlarged surface that aligns with a first and second section 24, 25 respectively. A member 37 extends between the platforms 36 and through the slot 38 to attach the mount 22 to the extensions 21. Mount 22 is vertically movable relative to the extensions 21 as indicated by arrows B. The extent of adjustment is controlled by the length of the slot 38.

Movement of the mount 22 along the length of the slot 38 adjusts a distance between the bearing face 26 and the L5 spinous process 103. Slot 38 may further have a width to adjust a height of the mount in a posterior direction. Once the proper positioning is obtained, member 37 may be locked to prevent further movement. As with the other embodiments, anchors 40 attach the base 20 to the sacrum 102.

In one embodiment, mount 22 extends posteriorly beyond the height of the sacral spinous process 105. The mount may extend over part or an entirety of the spinous process 105. In another embodiment, mount 22 includes a bearing face 26 positioned on a

superior face of the spinous process 105. In another embodiment, all or a portion of the spinous process 105 is removed during contouring prior to attachment of the base 20. In one embodiment as illustrated in Figure 1, base 20 is mounted to the sacrum 102 at a point relative to the S1 vertebrae. In another embodiment, base 20 is mounted to the sacrum 102 relative to another vertebrae, such as the S2 vertebrae. In this embodiment, implant 50 has a greater length to extend between the L5 spinous process 103 and the bearing face 26 at the S2 vertebrae.

Spatially relative terms such as “under”, “below”, “lower”, “over”, “upper”, and the like, are used for ease of description to explain the positioning of one element relative to a second element, or relative to the anatomical elements of a patient. These terms are intended to encompass different orientations of the device in addition to different orientations than those depicted in the figures. Further, terms such as “first”, “second”, and the like, are also used to describe various elements, regions, sections, etc and are also not intended to be limiting. Like numbers refer to like elements throughout.

The present invention may be carried out in other specific ways than those herein set forth without departing from the scope and essential characteristics of the invention. Implants 50 may have a variety of shapes depending upon the context of usage. In one embodiment, a mid-line of the bearing face 26 is equally distanced between the extensions 21. In one embodiment, a single extension 21 extends from the mount 22. In one embodiment, the S1 spinous process has an initial height prior to mounting the device. The mount 22 has a height greater than the initial height. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

**Claims**

What is claimed is:

1. A device to provide an inferior support for an interspinous implant between an L5 vertebrae and a spinous process of a sacrum, the device comprising:
  - first and second anchors mounted to the sacrum;
  - first and second lateral extensions coupled to the anchors to secure the device to the sacrum; and
  - a bearing face extending between the lateral extensions, the face having a height in an anterior-posterior direction greater than the spinous process of the sacrum and oriented in a superior direction when the device is mounted to the sacrum to support the interspinous implant.
2. The device of claim 1, wherein a width of the bearing face is substantially constant along the height.
3. The device of claim 1, further comprising first and second faces positioned between the bearing face and the first and second extensions, the first and second faces and the bearing face forming an enclosure to partially cover the spinous process.
4. The device of claim 1, wherein the bearing face is fixedly connected to the first and second extensions.
5. The device of claim 1, wherein the bearing face is movably connected to the first and second extensions.
6. The device of claim 1, further comprising first and second faces positioned between the bearing face and the first and second extensions, the first and second faces connecting together at the bearing face to form a V-shape.
7. The device of claim 1, wherein a mid-line of the bearing face is equally distanced between the first and second lateral extensions.

8. A device to provide an inferior support for an interspinous implant between an L5 and S1 vertebra, the device comprising:

first and second extensions sized to extend along a posterior face of the S1 vertebrae, the first extension positioned on a first lateral side of a S1 spinous process and the second extension positioned on a second lateral side of the S1 spinous process when the device is mounted to the S1 vertebrae; and

a mount extending between the lateral extensions and having a bearing face positioned superior to the S1 spinous process and extending outward in a posterior direction beyond the S1 spinous process when the device is mounted to the S1 vertebrae to support the interspinous implant.

9. The device of claim 8, wherein the mount further comprises lateral sidewalls extending from the bearing face in an inferior direction when the device is mounted to the S1 vertebrae to extend along lateral sides of the spinous process.

10. The device of claim 8, wherein the bearing face has a substantially constant width along a height of the face.

11. The device of claim 8, further comprising first and second faces positioned between the bearing face and the first and second extensions, the first and second faces and the bearing face forming an enclosure to partially cover the S1 spinous process.

12. The device of claim 8, wherein the mount is sized to extend beyond an initial height of the S1 spinous process.

13. A device to provide an inferior support for an interspinous implant between an L5 vertebrae and a spinous process of a sacrum, the device comprising:

first and second anchors;

first and second lateral extensions coupled to the anchors to secure the device to the sacrum; and

a mount disposed between the extensions and having a recess to receive the spinous process, the mount including a superior bearing face to support the interspinous implant.

14. The device of claim 13, wherein the mount is substantially V-shaped with first and second sidewalls extending along lateral sides of the spinous process and the bearing face positioned at an apex of the sidewalls and extending along a superior side of the spinous process when the device is attached to the sacrum.

15. The device of claim 13, further comprising an aperture positioned within the mount to receive a tether to secure the device to the sacrum.

16. The device of claim 13, wherein a midpoint of the bearing face is equally distanced between the first and second lateral extensions.

17. The device of claim 13, wherein the recess has anterior and posterior surfaces, the anterior surface defining an underside recess to receive the spinous process, the posterior surface including the superior bearing face disposed superior to the recess.

18. A system to space apart an L5 vertebrae and a sacrum, the system comprising:

a support member that attaches to the sacrum comprising a bearing face that aligns with a midline of the sacrum and having a height to extend posteriorly outward from the sacrum; and

an interspinous implant sized to extend between the L5 vertebrae and the sacrum, the interspinous implant having a first surface that contacts the bearing face of the support member and a second surface that faces an inferior surface of the L5 vertebrae.

19. The system of claim 18, wherein the support member further comprises lateral extensions connected with the bearing face and configured to receive anchors to attach the support member to the sacrum.

20. The system of claim 18, wherein the interspinous implant further includes first and second extensions that extend outward beyond the first surface, the first extension contacting a first sidewall of the interspinous implant and the second extension contacting a second sidewall of the interspinous implant.

21. The system of claim 18, wherein the implant has a smaller width than the bearing face.

22. The system of claim 18, wherein the interspinous implant is sized to contact the L5 vertebrae and the support member, the first surface contacts the bearing face of the support member and the second surface contacts the inferior surface of the spinous process of the L5 vertebrae.

23. A system to space apart an L5 vertebrae and a sacrum, the system comprising:

a base having a mount and an extension, the mount having a bearing face having a height in a posterior direction greater than the spinous process of the sacrum and oriented in a superior direction when the device is mounted to the sacrum, the extension extending from a lateral side of the mount and configured to receive an anchor to secure the base to the sacrum; and

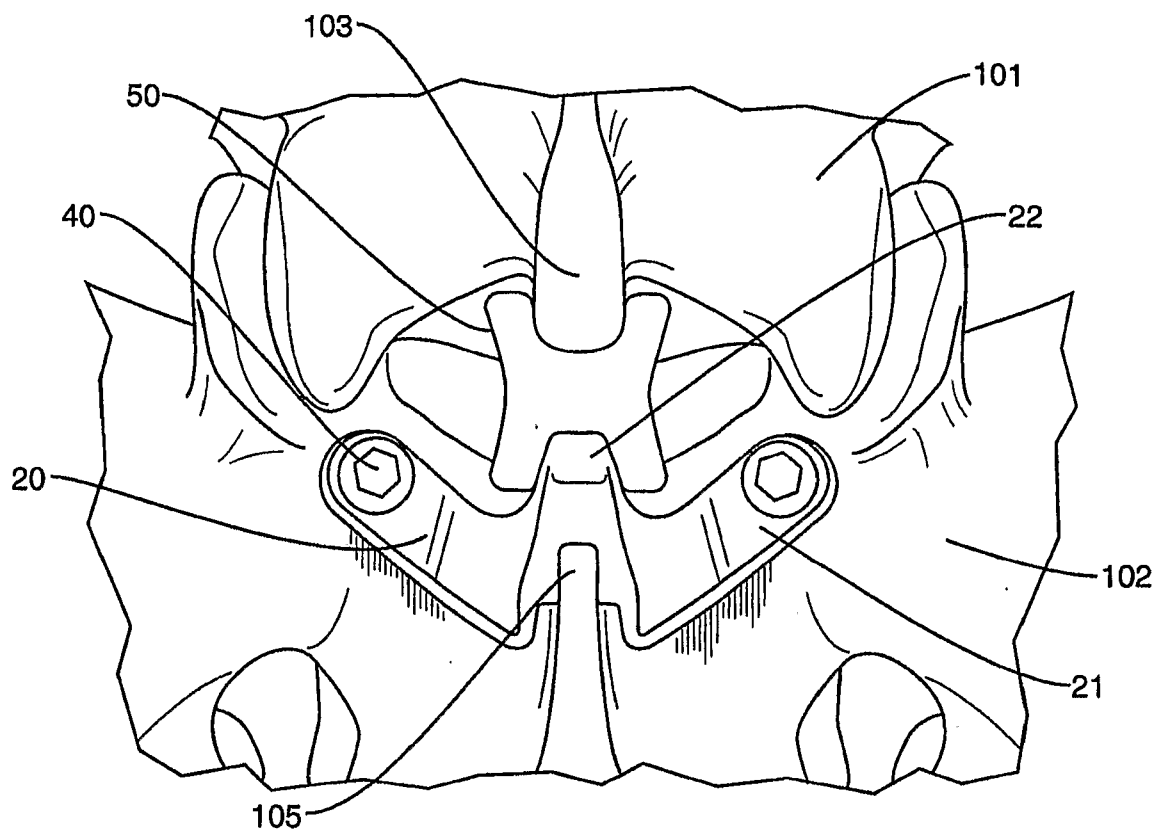
an interspinous implant having a first surface that contacts the bearing face and a second surface that contacts a spinous process of the L5 vertebrae, a width of the interspinous implant being less than the bearing face.

24. The device of claim 23, wherein a width of the bearing face is substantially constant along the height.

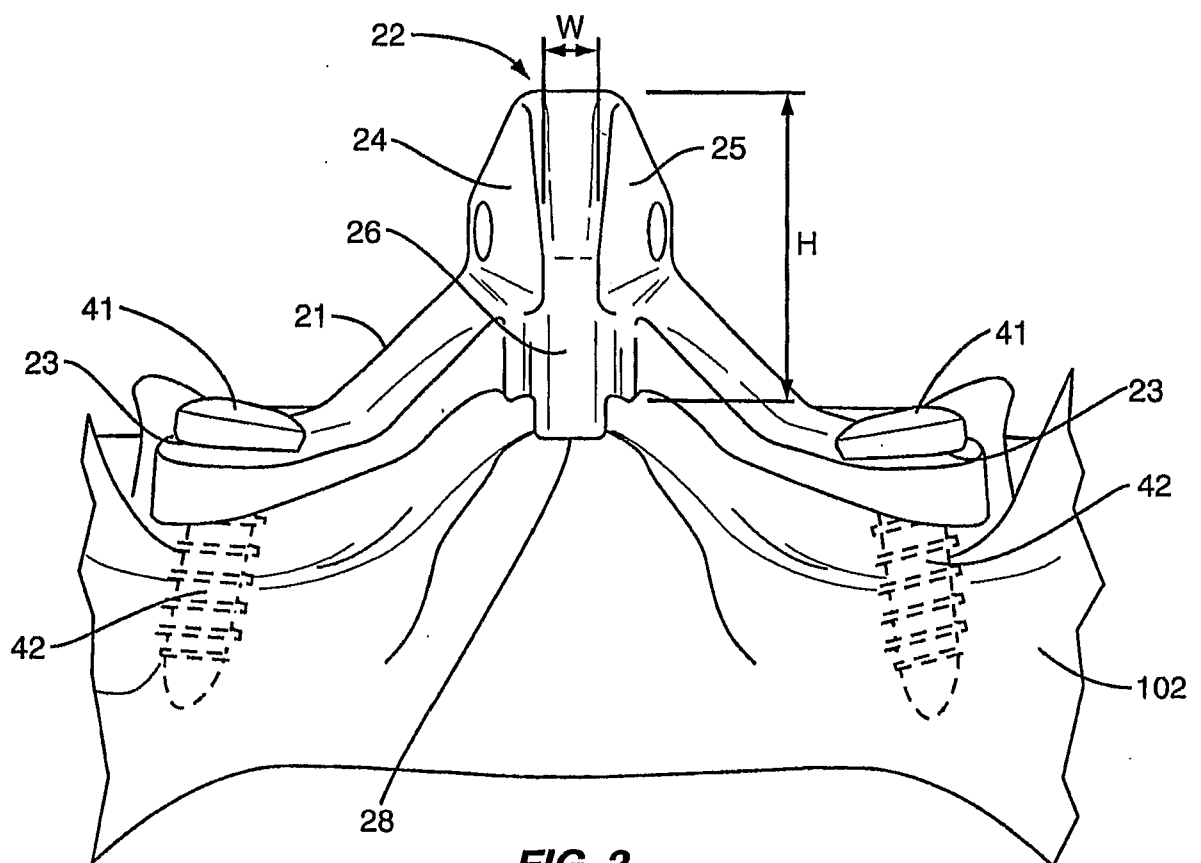
25. The device of claim 23, further comprising a face positioned between the bearing face and the extension, the face and the bearing face forming an enclosure to partially cover the spinous process of the sacrum.

26. The device of claim 23, wherein the bearing face is fixedly connected to the extension.

27. The device of claim 23, wherein the bearing face is movably connected to the extension.

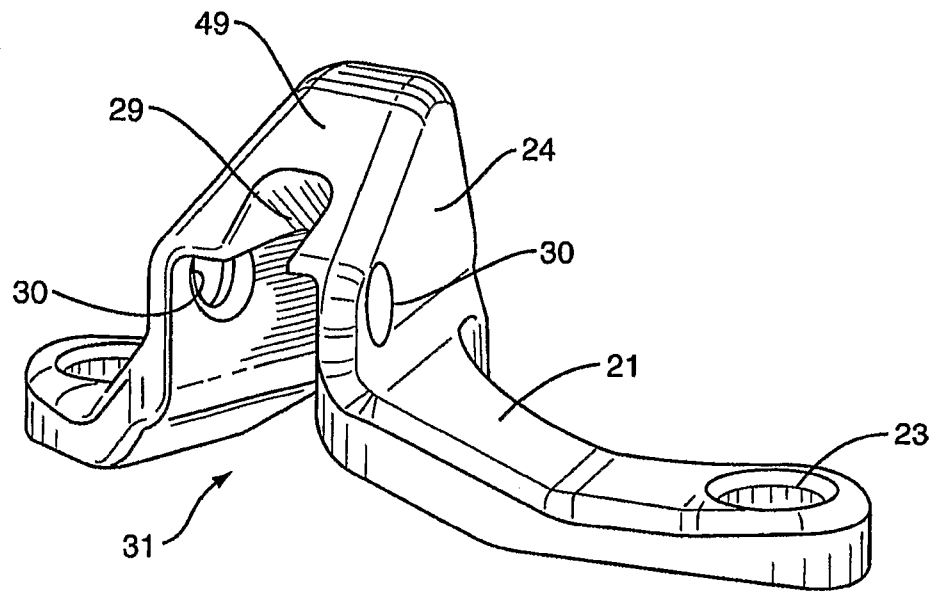


**FIG. 1**

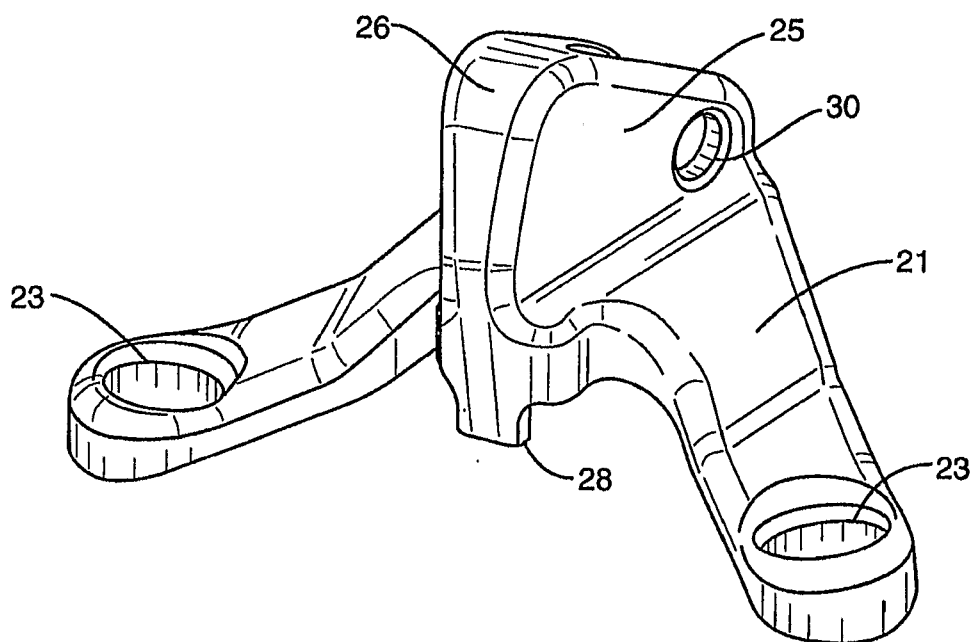


**FIG. 2**

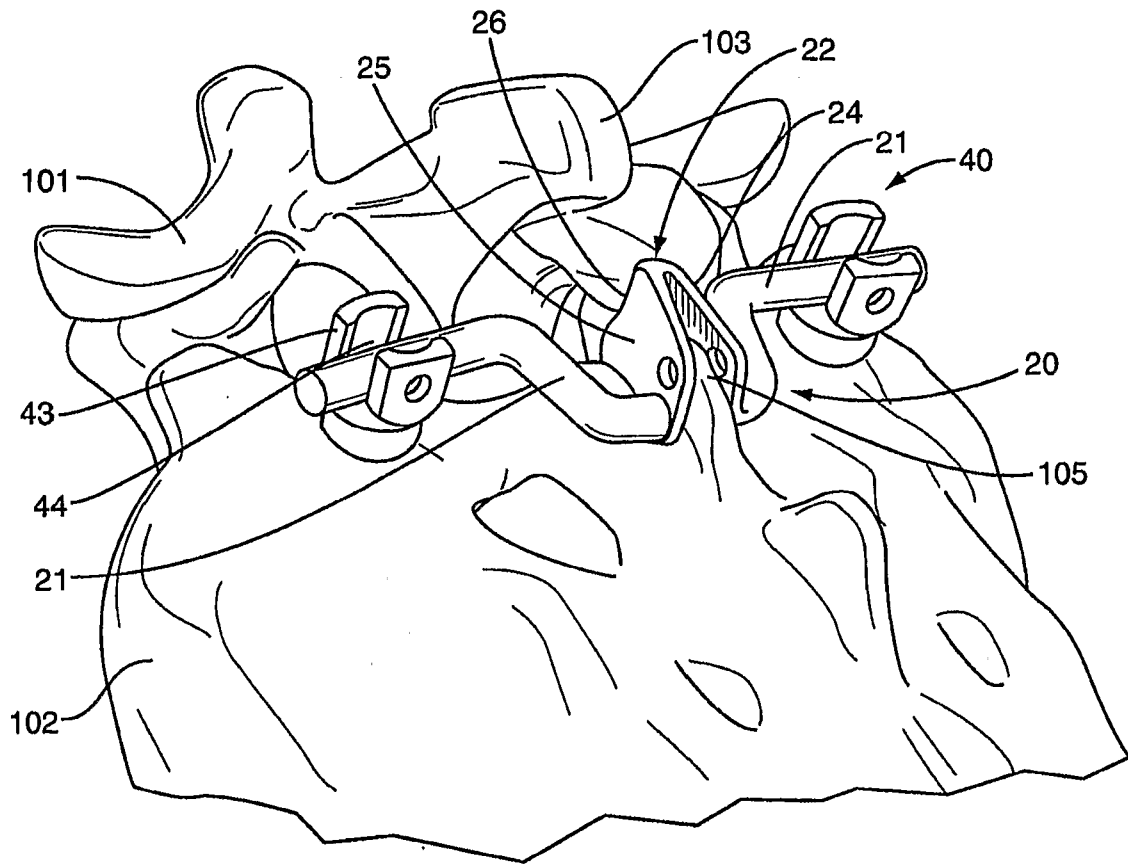




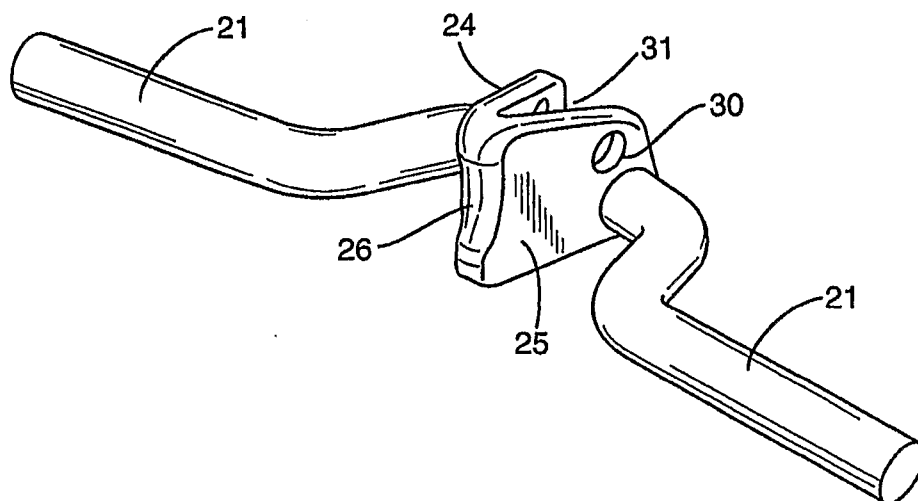
**FIG. 3**



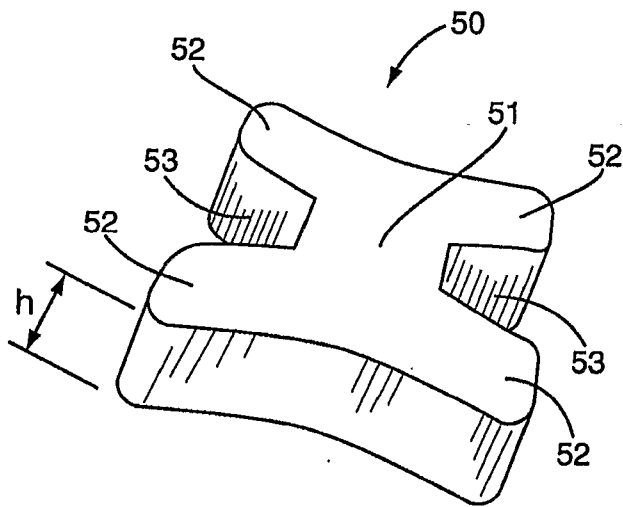
**FIG. 4**



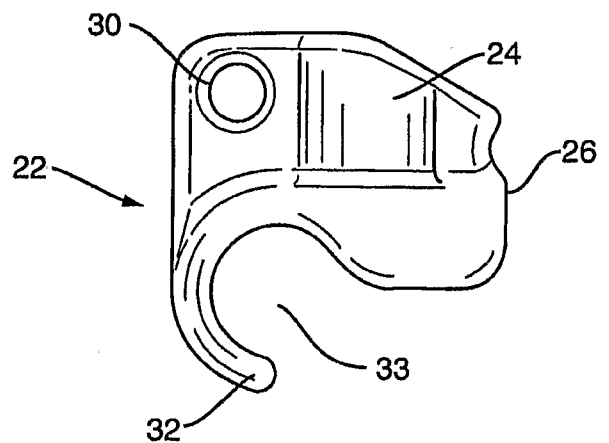
**FIG. 5**



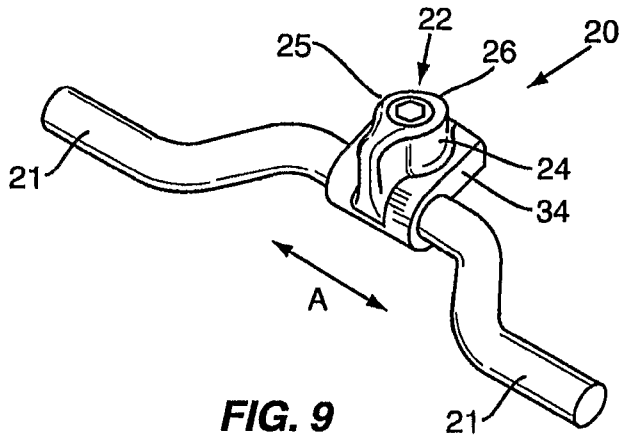
**FIG. 6**



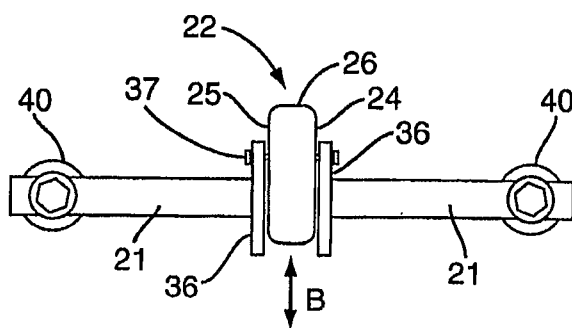
**FIG. 7**



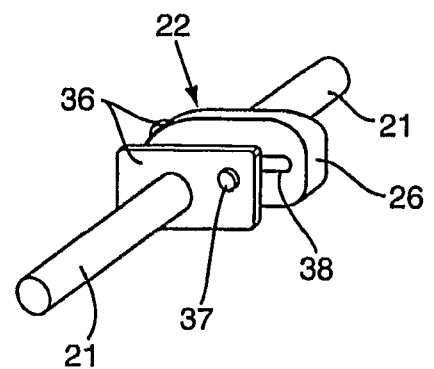
**FIG. 8**



**FIG. 9**



**FIG. 10**



**FIG. 11**

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/060571

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B17/70

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/015181 A1 (ELBERG JEAN-FRANCOIS [FR]) 19 January 2006 (2006-01-19)  page 3, paragraph 50-62 figures 12-17	1,2,5, 7-10,18, 19,22,27
Y A		20 3,11,13, 23,24
X	EP 1 138 268 A (COUSIN BIOTECH S A S [FR]; TAYLOR JEAN [FR]) 4 October 2001 (2001-10-04)  column 3, paragraph 21 - column 4, paragraph 28 figures 6,7  ----- -/-	1,2,4,7, 8,10,18, 19, 22-24,26

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents :

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*&amp;\* document member of the same patent family

Date of the actual completion of the international search

23 May 2007

Date of mailing of the international search report

31/05/2007

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Kakoullis, Marios

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/060571

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2 799 948 A1 (TRANSCO ESQUISSE [MC]) 27 April 2001 (2001-04-27) page 4, line 14 - page 7, line 27 figures 1,4	20
A	-----	1,8,18, 23

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2007/060571

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2006015181	A1	19-01-2006	NONE	
EP 1138268	A	04-10-2001	FR 2806616 A1	28-09-2001
FR 2799948	A1	27-04-2001	NONE	