



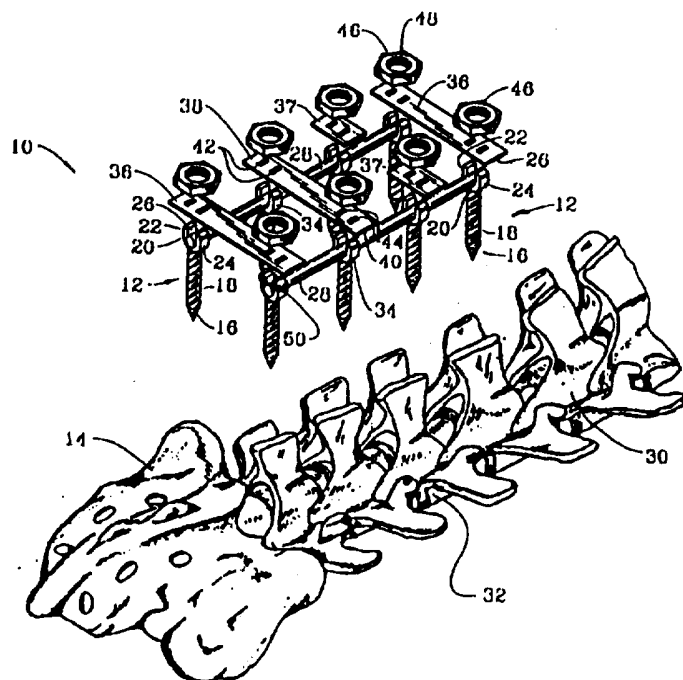
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(54) Title: SPINAL STABILIZATION IMPLANT SYSTEM

(57) Abstract

A surgical implant system for the stabilization of a human spine by fixation of the vertebra utilizing a stabilization cross-link spinal implant system. The system utilizes self-tapping screws having bifurcated protruding members to support an alignment rod, the protruding members available for placement of a fixed or variable traverse cross-link member that couples to the protruding members by use of threaded nuts corresponding to the threaded portion of the outer surface of the protruding members. The externally threaded coupling method can also be used for pedicle, caudal, cranial, thoracic and the like hooks. Also shown is a two-plate system for anterior cervical spine fixation.



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- 1 -

5 **SPINAL STABILIZATION IMPLANT SYSTEM**Field of the Invention

10 This invention relates generally to spinal implants and, in particular, to a spinal implant having a novel top-loading bolt attachment for support and alignment rods with cross links and ancillary components for stabilization of the vertebrae as well as a two plate system for cervical spine fixation.

Background of the Invention

15 Surgical implants are well known in the art for treatment of curvatures of the spine including anterior, trauma, deformity, and/or degenerative spinal conditions. The purpose of the implant is to reinforce the spine by use of strategically placed attachment screws capable of supporting alignment support rods placed bilateral along the vertebrae as well as cross-link members that bridge the sagittal of the spine.

20 The problem which this invention addresses is the method of fastening the spinal implants during surgery. Conventionally, the placement of an attachment screw provides the functional base for the support rod, cross-link, caudal facing hooks, cranial facing hook and the like components that form a spinal implant system. The conventional method of fastening utilizing a goal post mounting screw from which a bolt and nut is coupled perpendicular thereto for mounting to the component. This side attachment frequently requires the movement of muscle and other tissue during operation which increases the difficulty of the operation, is a time consuming effort, and can be a major trauma to a person.

30 In addition, the use of the prior art devices required pre-thought to where the cross-links are to be placed. Once the base screws are installed, they cannot be moved and if the screws are placed incorrectly, the cross-link will not fit.

35 U.S. Patent No. 5,084,048, issued to Jacob et al., entitled "Implant for Vertebrae With Spinal Stabilizer" discloses a vertebrae implant having a stabilizing element which is articulated to accommodate a pair of bone screws wherein each bone screw includes a clamp disposed between a shoulder in a

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- 2 -

spherical surface which is all coupled together by the use of a clamping nut directly on the end of the bone screw. The device allows for support of an alignment rod along the side of the bone screw, but fails to provide any type of cross link or ancillary component attachment devices.

U.S. Patent No. 4,041,939, issued to Hall, entitled "Surgical Implant Spinal Screw" discloses a spinal implant utilizing a screw having a centrally disposed aperture for placement of a metal cable therethrough with a nylon insert that will permanently secure the cable in a fixed position once attached. The device is best used in an operation for the correction of scoliosis.

Another problem with prior art is the use of anterior cervical plates. The prior art employs a single plate that is attached by the use of small bone attachment screws. After installation, the screws have a tendency of working their way out of the bone resulting in the loosening of the cervical plate causing the patient pain and typically resulting in further surgery to correct the problem.

Therefore there exists a need to correct the aforementioned problems by use of a top loading spinal implant system and associated cervical plate attachment cover.

#### SUMMARY OF THE INVENTION

The instant invention is a surgical implant system for the stabilization of the human spine by fixation of the vertebra. The system is based upon screws, nuts, rods, hooks, cross-members and variations thereof. The preferred embodiment employs a metal screw for placement in the sacrum or pedicle defined by a coarse self-tapping thread and a U-shaped saddle for placement of conventional alignment rods. Unique to this invention is that the screw is threaded on the outer surface of the saddle allowing the alignment rod to be securely fastened into the saddle by placement of the rod therein and the fastening of a nut to the top of saddle. Further unique to this invention is the use of an elongated sagittal traverse support member that can accommodate the saddle protrusion either in a fixed position or

- 3 -

by use of a rotatable insert that allows the cross member to be tightly fastened to the saddle in a variable alignment. The top-loading attachment is further applicable to caudal, cranial, and the like hook components.

5 An anterior cervical plate is set forth using a second plate to permanently lock the cervical plate in position. The second plate does not rely upon the bone to support the plate thus providing a means to prevent any bone attachment screws from loosening or otherwise backing out of the bone.

10 Accordingly, an objective of the instant invention is to provide thoracic lumbar stabilization by use of linking conventional support alignment rods placed bilaterally along the vertebrae with the top-loading sacral and pedicle screws of the instant invention.

15 Still another objective is to lessen the need for ancillary tissue movement during surgery by use of a top mounted attachment means for ancillary components and provide a variable attachment system to provide the surgeon with fixation components that will accommodate a variety of circumstances.

20 Yet another objective of the instant invention is to provide a cross-link member that is operatively associated with the attachment screws by means of a top mounted link that is receptive to the protruding members of the screws or separate cross link attachments.

25 Yet still another objective of the instant invention is to provide a variable attachment means for two member and four member attachment screws by the use of rotatable attachment slots within the cross-link members.

30 Still another objective of the instant invention is to simplify the means for attaching caudal, thoracic, cranial and the like hooks by use of a top loading fastening nut that is threaded directly onto the hook body.

35 Still another objective of the instant invention is to provide an improved sacral and pedicle pinion post screw that allows angular bridging by use of an indexing right angled base having the means for coupling to another right angled base.

- 4 -

Yet still another objective is to disclose an improved anterior cervical plate having a second plate that couples to the cervical mounted plate effectively locking the cervical mounted plate in position by preventing the retraction of the mounting screws, while allowing the mounting screws to be put in at various angles and positions.

Other objects and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings wherein set forth, by way of illustration and example, certain embodiments of this invention. The drawings constitute a part of this specification and include exemplary embodiments of the instant invention and illustrate various objects and features thereof.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an exploded perspective view of the preferred embodiment of the instant invention;

Figure 2 is perspective view of a variation to the cross-link member support;

Figure 3 is perspective view of another variation to the cross-link member support by use of an elongated slot;

Figure 4 is a perspective view of the spinal implant using employing the variable cross-link support member;

Figure 5 is a perspective view of the bifurcated externally threaded hook attachment;

Figure 6 is a perspective view of the attachment nut for use with the spinal screw of Figure 5;

Figure 7 is an exploded perspective view of a four protruding member spinal screw embodiment;

Figure 8 is an exploded view of a pinion spinal screw with a first rotatable directional shaft;

Figure 9 is an exploded view of a pinion spinal screw with a secondary rotatable direction shaft coupling to the first shaft of Figure 8;

Figure 10 is an exploded view of a bridge cross-link attachment member employing a C-shaped clamp with bolt and nut;

- 5 -

Figure 11 is a top view of the anterior cervical plates;

Figure 12 is a perspective view of the anterior cervical plates available for installation;

5 Figure 13 is a top view of an anterior cervical plate using a strap embodiment;

Figure 14 is a perspective view of the anterior cervical plates with the strap embodiment in an attached position;

10 Figure 15 is a perspective view of another two plate anterior cervical plate with the strap embodiment in an attached position;

Figure 16 is an exploded view of a pinion spinal screw with an enlarged shoulder;

Figure 17 is a perspective view of a variation to the cross-link member support employing a threaded rotatable member; and

15 Figure 18 is a perspective view of an enlarged bifurcated externally threaded hook attachment with a preformed support member.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

20 As required, detailed embodiments of the present invention are disclosed herein, however, it is to be understood that the disclosed embodiments are merely exemplary of the invention which may be embodied in various forms. Therefore, specific functional and structural details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a  
25 representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

30 Now referring to Figure 1, the surgical implant system of the instant invention is generally shown as numerated 10 for use in the stabilization of a human spine by fixation of vertebra. The construction materials consist of stainless steel, titanium, or the like high quality material. The base of the system employs a spinal screw 12 shown diverging in the sacrum 14. The  
35 sacral screw 12 characterized by a first end 16 having a relatively coarse self-tapping thread 18 over a major portion of its length. A second end 20 having a first 22 and second 24

- 6 -

spaced apart protruding member extending obliquely from the screw defining an inner surface saddle 26 having an inner diameter corresponding to the outer diameter of a conventional support alignment rod 28. The screw can be made of various lengths and diameters, the size dependant upon the location for placement, the amount of support or reconstruction required, and the actual size of the individual's bone structure. The outer surface of the second end 20 of the screw 12 includes a plurality of grooves placed therein to form a partial thread 34. The threads 34 can be cast or placed on the surface by means of a conventional thread shaping die. The saddle 26 receptive to an alignment support rod 28 placed along the length of the vertebra 30 of the spine 32 to provide longitudinal support.

A rectangular shaped rigid plate 36 can then be used to connect two sagittal placed screws 12. The plate 36 is defined as an elongated sagittal traverse support member having first 38 and second end 40 and two edges and upper and lower reversible surface. At the first end 36 is placed an opening 42 operatively associated with the protruding members 22 and 24 of the screw 12. The first screw is rigidly connected to the second screw by placement of the plate 36 over the protruding members respectively. Openings 42 are provided to accommodate the protruding members 22, 24 by use of two slots disposed at the first end 38 for insertion of the protruding members of the first screw and two slots 44 disposed in the second end 40 for insertion of the protruding members of the sagittal placed second screw. The connecting member 36 is rigidly secured to the screws 12 by use of metal nuts 46 having an internal thread 48 engageable with the threaded surface 34 of each protruding member.

A means for spacing the traverse support member a predetermined distance from the saddle surface 26 is accomplished by use of a washer 50 having an elongated slot for disposition over the protruding members. The screw allowing for placement on a top surface of the alignment support rod 28 placed within the saddle 26. Rod support can also be accomplished by top



- 7 -

loading, without a cross link, by use of the screw attachment 12 to the bone with a segmented slotted member 37 to fit directly over the protruding members of the screw. Securement is accomplished by the attachment nuts 46 to the screw 12 causing member 37 to fixate rod 28 in position. This embodiment is preferred for thoraco lumbar stabilization by use of linking the support alignment rods that are placed bilaterally. The use of additional screws, as shown, allow for support along the length of the vertebrae. The metal nuts 46 threaded directly to the top of the screws 12 eliminating the need for movement of muscle during surgery.

Referring in general to Figures 2 and 3, a variable angled cross-link sagittal traverse support member is shown having a first end 62 and a second end 64 and two edges 66 & 68 with an upper 70 and a lower 72 reversible surface. The first end 62 includes a centrally disposed opening 74 available for insertion of a cylindrical post commonly used with pedicle screws of the prior art and the variable offset screw of the instant invention described later in this embodiment. At the second end 64 is placed a means for rotating 76 the coupling slots in radial relation to the support member 60. The rotation allowing for the offset of a top loading screw by rotation member 76 permitting placement at variable directions for insertion of the protruding members through the slots 78. Alternatively, a rigid support member 80 can be defined by a first end 82 and a second end 84 with two surfaces therebetween as shown in Figure 3 wherein an elongated centrally disposed opening or slot 86 extends from the first end to the second end allowing a universally acceptable attachment means for pinon shafts or in the saddle post attachment by use of an enlarged slot.

Figure 4 illustrates the use of a variable cross-link support member 90 having a first end 92 and a second end 94 with a first rotatable disk 96 for rotating at least two slots 98 in radial relation to the support member 90. A second rotatable disk 100 for rotating at least two slots 102 in radial relation to the support member 90 is disposed at the second end. The

- 8 -

disks 96 and 100 are permanently secured to the support member 90 allowing freedom of circular rotation only. The freedom of rotation allows for correction of angle when the screws do not line up directly across the spine. The variable angled support member 90 can be attached to the screw a first screw in the previously described manner by placement of the slots 98 over the protruding members 106 of the saddle end of the screw 104. A second screw 108 can be placed sagittal across the spine but now in a dissimilar plane allowing a surgeon to custom place the screw 108 in the strongest area of the bone eliminating the need to bridge a damaged or degenerative area. The slots 102 are placed over the protruding members 110 of the saddle end of the screw 108. The metal nuts 112 are used for engagement with the outer surfaces 116 and 118 of the corresponding protruding members. The support member 90 residing tightly against the alignment support rod 120 causing a frictional engagement with the inner surface of the saddle. The variable angled support member is made of a variety of lengths for spanning any length range. As shown a second support member 90 is shown is a directly traversing manner wherein the rotatable disks 96 and 100 are placed in a conventional format for placement over the screws 104 and 108. The benefit of the rotatable disk is especially noticeable where the disk may need only a minute movement to accommodate the situation whereas the prior are would require screw removal and replacement.

The system includes the flexibility to attach a cross-link without screw support yet employ the top loading benefit. In this embodiment a U-shaped saddle 91 can be placed about the support rod 120 with a second sagittal placed saddle support 95 shown here in a four protruding member design. Variable cross-link support member 90 with a first rotatable disk 97 for rotating at the four slots in radial relation to the support member 90. A second rotatable disk 100 is placed at the opposite end for rotating at the two slots in radial relation to the support member 90. The freedom of rotation allows for correction of angle when the attachment devices 91 and 95 do not line up

- 9 -

directly across the spine. The metal nuts 112 engage the outer surfaces of the corresponding protruding members. The support member 90 residing tightly against the alignment support rod 120 causing a frictional engagement with the inner surface of the saddle.

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Figures 5 and 6 illustrate a perspective view of a caudal facing hook 130 having a hook shaped base 132 formed integral with a saddle shaped upper portion 134. The saddle shape portion illustrates the protruding member 136 and 138 common to the invention with the threads 140 cast into the outer surface of the members. The saddle in this type of hook allows for attachment directly onto an alignment support rod wherein the metal nut 142 includes internal threads 144 engageable directly with the hook body 130 threads 140 securely fastening the hook in position. Although not shown, but deemed a part of this invention, is the use of various hook embodiments such as claw and fork hook which employ the top-loading threaded attachment of the instant invention. Unique to this invention is the ability to top-load the screw, attachment device, or hook member allowing the surgeon to perform all couplings from directly above the spine, as compared to the prior art requiring the attachment from the side. The importance of this factor cannot be emphasized enough, or illustrated by drawings, as the amount of muscle that encompasses the spinal area must be moved to accommodate the prior art attachment methods.

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Now referring to Figure 7, shown is an alternative embodiment of the screw attachment 150 having four spaced apart protruding members 152. Each protruding member having a first side 154 surface and a second side 156 surface forming an arcuate shaped saddle 158. The third side surface 160 and fourth side surface 162 are threaded for engagement with the inner threaded surface 164 of attachment nut 166. The saddle surface adapted for support of an alignment support rod in a longitudinal or perpendicular mode, the increased saddle surface area providing additional stability for use as a hook or the like attachment. Coupling an alignment support rod to the screw 150 requires the

- 10 -

use of a rectangular rigid plate 170 defined by four edges rounded at the corners with two side surfaces with four openings 172 placed therethrough at each end operatively associated with the four spaced apart protruding members of the attachment screw 150. The support member allows for interconnecting to a second sagittal disposed and/or a bilaterally placed screw 174. The support member 170 for the four protruding members may also include a means for rotating the four openings 172 in radial relation to the support member 170 by use of a rotatable disk similar to that shown in Figure 4 which is permanently secured to the support member 170 allowing freedom of circular rotation. The freedom of rotation allowing for correction of angle when the screws do not line up directly across the spine. Singular attachment plates may also be employed when cross-linking is not desired.

Referring now to Figures 8 and 9, a variable directional attachment screw 180 is shown defined by a first end 182 and a second end 184. The first end 182 having a relatively coarse self-tapping thread 186 over a major portion of its length and a shoulder 188 having a plurality of ridges placed about the circumference. The second end 184 utilizes a rectilinear protruding shaft 190 extending obliquely from the shoulder 188 having a threaded section 192 for use in conjunction with an attachment nut 194. The variable directional screw 182 allows engagement of attachment member 196 having a first directional shaft 198 and base end 200 forming a shoulder. The base end 200 includes a side surface 202 engageable with the shoulder ridges 188 of the screw allowing the base to index about the circumference of the shaft 190 for direction application of the shaft 198. Once a directional locale is depicted, the metal nut 194 is used to engage the threads 192 of the protruding shaft fixing the directional shaft in a stationary position.

As shown in Figure 9, an alternative base end 210 is shown including a side surface 212 engageable with the shoulder ridges 188 of the screw 182 allowing the base to index about the circumference of the shaft 190 for direction application of a

- 11 -

shaft 214. Once a directional locale is depicted, the metal nut 194 is used to engage the threads 192 of the protruding shaft fixing the directional shaft in a stationary position. A second base member 216 can then be added having a side surface 218 engageable with the shoulder ridges 220 located about shaft 214 allowing the second base 216 to index about the circumference of the shaft 214 for direction application of a shaft 222. Once a directional locale is depicted, the metal nut 224 is used to engage the threads of the shaft 214 fixing the directional shaft in a stationary position. A third nut is made available to be tightened to devices such as the plates disclosed in Figures 2 and 3 for pinion type shaft attachment.

Figure 10 illustrates an alternative cross link based upon a C-shaped bracket 230 having two holes 232 and 234 with a peg 236 and nut 238 for locking the bracket 230 in position about a conventional alignment support rod 240. The cross-link 242 can be placed through the pinion type peg 236 by use of attachment holes 244 for stabilizing along the bilateral support rod 240. The cross-link 242 provides stability for a mid-thoracic and is less bulky than the aforementioned cross-links. Further shown is use of an improved alignment rod 240 having a plurality of spaced apart raised ridges 241 to assist in maintaining attachment brackets in a predetermined position.

Figure 11 is a anterior cervical plate employing a second plate for locking purposes. Cervical plate 250 is defined as a first rectangular shaped rigid plate having a first end 252 and a second end 254 and two side edges 256 and 258 with a curvature formed between the two edges causing the plate 252 to have a slight curve in it for the cervical curve. The plate utilizes a plurality of openings such as the slots 260 and holes 262 for use in attaching the plate 250 to the cervical by use of conventional bone screws. A second rectangular shaped rigid plate 270 defined by two ends 272 and 274 and two edges 276 and 278 also having a curvature between the two edges is used to couple to the first plate 250 to prevent the bone screws, not shown, from loosening out of the bone. One surface 280 of the

- 12 -

place includes a series of indentations 282 and 284 to accommodate the bone screws head. The second plate 270 has a plurality of attachment holes 286 placed about the outer edge of the plate 250 for insertion of threaded screws that which in turn  
5 can be threaded in coupling holes 288 placed about the circumference of the first plate 250.

As shown in Figure 12 is a anterior cervical plate employing a second plate for locking purposes. Cervical plate 250 is readily attached to the spine 290 by use of screws 292 placed  
10 into the slots 260. The second plate 270 is then placed over the cervical plate 250, the raised indentations 282 and 284 of the plate allowing a flush attachment. Attachment screws 294 are placed through the openings 286 of the second plate and are threaded into threaded openings 288 of the first plate 250. The  
15 second plate essentially locking the first plate in position by preventing bone screws 292 from working their way out of the bone.

Figure 13 is another embodiment of an anterior cervical plate employing a second plate for locking purposes. Cervical  
20 plate 300 is defined as a first rectangular shaped rigid plate having a first end 302 and a second end 304 and two side edges 306 and 308 with a curvature formed between the two edges causing the plate 302 to have a slight curve in it for the cervical curve. The plate utilizes a plurality of openings such as the  
25 slots 310 and holes 312 for use in attaching the plate 300 to the cervical by use of conventional bone screws. Permanently attached to each side of the plate is attachment strap 314 which includes a means for permanently attaching to strap 316.

A second rectangular shaped rigid plate 320 defined by two  
30 ends 322 and 324 and two edges 326 and 328 also having a curvature between the two edges is used to couple to the first plate 300 to prevent the bone screws, not shown, from loosening out of the bone. One surface of the place includes a series of indentations 330 to accommodate the bone screws head. The second  
35 plate 320 has two coupling points 332 that are operatively associated with the aforementioned strapping means 314 and 316.

- 13 -

As shown in Figure 14 the anterior cervical plate is shown attached in a locked position. Cervical plate 30 is readily attached to the spine by use of conventional bone screws placed. The second plate 320 is then placed over the cervical plate 300, the raised indentations of the plate allowing a flush attachment. The attachment straps 314 is then permanently affixed to the second plate 320 followed by attachment straps 316. The attachment straps permanently affixing the two plates in a juxtaposition.

Figure 15 is still another embodiment of an anterior cervical plate employing a second plate for locking purposes. Cervical plate 350 is defined as a first rectangular shaped rigid plate having a first raised end 352 and a second raised end 354 and two raised side edges 356 and 358 with a curvature formed between the two edges causing the plate 352 to have a slight curve in it for the cervical curve. The plate utilizes a plurality of openings such as the slots 360 for use in attaching the plate 350 to the cervical by use of conventional bone screws. This embodiment employs a plurality of threaded bosses 362 permanently attached to the inner surface of the plate for second plate attachment purposes.

A second rectangular shaped rigid plate 370 defined by two ends 372 and 374 and two edges 376 and 378 also having a curvature between the two edges is used to couple to the first plate 350 to prevent the bone screws, not shown, from loosening out of the bone. The ends and edges fitting within the first plate 350 assimilating a single piece anterior plate. One surface of the second plate includes a series of indentations 384 to accommodate the bone screws head used in attaching the first plate to the bone. The second plate 370 having a plurality of holes 380 to accommodate the bosses 362 wherein attachment nuts 382 permanently fasten the two plates in position.

Referring now to Figure 16, a post screw 390 for attachment to the pedicle bone is shown. A first end 392 includes a relatively coarse self-tapping thread over a major portion of its length. A second end 394 forming an enlarged shoulder 396 for

- 14 -

5 bracket support or placement of spacing washers 398. The second end utilizes a rectilinear protruding shaft 400 extending obliquely from the shoulder 396 having a threaded section 404 for use in conjunction with an attachment nut. Installation can be performed by use of the centrally disposed slot 402 or a hex shaped shaft or shoulder.

10 Referring to Figure 17, a variable angled and adjustable cross-link sagittal traverse support member 410 is shown having a finely threaded aperture 414 for insertion of rotatable disk 412 having engagement threads 416. The disk allowing the surgeon to rotate the disk as well as provide a means for vertical adjustment in a manner similarly to the spacing washers.

15 Figures 18 provides a perspective view of an oversized caudal facing hook 430 having a hook shaped base 432 with a fork opening 440 formed integral with a saddle shaped upper portion 434. The saddle shape portion illustrates the enlarged protruding member necessary in instances of large bone attachment or the need of greater strength. The embodiment utilizes a form of four member protrusion with the U-shaped side surfaces thereby providing the additional support. The saddle allows for attachment directly onto an alignment support rod wherein the metal nut 446 includes internal threads engageable directly with the threaded hook body 436. The nut 446 forcing the support plate 444 tightly against the alignment rod 442, the use of a beveled support plate is shown 444 which is preformed to accommodate the curvature of the rod thereby allowing an increase in the surface area of contact.

20 It is to be understood that while we have illustrated and described certain forms of our invention, it is not to be limited to the specific forms or arrangement of components herein described and shown. It will be apparent to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown in the drawings and described in the specification.

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- 15 -

What is claimed is:

Claim 1. A surgical implant system for the stabilization of a human spine by fixation of vertebra, said system comprising:

5 a first screw formed from a shank having a first end and a second end, said first end having a relatively coarse self-tapping thread over a predetermined length of said first end, said second end having at least two spaced apart protruding members extending obliquely therefrom, each protruding members defining an inner surface saddle shaped and configured for receipt of at least one rod therein, said surface saddle having at least one outer threaded surface;

10 means for connecting said first screw to a second screw and being directly engaged to first screw and second screw, said second screw having a first end and a second end, said first end having a relatively coarse self-tapping thread over a predetermined length of said first end, said second end having at least two spaced apart protruding members extending obliquely therefrom, said protruding members defining an inner surface saddle shaped and configured for receipt of at least one rod therein, said surface saddle having at least one outer threaded surface;

15 at least one nut having an internal thread engageable with said threads formed on said outer surface of said protruding member for rigidly coupling said means for connecting to either said first screw or said second screw;

20 wherein said first screw and said second screw are each configured and adapted to be inserted into bone structure of a human spinal column whereby placing a rod within the saddle of said first screw and the saddle of said second screw allows for the stabilization of a human spine in a fixed position upon securing said rod in said saddles upon attachment of said nut.

25 Claim 2. The surgical implant system according to Claim 1 wherein said saddle surface is receptive to a conventional alignment support rod for positioning along the length of the vertebra of the spine.

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- 16 -

Claim 3. The surgical implant system according to Claim 1 wherein said means for connecting is further defined as a rectangular shaped rigid plate having two ends and two edges with two surfaces therebetween, at least one opening disposed at each end of said plate operatively associated with said protruding members of said screw whereby a first metal screw is rigidly connected to a second screw by placement of said plate over said protruding members and attachment of said metal nuts to said threaded surface of said protruding member.

Claim 4. The surgical implant system according to Claim 3 wherein said slots disposed in each end of said plate includes a means for rotating said slots in radial relation to said plate.

Claim 5. The surgical implant system according to Claim 1 wherein said second end of said screw includes four spaced apart protruding members, each protruding member having an inner surface and an outer surface, said inner surfaces providing an enlarged U-shaped saddle for receiving a rod in a longitudinal or horizontal position, said outer surface having threads formed thereon providing attachment to a nut for rigidly coupling said rod in said longitudinal or horizontal position to said saddle.

Claim 6. The surgical implant system according to Claim 3 wherein said plate has four openings placed therethrough operatively associated with four spaced apart protruding members of a screw for coupling a first screw to a second screw.

Claim 7. The surgical implant system according to Claim 6 wherein said openings of said plate includes a means for rotation.

Claim 8. A surgical implant system for the stabilization of a human spine by fixation of the vertebra, said system comprising: at least two screws with each said screw formed from a shank having a first end and a second end, said first end having a relatively coarse self-tapping thread over a major portion of its length, said second end having spaced apart protruding members defining a U-shaped surface having an inner surface and an outer surface, said inner surface available for

- 17 -

receipt of an alignment rod, said outer surface having threads formed thereon; an alignment rod;

5 a horizontally disposed support member having two ends and two edges forming two side surfaces therebetween with slots disposed at a first end for insertion of said protruding members of a first screw and slots disposed in second end for insertion of said protruding members of a sagittal placed second screw; at least two metal nuts having an internal thread engageable with said threaded surface of said protruding members; wherein said 10 first and second screws are configured and adapted to be inserted into bone structure of a human spinal column along the longitudinal length or horizontal width of a human spine whereby placement of said alignment rod along longitudinally disposed screws provides spine fixation in the longitudinal format and 15 placement of said plate between horizontal disposed screws relative to the human spine provides fixation of the spine across the spinal cord.

Claim 9. The surgical implant system according to Claim 8 wherein said saddle surface is receptive to a perpendicularly placed alignment support rod placed along a length of the 20 vertebra.

Claim 10. The surgical implant system according to Claim 8 wherein said slots disposed in the first end of said horizontally disposed support member includes a means for rotating said two 25 slots in radial relation to said support member.

Claim 11. The surgical implant system according to Claim 8 wherein said two slots disposed in the second end of said horizontally disposed support member includes a means for rotating said slots in radial relation to said support member.

30 Claim 12. The surgical implant system according to Claim 8 including a means for spacing said horizontally disposed support member a predetermined distance from said saddle surface.

Claim 13. The surgical implant system according to Claim 12 wherein said means for spacing is defined as a washer having an 35 elongated slot for disposition over the protruding members of

- 18 -

said screw allowing for placement on a top surface of an alignment support rod placed therein.

5 Claim 14. A surgical implant system for the stabilization of a human spine by fixation of the vertebra, said system comprising: a metal screw having a first end and a second end, said first end having a relatively coarse self-tapping thread over a major portion of its length, said second end having four equally spaced apart protruding members with at least one saddle inner surface formed therebetween, said outer surface of each 10 said protruding member threaded; an elongated sagittal traverse support member having two ends and two edges forming two side surfaces therebetween, said member having four slots disposed at the first end for insertion of said protruding members of a first screw and four slots disposed in said second end for 15 insertion of said protruding members of a sagittal placed second screw; and, at least two metal nuts having internal threads engageable with said outer threaded surface of said spaced apart protruding members; whereby a first metal screw is rigidly connected to a second screw by placement of said support member 20 over said protruding members and attachment of a metal nut to said threaded surface of said protruding members, said saddle surface available for biasing an alignment support rod in conjunction with said support member.

25 Claim 15. The surgical implant system according to Claim 14 wherein said saddle surfaces is receptive to a perpendicular or transversely placed alignment support rod.

30 Claim 16. The surgical implant system according to Claim 14 wherein said four slots disposed in the first end of said traverse support member includes a means for rotating said four slots in radial relation to said support member.

Claim 17. The surgical implant system according to Claim 14 wherein said four slots disposed in the second end of said traverse support member includes a means for rotating said four slots in radial relation to said support member.

- 19 -

Claim 18. The surgical implant system according to Claim 14 including a means for spacing said traverse support member a predetermined distance from said saddle surface.

5 Claim 19. The surgical implant system according to Claim 18 wherein said means for spacing is defined as at least one washer having at least one centrally disposed aperture available for disposition over the protruding members of said screw allowing for placement on a top surface of an alignment support rod placed therein.

10 Claim 20. A surgical implant system for the stabilization of a human spine by fixation of the vertebra, said system comprising a metal sacral screw having a first end and a second end, said first end having a relatively coarse self-tapping thread over a major portion of its length and a shoulder formed from a plurality of ridges, said second end having a threaded protruding shaft rectilinear from said first end; a first direction shaft having a first end formed of a shoulder having a side surface engageable with said shoulder ridges with a shaft protruding perpendicular therefrom; and at least one metal nut having internal threads engageable with said threaded protruding shaft; said should ridges allowing said base to interdigitate.

20 Claim 21. The surgical implant system according to Claim 20 wherein said direction shaft having a shoulder placed at the proximal end of said protruding shaft.

25 Claim 22. The surgical implant system according to Claim 20 including a second direction shaft having a first end formed of a shoulder having a side surface engageable with the shoulder ridges of a first directional shaft, said shaft protruding perpendicular therefrom with at least one metal nut having internal threads engageable with said threaded protruding shaft.

30 Claim 23. A surgical implant system for the anterior cervical comprising; a first rectangular shaped rigid plate defined by two ends and two edges with two surfaces forming a curvature between said two edges, said two surfaces having a plurality of openings placed therethrough; a second rectangular shaped rigid plate defined by two ends and two edges with two

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surfaces forming a curvature between said two edges, one of said surfaces having a plurality of indentations to accommodate screw heads; and a means for coupling said first and second plate in a locked position; whereby said first plate is attached to the anterior cervical by use of conventional bone screws placed through said first plate openings, said second plate is coupled to said first plate wherein said second plate indentations accommodate said attachment screws and prevent said screws from loosening from the cervical.

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FIG. 1

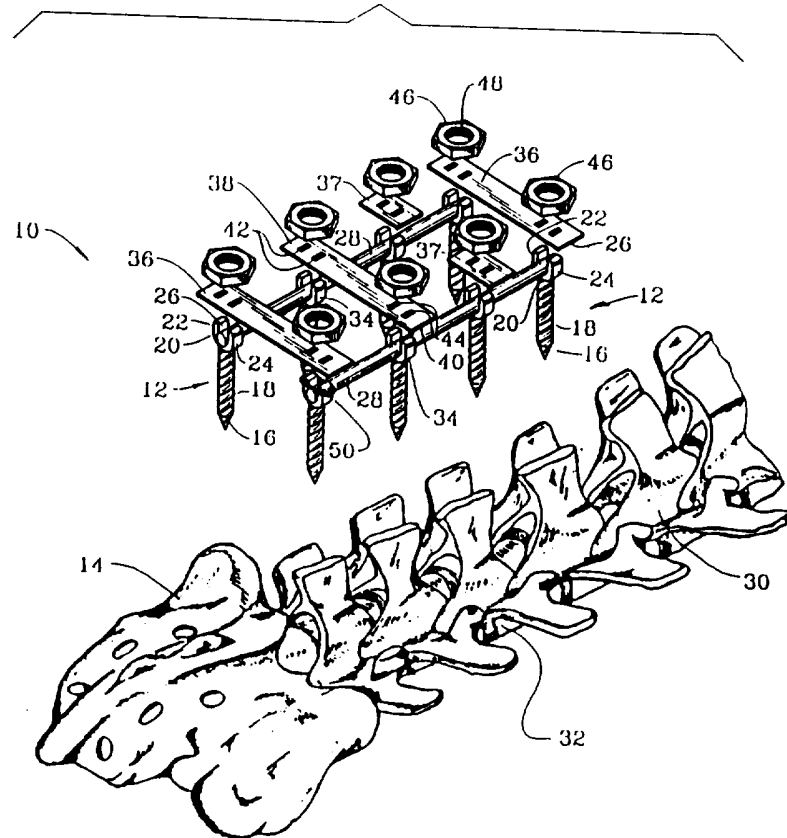


FIG. 2

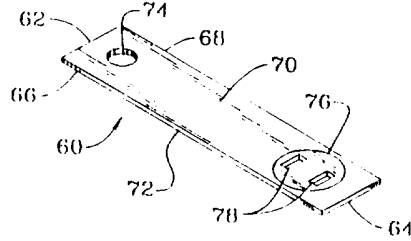


FIG. 3

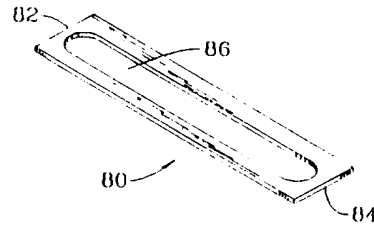


FIG. 4

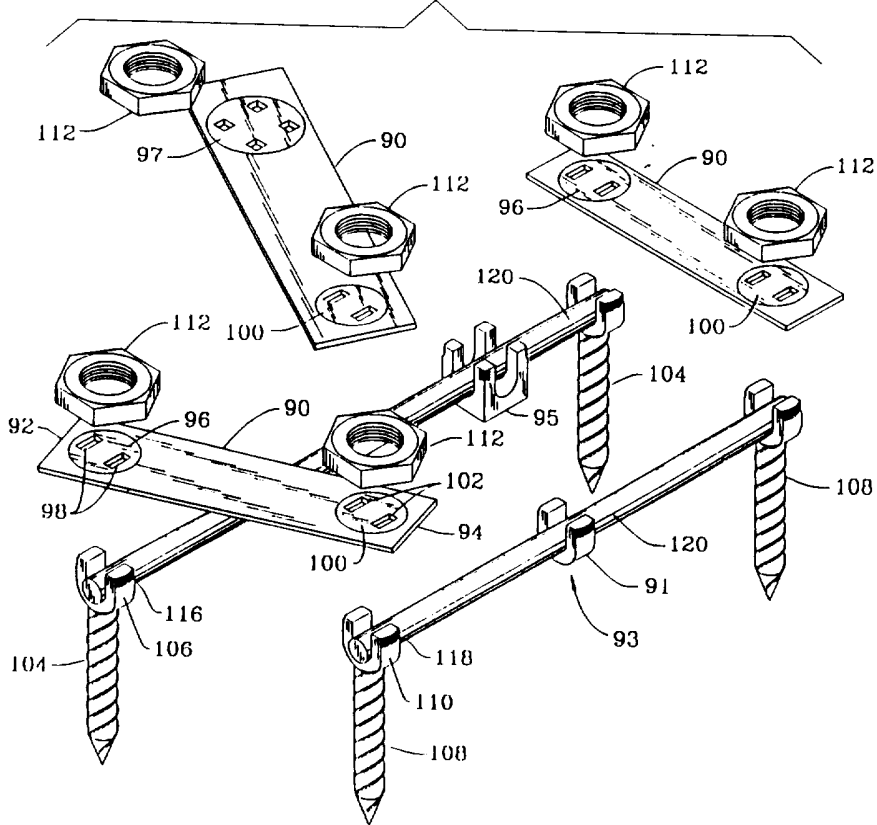




FIG. 5

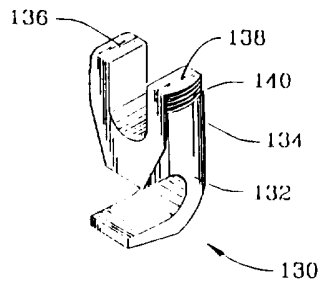


FIG. 6

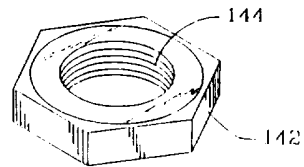


FIG. 7

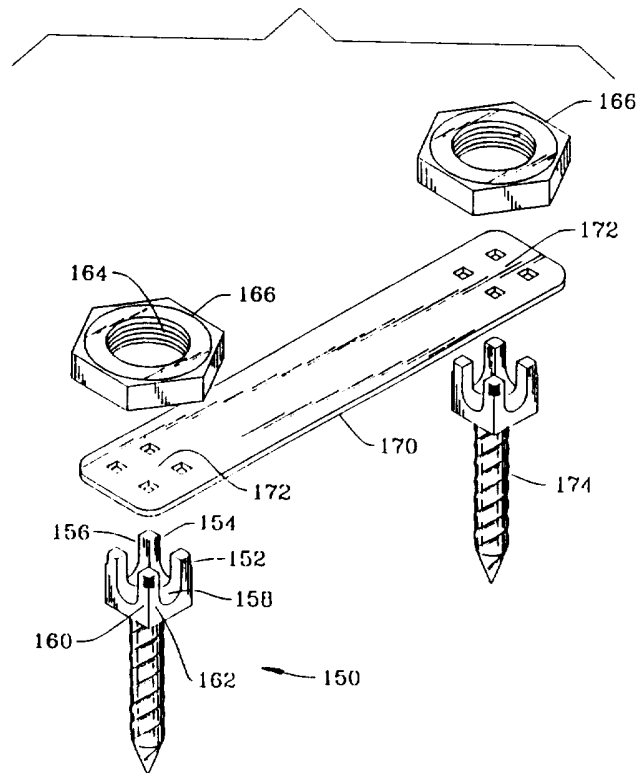


FIG. 10

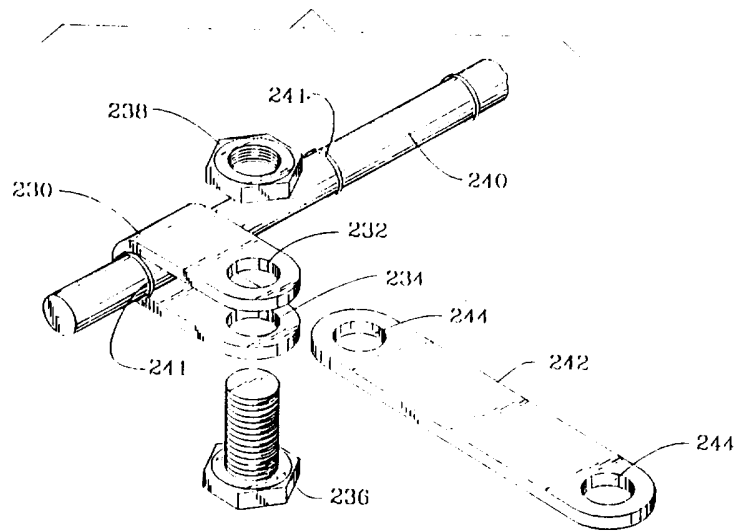


FIG. 9

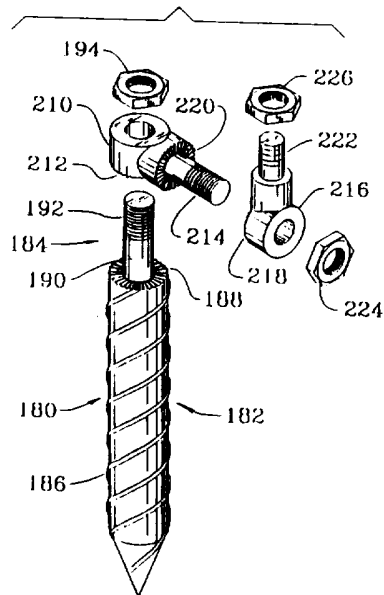


FIG. 8

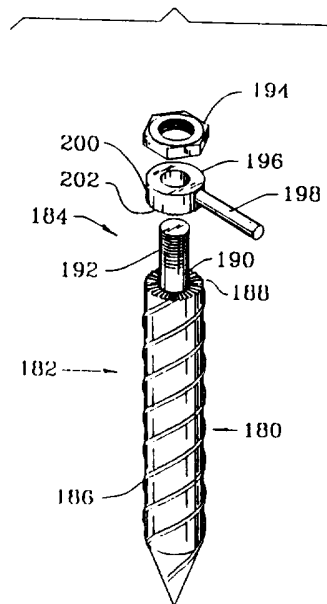


FIG. 11

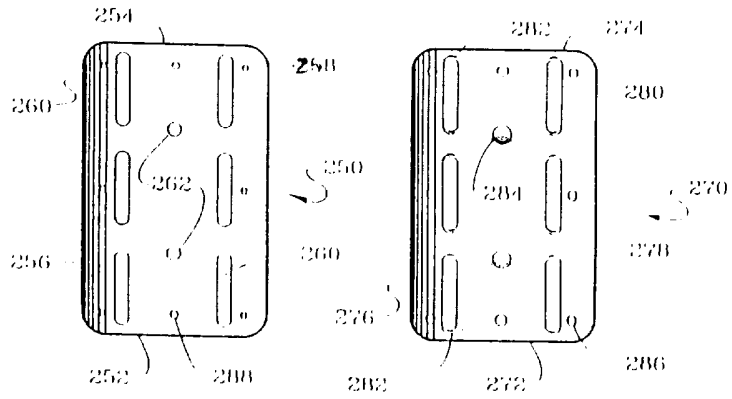


FIG. 12

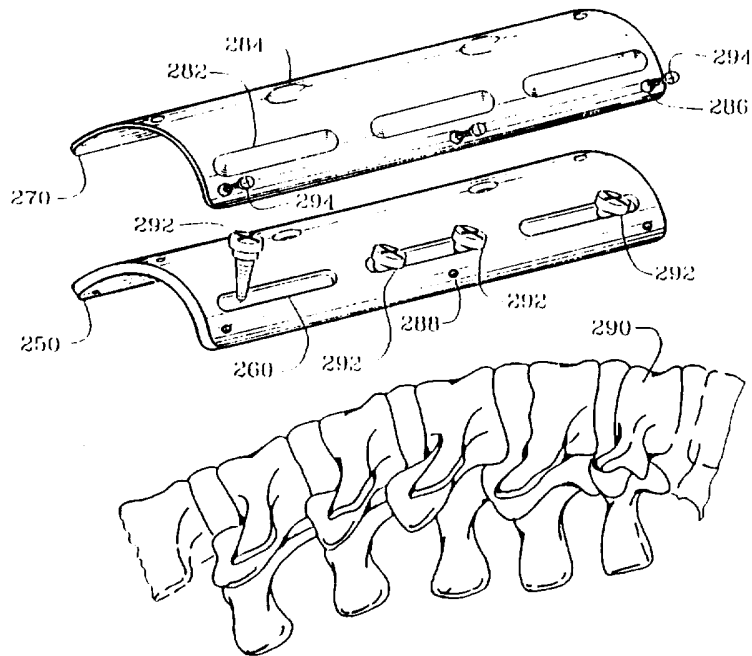


FIG. 13

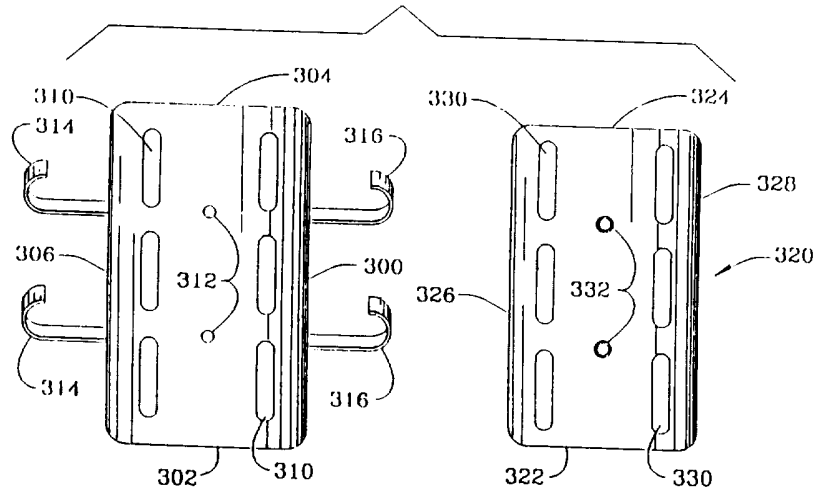


FIG. 15

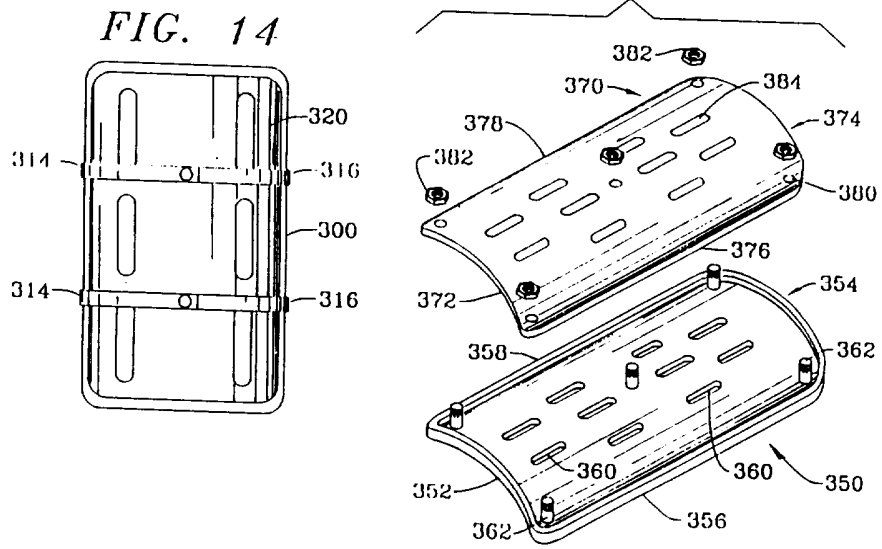


FIG. 16

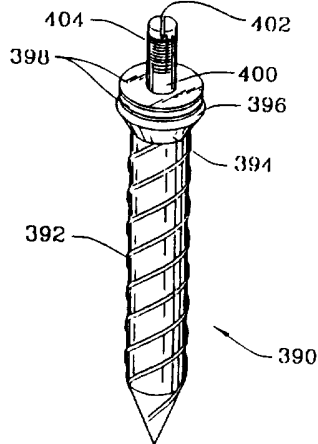


FIG. 17

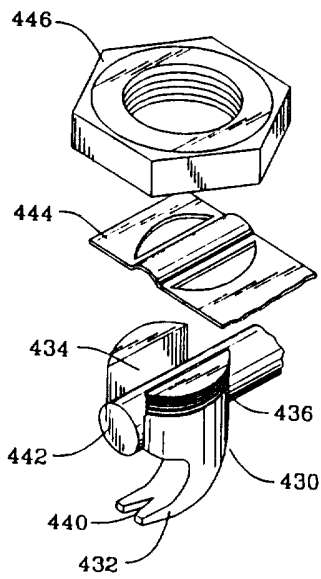
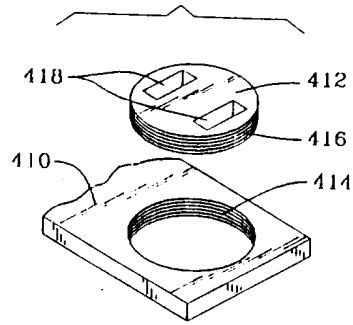


FIG. 18

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 95/03331

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 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)  
IPC 6 A61B

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)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,U,90 16 227 (HOWMEDICA GMBH) 14 February 1991 see the whole document	1,2
A	---	3,8,14
A	WO,A,91 01691 (J.B.S. S.A.) 21 February 1991 see page 9, line 26 - page 13, line 2 see page 15, line 5-30; figures 1-7,20-22	1,8,14
A	---	1
A	EP,A,0 514 303 (VIGNAUD ET AL.) 19 November 1992 see the whole document	1
A	---	1
A	FR,A,2 615 095 (SOCIETE DE FABRICATION DE MATERIEL ORTHOPEDIQUE) 18 November 1988 see abstract; figures	1
	---	-/--

Further documents are listed in the continuation of box C.

Patent family members are listed in 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.
- \*&\* document member of the same patent family

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Date of the actual completion of the international search  <p style="text-align: center; font-size: 1.2em;">12 December 1995</p>	Date of mailing of the international search report  <p style="text-align: center; font-size: 1.2em;">14. 03. 96</p>
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  <p style="text-align: center; font-size: 1.2em;">GIMENEZ BURGOS, R</p>

# INTERNATIONAL SEARCH REPORT

Internat. Application No.  
PCT/US 95/03331

**C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 242 842 (WOLTER) 28 October 1987 see abstract; figures 2,3 ---	
A	EP,A,0 553 517 (AMERICAN MEDICAL ELECTRONICS, INC.) 4 August 1993 see figure 4 -----	

## INTERNATIONAL SEARCH REPORT

national application No.

PCT/US 95/ 03331

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. Claims : 1-19 Surgical implant system comprising a screw, having protruding members defining an inner surface saddle for receiving a conventional support rod
2. Claims : 20-22 Surgical implant system comprising a variable directional attachment screw.
3. Claim : 23 Surgical implant system comprising a curved bone plate.

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-19

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 95/03331

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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