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THOPEDIC PLATE

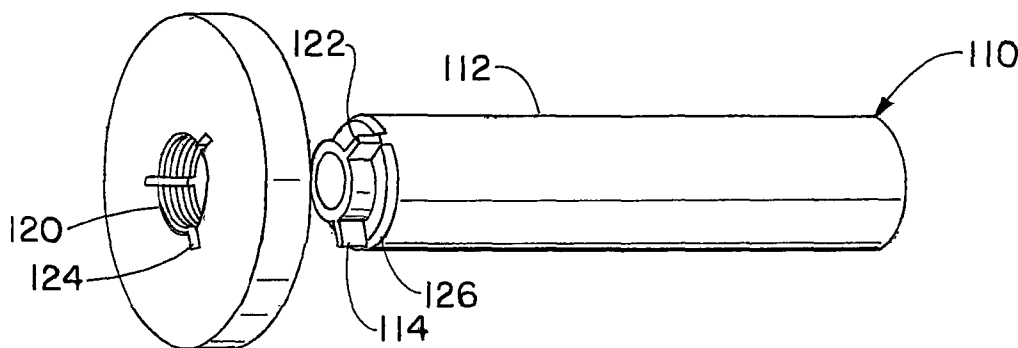


FIG. 8

(57) Abstract: A surgical drill guide for positioning, aligning, and of holes to be drilled in bone tissue has retaining means that holds the position and alignment of the drill guide body in a releasable manner with respect to a fastener hole in an orthopedic implant. The retaining means is a key guide that mates with a key way or key ways in or around a threaded locking hole of an orthopedic plate for alignment of a pilot hole and method of using the guide. The key guide has 2 to 8 projections that extend in the direction of the axis of the hole, such as hemi-cylindrical projections, and the plate has a corresponding female key way that receives the retaining means.

SURGICAL DRILL GUIDE HAVING KEYWAY FOR AXIAL ALIGNMENT OF FASTENER USED FOR AN ORTHOPEDIC PLATE

CROSS REFERENCE

[0001] This application claims the benefit of priority under 35 U.S.C. § 119 of U.S. Provisional Application Serial No. 60/959,097 filed on July 11, 2007.

FIELD OF THE INVENTION

[0002] The present invention relates generally to surgical drill guides. More specifically, the present invention relates to surgical drill guides used with corresponding orthopedic implants for positioning and orienting holes to be drilled in bone tissue for receiving a fastener which has a locking relationship to the implant.

BACKGROUND OF THE INVENTION

[0003] As the field of orthopedics has advanced, increasing types of constructs have been developed for implantation into human and other animal bodies. There is heightened sophistication in the interplay between the implant, the bone, or bones, the surrounding soft tissue, and the fastener. For example, as the field has developed an understanding has also developed that an implant, such as a plate, can be used to support bone fragments in close, or even compressed association in order to promote the fusion of the fragments, or segments. This has lead to plates, which have a structure that is increasingly designed to function in the healing process, rather than merely acting as a scaffold. For example, an orthopedic surgeon can use an orthopedic implant to reduce a fracture or to rebuild a shattered bone, as well to hold segments of a joint in compression to allow for fusion. Thus, the implant is designed with the understanding that the biological environment is not ever exactly static, and the forces that are applied by the implant to the bone, and by the bone and soft tissue back to the implant will influence the healing or even the restructuring of a bone or bones. Moreover, these plates are increasingly structured to have an anatomical contouring rather than a flat planar shape.

[0004] An essential aspect of the proper functioning of the construct is the fastening means that forms the attachment between the implant and the bone. These fastening means can include various types of screws, threaded and non-threaded pegs, k-wires, hooks and other anchoring means. The implants typically include plates, rods, spacers, and cages and implants can include multiple fasteners. Further, the fasteners have various types of interfaces with the implant, including a multiaxial relationship, or a locking relationship or a locking variable axial relationship. In the instance in which the fastener has a ball and socket interface with the implant, the angle at which the fastener is held in the bone is less critical since the implant can receive the fastener at a variety of angles. However, in some instances, it is desirable that the plate be held to the plate at a defined angle. In the prior art, plate surfaces might be planar, and the fastener simply resided in the bone more or less perpendicular to the plate. However, much more sophisticated plate design may dictate fastener holes in the plate that are at a desired angle in a non-planar plate. In this instance, the plate surface is no longer a satisfactory reference for determining the angle to drill in the bone for receiving the fastener.

[0005] Constructs are often designed so that the fasteners will reside in the bone and locked relative to the plate at a desired angle so that the construct achieves the optimal stability, the optimal pull-out values for the fasteners, and or the optimal fixation for typical fragments. There are present designs in distal radius plates, as an example, typically where pegs are located and angled to capture various types of fragments that result from the most common breaks. These plates might have a head design with 4 or 7 holes at designated angles so that a surgeon has the option of choosing one, two, all, or some number in between, in order to best set a broken radial fracture.

[0006] Often the surgical procedure includes a step of drilling holes in the bone or bones in order to accommodate fastening devices such as screws or pegs used to anchor implants within a patient's body. For instance, screws have

been used to anchor plate systems to the long bones of patients for stabilizing a variety of fractures or correcting disorders.

[0007] One commonly used technique for inserting a fastening screw into the bone includes the preparation of a pilot hole through the cortical surface of the bone and into the cancellous portion before inserting the screw therein. Typically, the selection of the insertion point is made based on the desired placement of the plate on the bone in relation to the break. Once the insertion point has been selected, a drill guide may be used separately or in conjunction with the plate to guide the drill bit along a desired axis, and/or to set the depth to which the drill bit penetrates the bone. These guides typically have a distal end, which may screw into an internal thread if the plate hole is threaded. Alternatively, the guides may include a tapered end, which can be jammed into the hole. While the former style of guide has the advantage of setting the angle for the screw relative to the plate, it can be cumbersome, time consuming and often difficult to screw the drill guide into these holes. While the taper fit has the advantage of a relatively easy interface, it does not guarantee the angle of the axis of the screw, in the bone or relative to the plate. One prior art guide include an overlay that is fixed to a distal radius plate to fix the angles of multiple holes for various screws or pegs used to fix the head to the distal portion of the radius bone.

[0008] The present invention relates to a surgical drill guide having a drill guide body which receives and guides a drill bit and which has a distal end for placement through a mating opening in a bone implant so that the distal end is substantially adjacent an exterior surface of a bone which is intended to receive a bone fastener. The implant is specifically a plate. The drill guide can be used with locking or non-locking fasteners, but is advantageously used with locking fasteners in which the angle of the fastener relative to the axis of the fastener hole is critical to proper functioning of the construct. Thus, the invention relates most specifically to a drill guide system comprising a drill guide used in conjunction with a plate having a threaded hole which receives the threaded head of a bone fastener. The distal end of the drill guide includes an interface

which mates with the plate so as to position the drill guide for placement and axial alignment of a hole in the bone that receives a fastener for the implant. The body of the drill guide is held in place relative to the implant so as to define the angle as well as the location of the fastener hole in the bone.

[0009] The drill guide of the present invention that has the ease and simplicity of use of a single hole drill guide. This allows the surgeon the best visual access to the bone, but as it has an interface that forms a removable key fit with the plate so that the guide that can be easily inserted and locked from rotation, as well as into a specified angle relative to the screw hole. By "key fit" it is meant that there is a relationship which is a sliding relationship in the longitudinal direction and in a radial direction about that longitudinal axis, there is a radial locking relationship such is formed between a channel having a complex or non circular cross-section. After the pilot hole has been drilled, the drill guide is easily and quickly removed from engagement with the key hole in the plate and moved to a further hole in the plate.

[0010] The key fit preferably includes the mating interface between the longitudinal surface of the drill guide tip and recesses in or around the fastener hole in the plate, which can be a key and key way that are respectively hemi-cylindrical, or more ridge-like projections along the long axis of the drill guide tip that mate with corresponding female shaped recesses in or around the fastener hole. There can be two or more projections, with two to six, and preferably three or four, being ideal. Fewer projection decrease the possibility of stripping the projections and increase the security of the locking, while more projections make it easier to find the proper orientation of the drill guide tip in the recess. Also, the drill guide may include a flat shoulder that seats on a flat internal surface of the fastener recess. Thus, the fastener hole may include a counterbore defining a rim that captures a shoulder on the drill guide tip. The drill guide may also include a means to determine the drill depth, such as a marked fenestration along the shaft of the drill guide body.

SUMMARY OF THE INVENTION

[0011] The present invention is directed to a surgical drill guide. The drill guide may include a drill guide body having a distal end for placement through a fastening hole or holes in an implant, such as a plate and substantially adjacent a bone. The drill guide body further includes a proximal end with an opening into a through bore for receiving and guiding a drill bit. The distal end of the drill guide includes an interface with the plate that releasably retains the position of the drill guide body with respect to the fastening hole. The interface preferably comprises a key having multiple lobes or projections (i.e., from 2 to 8 or preferably 6, and more preferably 3 or 4), which mates with corresponding females recesses that form key ways in or about the fastener recess to hold the drill guide in position in the recess. Further, the interface includes means to hold the axial positioning of the drill guide relative to the plate in order to fix the angle of the fastener relative to the plate. These lobes or projections may reside within the threads or any other location within the plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The invention will be better understood and other features and advantages will become apparent by reading the detailed description of the invention, taken together with the drawings, wherein:

Figure 1 is a perspective view of the drill guide in accordance with the present invention;

Figure 2 is a side view of the drill guide of Figure 1;

Figure 3 is an end view showing the alignment tip of the drill guide of Figure 1;

Figure 4 is a view from the other end of the drill guide of Figure 1;

Figure 5 is a top view of a plate having a threaded recess for a locking screw and further being configured to receive the alignment tip of the drill guide of Figure 1;

Figure 6 is a detail of a threaded recess for a locking screw from Figure 5;

Figure 7 is a cross section of the recess of Figure 6 taken at line 7-7;

Figure 8 is a perspective view of an alternative embodiment of the drill guide with a mating threaded locking hole in accordance with the present invention;

Figure 9 is a side view of the drill guide of Figure 8;

Figure 10 is an end view showing the alignment tip of the drill guide of Figure 8;

Figure 11 is a view from the other end of the drill guide of Figure 8;

Figure 12 is a top view of a detail from a plate showing the fastener recess which receives the detent tip of the drill guide of Figure 8;

Figure 13 is a cross section of the recess in a plate taken at line 13-13 of Figure 12;

Figure 14 is a side view of the drill guide with a drill in use to drill a hole through a recess in a plate into a bone;

Figure 15 is a top view of a distal radius plate illustrating the use of the present invention in yet another implant; and

Figure 16 is a side view of the distal radius plate of Figure 15.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Referring to FIGS. 1 and 2, an illustrative embodiment of a surgical drill guide according to the present invention is shown. Drill guide 10 includes a drill guide body 12 with a proximal end and a distal end which includes a drill guide tip 14. The drill guide body 12 has an opening 18 that extends through the body 12 so as to form a substantially tubular shaft which defines a cannula for

receiving a drill bit. The shaft terminates in the drill guide tip 14 which includes an aligning mechanism that defines the angle and position of the cannula so as to guide a drill bit for a desired angle and position for a pilot hole for a fastener.

[0014] The aligning mechanism 20 comprises a mating interface with the implant (which is preferably a plate) with which the drill guide is used. This preferably includes a mating interface between the longitudinal surfaces of the drill guide tip and recesses 21 in the fastener hole 19 of the plate 23, which can comprise a key and key way that are respectively hemi-cylindrical, or more ridge-like projections 22 along the long axis of the drill guide tip that mate with corresponding female shaped recesses 24 along the long axis of the screw hole. There can be two or more projections, with two to six, and preferably three or four, being ideal. Fewer projections are less disruptive to the internal locking threads of the fastener hole, while more projections make it easier to find the proper orientation of the drill guide tip in the recess. Also, the drill guide may include a shoulder 26 that seats on an internal surface 28 such as is formed by a counterbore at the opening to the fastener recess. The fastener recess also includes internal threads 30 that receive external threads on the head of a locking screw. The alignment recesses can also be external to or longitudinally superior to the threads.

[0015] An alternate embodiment of the drill guide 110 of the present invention is shown in Figure 8. This guide includes a drill guide tip 114 with a similar aligning mechanism 120. In this embodiment, the projections 122 are planar (i.e. forming a portion of a rectangle in cross-section) and the female aligning recesses 124 are also planar. The tip includes the shoulder 126 which seats on a rim 128 formed in the fastening recess 119. The recess 119 also includes internal threads 130 that receive the external threads of a locking screw or peg.

[0016] Figure 14 shows a drill 40 engaged in a drill guide of the present invention boring a hole in a bone.

[0017] Figures 15 and 16 illustrate a distal radius plate 223 having threaded through holes 219 for locking fasteners which are designed to receive the fasteners at specific angles in order to facilitate the optimal restructuring of typical fractures during surgery.

[0018] The invention also relates to a method of forming a bone construct for a bone that comprises a plate having one or more through holes for a fastener, and in particular where one of more of the holes include an internal thread that mates with a threaded portion on the fastener, comprising the step of placing the plate on the bone and using a drill guide having a distal end having at least one longitudinally extending projection that mates with a corresponding recess in the plate to hold the drill guide at a desired angle relative to the bone, and using the drill guide to guide the angle of a hole in the bone for a fastener which extends through the plate into the hole in the bone and which is locked at a desired angle relative to the plate by the mating of the internal thread in the hole in the plate with the threaded portion of the fastener.

[0019] While it is apparent that the illustrative embodiments of the invention herein disclosed fulfill the objectives stated above, it will be appreciated that numerous modifications and other embodiments may be devised by those skilled in the art. Therefore, it will be understood that the appended claims are intended to cover all such modifications and embodiments, which come within the spirit and scope of the present invention.

WHAT IS CLAIMED IS:

1. A drill guide system for positioning and aligning a hole drilled by a drill in a bone comprising:

a drill guide and a plate having at least one recess which defines a longitudinal axis for a fastener,

the drill guide having a drill guide body and a first end and a second end with a cannula therethrough, the second end of the drill guide body including an aligning tip which has at least one projection that extends in the direction of the longitudinal axis, and the recess including at least one female aligning recess which forms a mating interface with the at least one projection so as to define an angle of the cannula of the drill guide.

2. A drill guide as set forth in claim 1 wherein the aligning tip has from 2 to 8 projections.

3. A drill guide as set forth in claim 2 wherein the projections are hemicylindrical or planar flanges.

4. A drill guide as set forth in claim 3 wherein there are 3 or 4 projections.

5. A method of forming a bone construct for a bone that comprises selecting a plate having one or more through holes for a fastener, where one of more of the holes include an internal thread that mates with a threaded portion on the fastener the method comprising the step of placing the plate on the bone and using a drill guide having a distal end having at least one longitudinally extending projection that mates with a corresponding recess in the through hole in the plate to hold the drill guide at a desired angle relative to the bone, and using the drill guide to guide the angle of a hole in the bone and engaging a fastener which extends through the plate into the hole in the bone and locking the fastener at a desired angle relative to the plate by the screwing the threaded portion of the fastener into the internal thread in the hole in the plate.

6. A method as set forth in claim 5 wherein the distal end has from 2 to 8 projections and the plate has a corresponding number of recesses.

7. A method as set forth in claim 6 wherein the distal end has 3 or 4 projections.

8. A method as set forth in claim 8 wherein the distal end further includes a shoulder and the through hole include a counterbore that receives the shoulder.

9. A drill guide system for positioning and aligning a hole drilled by a drill in a bone comprising:

a drill guide and a plate having at least one recess which defines a longitudinal axis for a fastener,

the drill guide having a drill guide body and a first end and a second end with a cannula therethrough, the second end of the drill guide body including an aligning tip which has at least one key comprising a projection that extends in the direction of the longitudinal axis, and the recess including at least one key way comprising a female aligning recess which forms a mating interface with the key so as to define an angle of the cannula of the drill guide.

10. A drill guide as set forth in claim 9 wherein the aligning tip has from 2 to 8 projections.

11. A drill guide as set forth in claim 10 wherein the projections are hemi-cylindrical or planar flanges.

12. A drill guide as set forth in claim 11 wherein there are 3 or 4 projections.

13. . A method as set forth in claim 8 wherein the distal end further includes a shoulder and the through hole include a counterbore that receives the shoulder.

14. A method of forming a bone construct for a bone that comprises selecting a plate having one or more through holes for a fastener, the method comprising the step of placing the plate on the bone and using a drill guide having a distal end having a key that comprises at least one longitudinally extending projection that mates with a key way comprising a corresponding recess in the through hole in the plate to hold the drill guide at a desired angle relative to the bone, and using the drill guide to guide the angle of a hole in the bone and engaging a fastener which extends through the plate into the hole in the bone .

15. A method as set forth in claim 14 wherein the distal end has from 2 to 8 projections and the plate has a corresponding number of recesses.

16. A method as set forth in claim 15 wherein the distal end has 3 or 4 projections.

17. A method as set forth in claim 16 wherein the distal end further includes a shoulder and the through hole includes a counterbore that receives the shoulder.

18. A method as set forth in claim 14 wherein the fastener is a locking fastener which resides at a selected angle with respect to the longitudinal axis of the plate.

19. A method as set forth in claim 18 wherein the at least one through hole include internal threads and the fastener has a trailing end with external threads that mate with the internal threads to lock the angle of the fastener at the selected angle.

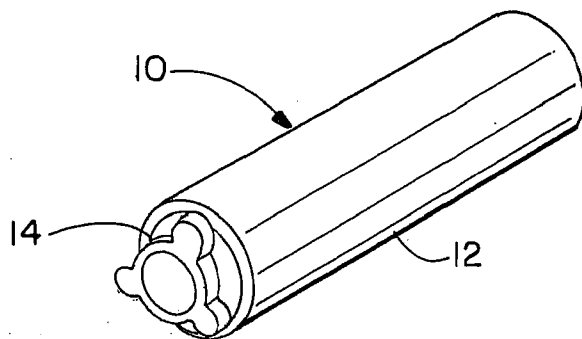


FIG. -1

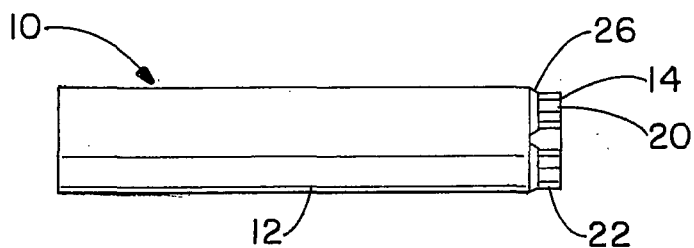


FIG. -2

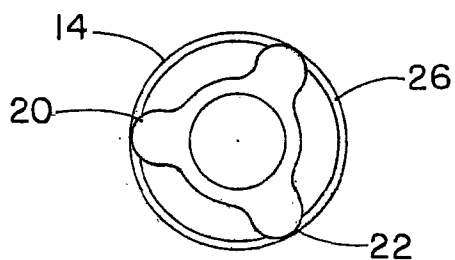


FIG. -3

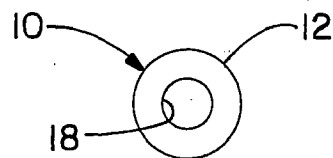


FIG. -4

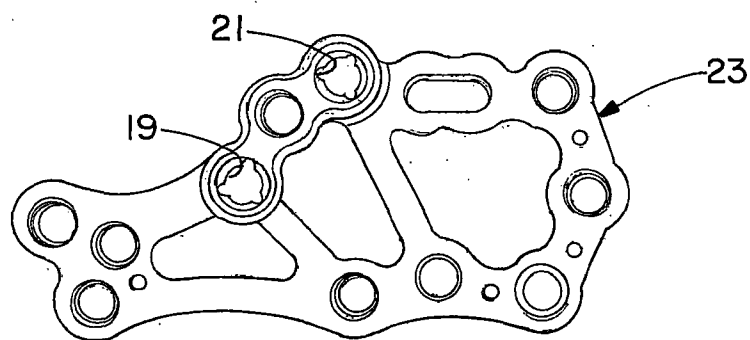


FIG. -5

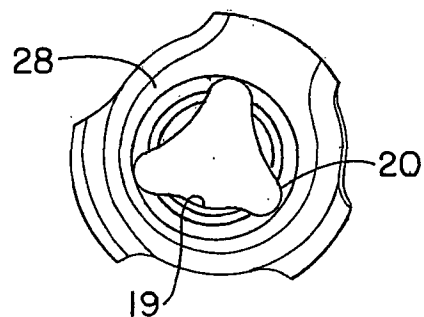


FIG. -6

FIG.-7

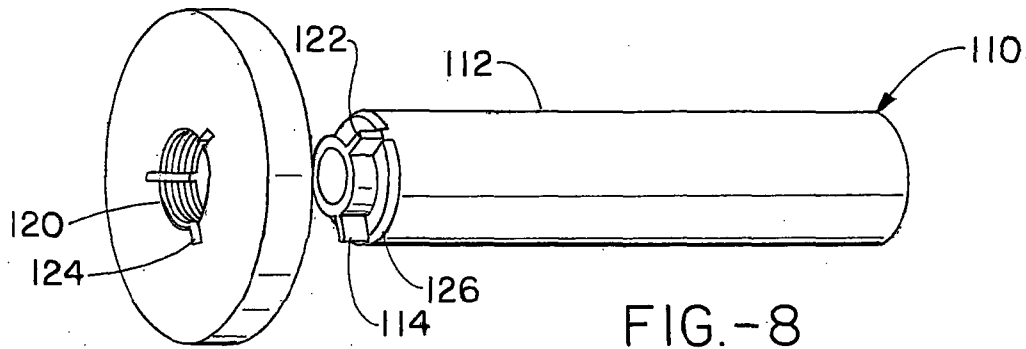
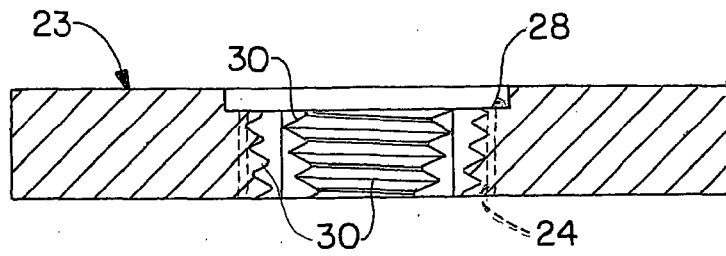


FIG.-8

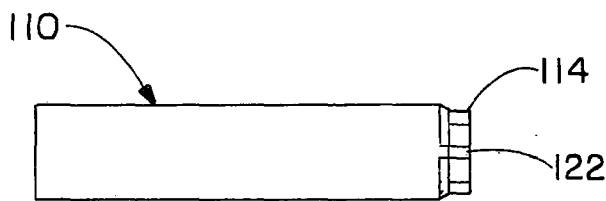


FIG.-9

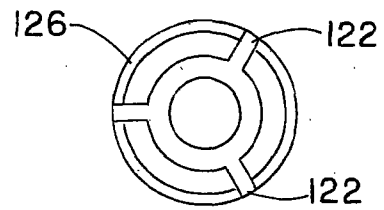


FIG.-10

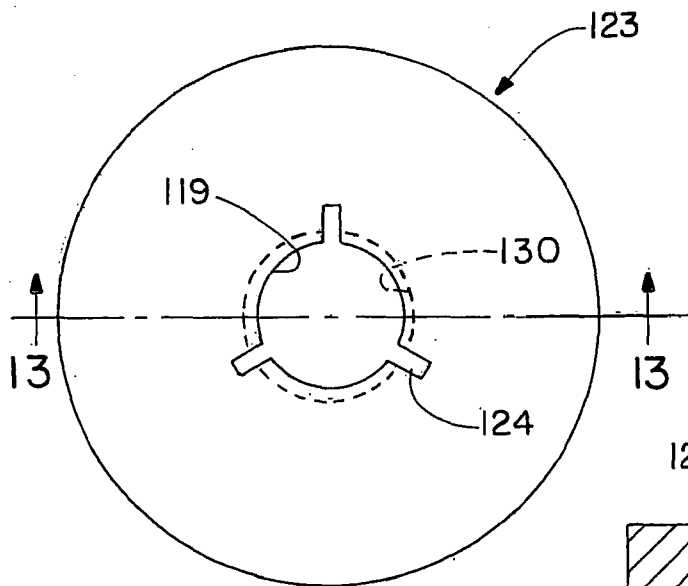


FIG.-12

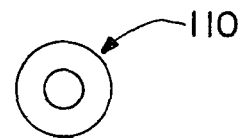


FIG.-11

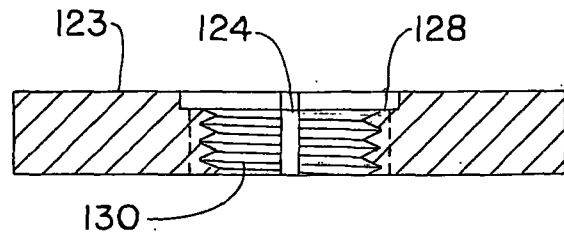


FIG.-13

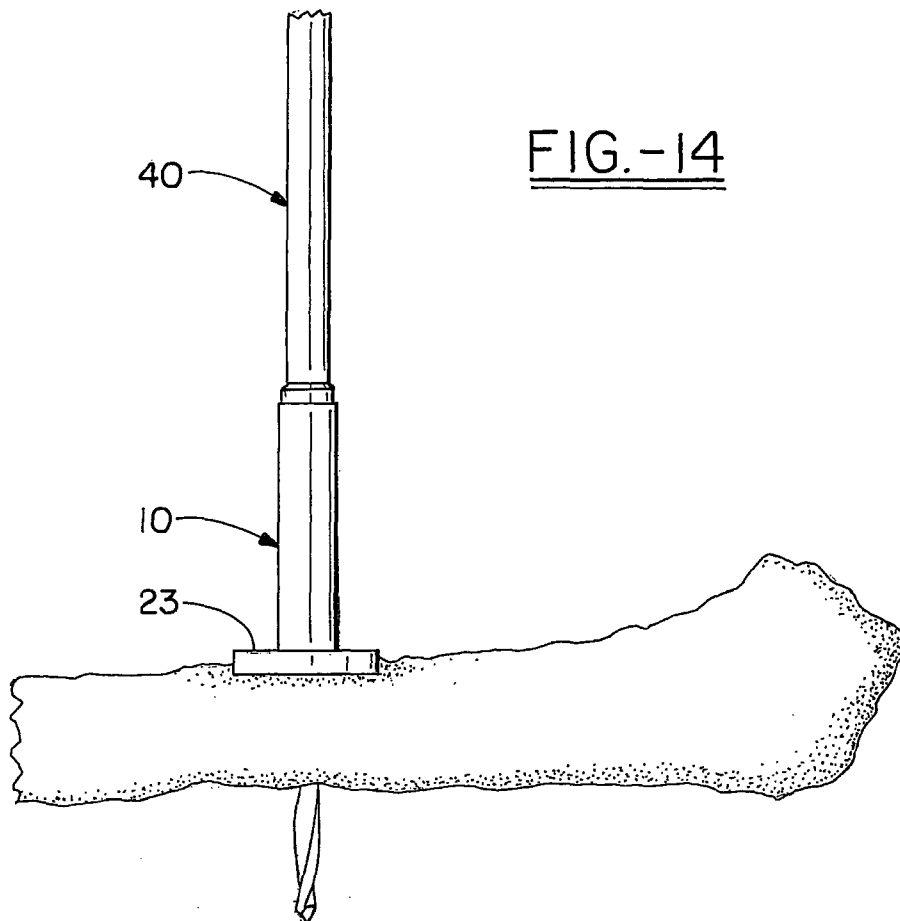


FIG.-15

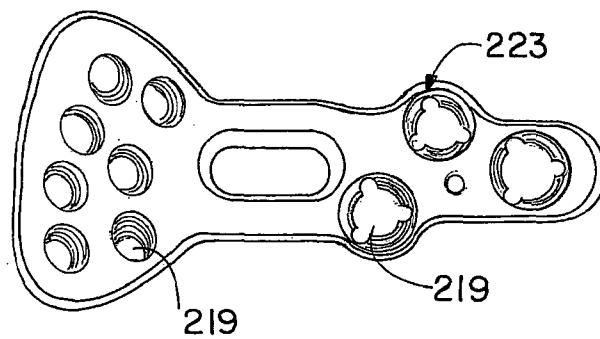
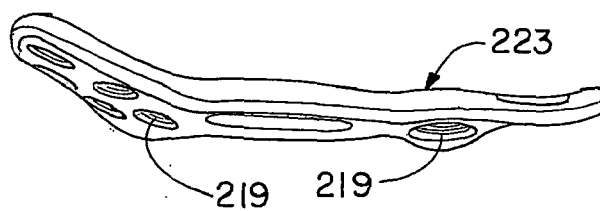


FIG.-16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 08/08397

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61B 17/90 (2008.04)

USPC - 606/96

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)
USPC- 606/96Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC- 606/86R, 98, 104

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

Google Patents, Google Scholar, PTO AppFT, PTO PatFT

Search Terms: aligning, angle, bone, drill guide, flange, thread, internal thread, cannula, projections, hemicylindrical flange, aligning tip,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 6,379,364 B1 (BRACE et al.) 30 Apr 2002 (30.04.2002); abstract; col 3, ln 5-12; col 9, ln 23-35; col 1, ln 33-3	14 ----- 1-13, 15-19
Y	US 5,403,322 A (HERZENBERG et al.) 04 Apr 1995 (04.04.1995); claim 12	5-8, 19
Y	US 2006/0085077 A1 (COOK et al.) 20 Apr 2006 (20.04.2006); para [0060].	1-4, 9-13, 15-19
Y	US 5,928,244 A (TOVEY et al.) 27 Jul 1999 (27.07.1999); col 6, ln 1-5; col 6, ln 32-36	1-4, 9-13, 15-17
Y	US 6,059,789 A (DINGER et al.) 09 May 2000 (09.05.2000); col 7, ln 20-29; col 9, ln 25-31	2-4, 6-8, 10-13, 15-17
Y	US 5,415,502 A (DAHLIN) 16 May 1995 (16.05.1995); claim 4	3, 4, 11, 12

☐ Further documents are listed in the continuation of Box C.

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Date of the actual completion of the international search

14 Oct. 2008 (14.10.2008)

Date of mailing of the international search report

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