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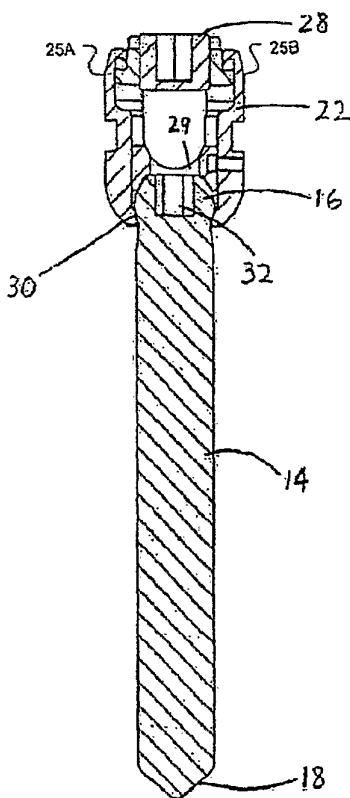
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[Continued on next page]

(54) Title: POLY-AXIAL BONE SCREW MATING SEAT



(57) Abstract: Embodiments of bone securing system including a coupling element having a seat are described generally herein. Other embodiments may be described and claimed.

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POLY-AXIAL BONE SCREW MATING SEAT

Technical Field

[0001] The present invention relates generally to poly-axial bone screws and, more particularly, to poly-axial bone screws having improved gripping action between a screw head and a coupling element seat of the bone screw.

Background Art

[0002] Bone securing systems may be provided to couple a bone stabilization rod or element to a bone securing member. In some systems a coupling member may be provided between the bone stabilization rod and bone securing member. The coupling member or element may include an interface between a portion of the bone securing member and the rod.

Brief Description of the Drawings

[0003] Figures 1A and 1B illustrate perspective views of a poly-axial bone securing system before and after assembly of the components of the system, in accordance with one embodiment of the invention.

[0004] Figure 1C illustrates a cross-sectional view of the poly-axial bone securing system of Figure 1B.

[0005] Figure 2A illustrates a perspective view of the coupling element, in accordance with one embodiment of the invention.

[0006] Figure 2B illustrates a cross-sectional side view of the coupling element of Figure 2A.

[0007] Figure 2C illustrates a cross-sectional top view of the coupling element of Figure 2A.

[0008] Figure 3A illustrates a perspective view of a coupling element, in accordance with another embodiment of the invention.

[0009] Figure 3B illustrates a cross-sectional top view of the coupling element of Figure 3A.

[0010] Figure 4A illustrates a cross-sectional side view of the poly-axial bone securing system.

[0011] Figure 4B illustrates a magnified view of the interface between the bone securing member head and a flexible J-shaped seat of the coupling element of Figure 4A.

Best Mode(s) for Carrying Out the Invention

[0012] Figure 1A illustrates an exploded view of a poly-axial bone securing system 10, in accordance with an embodiment of the invention. The poly-axial bone securing system 10 includes a bone securing member 12, rod to bone securing member coupling element 22, saddle member 29, and mating cap 28. In an embodiment, the bone securing member 12 has a threaded shaft portion 14 (threads not shown), a head portion 16, a tip 18, and a neck portion 20. The tip 18 may be configured to penetrate a patient's bone and be located at the distal end of the threaded shaft portion 14 opposite the bone securing member head 16. In an embodiment the bone securing member 12 may be a pedicle screw.

[0013] A neck portion 20 may be located between the screw head 16 and the threaded shaft 14. In one embodiment, the width of the neck portion 20 is narrower than the width of the threaded shaft 14, to enable increased poly-axial motion of the coupling element 22 when engaged with the bone securing member head 16. The coupling element 22 includes an opening 24 at a bottom surface configured to permit the bone securing tip 18 and the threaded shaft 14 to pass through. In an embodiment, the bone securing member head 16 may have a curved underside. The head 16 curved underside may engage a coupling member 22 seat 30 (FIG. 1C). The coupling element 22 may include a side groove or channel 26 formed by two arms 25A, 25B for receiving a bone stabilization rod 11 (FIG. 1B) therein.

[0014] The bone securing system 10 may further include a mating cap 28 including a snap cap with set screw, interlocking cap, or a lock cap with set screw positioned therein. In an embodiment the mating cap 28 may lock a rod 11 within the coupling element 22 groove 26 by transferring a downward force from the rod 11, saddle member 29, securing member 12 head 16, and coupling element 22 seat 30. In an embodiment the saddle 29 may rest within the channel 26 on top of the bone securing member 12 head 16 and assist with holding the system 10 together after installation. The saddle 29 may have a bottom surface configured to rest on securing member 12 head 16 top surface and a top surface inwardly curved to matingly receive a cylindrical rod 11.

[0015] In an embodiment, the saddle 29 may act as an intermediate structure to facilitate an even distribution of load forces onto the bone securing member 12 head 16 top surface, the load forces created by the mating cap 28 being tightened onto a rod 11. The coupling head 22 includes a seat 30 to provide gripping and holding power between the coupling member 22 and the bone securing member 12 head 16 to limit any post-installation shifting of the bone securing member 12 with respect to the coupling element 22.

[0016] Figure 1B illustrates a perspective view of an assembled poly-axial bone securing system of Figure 1A. In an embodiment the bone securing member 12, after insertion into the coupling element 22 via the opening 24 may be driven into a bone (to be secured), such as a spinal pedicle via known techniques. The bone securing member 12 head 16 may include a Hex, Phillips, or other tool mating opening 32 (FIG. 1C). The securing member 12 may be driven into bone up to the shoulder 20 to permit poly-axial articulation between the coupling member 22 and bone securing member 12 head 16 prior to mating cap 28 lock down. A rod 11 may be inserted into the channel 26 after the bone securing member 12 is installed in a bone.

[0017] The rod 11 and coupling element 22 may be adjusted into a desired relationship to the bone securing member 12 until the mating cap 28 is locked against the rod 11. Figure 1C is a cross-sectional side view of the bone securing system 10 shown in Figure 1B, taken along lines A-A. In an embodiment, the bone securing member head 16 underside may engage and rest upon a coupling element 12 seat 30. The seat 30 may define the opening 24 shape.

[0018] Figure 2A is a perspective side view of the coupling element 22, in accordance with an embodiment of the invention. Figure 2B is a cross-sectional side view of the coupling element 22 of Figure 2A, taken along lines A-A and Figure 2C is a cross-sectional top view of the coupling element 22 of Figures 2A and 2B. The coupling element 22 includes a multi-faceted 31 seat 30 that provides a discrete number of contact surfaces or points 34 for engaging the bone securing member 12 head 16 underside.

[0019] The coupling element 22 may also include a lip 36 for engaging a flange or protruding portion of the mating cap 28 to fixably couple the rod 11, coupling element 22, and bone securing member 12 together. As shown in Figure 2C, the multi-faceted 31 seat 30 may be configured as a polygon including an octagon having eight distinct side surfaces or facets 31. When a bone securing member head 16 is seated within a multi-faceted seat 30 and pressed against the seat 30 via a mating cap 28 discrete frictional or gripping forces may

be generated primarily at the interface points 34 indicated by the dots near the center of each side or facet 34 of the polygon-shaped seat 30.

[0020] The seat 30 may provide increased gripping forces between the bone securing member 12 head 16 and the coupling element 22 by providing a discrete number of contact points. In an embodiment when a bone securing member 12 head 16 is pressed into a seat 30, the primary contacts between the head 16 and the seat 30 are focused at or near the points 34. The multi-faceted 31 seat 30 may provide improved gripping action between the coupling element 22 and the bone securing member 12 head 16 due to the discrete number of contacts 34, reaction load, and head 16 deformation at the seat interface 30. The seat interface 30 may deform at each contact point 34 when a mating cap 38 is locked into place due to pressure or stress at points 34. In an embodiment the seat 30 discrete contact points 34 may significantly increase the force per area between the coupling element 22 and securing member 12.

[0021] Figure 3A is a perspective view of another coupling element 40 in accordance with an embodiment of the invention. The coupling element 40 includes a channel 42 for receiving a rod (not shown) therein and a seat 44 having a discrete number of prongs 46. Each prong 46 may curve inwardly at a bottom portion of the coupling element 40. Figure 3B is a cross-section top view of the coupling element 40. When a bone securing member 12 head 16 is seated on and pressed against the seat 44, it may engage the discrete number of prongs 46. In an embodiment the interior surface of the prongs 46 form the seat 44 and provide increased frictional force between the bone securing member 12 head 16 and the seat 44 in accordance with the principles discussed above with respect to coupling element 22.

[0022] The coupling element 40 may also provide increased flexibility and the ability to dynamically distribute loads across the seating surface due to the discrete number of prongs 46. The coupling element 40 may withstand and handle external forces reliably and not shift relative to the bone securing member 12 in the presence of external forces. In addition the prongs 46 may provide flexibility between the coupling element 40 and bone securing member 12 head 16 so loads may be distributed more evenly across the prongs 46.

[0023] Figures 4A is a cross-sectional view of a bone securing system 50 in accordance with an embodiment of the invention and Figure 4B is an enlarged view of a section of the system 50. The bone securing system 50 includes a bone securing member 52 having a threaded shaft 54, a neck portion 60, a tip 58, and a spherical-shaped screw head 56. In an embodiment, the neck portion 60 is narrower than the threaded shaft 54 to allow increased

poly-axial articulating motion between the coupling element 62 and bone securing member 52. The coupling head 62 may include a U-shaped channel 64 for receiving a bone stabilization rod 11 therein.

[0024] The system 50 may include a mating cap 68 (such as a snap cap) configured to be received and locked within a correspondingly shaped chamber 66 of the coupling element 62. The chamber 66 may include a ledge 70 configured to lock the mating cap 68 within the chamber 66. As shown in Figure 4B, the coupling element 62 may include a circular J-shaped seat 71 having a J-shaped lip 72. The J-shaped seat 71 may be configured to flexibly hold the bone securing member 52 head 56 within the coupling element 62. The J-shaped seating surface lip 72 may provide greater ability to withstand and distribute loads between the seating surface 71 and the head 56, thus being less prone to shifting or breaking due to external forces. In an embodiment the seat 72 may be segmented into a discrete number of J-shaped lips 72 similar to prongs 46 shown in Figure 3A.

[0025] The accompanying drawings that form a part hereof show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. The embodiments illustrated are described in sufficient detail to enable those skilled in the art to practice the teachings disclosed herein. Other embodiments may be utilized and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. This Detailed Description, therefore, is not to be taken in a limiting sense, and the scope of various embodiments is defined only by the appended claims, along with the full range of equivalents to which such claims are entitled.

[0026] Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is in fact disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

[0027] The Abstract of the Disclosure is provided to comply with 37 C.F.R. § 1.72(b), requiring an abstract that will allow the reader to quickly ascertain the nature of the technical

disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In the foregoing Detailed Description, various features are grouped together in a single embodiment for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted to require more features than are expressly recited in each claim. Rather, inventive subject matter may be found in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment.

Claims

1. A coupling element, the coupling element including a seat, the seat having an opening that a first portion of a bone securing member may pass through and the opening having a discrete number of non-contiguous contact elements, each contact element capable of engaging a second portion of the bone securing member.
2. The coupling element of claim 1, the bone securing member first portion including a bone securing element.
3. The coupling element of claim 1, the bone securing member second portion including an at least partially spherical head.
4. The coupling element of claim 1, wherein at least one of the limited number of contact elements is deformable.
5. The coupling element of claim 1, wherein at least one of the limited number of contact elements is flexible.
6. The coupling element of claim 1, wherein each contact element has a contact point capable of engaging the bone securing element second portion.
7. The coupling element of claim 1, wherein at least one of the limited number of contact elements includes a prong.
8. The coupling element of claim 1, wherein the coupling element couples a bone securing member to a rod.
9. The coupling element of claim 8, the coupling element further including a rod receiving channel.
10. A system, including:
a bone securing member;
a rod; and

a coupling element for coupling to a bone securing member to the rod, the coupling element including a seat, the seat having an opening that a first portion of the bone securing member may pass through and the opening having a limited number of contact elements, each contact element capable of engaging a second portion of the bone securing member.

11. The system of claim 10, the bone securing member first portion including a bone securing element.

12. The system of claim 10, the bone securing member second portion including an at least partially spherical head.

13. The system of claim 10, wherein at least one of the limited number of contact elements is deformable.

14. The system of claim 10, wherein at least one of the limited number of contact elements is flexible.

15. The system of claim 10, wherein each contact element has a contact point capable of engaging the bone securing element second portion.

16. The system of claim 10, wherein at least one of the limited number of contact elements includes a prong.

17. The system of claim 10, the coupling element further including a rod receiving channel.

18. A coupling element, the coupling element including a seat, the seat having an opening that a first portion of a bone securing member may pass through and the opening having a flexibly deformable contact element, the contact element capable of flexibly engaging a second portion of the bone securing member.

19. The coupling element of claim 18, the bone securing member first portion including a bone securing element.

20. The coupling element of claim 18, the bone securing member second portion including an at least partially spherical head.

21. The coupling element of claim 18, wherein the flexibly deformable contact element includes a plurality of discrete sub-elements each sub-element capable of flexibly engaging a second portion of the bone securing member.

22. The coupling element of claim 18, wherein the flexibly deformable contact element includes a flexibly deformable lip, the lip capable of flexibly engaging a second portion of the bone securing member.

23. The coupling element of claim 18, wherein the coupling element couples a bone securing member to a rod.

24. The coupling element of claim 23, the coupling element further including a rod receiving channel.

25. A system, including:

a bone securing member;

a rod; and

a coupling element for coupling to a bone securing member to the rod, the coupling element including a seat, the seat having an opening that a first portion of a bone securing member may pass through and the opening having a flexibly deformable contact element, the contact element capable of flexibly engaging a second portion of the bone securing member.

26. The system of claim 25, the bone securing member first portion including a bone securing element.

27. The system of claim 25, the bone securing member second portion including an at least partially spherical head.

28. The system of claim 25, wherein the flexibly deformable contact element includes a plurality of discrete sub-elements each sub-element capable of flexibly engaging a second portion of the bone securing member.

29. The system of claim 25, wherein the flexibly deformable contact element includes a flexibly deformable lip, the lip capable of flexibly engaging a second portion of the bone securing member.

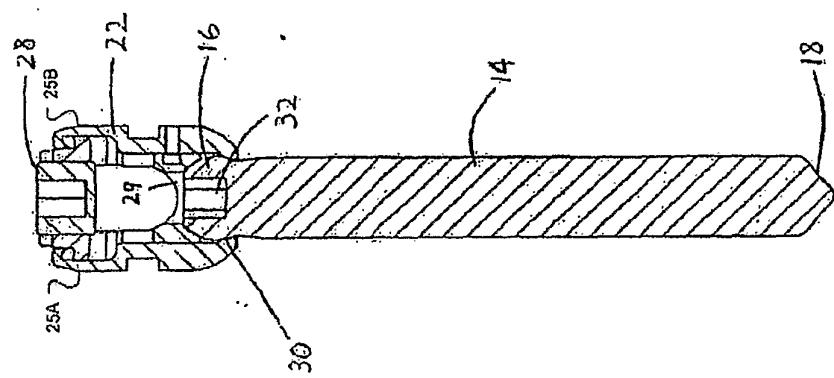


FIGURE 1C

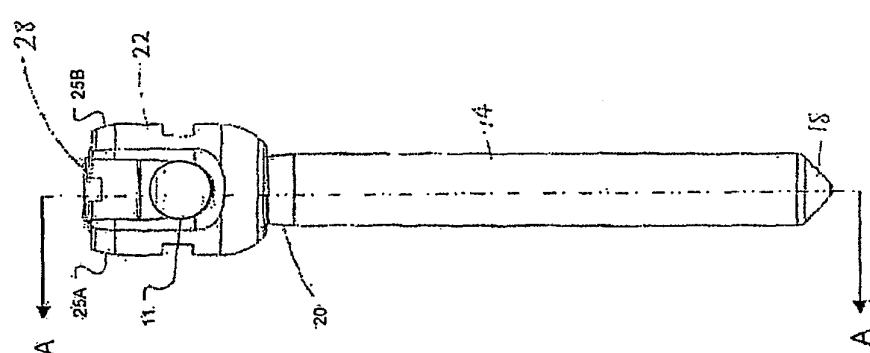


FIGURE 1B

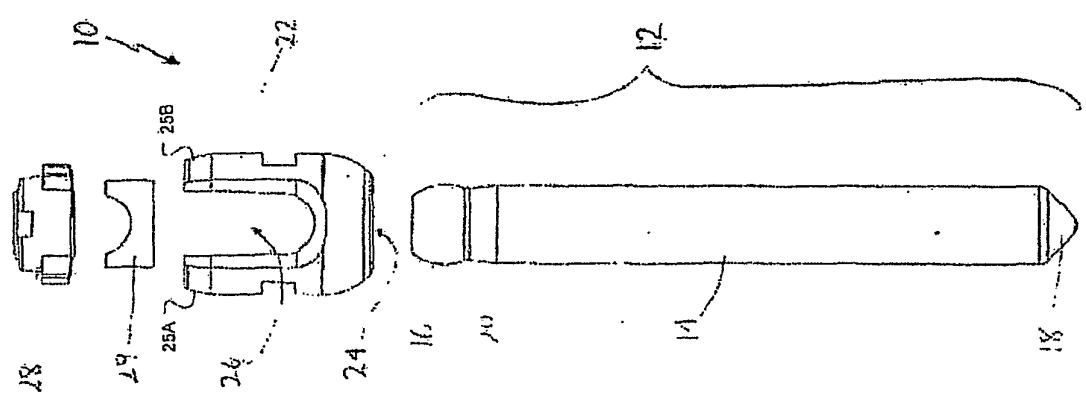
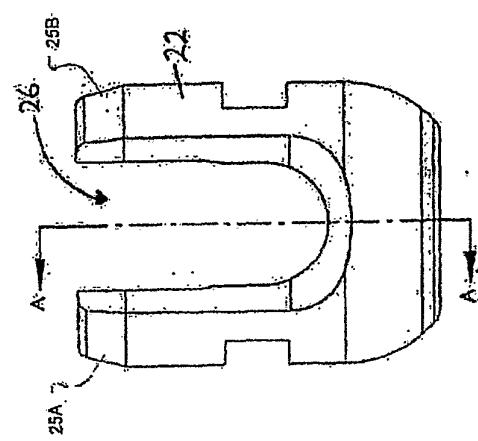
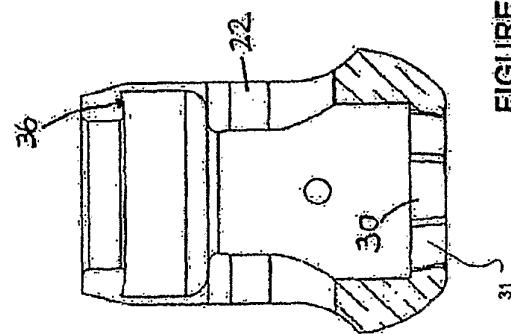
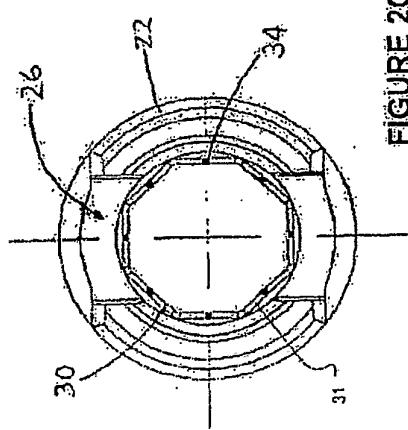


FIGURE 1A



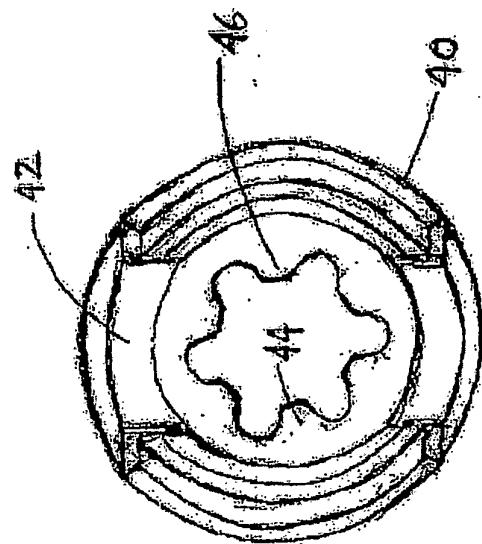


FIGURE 3B

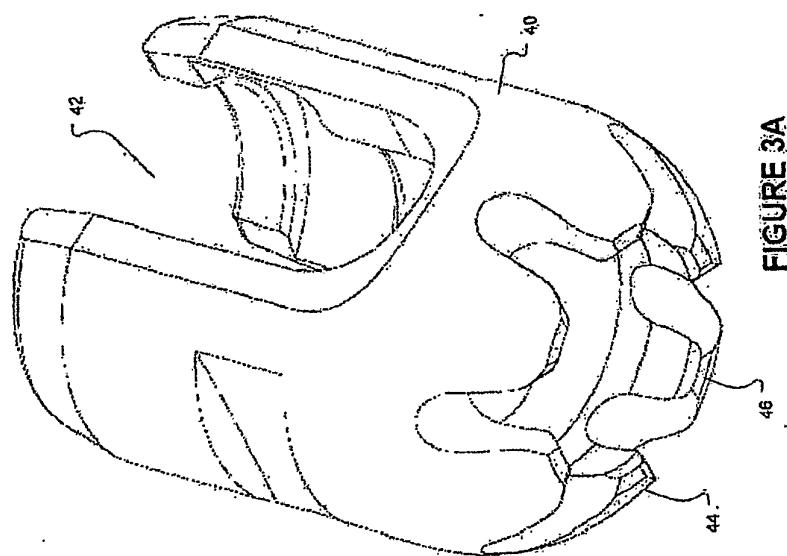


FIGURE 3A

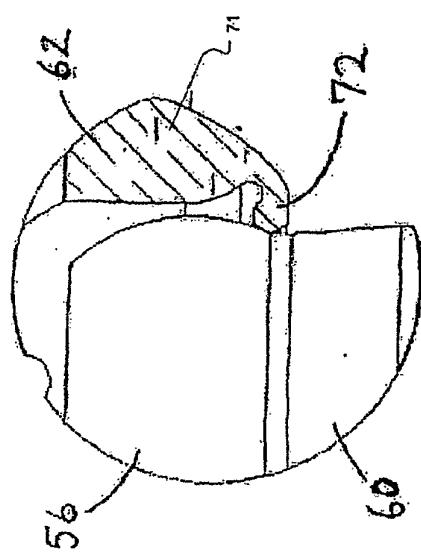


FIGURE 4B

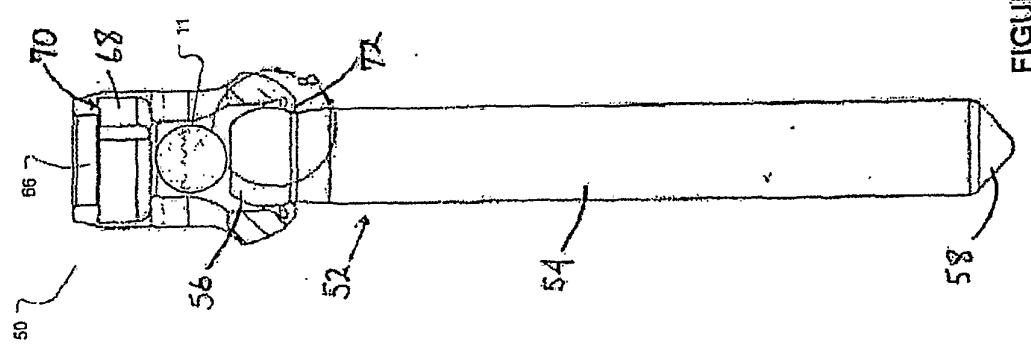


FIGURE 4A