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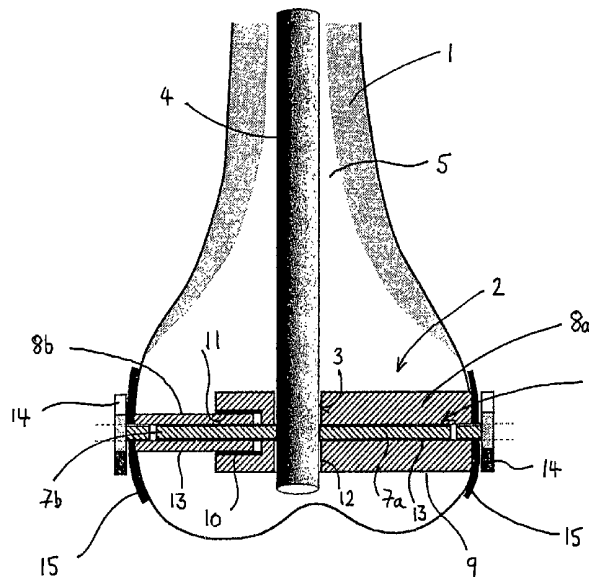
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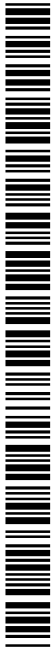
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(54) Title: BONE FIXTURE APPARATUS AND JIG



(57) Abstract: A bone fixture apparatus for application to a metaphyseal region of a long bone (1) comprises an elongate fixture device (2) intended to be inserted, in said region, generally transversely of the direction of the medullary cavity (5) in said bone; wherein the fixture device includes an aperture (3) extending laterally thereof and intended to accommodate an intramedullary nail (4) inserted longitudinally therethrough into said cavity, and wherein said fixture device is further formed with an axial aperture (6) intended to receive a securing element (7) capable of insertion therein to firmly engage the said nail with the fixture means. Also disclosed is a jig arrangement for locating, relative to a long bone, the bone fixture apparatus.



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BONE FIXTURE APPARATUS AND JIG

This invention relates to bone fixture apparatus for use in stabilising fractures at or near the metaphyses of long bones,
5 and to jigs for use in connection therewith or separately.

Techniques based upon the use of intramedullary nails are well established for stabilising fractures in long bones, and such techniques are valuable in many respects, in particular
10 because they require minimal surgery adjacent the bone to be treated. Their usefulness, however, is mainly restricted to the treatment of fractures located intermediate the metaphyseal regions, and in which there is little fracture damage running longitudinally of the bone.

15

This invention aims, inter alia, to render intramedullary nail technology suitable for use in the treatment of fractures at or near metaphyseal regions of long bones.

20 According to the invention from one aspect, there is provided a bone fixture apparatus for application to a metaphyseal region of a long bone, the apparatus comprising an elongate fixture device intended to be inserted, in said region, generally transversely of the direction of the medullary
25 cavity in said bone; wherein the fixture device includes an aperture extending laterally thereof and intended to accommodate an intramedullary nail inserted longitudinally therethrough into said cavity, and wherein said fixture device is further formed with an axial aperture intended to receive
30 a securing element capable of insertion therein to firmly engage the said nail with the fixture means.

The fixture device may conveniently comprise a bolt-like,

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screw-like or nail-like member intended for insertion into a pre-drilled passage in the bone and to engage with cancellous bone to provide a secure fixture which assists in stabilising a fracture and provides a rigid mount for the intramedullary
5 nail.

In one preferred embodiment of the invention, the fixture device comprises a bolt-like member including first and second hollow, cylindrical components of different diameter inserted
10 coaxially into the bone from opposite directions and adapted to interfit, within the bone, in any convenient manner so as to be capable of asserting stabilising forces laterally of the long bone under treatment.

15 In this embodiment, either or both of the hollow, cylindrical components of the bolt-like member may be formed with an nail-receiving aperture, extending transversely of the cylinder axes and intended to accommodate an intramedullary nail inserted therethrough into the medullary cavity of the bone.
20 Moreover, one or both of the cylindrical components is formed with an axially extending aperture, preferably screw-threaded, into which a locking device, such as a grub screw, may be inserted and tightened against an intramedullary nail, disposed in said nail-receiving aperture, to securely fix the
25 nail to the bolt-like fixture means.

In another preferred embodiment, the fixture device comprises a screw-like member, inserted from only one side of the bone but otherwise with generally the same disposition, with
30 respect to the bone, as the bolt-like device described previously. In this embodiment, it is essential for the screw-like component to engage, with its screw-threaded distal end, into cancellous bone in order to provide a firm fixture

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base. As with the previous embodiment, the screw-like member is formed with a nail-receiving aperture, extending transversely of its longitudinal axis, through which an intramedullary nail can be inserted. The nail can be firmly
5 secured to the screw-like member, as before, by means of a locking device, such as a grub screw, inserted into a suitable bore running axially of the screw-like member.

In yet another preferred embodiment of the invention, the
10 fixture device comprises a finned nail-like member, the finned, and sharpened distal end of which is intended to be embedded, by conventional means, in cancellous bone. The remaining features of the nail-like member are similar to those of the screw-like member.

15

Another object of the invention is to provide jig arrangements which, inter alia, are capable of accurately locating incision and boring positions required as a precursor to the insertion, into the bone, of the bone fixture apparatus of the first
20 aspect of the invention.

In accordance with this object of the invention there is provided a jig arrangement for locating a bone fixture apparatus relative to a long bone, the jig arrangement
25 comprising an elongate rod member with an intramedullary probe releasably attached to an end thereof and in axial alignment therewith; the rod member being provided, in the vicinity of its attachment to said probe, with a shoulder intended to engage with an external bone surface when the probe is
30 inserted into the medullary cavity of the bone; said rod member then acting as a core guide for a hollow sleeve member, also forming part of said jig arrangement, intended to be inserted over said rod member and bearing a guide portion at

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least partially encircling said bone and formed with at least one aperture extending transversely with respect to the axes of the rod member and the probe and intended to guide a drilling means for drilling in said bone a bore to accommodate
5 a component of the bone fixture apparatus.

In order that the invention may be clearly understood and readily carried into effect, certain embodiments thereof will now be described, by way of example only, with reference to
10 the accompanying drawings, of which:-

Figure 1 shows, in cross-section, a bone fixture apparatus in accordance with a first embodiment of the invention;

15 Figure 2 shows, in cross-section, a bone fixture apparatus in accordance with a second embodiment of the invention;

Figure 3 shows, in cross-section, a bone fixture apparatus in accordance with a third embodiment of the invention;

20

Figures 4(a) and 4(b) show respective side views, relatively displaced by 90 degrees, of an intramedullary probe used in conjunction with jig arrangements according to certain embodiments of the second aspect of the invention;

25

Figures 5, 6 and 7 show respective views of a jig arrangement for use with the first embodiment of a bone fixture apparatus, in accordance with the invention, described with reference to Figure 1; and

30

Figures 8, 9 and 10 show respective views of a jig arrangement for use with the second and third embodiments of a bone fixture apparatus, in accordance with the invention, described

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with reference to Figures 2 and 3.

Referring to Figure 1, there is shown a bone fixture apparatus in accordance with a first embodiment of the invention, as applied to a metaphyseal region of a long bone 1. The apparatus of this embodiment comprises an elongate fixture device, indicated at 2, intended to be inserted generally transversely of the direction of the medullary cavity of the bone 1. The fixture device 2 includes an aperture 3 extending laterally thereof and intended to accommodate an intramedullary nail 4 inserted longitudinally therethrough into the medullary cavity 5 of the bone 1, and the fixture device 2 is further formed with an axial aperture 6 intended to receive a securing element 7 capable of insertion therein to firmly engage the nail 4 with the fixture means 2.

The fixture device in this embodiment comprises a bolt-like, member 8 intended for insertion into a pre-drilled passage 9 in the bone 1 and to engage with cancellous bone to provide a secure fixture which assists in stabilising a fracture and provides a rigid mount for the intramedullary nail 4.

In particular, in this first embodiment of the invention, the bolt-like member 8, constituting the fixture device 2, includes first and second hollow, cylindrical components 8a, 8b of different diameter inserted coaxially into the bone 1 from opposite directions and adapted to interfit, within the bone, so as to be capable of asserting stabilising forces laterally of the long bone under treatment. In this example, the components 8a and 8b interfit by screw fitments, the larger diameter component 8a being formed with a screw-threaded bore 10 which engages with an external screw thread 11 formed on the outer surface of the smaller diameter

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component 8b; the screw threading being provided at least in the vicinity of the distal end of the component 8b.

As an alternative to the use of screw threading for the interfitting between components 8a and 8b, any suitable alternative arrangement can be used, such as bayonet fixtures or splined fixtures, bearing in mind that it is desired that the fixture device 2 shall provide sufficient force, directed laterally of the bone 1, to stabilise a fracture in the vicinity of the metaphyseal region thereof.

Either or both of the hollow, cylindrical components 8a, 8b of the bolt-like member may contain the nail-receiving aperture 3, extending transversely of the axes of the cylindrical components and intended to accommodate an intramedullary nail 4 inserted therethrough into the medullary cavity of the bone. In this example, the larger diameter component 8a is formed with a lateral throughbore 12 which constitutes the nail receiving aperture 3 in its entirety.

20

Moreover, one or both of the cylindrical components 8a, 8b is formed with a screw-threaded, axially extending aperture 13, constituting the axial aperture 6, into which securing elements, such as grub screws 7a, 7b, may be inserted and tightened against the intramedullary nail 4, when disposed in the nail-receiving aperture 12, to securely fix the nail 4 to the bolt-like fixture means 8.

In some circumstances, depending upon factors such as the nature of the fracture, the state of health of the bone itself and the diameter of the components of the fixture means 8, it can be advantageous to employ, between the bone 1 on the one hand, and the heads 14 of one or both of the component parts

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8a and 8b of the fixture means 8 on the other hand, washer-type plates 15 to perform a load-spreading function.

The heads 14 may be integrally formed with the respective components 8a, 8b, or they may be separately formed and screwed into the threaded bores 13 after the grub screws 7a, 7b have been fitted therein. If this construction is adopted, however, the proximal end of the bore 13 of one or both components 8a, 8b should be suitably keyed so that the components can be relatively manipulated to permit their interfitment as described above.

Referring now to Figure 2, there is shown a second embodiment of the invention, in which the fixture device 2 comprises a screw-like member 16, for example a lag screw, inserted from only one side of the bone but otherwise with generally the same disposition, with respect to the bone, as the bolt-like device 8 described with reference to Figure 1. In this embodiment, it is essential for the screw-like component 16 to engage, with its screw-threaded distal end 17, into cancellous bone 18 in order to provide a firm fixture base. As with the embodiment of the invention described with reference to figure 1, the screw-like member 16 is formed with a nail-receiving aperture 3, extending transversely of its longitudinal axis, through which an intramedullary nail 4 can be inserted. The nail 4 can be firmly secured to the screw-like member 16, as described with reference to figure 1, by means of a locking device, such as a grub screw 7, inserted into a suitable bore 6 running axially of the screw-like member 16.

30

It will be appreciated that the proximal end 19 of the screw-like member 16 is suitably keyed to permit the member 16 to be engaged, in any convenient, known manner, with the cancellous

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bone 18, using conventional tools. As described previously, a load-spreading washer-type plate 15 can be used against the bone surface, being held in place by means of a cap member 20 screw-fitted into the bore 6.

5

Referring now to Figure 3, a third embodiment of the invention will be described, in which the fixture device 2 comprises a finned, nail-like member 21, the finned, and sharpened distal end 22 of which is intended to be embedded, by conventional
10 means, in cancellous bone 18. The remaining features of the nail-like member 21 are similar to those of the screw-like member 16 described with reference to Figure 2, and will thus not be further described herein.

15 In order to accurately locate the fixture device 2 of any of the foregoing embodiments of the invention in relation to the bone to which they are to be affixed, it is preferable to utilise a jig arrangement of the kind to be described with reference to the following figures 4 to 10.

20

A common element of the preferred jig arrangements now to be described is the use of a preliminary intramedullary device 23, which will hereinafter be referred to as a probe since it is intended to enter, temporarily and for alignment purposes,
25 into the intramedullary cavity. The probe 23 is withdrawn from the cavity once the necessary alignment procedures have been completed and the holes necessary to accommodate the fixture device have been drilled, and is later to be replaced by the intramedullary nail 4. The probe 23 is shown (inter
30 alia) in Figures 4a and 4b, which are side views from orthogonal directions, and it will be seen that it comprises an elongate rod, slotted from its distal end 24 through most of its length. At the proximal end 25 of the probe 23 is an

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axially disposed bore hole 26 which is screw threaded, or otherwise provided for interfitment with the remaining components of the jig arrangement.

5 Referring now to Figures 5, 6 and 7, which show a jig arrangement for use in connection with the embodiment of the invention described with reference to Figure 1, a first component of the jig comprises an elongate rod member 27 with the probe 23 releasably attached to its distal end, in axial
10 alignment with the rod member 27, by means of a screw 28 protruding axially from the end of the rod member 27 and engaging in the screw-threaded bore 26 formed in the proximal end of probe 23. The rod member 27 is preferably of squared cross-section, and is provided, in the vicinity of its
15 attachment to the probe 23, with a shoulder 27a intended to engage with an external surface of the bone 1 when the probe 23 is inserted into the medullary cavity 5 of the bone 1. The rod member 27 acts as a core guide for a second component of the jig arrangement, which comprises a hollow sleeve member 29
20 intended to be inserted coaxially over the rod member 27.

The sleeve member 29 bears a guide portion 30 configured and positioned so as to extend to either side of the bone 1 and formed with a pair of apertures 31 and 32 extending
25 transversely with respect to the axes of the rod member 27 and the probe 23, and intended to guide a drilling means (not shown) of conventional kind used for drilling, in said bone, the bore-like passage 9 (see Figure 1) to accommodate the bone fixture device 8 of the bone fixture apparatus 2. In this
30 example, the guide portion 30 is of yoke-like form, containing a pair of limbs extending to either side of the bone. In alternative constructions, the guide portion 30 may be of arcuate form, and dimensioned to encircle or partially

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encircle the subject bone area.

A third jig component, comprising a cap member 33, is used to retain the jig components 27 and 29 in stable and fixed inter-
5 relationship during the jiggling operation. The cap member 33 may be screw-fitted or otherwise securable to the proximal end of rod member 27 so as to hold the sleeve member 29 in place.

At least the major components of the jig arrangement, such as
10 the rod member 27, the sleeve member 29, the probe 23 and possibly also the cap member 33, are preferably radiolucent so that radiographic techniques can be applied where necessary to permit positioning and alignment of critical features and components to be checked.

15

In operation, and assuming that a longitudinal metaphyseal fracture exists, it is to be expected that most surgeons will prefer to reduce and hold the major metaphyseal fracture fragments by percutaneous means prior to gaining access to the
20 medullary canal of the long bone in conventional manner. At this stage, the surgeon may prefer to use a guide wire prior to reaming the intramedullary canal to accommodate the correct diameter of probe (such as 23) or alternatively ream the canal by hand. This done, a probe 23 of appropriate length and
25 diameter is attached to the rod member 27 of the jig arrangement and inserted into the medullary canal until the shoulder 27a abuts the end of the bone. Once in place, the sleeve member 29 is slotted over the rod member 27 and the cap member 33 screwed or otherwise fixed into place, ensuring that
30 the three components 27, 29 and 33 are locked together as one, providing optimal placement of metaphyseal and diaphyseal implants.

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Short incisions, down to bone, are made over the medial and lateral metaphyseal cortices, and the overlying soft tissue parted using a periosteal elevator. Securing sleeves 34 and 35 respectively are screwed into position within the bore-
5 aligning apertures 31 and 32 formed in the guide portion 30 of the sleeve member 29 to lie on the outer aspect of the medial and lateral cortices of the metaphyseal fragments and thereby maintain reduction of the fracture. Once the jig components are all secured in place, it is possible to accurately
10 estimate the length of the bolt components 8a and 8b (see Figure 1) required to achieve fixation due to the inclusion, on the outer aspect of the securing sleeves 34 and 35 respectively, of measuring gauges 36 and 37 which can be read as to their displacement relative to the outer rims of the
15 apertures 31 and 32 respectively.

Guide drill sleeves 38, 39 permitting the surgeon to accurately place a guide wire across the metaphys are inserted respectively into the apertures 31 and 32 and, after checking
20 the position using an image intensifier, the probe 23 is removed and the appropriate diameter of drill inserted taking into account the sizes of the bolt components 8a and 8b and of the intramedullary nail 4 to be used.

25 After drilling the bone to the correct diameters, appropriately dimensioned hollow, cylindrical half-bolt components 8a and 8b are inserted, and the smaller (8b) screwed into the larger (8a) taking care to maintain correct alignment, especially of the latter. Washer-type plates
30 may be required in some circumstances to improve the hold on the bone, thereby improving compression of vertical fractures through the metaphys. After the bolt components are in place, the intramedullary nail 4 is attached to the rod-like jig

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member 27 in place of the probe 23, and inserted until the shoulder 27a of member 27 again rests against the bone. Once correctly aligned (as checked if necessary with an image intensifier) the grub screws 7a, 7b are tightened until the
5 nail 4 is securely held in the nail-retaining aperture 3 of the bolt-like fixture means 8.

Figures 8, 9 and 10 show a jig arrangement suitable for use with the bone fixture apparatus described with reference to
10 Figures 2 and 3. This arrangement also makes use of a probe 23 as described with reference to Figure 4.

The principles of operation and application to the bone of the jig arrangement shown in Figures 8 to 10 are similar to those
15 explained above in relation to the arrangement of Figures 5 to 7, and thus further detailed explanation will not be given except insofar as it relates to differences in the subject construction and/or procedure.

20 The sleeve member 29 performs the same function as its counterpart in the arrangement described with reference to Figures 5 to 7, but its associated guide member 30' differs from the member 30 described previously in extending only to one side of the bone and being formed with only one drill-
25 guiding aperture 31'.

Once the jig assembly, including a probe 23 as before, has been fixed in place, as described previously, and the positions checked by means of an image intensifier, additional
30 K-wires 40 to 43 are inserted so as to straddle the probe 23. The probe 23 can then be removed, and the appropriate diameter drill inserted through guide aperture 31'; the diameter being selected so as to take into account the intended size of the

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metaphyseal implant and of the intramedullary device itself.

Sleeves of varying diameters inserted into the guide apertures 31, 32 (Figures 5 to 7) and 31' (figures 8 to 10) can usefully be employed to adapt the apertures to accurately accommodate drills and other tools of differing diameters.

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CLAIMS:

1. A bone fixture apparatus for application to a metaphyseal region of a long bone, the apparatus comprising an elongate fixture device intended to be inserted, in said region, generally transversely of the direction of the medullary cavity in said bone; wherein the fixture device includes an aperture extending laterally thereof and intended to accommodate an intramedullary nail inserted longitudinally therethrough into said cavity, and wherein said fixture device is further formed with an axial aperture intended to receive a securing element capable of insertion therein to firmly engage the said nail with the fixture means.
2. Apparatus according to claim 1 wherein the fixture device comprises a bolt-like member, intended for insertion into a pre-drilled passage in the bone and to engage with cancellous bone to provide a secure fixture which assists in stabilising a fracture and provides a rigid mount for the intramedullary nail.
3. Apparatus according to claim 2 wherein said bolt-like member includes first and second hollow, cylindrical components of different diameter intended to be inserted coaxially into the bone from opposite directions and adapted to interfit, within the bone, so as to be capable of asserting stabilising forces laterally of the long bone under treatment.
4. Apparatus according to claim 3 wherein at least one of the hollow, cylindrical components of the bolt-like member is formed with a nail-receiving aperture, extending transversely of the cylinder axes and intended to accommodate an intramedullary nail inserted therethrough into the medullary

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cavity of the bone.

5. Apparatus according to claim 4 wherein at least one of said cylindrical components is formed with an aperture, 5 extending axially therethrough, intended to receive a locking device for engaging said intramedullary nail, when disposed in said nail-receiving aperture, to securely fix the nail to the bolt-like fixture means.

10 6. Apparatus according to claim 5 wherein said axially extending aperture is screw-threaded and said locking device comprises a grub screw.

7. Apparatus according to claim 1 wherein said fixture 15 device comprises a screw-like member, intended to be inserted from only one side of the bone, so as to engage, with its screw-threaded distal end, into cancellous bone in order to provide a firm fixture base.

20 8. Apparatus according to claim 7 wherein the screw-like member is formed with a nail-receiving aperture, extending transversely of its longitudinal axis, through which an intramedullary nail can be inserted.

25 9. Apparatus according to claim 8 wherein the screw-like member is formed with bore, running axially therethrough, and adapted to receive a locking device for firmly securing said nail to the screw-like member.

30 10. Apparatus according to claim 9 wherein said axially

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extending bore is screw-threaded and said locking device comprises a grub screw.

11. Apparatus according to claim 1 wherein the fixture
5 device comprises a finned nail-like member, the finned and sharpened distal end of which is intended to be embedded in cancellous bone.

12. Apparatus according to claim 11 wherein the finned,
10 nail-like member is formed with an intramedullary nail-receiving aperture, extending transversely of its longitudinal axis, through which an intramedullary nail can be inserted.

13. Apparatus according to claim 12 wherein the finned,
nail-like member is formed with bore, running axially
15 therethrough, and adapted to receive a locking device for firmly securing said intramedullary nail to the finned, nail-like member.

14. Apparatus according to claim 13 wherein said axially
20 extending bore is screw-threaded and said locking device comprises a grub screw.

15. A bone fixture apparatus for application to a
metaphyseal region of a long bone, the apparatus being
25 substantially as herein described with reference to and/or as shown in any of Figures 1 to 3 of the accompanying drawings.

16. A jig arrangement for locating, relative to a long bone,
a bone fixture apparatus according to any preceding claim, the
30 jig arrangement comprising an elongate rod member with an intramedullary probe releasably attached to an end thereof and in axial alignment therewith; the rod member being provided, in the vicinity of its attachment to said probe, with a

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shoulder intended to engage with an external bone surface when the probe is inserted into the medullary cavity of the bone.

17. A jig arrangement for locating a bone fixture apparatus
5 relative to a long bone, the jig arrangement comprising an
elongate rod member with an intramedullary probe releasably
attached to an end thereof and in axial alignment therewith;
the rod member being provided, in the vicinity of its
attachment to said probe, with a shoulder intended to engage
10 with an external bone surface when the probe is inserted into
the medullary cavity of the bone; said rod member then acting
as a core guide for a hollow sleeve member, also forming part
of said jig arrangement, intended to be inserted over said rod
member and bearing a guide portion at least partially
15 encircling said bone and formed with at least one aperture
extending transversely with respect to the axes of the rod
member and the probe and intended to guide a drilling means
for drilling in said bone a bore to accommodate a component of
the bone fixture apparatus.

20

18. A jig arrangement according to claim 16 or claim 17
further comprising a hollow sleeve member, intended to be
inserted over said rod member, bearing a guide portion
extending to at least one side of said bone and formed with at
25 least one guide aperture extending transversely with respect
to the axes of the rod member and the probe and intended to
guide a drilling means for drilling in said bone a bore to
accommodate the bone fixture device.

30 19. A jig arrangement according to claim 18 wherein
sleevings of differing dimensions for insertion in said at
least one guide aperture to accommodate drilling means of
different diameters.

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20. A jig arrangement according to claim 18 or claim 19 further comprising a cap member adapted to secure said sleeve member to said rod member.

5 21. A jig arrangement according to claim 20 wherein at least one of said rod member and said sleeve member is radiolucent.

22. A jig arrangement for locating, relative to a long bone, a bone fixture apparatus according to any preceding claim, the
10 jig arrangement being substantially as herein described with reference to, and/or as shown in, Figures 5 to 7 or figures 8 to 10 of the accompanying drawings.

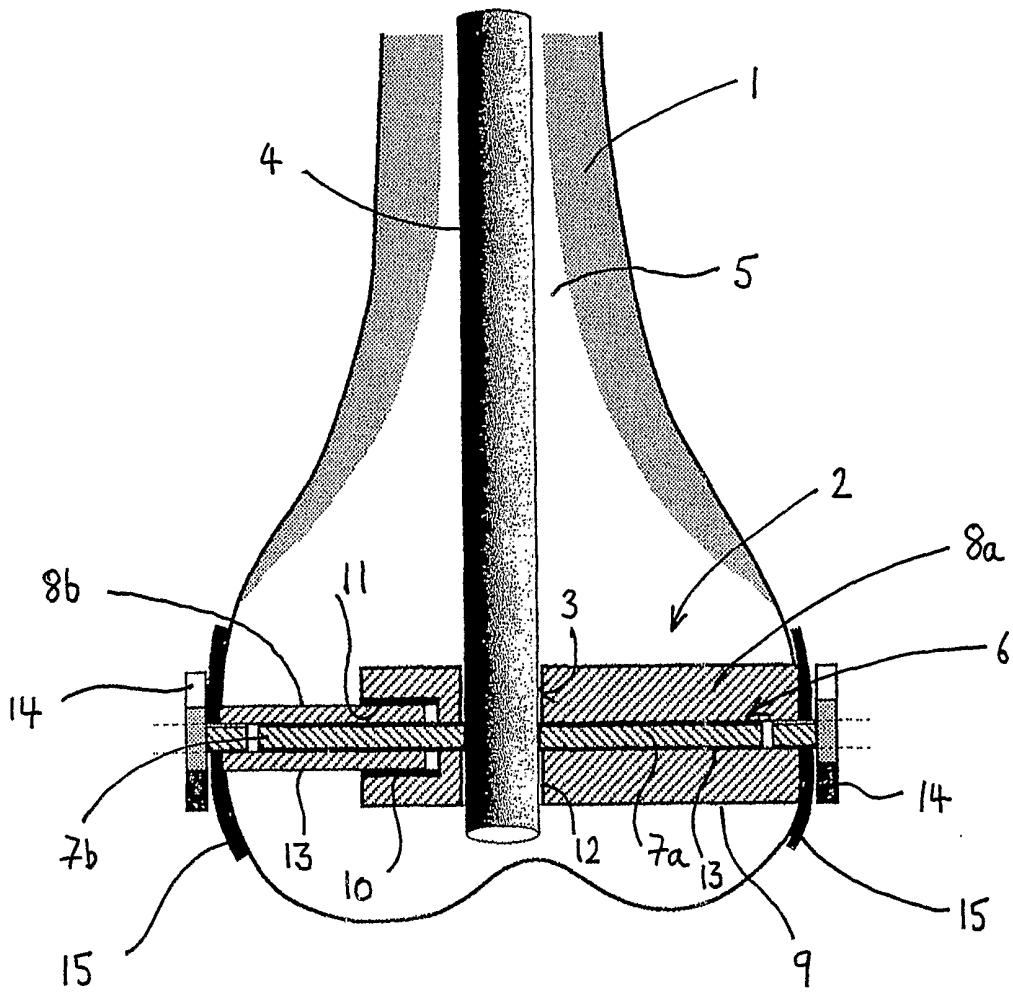


FIGURE 1

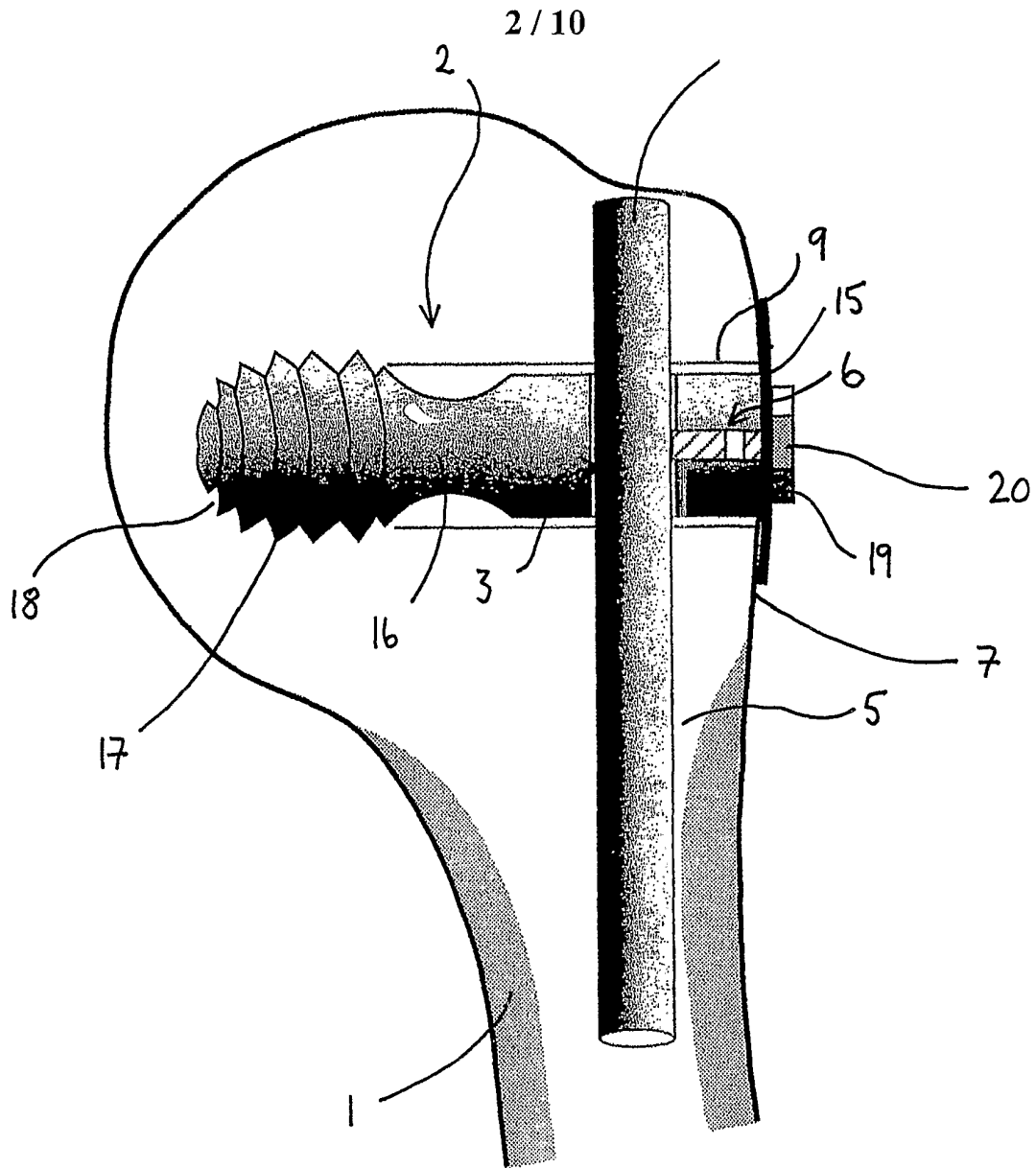


FIGURE 2

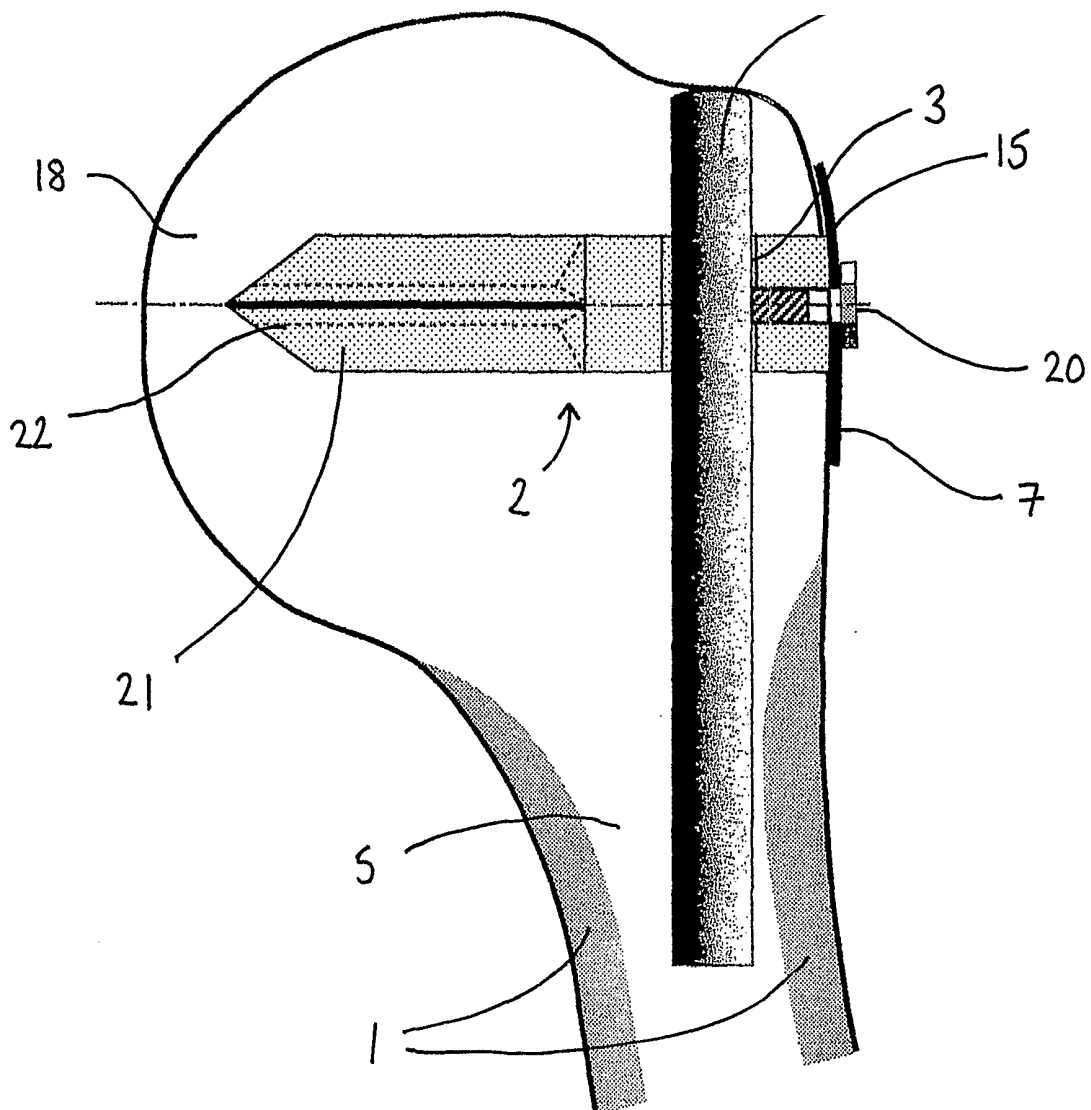


FIGURE 3

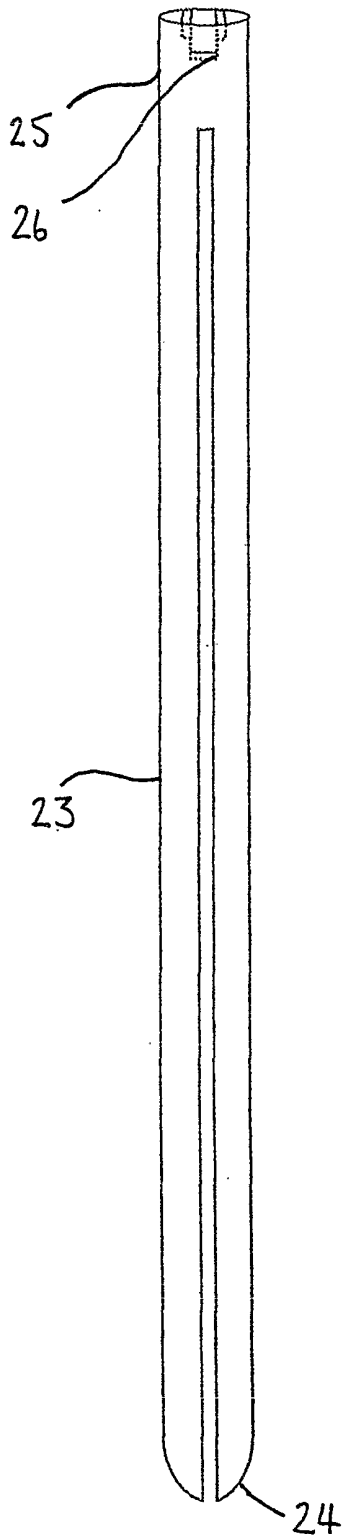


FIGURE 4A

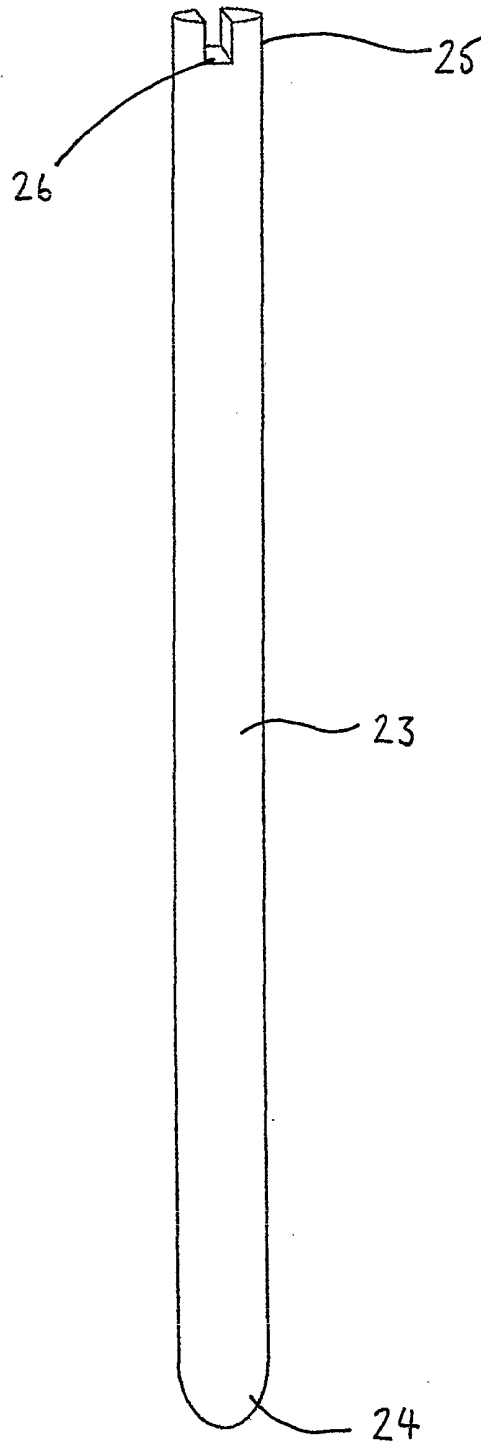


FIGURE 4B

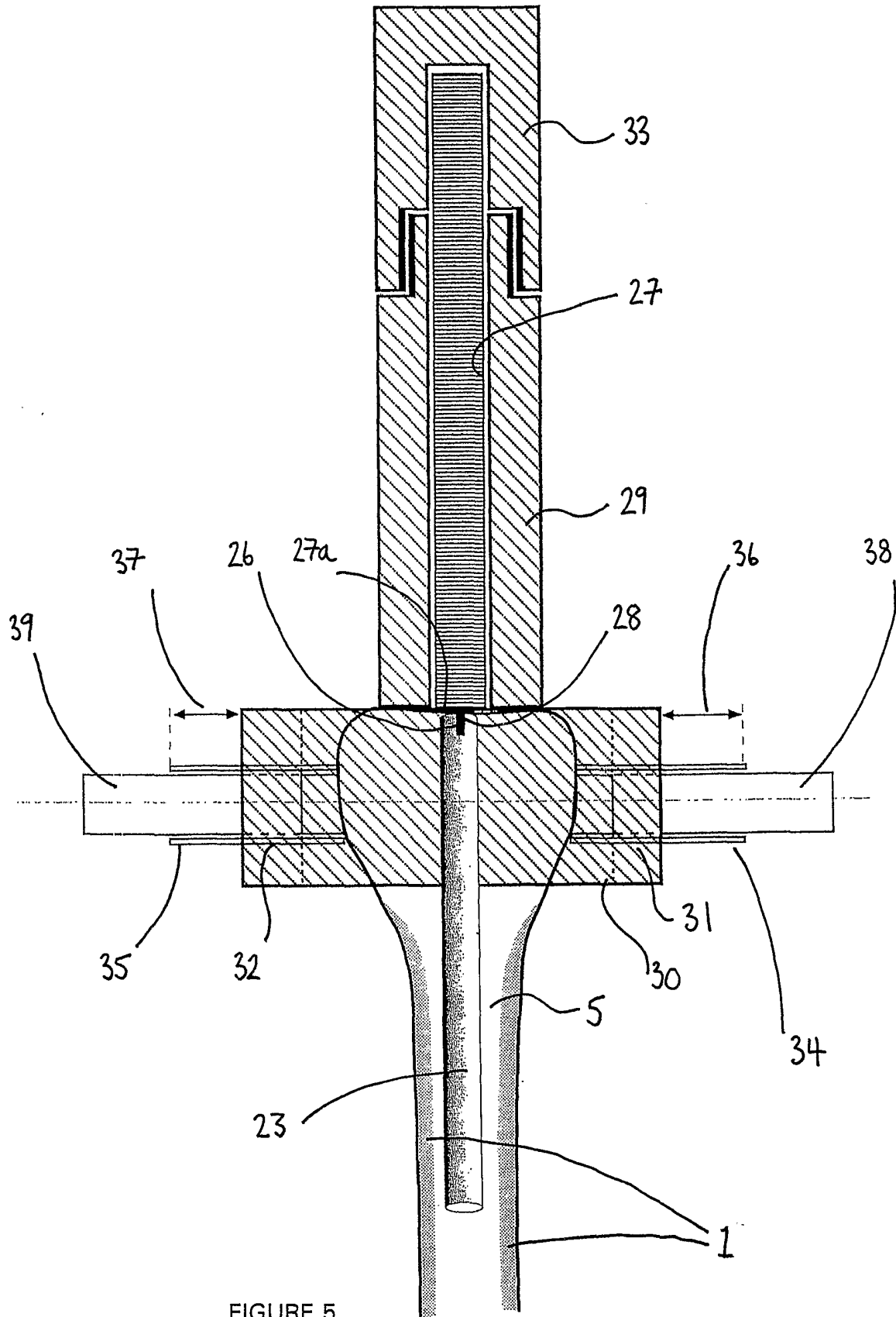


FIGURE 5

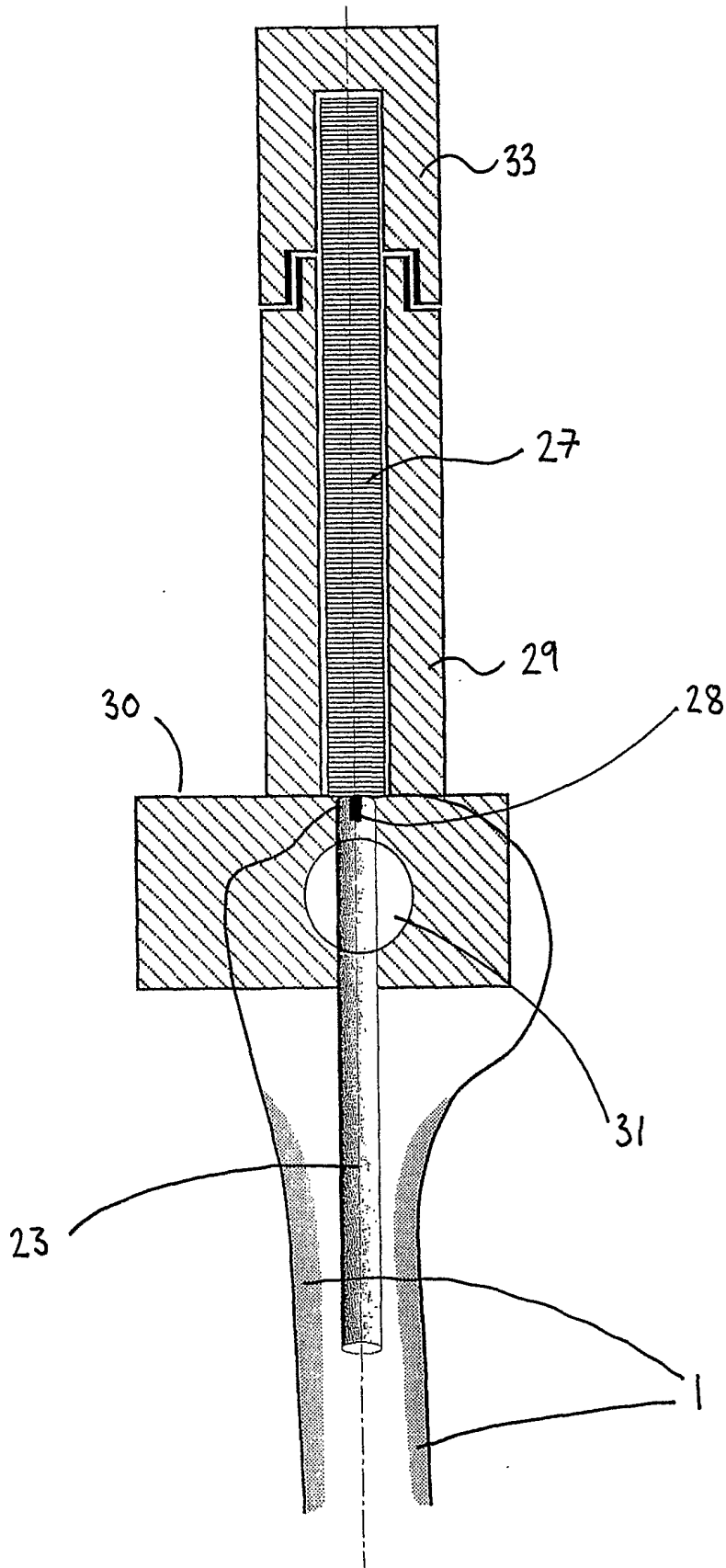


FIGURE 6

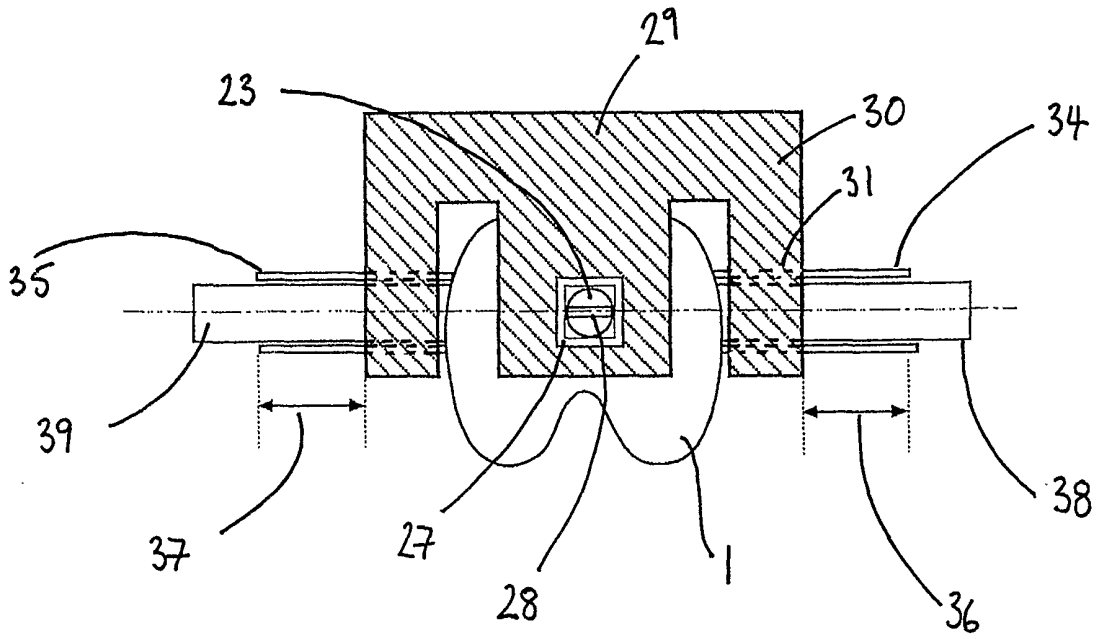


FIGURE 7

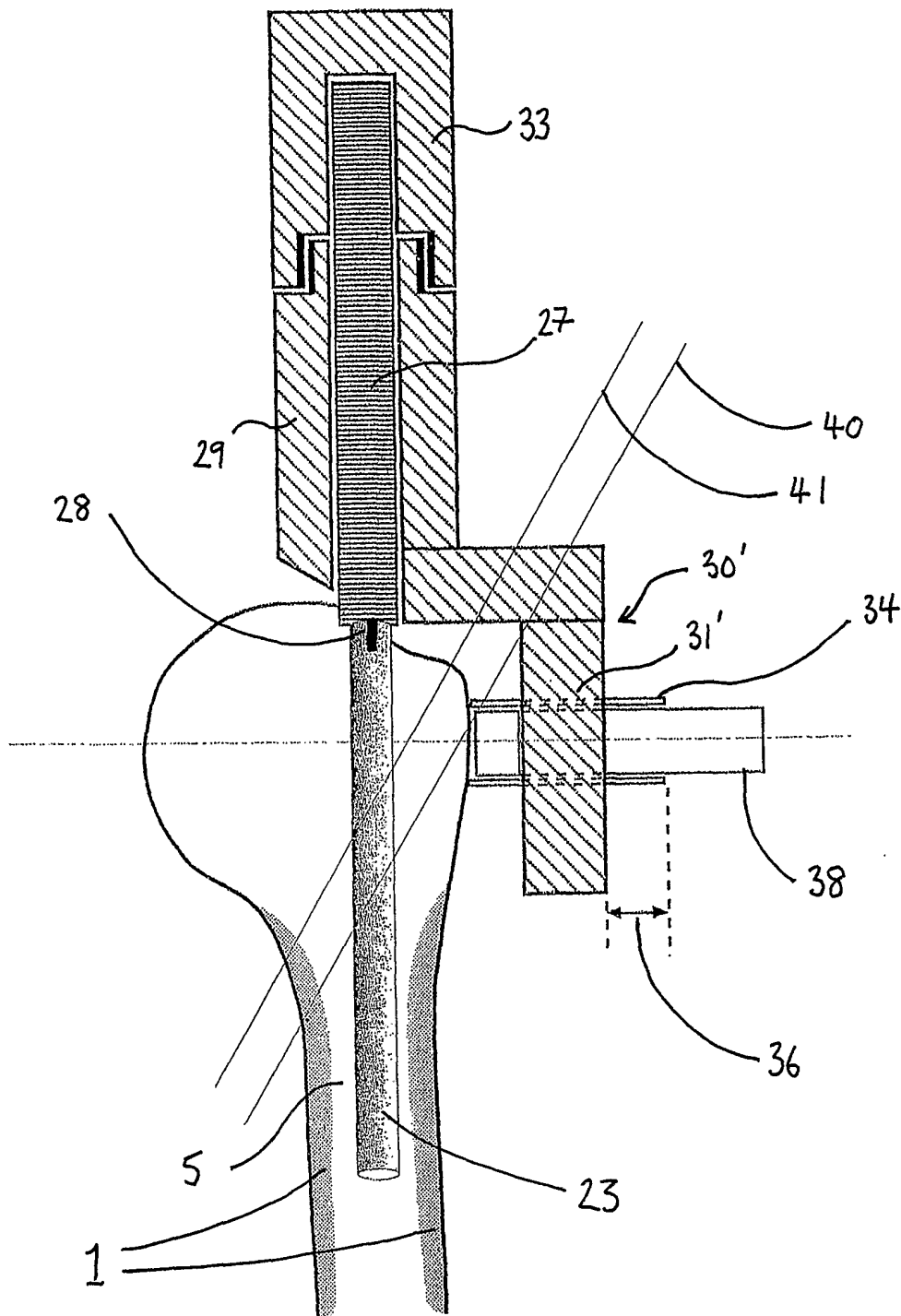


FIGURE 8

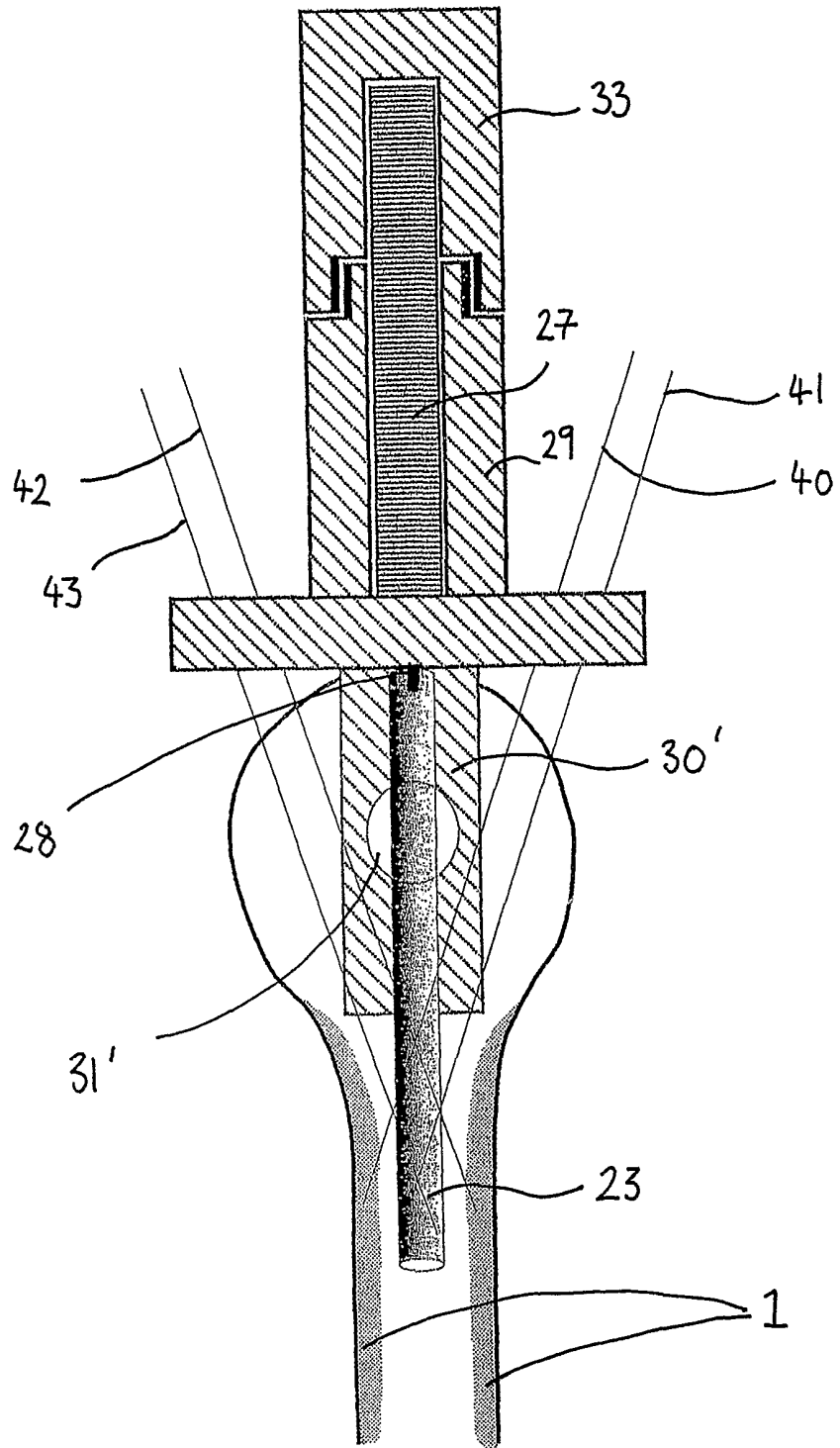


FIGURE 9

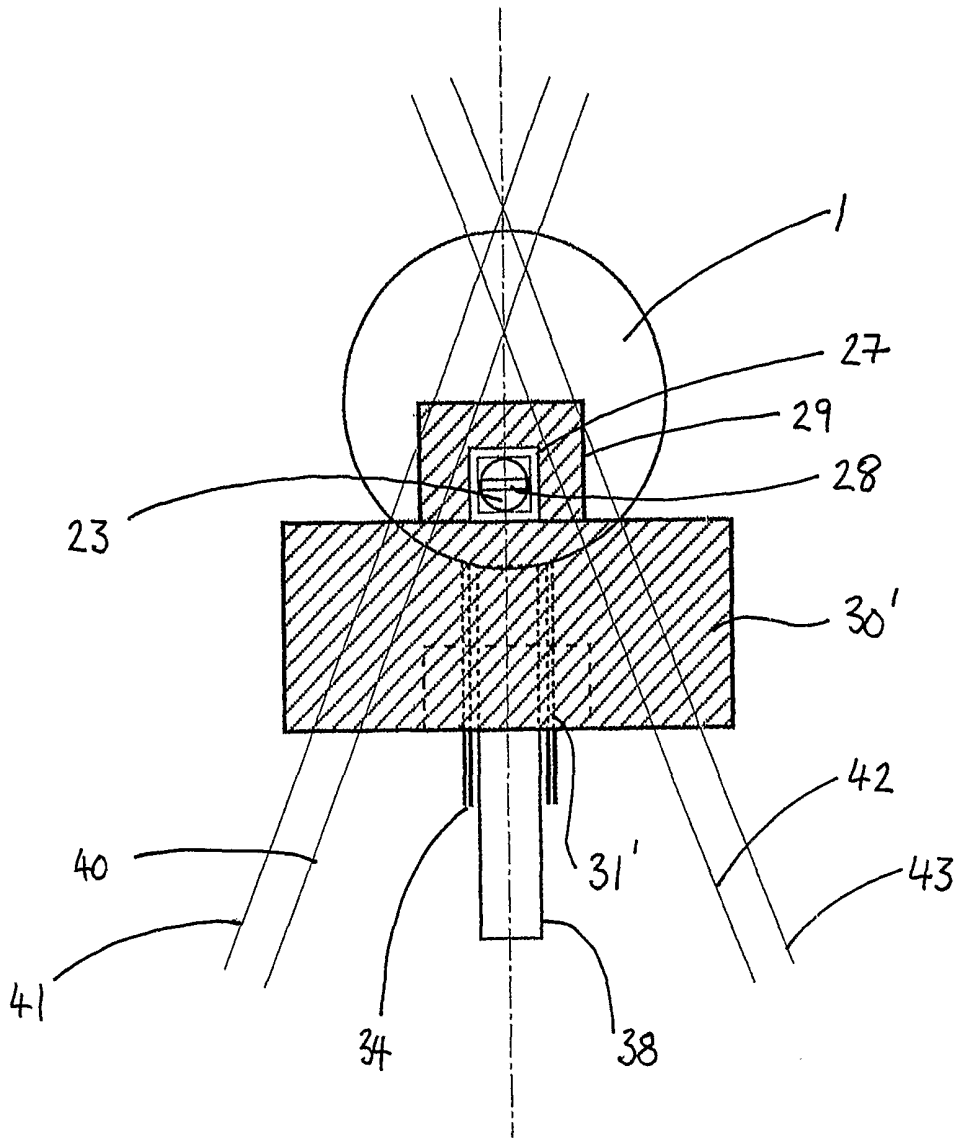


FIGURE 10

INTERNATIONAL SEARCH REPORT

International Application No
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| A. CLASSIFICATION OF SUBJECT MATTER IPC 7 A61B17/74 A61B17/17 | | |
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| According to International Patent Classification (IPC) or to both national classification and IPC | | |
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| ° Special categories of cited documents : | | |
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