

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
30 November 2000 (30.11.2000)

PCT

(10) International Publication Number
WO 00/71035 A1

- (51) International Patent Classification⁷: **A61B 17/15** LS23 6PB (GB). **BASSIL, Robert** [GB/GB]; DCA Design Consultants, 19 Church Street, Warwick CV34 4AB (GB).
- (21) International Application Number: PCT/GB00/01839
- (22) International Filing Date: 19 May 2000 (19.05.2000) (74) Agent: **BELCHER, Simon, James**; Urquhart-Dykes & Lord, Tower House, Merrion Way, Leeds LS2 8PA (GB).
- (25) Filing Language: English (81) Designated States (*national*): AU, JP, US.
- (26) Publication Language: English (84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
- (30) Priority Data:
9911731.9 20 May 1999 (20.05.1999) GB
9912279.8 27 May 1999 (27.05.1999) GB
- (71) Applicant (*for all designated States except US*): **DEPUY INTERNATIONAL LIMITED** [GB/GB]; St. Anthony's Road, Beeston, Leeds LS11 8DT (GB).
- Published:**
— With international search report.
— Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.
- (72) Inventors; and
(75) Inventors/Applicants (*for US only*): **ORTON, Marcus** [GB/GB]; 40 Heath Drive, Boston Spa, West Yorkshire
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*



WO 00/71035 A1

(54) Title: BONE RESECTION GUIDE

(57) Abstract: A guide for use in resection of a patient's bone to prepare the bone for implantation of a component of a joint prosthesis, comprises (a) an arm which can be positioned in general alignment with the bone axis, (b) a cutting block having a control surface against which a saw can slide so as to control the location of the saw when acting against the bone to cut it, and (c) a mount on the arm for the cutting block. At least one of the arm and the mount has an attachment formation by which the guide can be fastened to the bone to prevent movement of the mount relative to the bone. The cutting block and mount between them define a track along which the cutting block can be slid in a plane that is oriented appropriately relative to the bone axis.

BONE RESECTION GUIDE

This invention relates to a guide for use in resection of a patient's bone to prepare the bone for implantation of a component of a joint prosthesis.

An initial stage of preparing a bone for implantation of a component of a joint prosthesis involves resecting the bone, for example in the preparation of the tibia and the femur for implantation of a knee joint prosthesis. It is important that the resection be accurate to ensure that the prosthesis component is located appropriately to ensure good biomechanical performance of the prosthesis.

It is known to use a guide to control the process of resecting a bone such as a tibia. The guide can be fixed to the bone, and the resecting saw then positioned against a support surface of the guide during resection and slid in contact with the support surface.

Alignment of the guide relative to the axis of the bone can be achieved by means of a rod which can be aligned with the axis.

While the use of a resection guide is common to many surgical techniques, different components of the resection instrumentation can be required to suit the requirements of a particular patient. In particular, different cutting guides can be required according to whether the knee joint that is being replaced is in the right leg or the left leg. The location of the incision relative to ligament and other soft tissue components of the natural joint can also affect the choice of an appropriate cutting guide.

The present invention provides a resection guide in which the cutting block and its mount between them define a track along which the cutting block can be slid. The plane along which the cutting block is slid remains at a constant level relative to the bone axis throughout the movement of the block.

Accordingly, in one aspect, the invention provides a guide for use in resection of a patient's bone to prepare the bone for implantation of a component of a joint prosthesis, the guide comprising:

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- a. an arm which can be positioned in general alignment with the bone axis,
- b. a cutting block having a control surface against which a saw can slide so as to control the a location of the saw when acting against the bone to cut it,
- c. a mount on the arm for the cutting block,

at least one of the arm and the mount having at least one attachment formation by which the guide can be fastened to the bone to prevent movement of the mount relative to the bone, and the cutting block and mount between them defining a track along which the cutting block can be slid in a plane that is oriented appropriately relative to the bone axis.

The guide of the present invention has the advantage that it enables the location of a cutting guide to be selected to meet the requirements of a particular patient without having to provide a range of cutting guide components. Thus for example the guide can be used in the implantation of a prosthesis in a left knee or in a right knee. The guide can also be adapted for use whether the surgeon makes a medial incision or a lateral incision, again by selection of the position of the cutting block on the mount, the plane that is defined by the control surface of the cutting block remaining at a constant level relative to the bone axis throughout the movement of the block. The invention therefore enables the inventory of surgical instrumentation that is provided for a joint replacement, especially a knee joint replacement, to be reduced. This gives rise to several advantages. In particular, it simplifies the process of selection of the appropriate instrumentation during a procedure. Furthermore, it reduces the size and weight of the instrumentation kit, resulting in reduced material, and transportation costs. Furthermore, the reduction in the number of components of an instrumentation kit can simplify and reduce the cost of manufacture.

Preferably, the track along which the cutting block slides is arcuate so that it has concave and convex sides, and is arranged so that when the mount is fixed against a bone, the bone faces the concave side of the track. In this way, the cutting block can effectively slide around the bone as it is slid along the track, following approximately the external shape of the bone. This enables the cutting block to remain close to the bone as it is moved along the track, enabling inaccuracies in the resection to be minimised.

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Preferably, the track is provided by a cooperating rib and groove. Preferably, the groove has a dove-tail configuration so that the opening into the groove is narrower than the groove at its base. The configuration of the rib should then correspond to that of the groove so that the rib cannot be removed from the groove other than by sliding the rib along the groove. In a preferred construction, the rib is provided on the cutting block and the groove is provided on the mount.

Preferably, the cutting block and the mount between them define at least one detent (for example two, three or four detents) to define one or more predetermined positions for the cutting block relative to the mount. They might define two detents, for example corresponding to positions for the cutting block for tibial resection in the left leg and right leg, or for medial and lateral incisions, respectively. The detent might be provided in the track along which the cutting block can slide relative to its mount. Preferably, the cutting block is located in the detent by movement of a resiliently deformable locator. For example, when the track is provided by a cooperating rib and groove, the detent can be provided by a spring loaded element which acts between opposite faces of the rib and the groove. The element can be received in a recess when the cutting block is in its predetermined position.

Preferably, the mount is hinged so that the angle between the control surface of the cutting block and the arm can be adjusted. Generally, it will be preferred for the bone to be resected in a plane that is generally perpendicular to the bone axis, preferably as close as possible to perpendicular to the bone axis. However, a hinged mount can enable the orientation of the resection plane to be adjusted, for example to accommodate misalignment of the mount relative to the bone axis, or to accommodate the requirements of a particular patient. For example, the angle of the resection may be offset from perpendicular to the bone axis, in the anterior-posterior or in the medial-lateral aspects, according to known biomechanical principles and taking into account the design of the particular component to be implanted.

Preferably, the mount provides for a plurality of predetermined orientations of the resection plane. For example, two mating parts of the mount can have teeth which can interengage when the resection plane is in one of its predetermined orientations.

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The arm can be arranged to extend along the outside of the patient's bone. An arm of this kind is often referred to as an extramedullary alignment rod. Preferably, the length of the arm can be adjusted. This can enable the guide of the invention to be used on patients whose bone vary in length while the distal end of the guide engages the patient's bone towards its remote end, for example just above the ankle in the case of the tibia. A preferred construction which enables the length of the arm to be adjusted comprises a pair of rods which have profiles which define between them an interengaging rib and groove when viewed in cross-section, with a dovetailed cross-section. A clamp can be used to lock the two rods together. The use of profiled rods has the advantage that it can provide a large surface area which can provide a secure connection between the rods and therefore a stable connection between them.

Preferably, the arm includes means for locating the arm relative to the patient's bone towards the end that is remote from the cutting block and mount. Preferably, the means for locating the arm comprises a clamp which can extend around the bone. The clamp can be configured to engage the patient's limb at a point towards its end, for example at or a small distance above the ankle in the case of a guide for use in connection with a knee joint replacement.

The arm can be arranged to extend into the medullary cavity of the patient's bone. The mount can then be connected to the arm by means of a member which extends generally laterally from the arm at a point towards the end which extends from the medullary cavity. An arm of this kind is often referred to as an intramedullary alignment rod.

The guide can include both (a) an intramedullary arm which is arranged to extend into the medullary cavity of the patient's bone, and (b) an extramedullary arm which is arranged to extend along the outside of the bone.

Preferably, the mount has at least one hole extending through it for accommodating a bone screw or other fastener (such as a pin, or drill bit) by which the mount can be fastened to the patient's bone.

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Preferably, the cutting block has at least one feature formed in it for locating accessories and attaching them to the cutting block. The feature for locating accessories comprises a track in which an accessory can be slid across the control surface of the cutting block. The accessories can facilitate location of the cutting block relative to features on the patient's bone to facilitate accurate resection. They can be relied on during the step of resecting the bone to control the orientation of the saw blade. They can also be used after resection during preparation of the resected bone for implantation of the prosthesis when the cutting block can effectively serve as a platform on which instruments can be mounted.

Preferably, the guide includes at least one accessory which can be attached to the cutting block using an attachment feature thereon. The accessory can comprise a stylus for calibrating the position of the cutting block relative to the patient's bone, especially the top of the bone prior to resection, or for indicating the superior aspect of the intended implant with respect to the distal cut. The stylus can have associated with it means for adjusting its height above the cutting block, or its length of the stylus beyond the cutting block, or both.

The accessory can comprise an element which can be positioned so that it extends substantially parallel to the control surface of the cutting block to define a slot in which a saw can be slid.

The material that is used to make the guide of the invention should be hard wearing so that it is not deformed or subject to significant wear in use. It should of course be corrosion resistant. Commonly used materials for surgical instruments will generally be appropriate, such as for example stainless steels. The cutting surface can incorporate inserts of appropriate low friction materials such as certain ceramic or polymeric materials.

The guide of the present invention finds particular application in preparation of a tibia for implantation of the tibial component of a knee joint prosthesis. However, it can be used to prepare other bones for implantation of a component of a joint prosthesis. For example, it might be used to prepare the femur for implantation of a component of a knee joint prosthesis or of a hip prosthesis, or to prepare the tibia for implantation of a component of

an ankle joint prosthesis, or to prepare the humerus for implantation of a component of a shoulder joint prosthesis.

Embodiments of a guide for preparing a tibia for implantation of a component of a knee joint prosthesis, according to the present invention, will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of a guide which includes an extramedullary alignment rod.

Figure 2 is an isometric view of a guide which includes an intramedullary alignment rod.

Figure 3 is an enlarged isometric view of the top portion of the guide shown in Figure 1.

Figure 4 is an exploded view of the top portion of the guide shown in Figure 2, with a stylus accessory and a cutting guide accessory.

Figure 5 is a side view of a stylus accessory that can be used on the guide.

Figure 6 is a side view of a saw capture block accessory that can be used on the guide.

Figure 7 is a side view of a template clamp accessory that can be used on the guide.

Figure 8 is a side elevation of a mount which can provide angular adjustment of the cutting block relative to the axis of the tibia defined by the alignment rod.

Referring to the drawings, Figure 1 shows a guide 2 for use in resection of a patient's tibia to prepare the tibia for implantation of a tibial component of a knee joint prosthesis. The guide comprises an alignment rod 4 which can be positioned in general alignment with the patient's tibia. At its lower end, the alignment rod has a Y-shaped locator 6. The tibia can be located between the arms of the locator. A strap extending between the arms of the claim can retain the tibia in place between the arms of the locator. The strap is preferably extensible, for example in the form of a spring. The locator is preferably arranged to be slid inwardly and outwardly relative to the alignment rod; it can be held in a desired position by means of a clamp 8.

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The alignment rod 4 is has two sections 10, 12 which are connected at a rod clamp 14. The effective length of the alignment rod can be adjusted by sliding one of the rod sections relative to the other rod section. The clamp can prevent relative movement of the rod sections when the rod has a desired length. Preferably, the rod sections have profiles which define between them an interengaging rib and groove when viewed in cross-section, with a dovetailed cross-section. The use of profiled rod sections has the advantage that it can provide a large surface area which can provide a secure connection between the rod sections and therefore a stable connection between them.

A clamp assembly 20 is provided at the top of the alignment rod 2. The assembly can be moved up and down on the rod. In the illustrated embodiment, movement is controlled by means of a toothed rack on the upper alignment rod section 10 and a cooperating toothed wheel which can be turned by means of a control knob 22. The clamp assembly includes a bone fixation block 24 which has holes 26 extending through it for bone screws by which the clamp assembly can be affixed to the tibia.

Figure 2 shows a construction of guide in which the alignment rod 4' is configured for location within the intramedullary cavity. A clamp assembly 20' is provided at the top of the alignment rod. The clamp assembly is able to move along an axis that is parallel to the tibial axis by rotation of a control knob 22', in a manner similar to that of the clamp assembly on the extramedullary alignment rod construction shown in Figure 1.

The cutting block 30 and mount 28 of the clamp assembly of the guide shown in Figure 1 are shown in detail in Figures 3 and 4. The mount is provided on an arm 29 which extends laterally from the alignment rod. It is held on the arm by means of a notch 32 on a spring loaded member 34. The notch can be received in a recess (not shown) on the underside of the mount when the mount is properly located on the arm. The mount has a number of holes 36 extending through it which can accommodate bone screws to fasten the mount to the tibia, instead of or in conjunction with bone screws which extend through holes in the bone fixation block 24. The mount 28 has an upstanding rib 38 formed on it. The rib has a dovetailed shape when viewed in cross-section and is substantially straight.

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The cutting block 30 has a generally planar control surface 42 against which a saw can run. Upstanding rails of a low friction material (especially a ceramic material) can be provided on the control surface. The cutting block has a groove 44 in its lower surface, which is configured to receive the rib 38 on the mount 28 so that the cutting block can fit onto the rib and be slid along it. The rib 38 and the groove 44 between them define at least one detent (for example two, three or four detents) to define one or more predetermined positions for the cutting block relative to the mount. They might define two detents, for example corresponding to positions for the cutting block for tibial resection in the left leg and right leg, or for medial and lateral incisions, respectively. The detent might be provided in the track along which the cutting block can slide relative to its mount. Preferably, the cutting block is located in the detent by movement of a resiliently deformable locator. For example, the groove 44 can have one or more recesses in one of its walls, into which a spring loaded locator 46 on the rib 38 can fit when the cutting block is in one of its predetermined positions.

The control surface 42 has markings 48 on it to facilitate accurate location relative to the tibia.

The shape of the cutting block when viewed in plan can be selected to suit the requirements of a particular surgeon. It will often be preferred for the size of the block to be maximised to provide optimum stability for the saw which acts against it. The cutting block will unusually have a concave edge 50 which is positioned adjacent to the tibia when the block is in use. The opposite surface 52 will often be convex. The side edges 54 will generally extend substantially parallel to one another. However, other shapes might be preferred.

The cutting block has a groove 60 formed in its control surface 42. The groove has a dovetailed shape when viewed in cross-section. The groove can receive an appropriately profiled foot 62 of an accessory which can be fixed to the control surface by sliding the foot into the groove. Accessories that can be used in this way are shown in Figures 4 to 7.

A stylus 64 is shown in Figures 4 and 5. The stylus comprises an upwardly extending limb 66 and a transverse limb 68 which has a downwardly extending portion 70 at its remote

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end. The foot 62 is provided at the base of the upwardly extending limb 66. The length of the upwardly extending limb 66 can be adjusted to control the height of the remote end of the transverse limb above the control surface of the cutting block. The transverse limb can slide in an opening in the upwardly extending limb so that the length of the transverse limb can be adjusted.

A saw capture block 72 is shown in Figures 4 and 6. The block comprises a transverse portion 74 which, when the foot 62 is received in the groove 60, is spaced apart from the control surface 42 of the cutting block so that it defines a narrow slot between it and the control surface in which a saw can be slid.

The template clamp 76 can clamp a template onto the control surface 42 of the cutting block.

Figure 8 shows an alternative mount 80 which comprises upper and lower portions 82, 84. The upper portion has a dovetailed shaped rib formed on it which can be received in an correspondingly profiled groove 44 on a cutting block. The lower portion has a groove formed in it to engage an alignment rod, for example by means of a spring loaded locking member on a transverse arm.

The upper and lower portions of the mount 80 are hinged at the edge which, when the guide is in use, faces the tibia. The hinge enables the angle between the upper surface of the upper portion and the lower surface of the lower surface to be adjusted. The portions should be capable of being locked in a desired angular orientation, for example by means of a thumb screw.

In use, the guide is positioned adjacent to a tibia with the tibia located between the arms of the Y-shaped locator. The length of the alignment rod is adjusted roughly by relative movement of the rod sections and locked using the clamp. The stylus is mounted on the control surface of the cutting block and, by setting the height of the stylus above the cutting block, is used to locate the cutting block relative to the top of the tibia. The clamp assembly is then fixed to the tibia by means of screws passing through holes in the bone

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fixation block or the mount for the cutting block or both. The location of the cutting block around the axis of the tibia can be adjusted by sliding the cutting block on its mount. The saw capture block is then mounted on the control surface of the cutting block and a saw inserted into the slot between the saw capture block and the cutting block which is used to resect the tibia.

Once the clamp assembly has been fixed to the tibia, the alignment components (in particular the alignment rods and the Y-shaped locator) can be removed if desired. It is an advantage of the assembly of the present invention that, even with the alignment components removed, the lateral position of the cutting block on the fixation block can be adjusted.

CLAIMS:

1. A guide for use in resection of a patient's bone to prepare the bone for implantation of a component of a joint prosthesis, the guide comprising:
 - a. an arm which can be positioned in general alignment with the bone axis,
 - b. a cutting block having a control surface against which a saw can slide so as to control the a location of the saw when acting against the bone to cut it,
 - c. a mount on the arm for the cutting block,at least one of the arm and the mount having at least one attachment formation by which the guide can be fastened to the bone to prevent movement of the mount relative to the bone, and the cutting block and mount between them defining a track along which the cutting block can be slid in a plane that is oriented appropriately relative to the bone axis.
2. A guide as claimed in claim 1, in which the track is configured to enable the location of the cutting block relative to the bone to be adjusted along the medial-lateral axis or the anterior-posterior axis or both.
3. A guide as claimed in claim 1, in which the said track is arcuate so that it has concave and convex sides, and is arranged so that when the mount is fixed against a patient's bone, the bone faces the concave side of the track.
4. A guide as claimed in claim 1, in which the track is provided by a cooperating rib and groove.
5. A guide as claimed in claim 1, in which the cutting block and the mount between them provide at least one detent to define a predetermined position for the cutting block relative to the mount.
6. A guide as claimed in claim 4, in which the cutting block is located in the detent by movement of a resiliently deformable locator.

7. A guide as claimed in claim 1, in which the mount is hinged so that the angle between the control surface of the cutting block and the arm can be adjusted.
8. A guide as claimed in claim 1, in which the length of the arm can be adjusted.
9. A guide as claimed in claim 1, in which the cutting block has at least one feature formed in it for locating accessories and attaching them to the cutting block.
10. A guide as claimed in claim 8, in which the feature for locating accessories comprises a track in which an accessory can be slid across the control surface of the cutting block.
11. A guide as claimed in claim 8, which includes at least one accessory which can be attached to the cutting block using an attachment feature thereon.
12. A guide as claimed in claim 10, in which the accessory comprises a stylus for calibrating the position of the cutting block relative to the patient's bone.
13. A guide as claimed in claim 11, which includes means for adjusting the height of the stylus above the cutting block, or the length of the stylus beyond the cutting block, or both.
14. A guide as claimed in claim 10, in which the accessory comprises an element which can be positioned so that it extends substantially parallel to the control surface of the cutting block to define a slot in which a saw can be slid.
15. A guide as claimed in claim 1, in which the arm is arranged to extend along the outside of the patient's bone.

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16. A guide as claimed in claim 14, in which the arm includes means for locating the arm relative to the patient's bone towards the end that is remote from the cutting block and mount.

17. A guide as claimed in claim 15, in which the means for locating the arm comprises a clamp which can extend around the bone.

18. A guide as claimed in claim 1, in which the arm is arranged to extend into the medullary cavity of the patient's bone, and in which the mount is connected to the arm by means of a member which extends generally laterally from the arm at a point towards the end which extends from the medullary cavity.

19. A guide as claimed in claim 1, which includes (a) an intramedullary arm which is arranged to extend into the medullary cavity of the patient's bone, and (b) an extra-medullary arm which is arranged to extend along the outside of the bone.

20. A guide as claimed in claim 1, in which the mount has at least one hole extending through it for accommodating a bone screw or other fastener by which the mount can be fastened to the patient's bone.

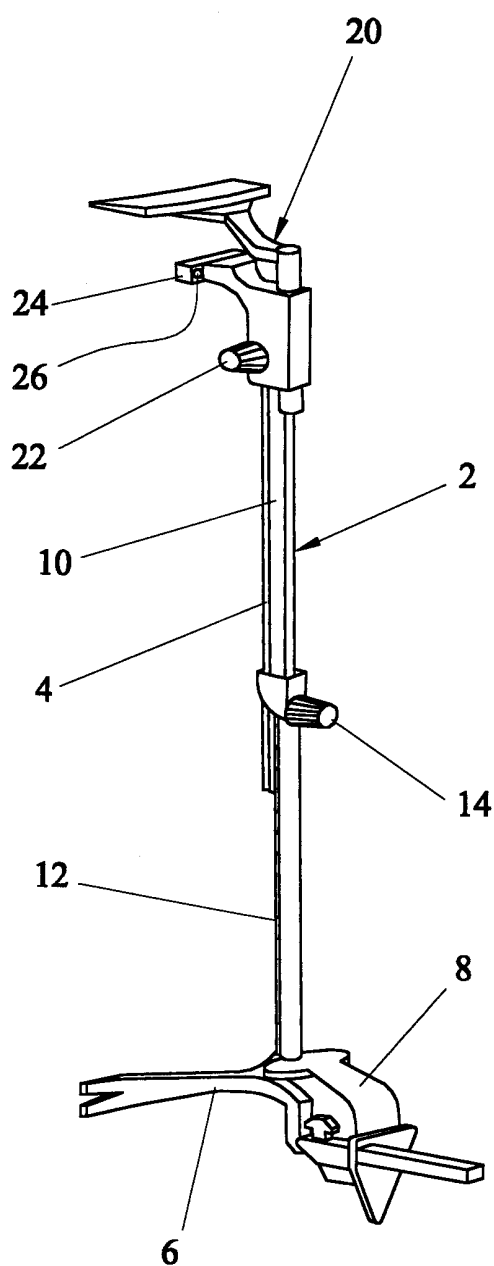


FIG. 1

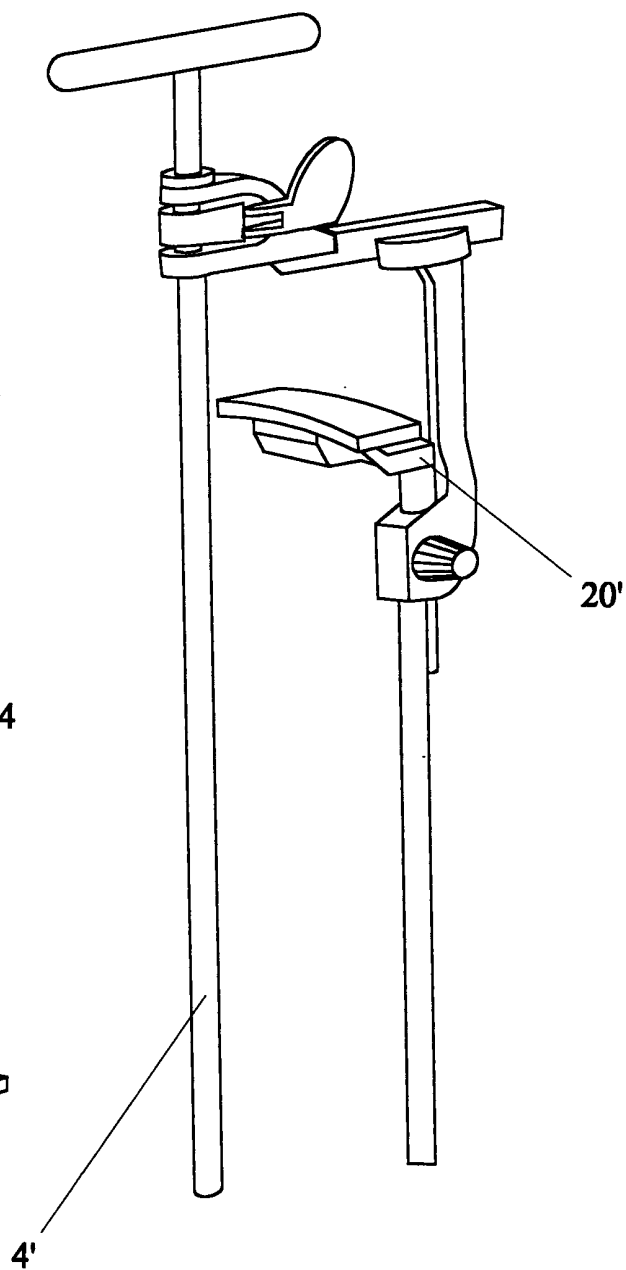
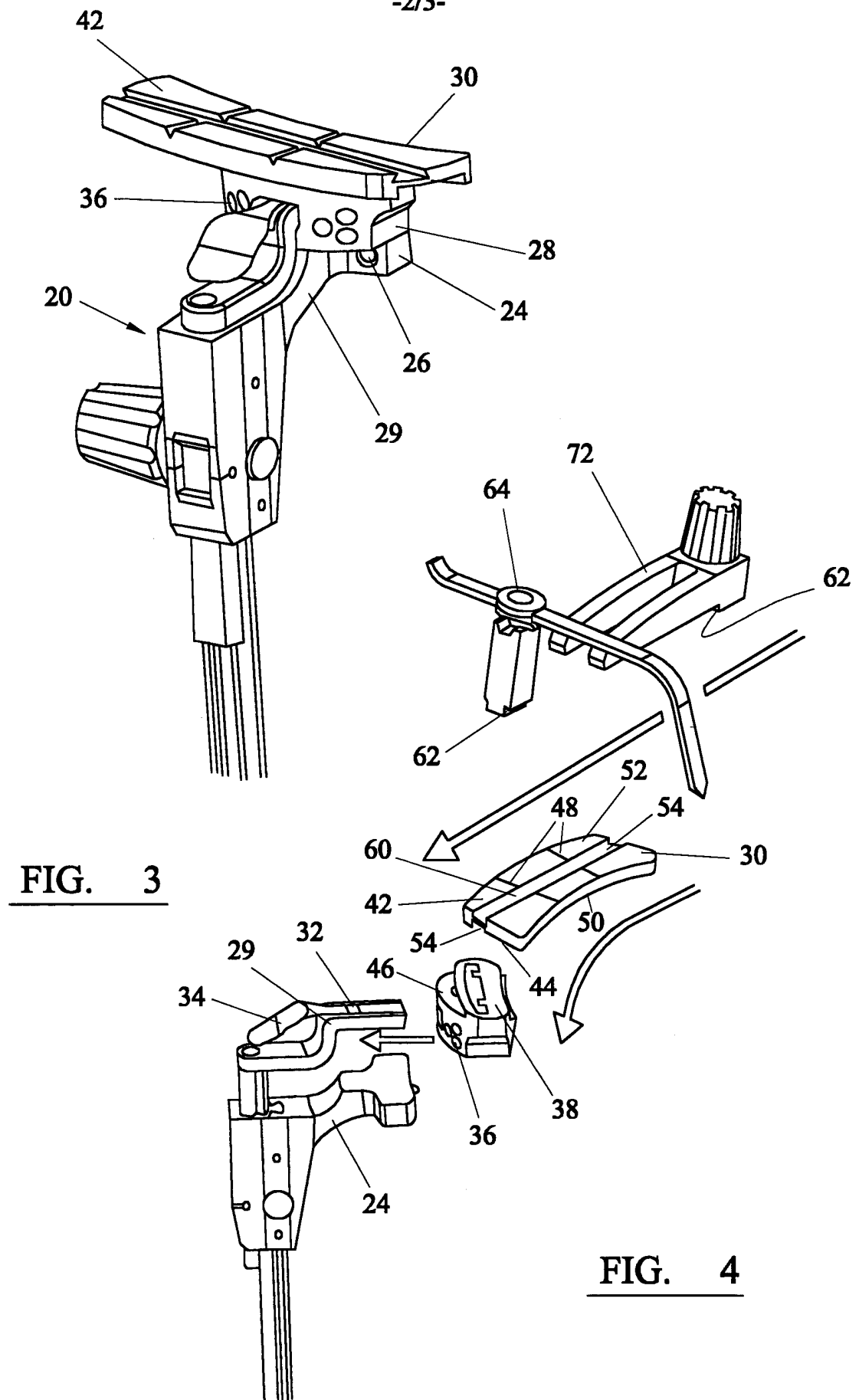


FIG. 2

-2/3-



-3/3-

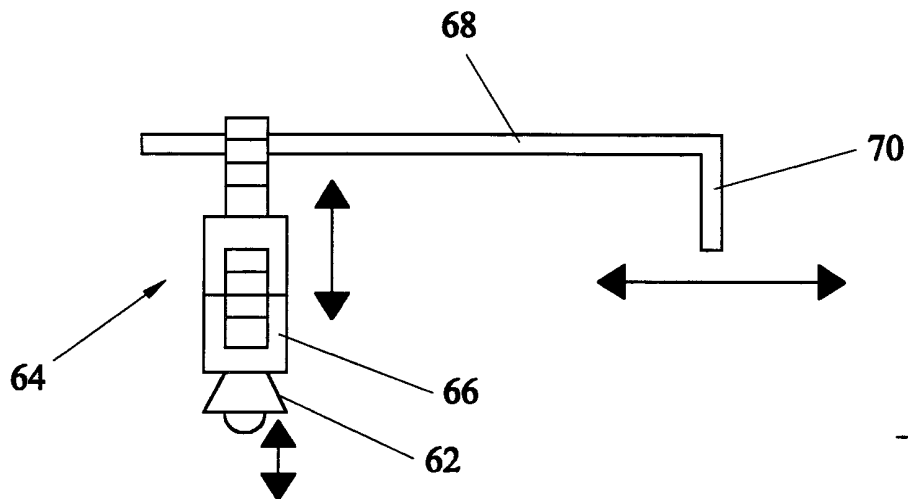


FIG. 5

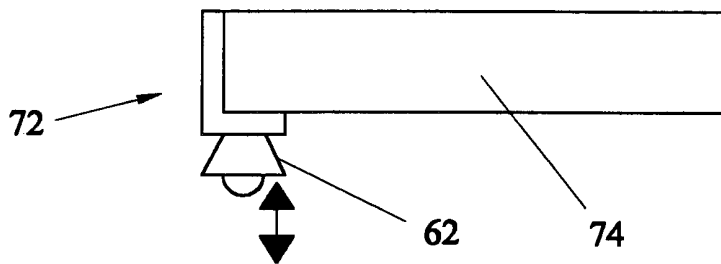


FIG. 6

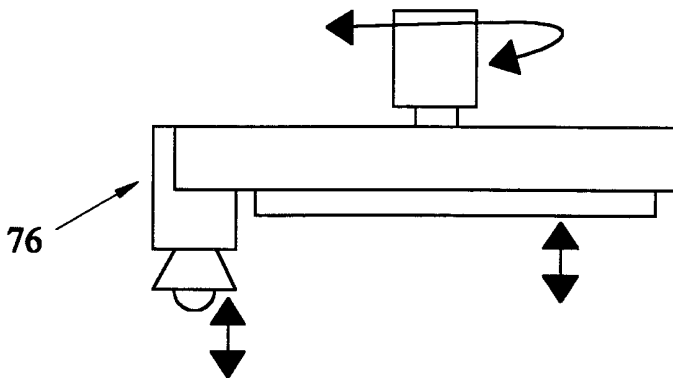


FIG. 7

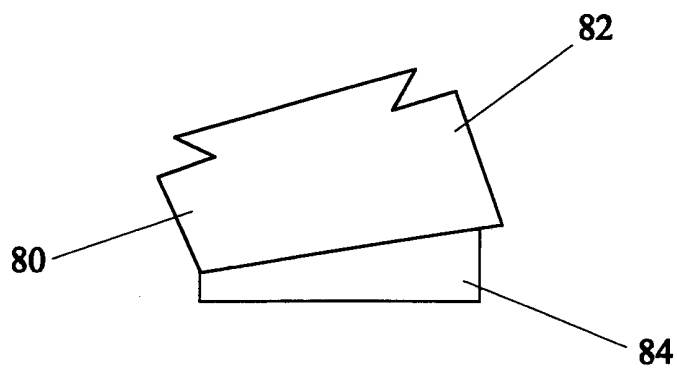


FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01839

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A61B17/15

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 7 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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 0 709 062 A (BASCOULERGUE GERARD ;PEYROT JACQUES (FR); CHARRET PHILIPPE (FR); D) 1 May 1996 (1996-05-01) column 5, line 44 -column 6, line 44; figure 1 ---	1,2,4,8, 9,11-17
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X	FR 2 679 126 A (CHAGNEAU FRANCIS ;LEVASSEUR MICHEL (FR)) 22 January 1993 (1993-01-22) abstract; figure 2 ---	1-3
	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

3 November 2000

Date of mailing of the international search report

15/11/2000

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

Hansen, S

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01839

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 5 395 376 A (CASPARI RICHARD B ET AL) 7 March 1995 (1995-03-07) abstract; figures 1,7 ----	1,2
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