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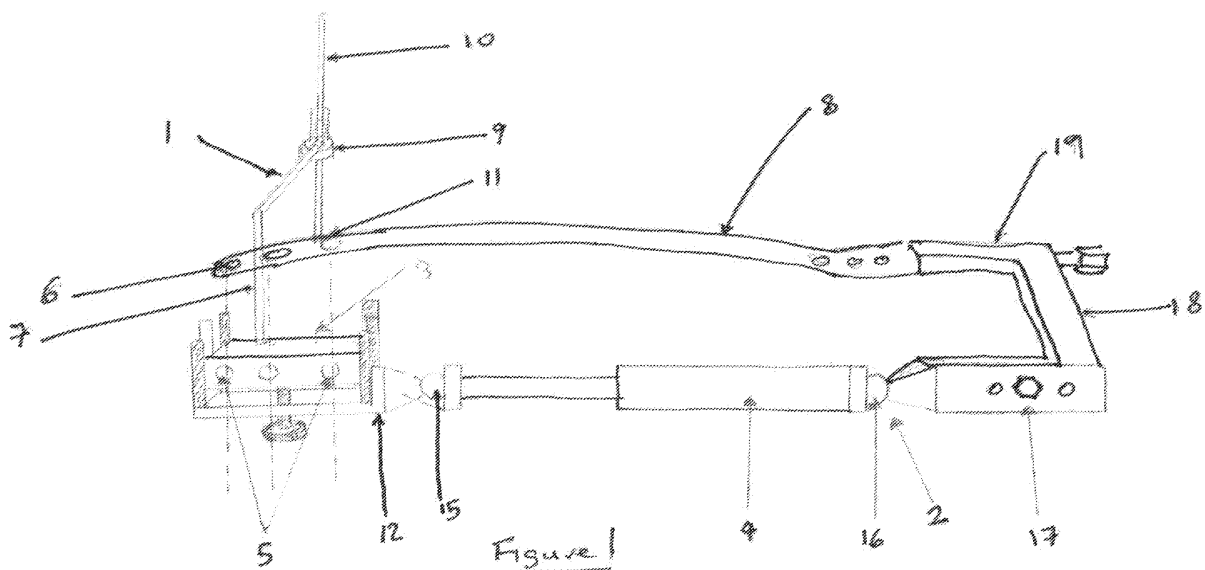
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(54) Title of the Invention: **Distal locking targeting device**  
Abstract Title: **Mechanical locator and positioning device for locking intramedullary nails**

(57) A locator device for consistently providing relative positioning of a drilling positioning block with the distal end of a surgical nail, for accurate alignment of the locking screws with the nail distal holes. The locator device 1 comprises a projection block 3 lockable upon a positioning arm 4. The block 3 has an arch 7 which extends towards the nail 8, the arch carries a guide sleeve 9 and a rod 10 guided therein, the rod having a contact end 11 to engage the surgical nail, and marking means to indicate the rod position within the guide 9. The block 3 has apertures 5 and may be movable in a frame 12 by adjustment means having a screw thread attachment. The marking means may be scale increments on the rod, ink or a clamp associated with the rod. A positioning arrangement which may be used with the locator device is also provided comprising a handle 18 and mounting 17, a positioning arm 4, and universal joints 15, 16. Methods of locating and positioning the devices are also disclosed.



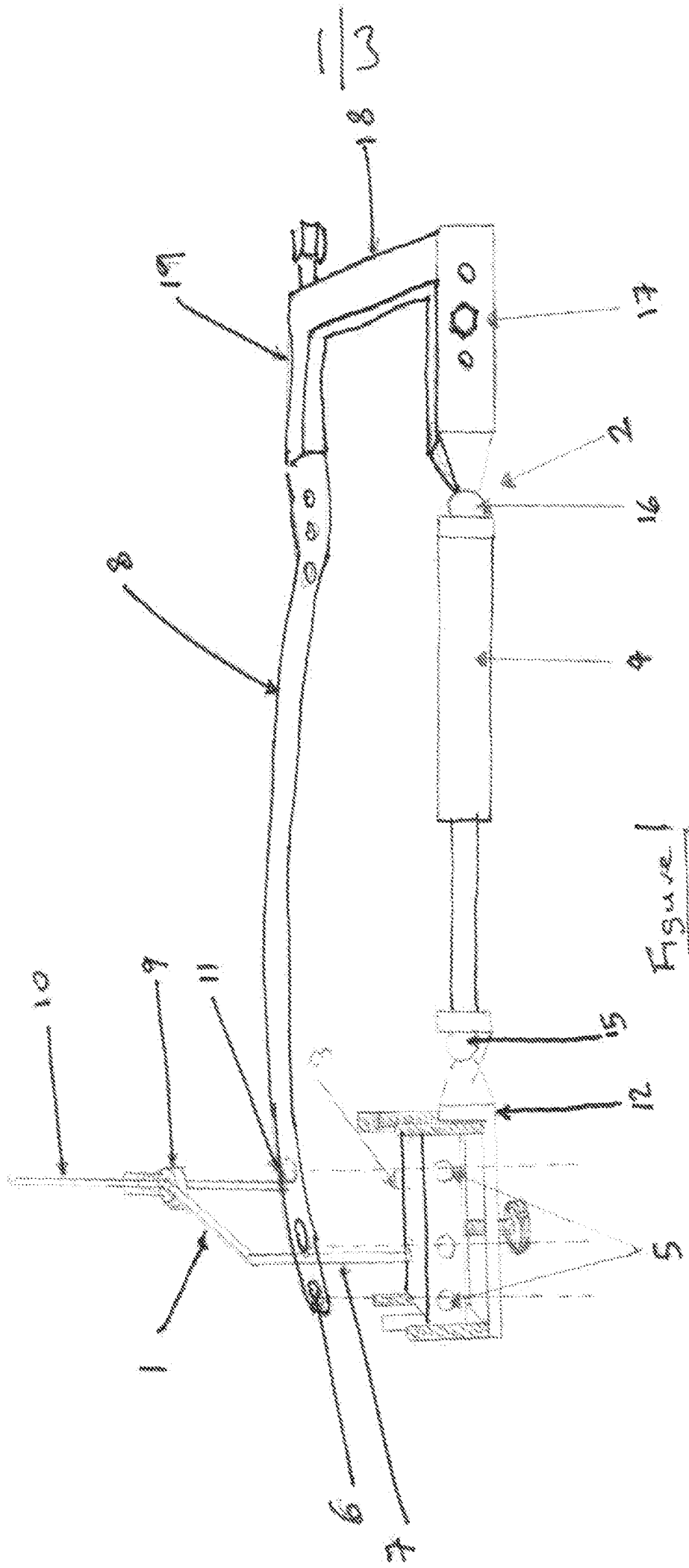


Figure 1

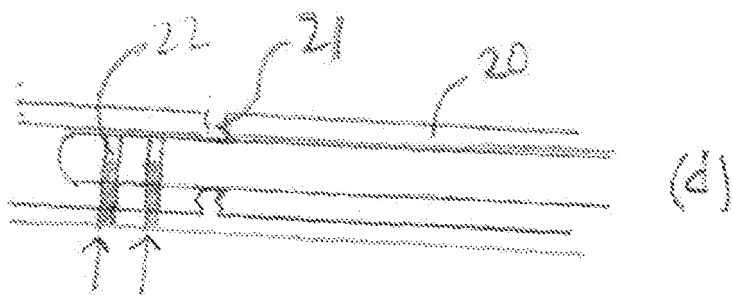
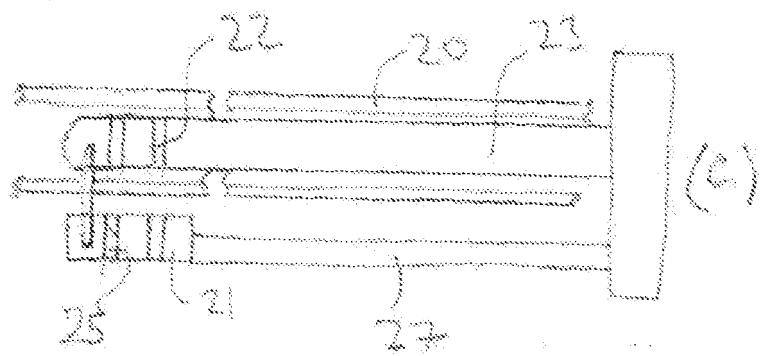
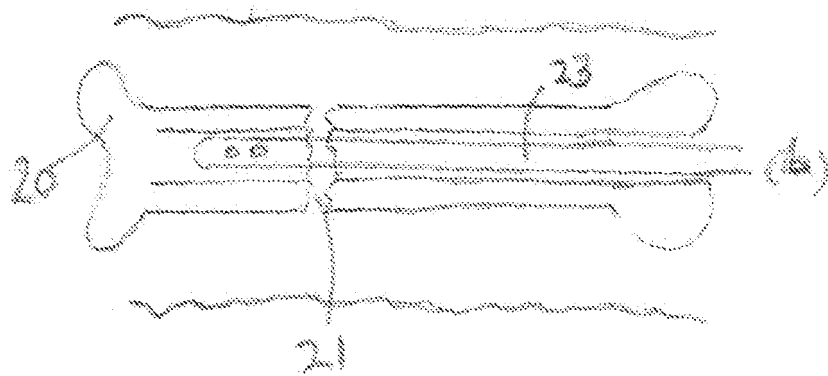
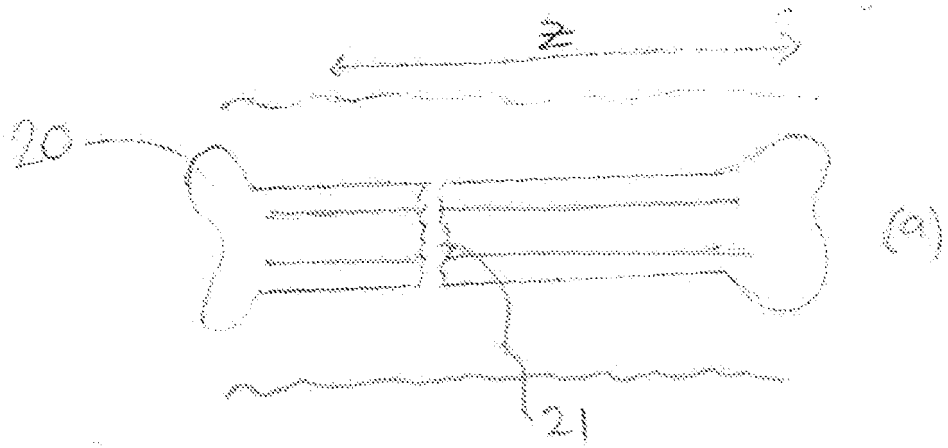


Figure 2

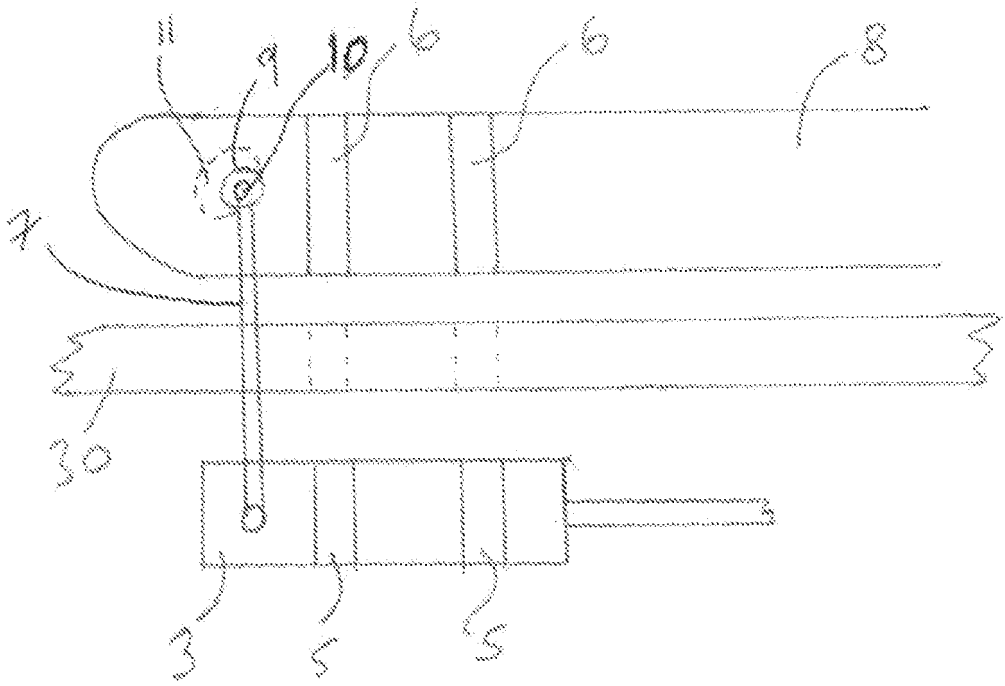


Figure 3

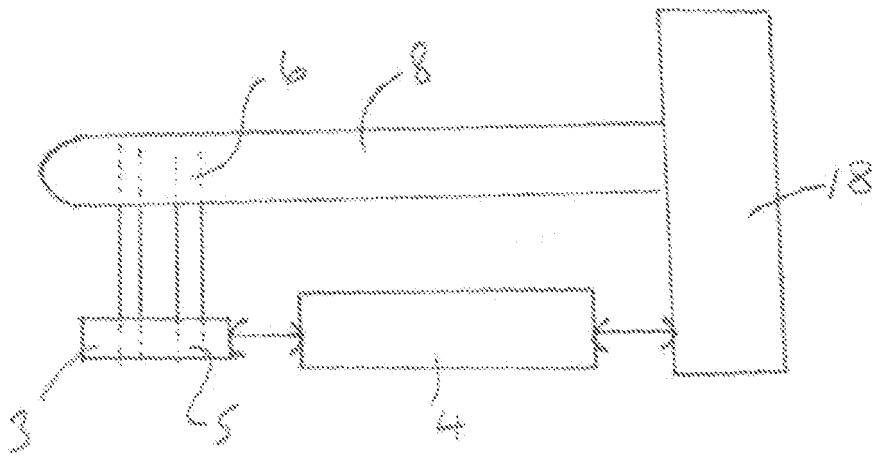


Figure 4

### **Distal Locking targeting device**

5            This invention relates generally to distal locking of surgical nails and more particularly but not exclusively to so-called an IntraMedullary Nail (IMN), used to fix long bone fractures.

             Distal locking is recommended for unstable fractures and when rotational stability is required. Most surgeons currently use fluoroscope imaging to help guide the process of  
10        drilling holes for screws in the distal end of a bone within which a nail is to be secured. Fluoroscopy, while essential for proper nail placement can subject the surgical team and patient to substantial radiation.

             The standard operating procedure for the fixation of long bone fractures with an IntraMedullary Nail (IMN) consists of the implantation of the IMN, an elongated, rod-like, in  
15        the bone. The surgeon typically starts with an incision and thereafter creates an opening in the proximal or distal end (antegrade or retrograde) of a given long bone, thereby providing access to the affected medullary canal in which the IMN is then implanted. One goal in IMN treatment is fracture reduction so that near anatomic alignment takes place under stabilized conditions, often facilitated by means of locking screws that are integrated within the IMN.

20            Any given IMN is typically prefabricated, for example, with locking holes that are located in the general vicinity of the proximal and distal ends of the IMN. There are several holes at each end of the nail, each hole takes one screw. The locking screws when interlocked with an IMN are designed to stabilize the fracture and fix the bone relative to the implanted IMN.

25            In order to accurately lock long intramedullary nails the distal screws have to be accurately aligned with the holes in the nail. This locking is complicated by the deflection of the nail during insertion into the bone canal which normally changes the location of the hole from the initial 'relaxed' position before insertion. In such circumstances the surgeon has been forced to determine hole positions in the nail freehand with the help of an X-ray C-arm.  
30        A common problem in such a procedure is that the surgical instruments are "in the way" since they are on the image plane of the C-arm, obstructing a clear view, the procedure also takes a long time and exposes the surgical team to excessive radiation.

Several simplified techniques, jigs, laser assisted and mechanical guiding instruments, and surgical navigation systems have been used to perform distal interlocking of intramedullary nails, but none has found widespread acceptance. Mechanical aiming systems had been introduced for radiation independent tibial and femoral nail interlocking, but they were not successful because of failure to take into account the deformation the nail undergoes during insertion into the medullary cavity. Secondly, the manufacturers can't guarantee the nails to have exactly the same shape as minor differences could happen during the manufacturing process.

In accordance with aspects of the first invention there is provided a locator for a surgical nail, the locator comprising a projection block for surgical pins and lockable upon a positioning arm spaced in use relative to a surgical nail, the positioning block having an arch to extend in use towards a surgical nail, the arch having a guide and a rod guided by the guide, the rod having a contact end to engage the surgical nail when projected through the guide and marking means to indicate the rod position upon engagement with the surgical nail for subsequent return of relative positioning between the positioning block and a surgical nail in use.

Aspects of the first invention also include a method of locating a surgical nail in a bone, the method comprising:-

- a) Prior to insertion of a surgical nail into a bone cavity associating the surgical nail with an arm having a positioning block adjacent a distal end of the nail;
- b) Securing the block towards the distal end of the surgical nail through nail apertures;
- c) Positioning a calibration arch with a guide over a part of the distal end of the surgical nail, placing within the guide a rod with a foot end to engage a surface of the surgical nail and marking the position of the rod upon the rod or an associated part when the foot end engages the surface of the surgical nail with a mark or recording that position;
- d) Detaching the whole device from the proximal end of the nail and inserting the nail into a bone cavity;
- e) Re-attaching as required the now inserted surgical nail in the bone cavity and arm as previously with the calibration arch extending over the nail;
- f) Inserting the rod and providing the foot end in engagement with the surface of the surgical nail and adjusting the block to return to the previous marker position if required.

In accordance with aspects of the second invention there is provided a distal locking positioning arrangement for a surgical nail, the arrangement comprising a positioning arm associated with a universal joint with a locking cam joint, the arm is extendable telescopically means ,and at a distal end there is an positioning aperture whereby in use a pin can extend through the positioning aperture to a nail aperture in a surgical nail and at least when suitably aligned the universal joint and the extension means are lockable to allow removal and return of the nail if required.

Aspects of the second invention include a method of positioning a surgical nail in a bone cavity, the method comprising:-

- a) Assembling a surgical nail with a positioning arrangement comprising an adjustable arm with extension means and/or a universal joint in a free state, the association being at both a proximal end as required and at distal end by fastenings between positioning apertures in a block upon the arm and nail apertures in the distal end of the nail;
- b) Once assembled lock the adjustable arm to maintain orientation and configuration;
- c) Releasing at least association between the block and the distal end of the surgical nail then insertion of the nail into a bone cavity;
- d) Re-assembly of the nail with the locked positioning arrangement whereby the block provides through the positioning apertures a guide for a drill device in alignment with the nail apertures in the distal end of the surgical nail.

The universal joint may be a ball and socket type union or joint.

The positioning block may have a plurality of positioning apertures.

The universal joint may comprise a number of universal joint elements. The universal joints may be intermediate along the length of the arm. The positioning arm is adjustable at least along an axis in use parallel to a surgical nail.

The positioning block may comprise a carrier incorporating the positioning aperture in a frame whereby the carrier is moveable in the frame by adjustment means for subsequent return of relative positioning between the positioning block and a surgical nail in use. The adjustment means may be by a screw thread attachment or a sliding mechanism.

The guide may be a sleeve. The sleeve may extend substantially perpendicularly at a spaced position from the positioning block.

The marking means may be a semi-permanent ink. The marking means may be a clamp or similar retainer associated with the rod. The marking means may be increments  
5 marked on the rod to allow recordal of rod position relative to part of the guide. The increments may correspond with incremental adjustment by the adjustment means.

Embodiments of the first invention and the second invention will now be described by way of example only with reference to the accompanying drawings in which:

10 Figure 1 is a schematic perspective view of both first and second inventions in accordance with aspects of the present invention;  
Figure 2 is a schematic illustration of stages a) to d) of inserting, positioning and locking a surgical nail in accordance with aspects of the present invention;  
Figure 3 is a schematic illustration of a first invention in accordance with aspects of the  
15 present invention; and,  
Figure 4 is a schematic illustration of a second invention in accordance with aspect of the present invention.

As indicated above positioning of a surgical nail is important to provide effective  
20 stabilization of a fracture, but with an IntraMedullary Nail there are the added problems of the surgeon working blind in terms of accurate actual screw or nail aperture position within the bone. It will be understood that the nail is located within the bone so not only are there manufacturing tolerance variations but also distortions of the nail as it is driven into the bone during the procedure. As indicated above previously Fluoroscopy, free hand techniques and  
25 surgeon skill have been depended upon to ensure that an accurately drilled hole in the bone aligns with a hole in the nail itself so that a screw can then be located as required. Correct location of the drilled aperture in the bone is necessary to avoid weakening of the bone with a bigger aperture than necessary and to fully stabilize the nail against slippage which may lead to premature failure.

30 Aspects of the present inventions respectively relate to proximal positioning of a surgical nail and positional correction for accurate positioning and locking with screws as required. A first invention provides a locator which includes an arch to extend over to a surgical nail initially outside of a bone and then with the nail in position within a bone so that a marked rod within a guide can ensure subsequent return to relative positioning between a



projection block for a drill and a pin or nail aperture position in a nail within a bone. A second invention relates to providing a distal lock positioning arrangement which includes a positioning arm which has universal adjustment through a joint and extension between a mounting end and a distal end upon which a positioning block is located so that a pin can be arranged to extend between the positioning block and the nail aperture so that the positioning arm can then be locked, the pin removed then the nail inserted into a bone and the position block used to drill an aperture in the bone to the nail aperture in the surgical nail now located in the bone to allow a screw be secured to stabilise the distal end of the surgical nail in use.

Advantages associated with the usage of an IMN include providing sufficient stability to maintain alignment and length, and limit rotation of the fracture site. Further advantages include allowing minimally invasive techniques, reduced hospitalization, earlier postoperative ambulation, and an earlier active range of motion (ROM) when compared to some conventional casting or external fixation methods.

Both inventions individually and when combined in one device will allow better positioning and locking of a surgical nail with reduction of the X-Ray exposure and operating theatre time due to quicker correct positioning and location of the locking nail aperture or hole along with typically easier and more surety in use.

Aspects of the inventions allow for adjustment due to deformation of the surgical nail during installation within a bone. Such adjustment may potentially reduce a need for intuitive skill level requirements of the surgeon to be built up with experience and training so benefiting operating times and also the need for a specialist radiographer. Furthermore some equipment which may inhibit access by the surgeon such as an image intensifier will not be required and the inventions could be used with both solid and cannulated surgical nails. The inventions are adjustable and adaptable to almost any surgical nail of any shape or customized to particular surgical nail systems with bespoke mountings etc. to ensure the correct nail is used for a particular situation.

Prior placement of distal locking screws was done primarily by a variety of freehand techniques, using conventional or radiolucent drilling devices. These methods may result in repeated drilling, repeated X-Ray adjustment, which may require longer exposure as well as higher potential for mis-drilling. This is to be avoided so the present inventions effectively pre-calibrate an arrangement for positioning a nail and a locator to provide adjustment for installation distortion.

The inventions can be adapted to determine a targeting position on a surgically implantable nail adapted to be used in internal fixation of a long bone, the nail comprising a distal end and a proximal end. Ideally both inventions are provided in a device which includes an articulating arm that is adapted to be detachably coupled to the proximal end of the nail, this arm is rotationally and longitudinally adjustable to be compatible with any nail of any shape then locked in that position, and a locator jig for targeting adjustably coupling to the distal end of the arm with a positioning block and a guide with a rod marked in use to provide subsequent return to relative position between them for drilling.

A combined invention device consists of three main parts:

- 1- An extendable first part typically in the form of a telescopic arm and a universal angular adjustment means which typically includes two multidirectional ball and socket type joints. The proximal end of the arm is attached firmly by a mounting to a nail inserting handle using pegs and screws or any other method. A distal end of the arm is attached to a second part of the device below. The telescopic articulating function and the ball and socket joints of the arm allows it to be used with any surgical nail of any given length or shape, is very strong and doesn't become loose during device handling intra-operatively between stages of nail insertion and locking as described later.
- 2- A second part is provided by a targeting jig or positioning block and is attached firmly to the extendable first part (the telescopic arm). The jig or block contains holes or apertures that match the axes and direction of the nail holes or apertures in the surgical nail in order to guide a drilling device in to the bone and through in to the nail holes or apertures as necessary. The block in accordance with preferred aspects of a locator has adjustment through a sliding function which enables the jig or block holes/apertures to follow the nail deformation during insertion and so the nail holes/apertures as well.
- 3- A third part is provided by a calibration arch of the first invention. The third part is attached firmly to the second part and consists of an L shaped arch have a guide generally in the form of a sleeve at the free or distal end of the arch and a calibrating rod identifies through a marker the surgical nail position within the bone during a pre-installation phase and allows subsequent return to that relative positioning upon installation of the surgical nail in to the bone.

The method of installation includes the following steps:-

A - Check that the targeting jig or block is free and is in the neutral position to allow adjustment.

5 B - Calibration of distal locking holes must be done prior to surgical nail insertion into a bone so by using positioning pins which extend from the jig or block to the nail apertures in the nail so that an acceptable relative position is achieved and then secured with nuts or other means so that the extendable telescopic/universal joint arm is locked in position.

10 C - Once in an acceptable relative position it is important to ensure that the positioning pins slide smoothly in the holes of the nail so that the locking screws to lock the distal end position of the nail will also be easily located with limited stress.

15 D - Adjustment of the calibrating arch which accommodates a rod which is guided all the way to the anterior nail surface by a guide in the form of a sleeve upon the arch. In this manner, the calibrating arch will extend over the surgical nail so that the rod can be marked in some way for recording relative position. This mark is a specific reading upon the rod and normally takes a semi-permanent form through an ink mark or clamped on retainer. The position where the rod and in particular a foot end to the rod engages the surface of the surgical nail will change if the nail deforms. Such deformation will be seen through the  
20 marker or reading as the rod can freely or controllably side in the guide sleeve. Normally there will be means to adjust the positioning block by a sliding mechanism which will allow movement of the block so that with the calibration arch secured to the block the locator can be configured so that the displaced marking or reading is returned to be consistent with the original marking position for subsequent return of relative position for consistency between  
25 the relaxed state and the inserted state to enable the drill and locking screws to be inserted and secured in the correct position without the need for X ray guidance.

E - Once the surgical nail is ready to be positioned, located and locked the positioning arrangement including the locator jig are removed from the nail. The nail is then inserted into the typically reamed bone intramedullary canal.

G -Once the nail is forced into the bone intramedullary canal then the device normally comprising the positioning arrangement and the locator respectively with the positioning arm and the calibrating arch is reattached to the nail at the open or proximal end.

5 H -The guide of the locator is then used to drill down through the bone to the surgical nail.

I - The rod is then located in the guide and slide down until there is contact with the nail and review of marker position made so there can be adjustment of the distal positioning block until the pre-calibrated relative positioning is achieved that is to say the marker position  
10 is the same for the pre-calibrated condition and the inserted condition. Thus with the positioning arrangement comprising the positioning arm with extension means and universal joints locked and the markers consistent the position apertures in the position block should be substantially aligned with the nail apertures so a drilling device can be guided through the positioning block will coincide with the nail apertures.

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J - Nail distal locking is now achieved by drilling an aperture in the bone and inserting a locking screw appropriately.

Typically there are three options for distal locking of a surgical nail:

20 1-Static locking: One screw is placed in a round hole and the other is placed in the proximal part of an oblong hole in the nail with apertures drilled appropriately thorough the bone.

2-Dynamic locking: Locking in the distal part of an oblong hole in a surgical nail creates a "Dynamic Locking" (slide) mechanism – requires only one screw

25 3-Static/dynamic locking: one screw is placed in the distal part of the oblong hole and the other in the round hole in a surgical nail. If dynamization is required after a period of time, the screw that was placed in the round hole is removed to allow a dynamic locking action as described above with regard to option 2.

All these 3 options are achievable with the present invention.

Figure 1 provides a schematic perspective view of a device incorporating a locator jig 1 in accordance with aspects of the first invention and a positioning arrangement 2 in accordance with aspects of the second invention.

The locator 1 comprise a positioning block 3 secured to a distal end of a positioning arm 4. The positioning block 3 may be a solid block of robust material as depicted or another structure to provide positioning apertures 5 each arranged to be consistent with distal end surgical nail apertures or holes 6 in a surgical nail 8. It will be understood that the block 3 may be generic or specific blocks provided for specific or groups or particular manufacturers of nails in terms of aperture sizes, spacing, orientation and number.

Associated with the block 3 is a calibration arch 7 which is generally L shaped to extend over the surgical nail 8 with a guide 9 positioned to guide and project a rod 10 with a foot end 11 towards the nail 8.

In use the rod 10 slides along or through the guide 9 typically in the form of a sleeve or open sided channel or is captive on a rail until the foot end 11 engages an anterior surface of the nail 8. This engagement position is marked in some way on the rod 10 or an associated part and typically by a semi-permanent pen ink or clamp marker/retainer or otherwise. Alternatively, the rod 11 may have accurate incremental numbering or markings which can be recorded for reference later as a calibration marker. Such marking in use only occurs when a respective positioning pin (not shown) is located and preferably secured between the at least one and preferably all the holes 5 in the block 3 and at least one and normally all the apertures 6 in the nail 8. The marking or reading provides a reference for relative positioning between the block 3 and the holes 6 and the nail 8.

Once marking of the rod or an associate part has occurred to register the rod10/end11 and so nail relative position, the rod 11 can be removed and put in a safe location. The nail 8 can then be inserted in accordance with normal practice or as described below with regard to the second invention within a bone (not shown). The nail 8 may distort during the insertion process. Thus, when the arm 4 is used to present the block 3 again then when the rod 10 with end 11 are presented through the guide 9 it will be appreciated that the marking on the rod 11 or an associated part may not be consistent with the pre-calibration marking position prior to insertion. In such circumstances the block 3 includes an adjuster comprising a frame 12 and a screw thread displacement mechanism so that a carrier part upon which the arch 7 is secured can be adjusted until the marked position upon the rod 10

is returned and alignment of the positioning holes 5 and the nail holes 6 is achieved. Once aligned apertures can be drilled and more permanent pins or screws arranged to extend in to the apertures to secure the bone to the nail 8.

5 It will be understood to provide a reference or calibration for installation of a surgical nail means must be provided to accommodate not only for each type and style of nail but also for differences in manufacturer and tolerance variation. A second invention which typically will be combined with the first invention but not necessarily compromises an arm 4 which has longitudinal extension means such as a telescopic section 14 with at least two  
10 universal joints such as ball and socket joints 15, 16. The arm 4 is secured by a mounting 17 to a handle 18 which in turn is secured on the other side to a surgical nail 8. In use the nail 8 and the arm 4 are broadly parallel to each other.

In order to calibrate the nail 8 and arm 4 assembly the extension means 14 and  
15 universal joint(s) 15, 16 are released and allowed to freely adjust as the block 3 and distal end of the nail 8 are associated in an arrangement where one or normally all the positioning apertures 5 and the nail apertures 6 are connected and secured by pins or screws (not shown). In this state the extension means 14 and universal joints 15, 16 adjust for curvature, shaping and otherwise for the actual nail 8 in use rather than a notional design standard.  
20 The extension means 14 and the universal joints 15, 16 are locked in the adjusted state. It will be understood that the surgeon can also ensure that the actual pins, screws or bolts to be used to fix the nail 8 at the distal end to bone fit and assemble perfectly. This condition is stabilised by locking the extension means 14 and the joints 15, 16. The locks used may be of any suitable type including compression, friction and interference fits.

25 For installation of a nail 8 typically the handle 18 will be detached from the nail 8 through release of a retainer mounting 19. The pins extending between the positioning block 3 and the distal end of the nail 8 are also removed so that the remainder of the arrangement can be set aside in its locked state. The nail 8 can then be inserted into the bone as required  
30 then the handle and remainder to the arrangement re-attached with drilling to the nail apertures as previously described.

Figure 2 provides basic schematic illustrations of the stages a) to d) of surgical nail installation within a bone 20 with a fracture 21. Thus, at stage a) the fracture 21 is reviewed  
35 and set in the desired restored state so that in accordance with aspects of the present invention a clinician or surgeon can determine a surgical nail is needed and determines the

length Z and type required. Between stages a) and b) the processes of calibration in accordance with the first invention and the second invention above are performed such that at stage b) a surgical nail 23 such as an IMN is inserted after incisions and reaming etc. In such circumstances it is necessary to find the nail apertures 22 for distal end locking in the bone 20. At stage c) the positioning arrangement and/or the locator as described above are used to position a drill device to drill holes to align with the nail apertures 22 and to adjust for nail distortion upon insertion to the bone 20. At stage d) the locking screws are inserted and secured to stabilise and lock the distal end of the nail 23.

As described above with the locator the end foot will be allowed to slide upon the rod through the guide to contact the nail 23 surface. Adjustment to the marker made during calibration can be made for subsequent return to relative positioning between a positioning block 24 and the distal end of the nail or more particularly the nail holes 22 and positioning holes 25. Thus, a drilling device presented through the holes 25 will drill in substantive alignment with the nail holes or apertures 22. The foot end of the marker may extend through a hole drilled into the bone through the guide to provide access to the nail surface for positioning.

As described above, with a positioning arrangement 26 comprising an adjustable (extension and angular) arm 27 locked in the desired configuration when the arrangement 26 is secured to the nail 23 again then the positioning block 24 should again return to the desired relative position between the block 24/distal end of the nail 23 or holes 22, 25 ignoring nail installation distortion but normally some adjustment will be required for such distortion. Thus, at stage d) the device described above is re-attached to the nail 23 so that the holes 22, 25 are aligned and so that drilled holes can be formed for locking the distal end of the nail to the bone.

Figure 3 provides a schematic illustration of a locator in accordance with aspects of the first invention. Thus, as previously the objective is to align the nail holes 6 with positioning holes 5 in a positioning block 3 secured to an arm 4 so that holes through bone 30 can be drilled and subsequently screws used to lock the distal end of the nail 8. The locator has an arch 7 extending from the block 3 over the nail 8 such that the foot end 11 can engage the nail to determine distortion and provide adjustment of the block 3 accordingly to provide alignment. The foot end 11 is on a rod 10 which extends through the guide 9 so that as described above a marker can be provided on the rod 10 itself or another part by proxy for relative positioning to give a semi-permanent reference on the rod or by

recordal of incremental position for subsequent return. In any event by using the calibration marker as a reference and consistency between pre and post installation it will be understood that alignment of the positioning holes 5 for a drilling device and the nail holes 6 is more assured.

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A specific further hole for the foot end 11 and rod 10 can be drilled to gain access to the nail 8. The block 3 is generally at least adjustable by appropriate means perpendicular to the illustration of figure 3 but may have other domains of adjustment dependent upon the need to achieve return to the marker position determined upon pre installation calibration. By such an approach greater adjustment of the positioning block for consistency with distortions of the nail can be provided.

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It will be understood that the arch and guide will tend to be reusable with appropriate sterilisation or disposable, and the rod and foot end either reusable or disposable.

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Figure 4 provides a schematic plan view of a positioning arrangement in accordance with aspects of the second invention. Thus, as previously an adjustable arm 4 is secured at one (proximal) end to a handle 18 to which a nail 8 is also secured. At the respective distal ends of the arm 4 and the nail 8 during calibration pins 40 extend across between a positioning block 3 and the distal end of the nail 8 through respective apertures 5, 6. Once assembled the positioning arrangement is locked by locking the extension means and the universal joint means in the arm 4. The handle 18 is then detached from the nail 8 and the nail 8 driven into a bone as described previously. If there is no distortion of the nail then when the nail 8 now inserted into the bone is re-attached to the handle and arm/block combination the positioning holes in the block should be returned to substantive alignment with the nail holes or apertures so holes drilled by projection from the positioning holes in the block will align with the nail holes to allow locking screws or bolts to be secured by drilling there through bone to underlying nail apertures.

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It will be appreciated by those skilled in the art that any number of combinations of the aforementioned features and/or those shown in the appended drawings provide clear advantages over the prior art and are therefore within the scope of the invention described herein.

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**Claims**

1. A locator for a surgical nail, the locator comprising a projection block for surgical  
5 fixings and lockable upon a positioning arm spaced in use relative to a surgical nail, the  
positioning block having an arch to extend in use towards a surgical nail, the arch having a  
guide and a rod guided by the guide, the rod having a contact end to engage in use a  
surgical nail when projected through the guide and marking means to indicate the rod  
10 position upon engagement with the surgical nail for subsequent return of relative positioning  
between the positioning block and a surgical nail in use.
2. A locator as claimed in claim 1 wherein the positioning block has a plurality of  
positioning apertures.
3. A locator as claimed in claim 1 or claim 2 wherein the positioning block comprises a  
15 carrier incorporating each positioning aperture in a frame whereby the carrier is moveable in  
the frame by adjustment means for subsequent return of relative positioning between the  
positioning block and a surgical nail in use.
4. A locator as claimed in claim 3 wherein the adjustment means comprises a screw  
thread attachment.
5. A locator as claimed in any preceding claim wherein the guide is a sleeve.
- 20 6. A locator as claimed in claim 5 wherein the sleeve extends substantially  
perpendicularly at a spaced position from the positioning block.
7. A locator as claimed in any preceding claim wherein the contact end comprises a  
foot.
8. A locator as claimed in claim 7 wherein the foot is off centre upon the rod.
- 25 10. A locator as claimed in any preceding claim wherein the marking means includes a  
semi-permanent ink and/or a clamp or similar retainer associated with the rod.
11. A locator as claimed in any preceding claim wherein the marking means includes  
increments marked on the rod to allow recordal of rod position relative to part of the guide.

12. A locator as claimed in claim 11 wherein the increments correspond with incremental adjustment by the adjustment means as claimed in claim 3.

13. A locator for a surgical nail substantially as hereinbefore described with reference to the accompanying drawings.

5 14. A method of locating a surgical nail in a bone, the method comprising:-

a) Prior to insertion of a surgical nail into a bone cavity associating the surgical nail with an arm having a positioning block adjacent a distal end of the nail;

b) Securing the block towards the distal end of the surgical nail thorough nail apertures;

10 c) Positioning a calibration arch with a guide over a part of the distal end of the surgical nail, placing within the guide a rod with a foot end to engage a surface of the surgical nail and marking a marker position of the rod upon the rod or an associated part when the foot end engages the surface of the surgical nail with a calibration mark or recording that position;

15 d) Detaching at least the block from the distal end of the nail and inserting the nail into a bone cavity;

e) Re-attaching together as required the now inserted surgical nail in the bone cavity and arm as previously with the calibration arch extending over the nail; and,

20 f) Inserting the rod and providing the foot end in engagement with the surface of the surgical nail and adjusting the block to return to the calibration marker or position recorded if required.

15. A method as claimed in claim 14 wherein the positioning block is used to drill an aperture and/or position a fixing such as a pin or screw.

25 16. A method of locating a surgical nail in a bone substantially as hereinbefore described with reference to the accompanying drawings.

17. A distal lock positioning arrangement for a surgical nail, the arrangement comprising a mounting to present a nail with a distal end having a nail aperture, a positioning arm associated with the mounting by a universal joint, the arm having extension means and at a distal end there is a positioning aperture whereby in use a pin can extend through the  
30 positioning aperture to a nail aperture in a surgical nail and at least when suitably aligned the

universal joint and the extension means are lockable to allow removal and return of the nail if required in use from attachment to the distal lock positioning arrangement.

18. A distal lock positioning arrangement as claimed in claim 17 wherein the positioning arm has a positioning block with a plurality of positioning apertures.

5 19. A distal lock positioning arrangement as claimed in claim 18 wherein the positioning block comprises a carrier incorporating each positioning aperture in a frame whereby the carrier is moveable in the frame by adjustment means for subsequent return of relative positioning between the positioning block and a surgical nail in use.

10 20. An arrangement as claimed in claim 19 wherein the adjustment means is a screw thread attachment.

21. An arrangement as claimed in any of claims 17 to 20 wherein the universal joint comprises a number of universal joint elements.

22. An arrangement as claimed in claim 21 wherein the universal joint elements are intermediate along the length of the arm.

15 23. An arrangement as claimed in any of claims 17 to 22 wherein the positioning arm is adjustable at least along an axis in use parallel to a surgical nail.

24. An arrangement as claimed in any of claims 17 to 23 wherein the extension means comprises a telescopic part or means to allow arms of different length to be attached as required for extension.

20 25. A distal lock positioning arrangement for a surgical nail substantially as hereinbefore described with reference to the accompanying drawings.

26. A method of positioning a surgical nail in a bone cavity, the method comprising:-

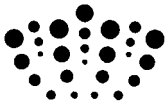
25 a) Assembling a surgical nail with a positioning arrangement comprising an adjustable arm with extension means and/or a universal joint in a free state, the association being at both a proximal end as required and at distal end by fastenings between positioning apertures in a block upon the arm and nail apertures in the distal end of the nail;

b) Once assembled locking the adjustable arm to maintain orientation and configuration;

c) Releasing at least association between the block and the distal end of the surgical nail then insertion of the nail into a bone cavity; and,

d) Re-assembly of the nail with the locked positioning arrangement whereby the block provides thorough the positioning apertures a guide for a drilling device in alignment with the nail apertures in the distal end of the surgical nail.

- 5 27. A method of positioning as claimed in claim 26 wherein the positioning apertures are in a positioning block and the method includes adjusting the position of the block.
28. A method of positioning a surgical nail in a bone cavity substantially as hereinbefore described with reference to the accompanying drawings.
29. A device comprising a locator as claimed in any of claims 1 to 13 and a positioning  
10 arrangement as claimed in any of claims 17 to 25.
30. A method of positioning and locating a surgical nail comprising a combination of the method as claimed in any of claims 14 to 16 and the method as claimed in any of claims 26 to 28.



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**Claims searched:** 1-13, 29

**Date of search:** 30 January 2012

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-2, 5-7, 11	CN 200963183 Y (YANG) 24.10.2007 See the figures and WPI Abstract, Accession Number: 2007-057566 [06]
X	1-2, 5-7, 11	DE 202004014226 U (MERETE MEDICL GMBH) 02.12.2004 See the figures and WPI Abstract, Accession Number: 2005-133842 [15]
X	1-2, 5-7, 10	CN 201398996 Y (XIADONG) 10.02.2010 See the figures and WPI Abstract, Accession Number: 2010-B98985 [16]
X	1-2, 5-7, 10	US 2003/135211 A1 (CHO) See paragraph 7 and figure 3 in particular
A	-	US 6039742 A (KRETTEK et al) See the whole document
A	-	WO 96/03085 A1 (ORTHOFIX SRL) See pages 5-9 and figures 2, 3 and 8 in particular

**Categories:**

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

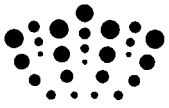
Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup>:

Worldwide search of patent documents classified in the following areas of the IPC

A61B

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI



**International Classification:**

<b>Subclass</b>	<b>Subgroup</b>	<b>Valid From</b>
A61B	0017/17	01/01/2006
A61B	0017/88	01/01/2006