PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
A61B 17/72, E04B 1/38, F16B 13/10

A1

(11) International Publication Number: **WO 00/25690**

(43) International Publication Date: 11 May 2000 (11.05.00)

(21) International Application Number: PCT/AU99/00937

(22) International Filing Date: 28 October 1999 (28.10.99)

(30) Priority Data:

PP 6847	30 October 1998 (30.10.98)	AU
PQ 0336	13 May 1999 (13.05.99)	AU

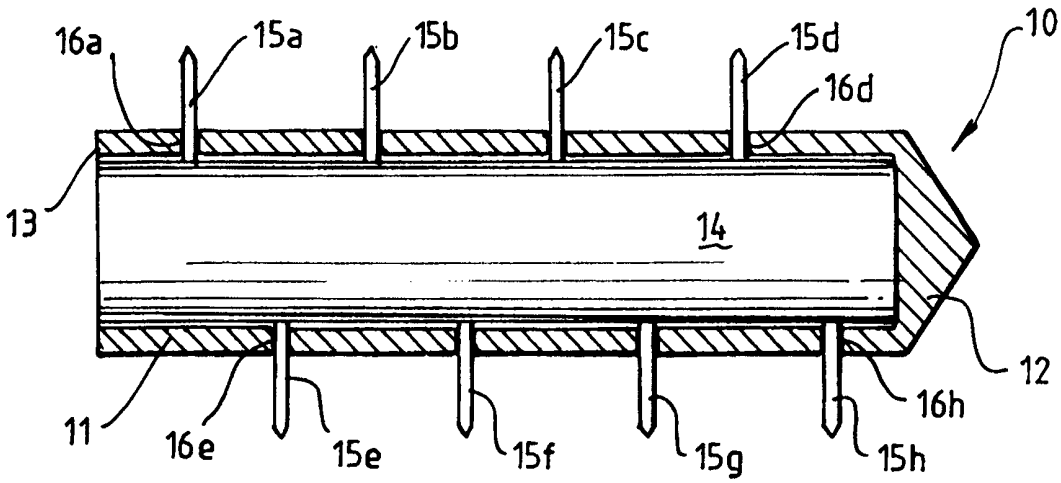
(71)(72) Applicant and Inventor: GRIGGS, Ian, Ross [AU/AU]; Wookey Barn, Lot 5, Homestead Road, Wonga Park, VIC 3115 (AU).

(74) Agent: CARTER SMITH & BEADLE; Level 10, 189 Kent Street, Sydney, NSW 2000 (AU).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: FIXATION DEVICE



(57) Abstract

A fixation device comprises an outer hollow elongate member (11) having a plurality of holes (16a...16h) in its outer wall. An inner member (14) carries a plurality of pins (15a...15h). To use the fixation device, the device is placed in a suitable cavity or hole and the pins are extended through the respective holes. The device may be used as an intra-medullary bone fixation device for fixing fractures in bones, or as a device used in the building industry.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

FIXATION DEVICE

The present invention relates to an intramedullary bone fixation device and to a method of fixing an intramedullary device to a bone. The apparatus and method of the present invention are especially suitable for stabilising bone fractures and for fixing prostheses, such as artificial hips, knees or other joints, into bones.

The present invention also relates to an apparatus for fixing to a structure, beam, member, wall, or the like. The apparatus may be adapted to have other connecting apparatus, such as bolts, screws, nails, hooks or the like affixed thereto, of it may be adapted to join elements, such as bricks, beams, or the like, together.

Fixation and stabilisation of fractures can be difficult, especially in long bones. Two techniques are normally used. The first technique involves placing a plate on one side of the bone and screwing the plate to the bone on either side of the fracture with a plurality of screws. This technique suffers from the disadvantage that forces are applied to the bone via the screws from one side of the bone only, which can cause uneven loading on the bone.

The second technique for fixation and stabilisation of fractures involves inserting an intramedullary pin into the medullary canal of the bone. Fixation pins may or may not be used. If fixation pins are not used, the bone at either side of the fracture may rotate around the intramedullary pin which leads to misalignment of the bone. If fixation pins are used, it is necessary to drill holes through the bone on either side of the fracture and insert fixation pins through the holes in the bone and through holes formed in the intramedullary pin. It is often difficult to align the holes in the bone with those in the intramedullary pin, thereby complicating the operative procedure and potentially causing an increase in post-operative recovery time for the patient.

Fixation of prosthesis, such as artificial hips and artificial knees, also faces similar difficulties. For example, fitting an artificial hip to a patient typically involves preparing the upper part of the femur and inserting a stem portion of the hip prosthesis into the medullary canal of the femur. The stem is fixed to the femur by bone cement or by inserting external pins through holes

drilled through the femur and into and through holes in the stem portion of the artificial hip. The difficulties with using external pins have been discussed above. In cases where bone cement is used, misalignment and shifting of the prostheses can occur if the cement does not adequately adhere to the bone.

It is an object of the present invention to provide a device and a method that overcomes or at least ameliorates one or more of the above-mentioned disadvantages of the prior art.

In a first aspect, the present invention provides an intramedullary bone fixation device comprising a hollow elongate member having at least one opening in a side wall thereof, the hollow elongate member being adapted for insertion into a medullary canal of a bone, and an inner member sized to be slidably receivable within the hollow elongate member, the inner member carrying at least one pin, the at least one pin being movable from a retracted position to an extended position in which the at least one pin extends through respective one or ones of the at least one opening in the hollow elongate member.

The distal end of the hollow elongate member may have a point or a closed end at the distal end thereof to facilitate insertion of the hollow elongate member into the medullary canal. The distal end of the hollow elongate member is preferably provided with a conical point, which may be formed integrally with the hollow elongate member or provided as a separate part that is subsequently affixed to the hollow elongate member .

The inner member is preferably a solid member but it may also comprise a hollow member. The inner member is preferably sized to fit snugly but not too tightly into the hollow elongate member to thereby allow easy movement of the inner member within the hollow elongate member whilst avoiding slack or "looseness" between the inner member and the hollow elongate member. Preferably, both the inner member and the hollow elongate member are cylindrical for a major portion of their length.

The inner member carried the at least one pin. It is preferred that the inner member carries a plurality of pins. The hollow elongate member should

have at least the same number of openings in its side wall as pins on the inner member. Alternatively, the opening(s) may be shaped such that two or more pins may extend therethrough. For example, the hollow elongate member may be provided with a slot through which two or more pins may project

The one or more pins are the means by which the device of the present invention is held in position with respect to the bone. In use of the device of the present invention, the device is inserted into the intramedullary canal of the bone. Once in the desired position, the pins are moved from the retracted position to the extended position. In the extended position, the or each pin extends through a hole in the side wall of the hollow elongate member and into the bone, thereby fixing the relative position of the device and the bone. The device is simple to use because it does not require holes to be drilled through the bone to cater for external fixing pins. It also securely holds the bone in position relative to the device.

In preferred embodiments of the present invention, a plurality of pins are carried by the inner member in order to firmly fix or connect the device to the bone. For convenience of description, the invention will hereinafter be described with reference to a plurality of pins. However, it will be understood that the objects of the present invention could be met with a single pin and that such an embodiment falls within the scope of the present invention.

The pins may be carried on, or mounted to, the inner member by any suitable manner that allows the pins to move from a retracted position to an extended position. In the retracted position, the pins preferably do not extend beyond the outer diameter or perimeter of the hollow elongate member. In the extended position, the pins extend through the holes in the side wall of the hollow elongate member and into the bone.

In one embodiment, the inner member is provided with generally radially positioned holes that house the pins in the retracted position and the pins move in a generally radial direction or in a direction generally along the longitudinal axis of the pins to the extended position. The pins are advantageously spring loaded in this embodiment such that the pins move into the extended position as

soon as the inner member is oriented such that the pins are in alignment with the holes in the side wall of the hollow elongate member.

In another and currently more preferred embodiment, the inner member is provided with one or more grooves in an outer surface thereof. Such grooves are suitably generally transverse grooves. The pins are placed in the grooves and pivotally connected at or near one end to the inner member. The other end of each pin may extend slightly beyond the surface of the inner member. In order to move the pins to the extended position, the inner member may be rotated or turned when the free ends of the pins are in alignment with the holes in the side wall of the hollow elongate member. The free ends of the pins will extend through the holes. As rotation of the inner member continues, the distance between the pivotally mounted ends of the pins and the holes in the hollow elongate member decreases and this causes the pins to move outwardly through the holes until they are fully extended.

In order to enable the inner member to be rotated with the force required to extend the pins into the bone, the proximal end of the inner member may be provided with an engaging surface for engaging with a handle or a torque applying means. To avoid or minimise rotation of the hollow elongate member may also be provided with a holding surface for holding the hollow elongate member in position. The holding surface may be a square, rectangular, hexagonal or other polygonal surface on the proximal end of the hollow elongate member. Alternatively, the hollow elongate member may be provided with a keyway to engage with a suitable tool to hold the hollow elongate member in position.

The hollow elongate member and the inner member may be fixed length members or they may be of variable or adjustable length. Variable or adjustable length members are especially useful in cases where the device is used for fixating fractures and it is desirable to adjust the length of the device during healing of the fracture.

The present invention also encompasses a method of fixing an intramedullary device to a bone comprising providing an intramedullary bone

fixation device comprising a hollow elongate member having at least one opening in a side wall thereof, the hollow elongate member being adapted for insertion into a medullary canal of a bone, and an inner member sized to be slidably receivable within the hollow elongate member, the inner member carrying at least one pin, the at least one pin being movable from a retracted position to an extended position in which the at least one pin extends through respective one or ones of the at least one opening in the hollow elongate member, inserting the intramedullary device into the medullary canal of the bone, and extending the at least one pin from the retracted position to the extended position in which the pins extend through respective one or ones of the at least one opening in the side wall of the hollow elongate member and into the bone to thereby fix the relative position of the device and the bone.

Preferably, the device is provided with a plurality of pins.

In one embodiment, the step of inserting the device into the medullary canal of the bone comprises inserting the hollow elongate member into the medullary canal and subsequently inserting the inner member into the hollow elongate member. Alternatively, this step may comprise inserting the inner member into the hollow elongate member and subsequently inserting the hollow elongate member into the medullary canal. As a further alternative, this step may comprise partly inserting the inner member into the hollow elongate member, inserting the hollow elongate member into the medullary canal and then fully inserting the inner member into the hollow elongate member.

The step of moving the pins from the retracted position to the extended position may comprise rotating the inner member to thereby move the pins so that they extend through the at least one hole in the side wall of the hollow elongate member. The hollow elongate member is preferably held in position whilst the inner member is rotated.

Preferably, pins extend into the bone on either side of a fracture once the device has been fitted, if the device is being used for stabilising or fixing a fracture.

The present invention also provides an apparatus that can be used in the building industry or other industries as a connector or connections or for joining two or more elements together or for fixing to a structure, beam, member, wall or the like.

In another aspect, the present invention provides an apparatus for fixing to a structure, beam, member, wall or the like, comprising a hollow elongate member having at least one opening in a side wall thereof, the hollow elongate member being adapted for insertion into a hole in a structure, beam, member or the like, and an inner member that is insertable into the hollow elongate member, the inner member carrying at least one pin, the at least one pin being moveable from a retracted position to an extended position to an extended position in which the at least one pin extends through respective one or ones of the at least one opening in the hollow elongate member.

The distal end of the hollow elongate member, being the end that is inserted into the hole in the structure, member, beam, wall or the like, preferably has a closed end. This will avoid the hollow elongate member possibly filling with debris when inserted into the hole in the structure or the like (hereinafter, the term "structure or the like" will be used to refer to the "structure, beam, member, wall or the like" for the sake of brevity). A closed end on the hollow elongate member will also act as a stop member for the inner member and ensure that the inner member is inserted to the to the correct depth into the hollow elongate member. The distal end of the hollow elongate member may be provided with a pointed or generally conical end to assist with insertion into the hole of the structure or the like.

The inner member is preferably a solid member but it may also comprise a hollow member. The inner member is preferably sized to fit snugly but not too tightly into the hollow elongate member whilst avoiding slack or "looseness" between the inner member and the hollow elongate member. Preferably, both the inner member and the hollow elongate member are cylindrical for a major portion of their length.

The inner member carried the at least one pin. It is preferred that the inner member carries a plurality of pins. The hollow elongate member should have at least the same number of openings in its side wall as pins on the inner member. Alternatively, the opening(s) may be shaped such that two or more pins may extend therethrough. For example, the hollow elongate member may be provided with a slot through which two or more pins may project.

The one or more pins are the means by which the device of the present invention is connected to the structure or the like. In use, the apparatus is inserted into a hole in the structure or the like. The hole in the structure or the like may be made by drilling or by forming during manufacture or construction of the structure or the like. When the apparatus has been inserted to the desired depth, the pins are moved from the retracted position to the extended position in which the pins extend into the material of the structure or the like to thereby fix or connect the apparatus to the structure or the like.

In order to ensure that the apparatus is inserted to the correct depth in the hole in the structure or the like, some embodiments of the present invention may include a flange or outwardly extending abutment member on the proximal end of the hollow elongate member to ensure that the proximal end of the hollow elongate member lies flush with the outer surface of the structure of the like.

In one embodiment, the inner member is provided with generally radially positioned holes that house the pins in the retracted position and the pins move in a generally radial direction or in a direction generally along the longitudinal axis of the pins to the extended position. The pins are advantageously spring loaded in this embodiment such that the pins move into the extended position as soon as the inner member is oriented such that the pins are in alignment with the holes in the side wall of the hollow elongate member.

In another and currently preferred embodiment, the inner member is provided with one or more grooves in an outer surface thereof. Such grooves are suitably generally transverse grooves. The pins are placed in the grooves and pivotally connected at or near one end to the inner member. The other end of each pin may extend slightly beyond the surface of the inner member. In order to move the pins to the extended position, the inner member may be rotated or turned when the free ends of the pins are in alignment with the holes in the side wall of the hollow elongate member. The free ends of the pins will extend through the holes. As rotation of the inner member continues, the distance between the pivotally mounted ends of the pins and the holes in the hollow elongate member decreases and this causes the pins to move outwardly through the holes until they are fully extended.

In order to enable the inner member to be rotated with the force required to extend the pins into the material of the structure or the like, the proximal end of the inner member may be provided with an engaging surface for engaging with a handle or

torque applying means. The torque applying means may be a spanner, wrench, screwdriver, pliers or the like.

The apparatus of the present invention may be fixed or connected to the structure or the like to enable other devices to be fixed thereto. For example, the inner member may be provided with an internal thread to enable another screw or bolt to be joined thereto. Alternatively, the inner member may extend out of the hollow elongate member (and extend outwardly from the outer wall or surface of the structure or the like when the apparatus is fixed or connected) and the outwardly extending part of the inner member could be used to join or connect other elements thereto.

The apparatus of the present invention could also be used as a fixation device for connecting two structures or the like, such as planks, beams, or bricks together. In this case, holes would have to be made in both of the articles to be connected.

The present invention will now be described further with reference to the accompanying drawings, which show a preferred embodiment of the invention. It will be appreciated that the accompanying drawings are provided to illustrate the invention and the present invention should not be considered to be limited to the particular embodiment shown in the drawings. In the drawings:

Figure 1 shows a cross-sectional side view of a device in accordance with the present invention with the pins in the extended position;

Figure 2 shows a perspective view of the hollow elongate member of the device of Figure 1;

Figure 3 is a top view of the inner member of Figure 1 with the pins in the retracted position;

Figure 4 is a cross-sectional end view taken along line 4-4 of Figure 3;

Figure 5 is an end cross-sectional view showing the inner member inserted into the hollow elongate member;

Figures 6 to 9 are end cross-sectional views showing the pin moving from the retracted position to the extended position;

Figure 10 is a cross-sectional side view of another embodiment of the present invention;

Figure 11 is a side view, partly in cross section, of the proximal end of an apparatus in accordance with the present invention;

Figure 12 is a schematic diagram of the hollow elongate member holding means shown in Figure 11;

Figure 14 is a side view of a pin or nail suitable for use in another embodiment of the present invention;

Figure 15 is a cross-sectional end view of another embodiment of the present invention;

Figure 16 is a side view, partly in cross-section, showing the apparatus in accordance with the present invention being used to hold the beams together; and

Figures 17 and 18 show embodiments of the present invention in which the apparatus is fixed to a wall.

Figure 13 is a schematic, cross-sectional view of a further embodiment of the present invention of variable length.

Figure 1 shows an apparatus 10 in accordance with the present invention. The apparatus 10 includes a hollow elongate member 11 which has a distal end 12 that has a closed conical point formed thereon and an open proximal end 13. An inner member 14 having a plurality of pins 15a, 15b,...15h mounted thereon. The pins 15a to 15h extend through respective holes 16a to 16h. Holes 16a to 16d are more clearly shown in Figure 2.

Turning now to Figures 3 and 4, which show some details of the inner member 14 of the device of the present invention, the inner member 14 comprises a solid pin having a plurality of transversely extending grooves 17a, 17b, 17c, 17d formed therein, for example, by machining. The grooves 17a to 17d house respective pins 15a to 15d when the pins are in the retracted position. A wire or nail 18 extends along a substantial part of the length of inner member 14 and through one end of each of the pins 15a to 15d to thereby pivotally mount the pins 15a to 15d to the inner member 14.

As is best shown in Figure 4, the free end of pin 15a extends beyond the outer surface of inner member 14. In order to ensure that the inner member 14 can be inserted into the hollow elongate member 11 without the free end of the pins catching on the inner surface of the hollow elongate member 11, the hollow elongate member 11 may be provided with one or more longitudinally extending grooves 19 (see Figure 2) in which the tips of the free ends of the pins can

extend. It will be appreciated that the longitudinally extending groove 19 extends along the same line as the row of holes 16a to 16d.

The positioning of the fixing pin 15a relative to the groove 19 is more clearly shown in Figure 5.

Figures 6 to 9 show the manner in which the fixing pin 15a is moved from the retracted position (shown in Figure 6) to the extended position (shown in Figure 9). In particular, the inner member 14 is slid along the central bore of hollow elongate member 11, with the tip of pin 15a moving in groove 19, until the fixing pin 15a comes into alignment with hole 16a (as shown in Figure 6). As can be seen from Figure 6, the tip of fixing pin 15a extends a short distance into hole 16a, but in the retracted position the tip of fixing pin 15a does not extend beyond the outer periphery of hollow elongate member 11.

In order to move the fixing pin 15a from its retracted position, the inner member 14 is rotated, typically by applying a turning force to its proximal end. As inner member 14 is rotated, the tip of fixing pin 15a is caught by the edges of the hole 16a. As rotation of the inner member 14 continues, the point 20 at which the fixing pin 15a is pivotally mounted to the wire 18 moves closer to the hole 16a. This acts to force the pin 15a to extend outwardly through the hole 16a. Further rotation, as shown in Figures 8 and 9, forces the pin to extend even further until it is in the fully extended position as shown in Figure 9.

Figure 10 shows a schematic diagram of an inner member 30 that has fixing pins 31, 32 mounted in diametrically opposed positions. The pins 31, 32 are fitted in grooves 33, 34 and are held by respective nails 35, 36 that pivotally connect the pins 31, 32 to the inner member 30.

In order to facilitate fixing the device of the present invention into the medullary canal, it is preferred that both the inner member and the hollow elongate member are fitted or shaped at their proximal end with features that enable tools or holding means to be applied thereto. This is best shown in Figure 11 in which the inner member 30 has a square or hexagonal projection 37 formed on its proximal end to engage with the complementarily shaped tool 38 having a handle (not shown) that can apply a torque or turning force thereto. It

is especially preferred that the tool 38 has a ratchet handle fitted to enable easier application of the turning force.

In order to prevent the hollow elongate member turning when the rotational force is applied to the inner member to extend the pins, it is preferred that the outer hollow elongate member has holding means formed on the proximal end thereof, which holding means may include a square, rectangular, hexagonal or other polygona shaped ending that can engage with a stabilising tool 39. As more clearly shown in Figure 12, the stabilising tool 39 includes a handle 40 and an engaging portion 41 that engages with the proximal end of the hollow elongate member.

Figure 13 shows another embodiment of the present invention in which the intramedullary bone fixation device is of expandable length. In particular, the device shown in Figure 13 includes an inner member 50 and an outer member 51 that includes a first portion 52 and a second portion 53. Inner a member 50 also includes a first portion 54 and a second portion 55. First portion 54 includes a bore 56 having at least a small threaded portion thereon. A bore 57 is also included in the second portion 55 of inner member 50 and bore 57 terminates in a blind end 58. A screw 59 is threadably inserted into bores 56, 57. When the screw has been fully inserted, the end of the screw strikes the blind end. Further rotation of the screw then acts to expand the length of the inner member 50 by pushing apart the two portions 54, 55. As the pins have been inserted into the bone surrounding the medullary canal, as the inner member 50 is expanded in length, the outer member 51 also expands in length.

It is also preferred that the proximal end of the inner member is provided with some marking in order to enable the alignment of the inner member to be readily ascertained.

Turning now to Figures 14 and 15, which show another embodiment of the present invention, a pin or nail 30 has a spherical portion 31 at one end with the shank 32 of the nail extending from the spherical portion 31 and tapering to a point 33. The pin or nail 30 shown in Figure 14 is one of a plurality of such pins or nails used in the apparatus of the present invention.

The hollow elongate member 35 (see Figure 15) has at least one hole 36 formed therein, with the at least one hole 36 having a diameter slightly larger than the diameter of the spherical portion 31 of pin or nail 30. The inner member 37 includes a similar sized hole 38 and a groove 39 runs through this hole transverse to the length of the inner member 37. In order to load the pin or nail 30 with the apparatus, hole 36 and 38 are aligned and the pin or nail is inserted through the holes until the spherical portion 31 of pin or nail 30 rests in hole 38. The point 33 of pin or nail 30 extends into a slot or hole 40 almost opposite hole 36.

When the pin or nail 30 is loaded the outer tube is turned clockwise until the hole 38 in the inner member is covered by the outer tube. The slot 40 moves at the same time and just contacts the distal end of the point 32 of the pin or nail 30. The pin or nail 30 is now armed and ready for insertion.

Once the apparatus has been inserted into an appropriately sized hole in the structure or the like, the inner member 37 is rotated in a clockwise direction until the pins or nails 30 are fully extended. In this regard, extension of the pins or nails is similar to that as shown in Figures 6 to 9.

In the embodiment shown in Figures 14 and 15, the pins or nails 30 are not connected to or mounted to the inner member. Rather, they are retained in place by the interaction between the outer tube (or hollow elongate member) and the inner member. In this sense, it will be appreciated that the inner member is still carrying the at least one pin or nail even through there is no physical mounting between the inner member and the at least one pin or nail.

Some uses of the embodiments of the present invention in the building industry are shown in Figures 16, 17 and 18. In Figure 16, two beams 50, 51 are joined together by apparatus 52 of the present invention. Apparatus 52 is inserted through hole 53 drilled in beam 51 and into an aligned hole drilled in beam 50. The inner member is then rotated, for example by use of a socket, and the pins or nails moved to the extended position as shown in Figure 16.

In Figure 17, the apparatus 60 of the present invention is inserted into a hole 61 drilled into the surface of a wall 62. The inner member 63 is rotated to fully extend the nails or pins and hold the apparatus in position in the wall 62. The inner member 63 has an internal thread formed therein and screw or bolt 64 can be screwed into the internal thread.

In Figure 18, the apparatus 70 of the present invention is inserted into a hole 71 formed in wall 72 and the pins or nails extended to hold the apparatus in position. The inner member has a proximal end 73 that extends out beyond the surface of wall 72 and this can be used to bolt things onto.

Although not shown, in the embodiments of Figures 17 and 18 the hollow elongate member or outer tube may be provided with an outwardly extending flange, lip or projection on the proximal end thereof to ensure that the proximal end lies substantially flush with the outer surface of the wall.

It will be appreciated that the embodiment of the present invention shown in Figures 14 and 15 may also be used in the intramedullary bone fixation device described in the first aspect of the present invention.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It will be understood that the present invention encompasses all such variations and modifications that fall within its spirit and scope.

The claims defining the invention are as follows:

1. An intramedullary bone fixation device comprising a hollow elongate member having at least one opening in a side wall thereof, the hollow elongate member being adapted for insertion into a medullary canal of a bone, and an inner member sized to be slidably receivable within the hollow elongate member, the inner member carrying a least one pin, the at least one pin being movable from a retracted position to an extended position in which the at least one pin extends through respective ones of the at least one opening in the hollow elongate member.

2. A device as claimed in claim 1 wherein the hollow elongate member has a point or a closed end at the distal end thereof to facilitate insertion of the hollow elongate member into the medullary canal.

3. A device as claimed in claim 2 wherein the distal end of the hollow elongate member is provided with a conical point.

4. A device as claimed in any one of claims 1 to 3 wherein the inner member is sized to fit snuggly but not too tightly into the hollow elongate member to thereby allow easy movement of the inner member within the hollow elongate member whilst avoiding slack between the inner member and the hollow elongate member.

5. A device as claimed in any one of the preceding claims wherein both the inner member and the hollow elongate member are cylindrical for a major portion of their length.

6. A device as claimed in any one of the preceding claims wherein the inner member carries a plurality of pins.

7. A device as claimed in any one of the preceding claims wherein the inner member is provided with generally radially positioned holes that house the pins in the retracted position and the pins move in a generally radial direction or in a direction generally along the longitudinal axis of the pins to the extended position.

8. A device as claimed in claim 7 wherein the pins are spring loaded such that the pins move into the extended position as soon as the inner member is oriented such that the pins are in alignment with the at least one opening in the side wall of the hollow elongate member.

9. A device as claimed in any one of claims 1 to 6 wherein the inner member is provided with one or more grooves in an outer surface thereof and the pins are placed in the one or more groves and pivotally connected at one end thereof to the inner member and wherein the pins are moved to the extended position by placing free ends of the pins into alignment with the one or more openings and rotating the inner member to thereby extend the pins through the one or more openings.

10. A device as claimed in claim 9 wherein the free ends of the pins extend slightly beyond the surface of the inner member.

11. A device as claimed in any one of claims 1 to 6 wherein the one or more pins each have an enlargement at one end thereof and the enlargement rests in a respective hole or recess formed in the inner member and the one or more pins extend along respective grooves formed in the inner member, wherein the one or more pins are retained in place by an inner wall of the hollow elongate member and the one or more pins are extended by aligning free ends thereof with the at least one opening in the hollow elongate member and rotating the inner member.

12. A device as claimed in any one of the preceding claims wherein a proximal end of the inner member is provided with an engaging surface for engaging a handle or a torque applying means.

13. A device as claimed in any one of the preceding claims wherein the hollow elongate member is provided with a holding surface for holding the hollow elongate member in position and preventing rotation thereof.

14. A device as claimed in any one of the preceding claims wherein the hollow elongate member and the inner member are of fixed length.

15. A device as claimed in any one of claims 1 to 13 wherein the hollow elongate member and the inner member are of adjustable length.

16. An apparatus for fixing to a structure, beam, member, wall or the like, comprising a hollow elongate member having at least one opening in a side wall thereof, the hollow elongate member being adapted for insertion into a hole in a structure, beam, member of the like, and an inner member that is insertable into the hollow elongate member, the inner member carrying at least one pin, the at least one pin being moveable from a retracted position to an extended position to an extended

position in which the at least one pin extends through respective one or ones of the at least one opening in the hollow elongate member.

17. A device as claimed in claim 16 wherein the hollow elongate member has a point or a closed end at the distal end thereof to facilitate insertion of the hollow elongate member into the medullary canal.

18. A device as claimed in claim 17 wherein the distal end of the hollow elongate member is provided with a conical point.

19. A device as claimed in any one of claims 16 to 18 wherein the inner member is sized to fit snugly but not too tightly into the hollow elongate member to thereby allow easy movement of the inner member within the hollow elongate member whilst avoiding slack between the inner member and the hollow elongate member.

20. A device as claimed in any one of claims 16 to 19 wherein both the inner member and the hollow elongate member are cylindrical for a major portion of their length.

21. A device as claimed in any one of claims 16 to 20 wherein the inner member carries a plurality of pins.

22. A device as claimed in any one of claims 16 to 21 wherein the inner member is provided with generally radially positioned holes that house the pins in the retracted position and the pins move in a generally radial direction or in a direction generally along the longitudinal axis of the pins to the extended position.

23. A device as claimed in claim 22 wherein the pins are spring loaded such that the pins move into the extended position as soon as the inner member is oriented such that the pins are in alignment with the at least one opening in the side wall of the hollow elongate member.

24. A device as claimed in any one of claims 16 to 21 wherein the inner member is provided with one or more grooves in an outer surface thereof and the pins are placed in the one or more grooves and pivotally connected at one end thereof to the inner member and wherein the pins are moved to the extended position by placing free ends of the pins into alignment with the one or more openings and rotating the inner member to thereby extend the pins through the one or more openings.

25. A device as claimed in claim 24 wherein the free ends of the pins extend slightly beyond the surface of the inner member.

26. A device as claimed in any one of claims 16 to 21 wherein the one or more pins each have an enlargement at one end thereof and the enlargement rests in a respective hole or recess formed in the inner member and the one or more pins extend along respective grooves formed in the inner member, wherein the one or more pins are retained in place by an inner wall of the hollow elongate member and the one or more pins are extended by aligning free ends thereof with the at least one opening in the hollow elongate member and rotating the inner member.

27. A device as claimed in any one of claims 16 to 26 wherein a proximal end of the inner member is provided with an engaging surface for engaging a handle or a torque applying means.

28. A device as claimed in any one of claims 16 to 27 wherein the hollow elongate member is provided with a holding surface for holding the hollow elongate member in position and preventing rotation thereof.

29. A device as claimed in any one of claims 16 to 28 wherein the hollow elongate member and the inner member are of fixed length.

30. A device as claimed in any one of claims 16 to 28 wherein the hollow elongate member and the inner member are of adjustable length.

31. A method of fixing an intramedullary device to a bone comprising providing an intramedullary bone fixation device comprising a hollow elongate member having at least one opening in a side wall thereof, the hollow elongate member being adapted for insertion into a medullary canal of a bone, and an inner member sized to be slidably receivable within the hollow elongate member, the inner member carrying at least one pin, the at least one pin being movable from a retracted position to an extended position in which the at least one pin extends through respective ones of the at lest one opening in the hollow elongate member, inserting the intramedullary device into the medullary canal of the bone, extending the at least one pin from the retracted position to extended position in which the pins extend through the at least one opening in the side wall of the hollow elongate member and into the bone to thereby fix the relative position of the device and the bone.

32. A method as claimed in claim 31 wherein the step of moving the pins from the retracted position to the extended position may comprise rotating the inner member to thereby move the pins so that they extend through the holes in the side wall of the hollow elongate member.

33. A method as claimed in claim 31 or claim 32 wherein the pins extend into the bone on either side of a fracture to thereby stabilise the fracture.

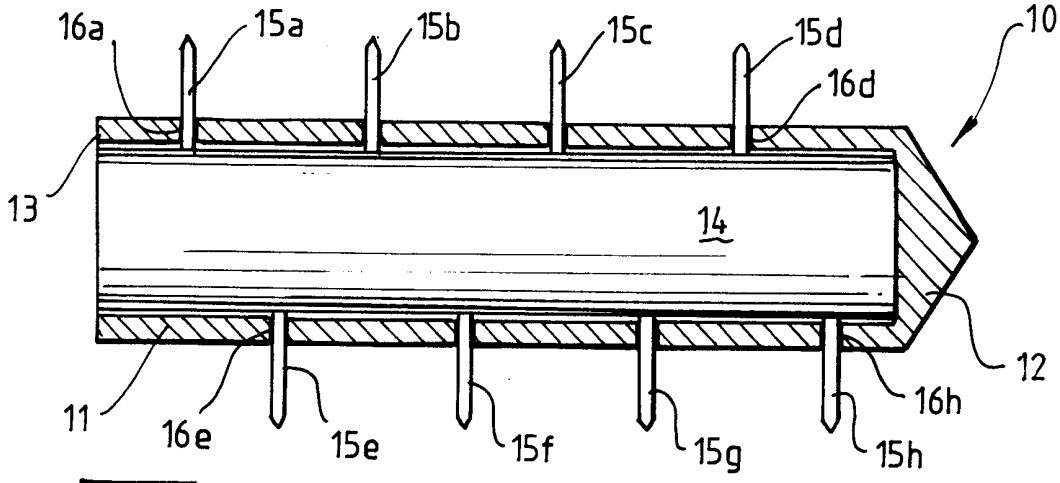


FIG. 1.

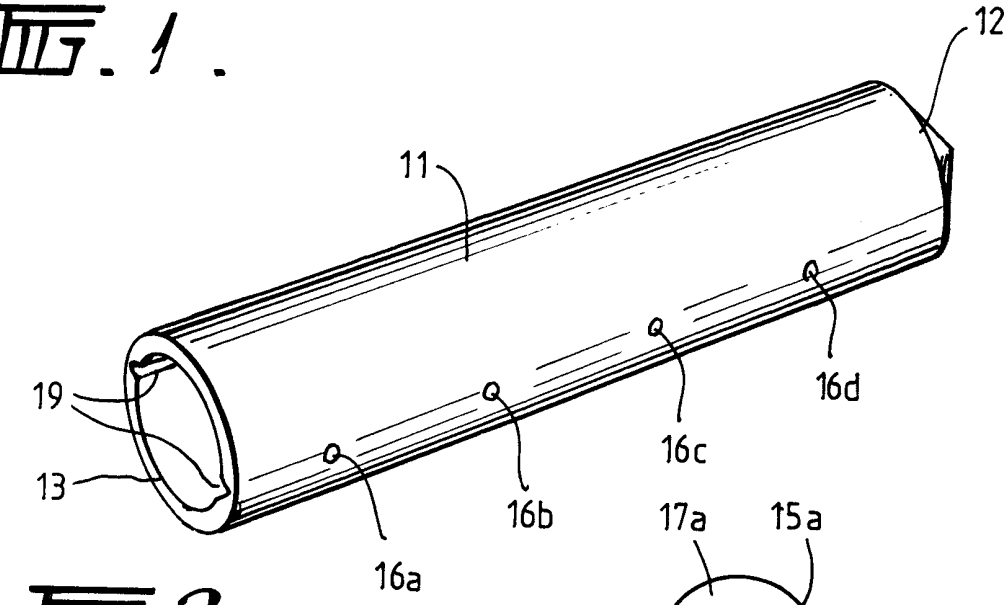


FIG. 2.

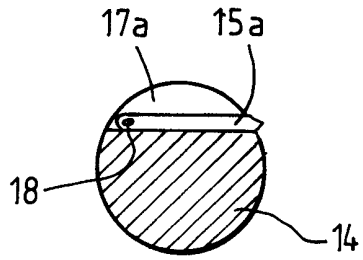


FIG. 4.

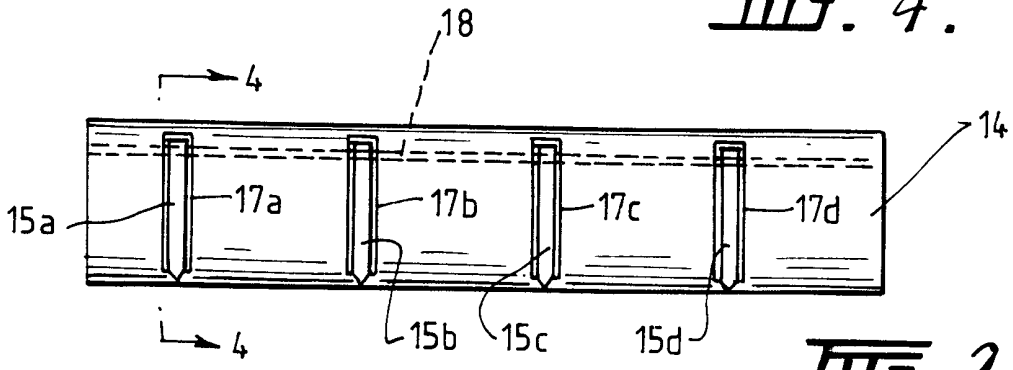


FIG. 3.

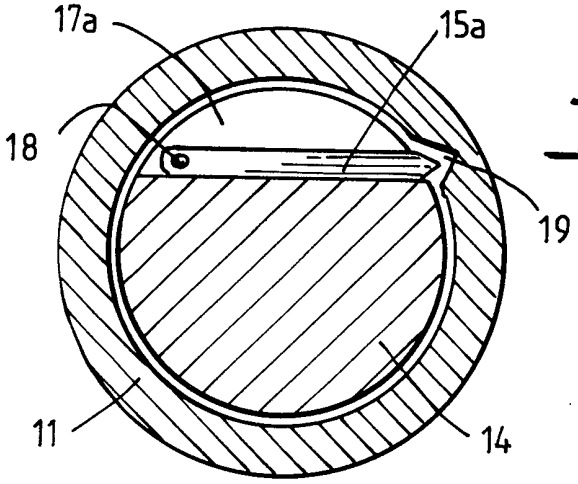


FIG. 5.

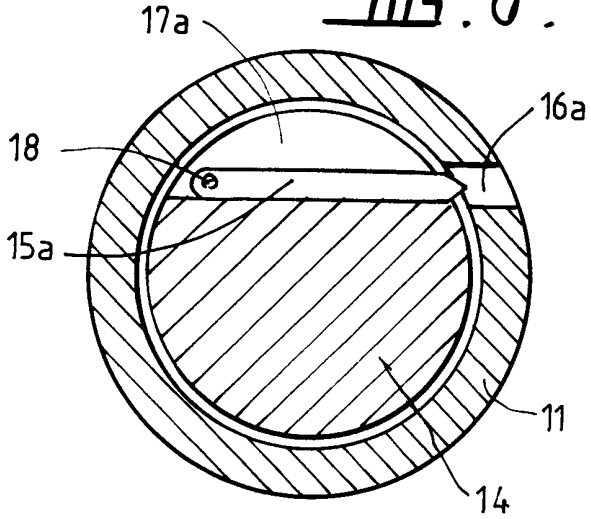


FIG. 6.

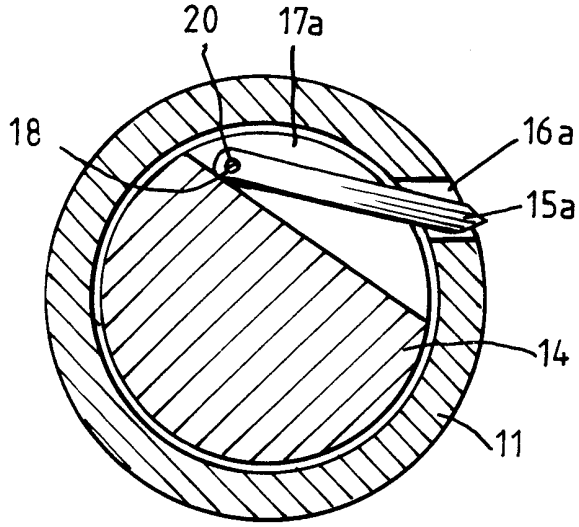


FIG. 7.

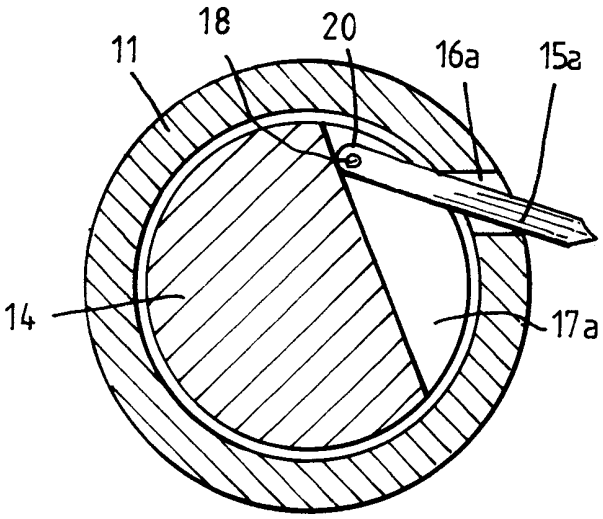


FIG. 8.

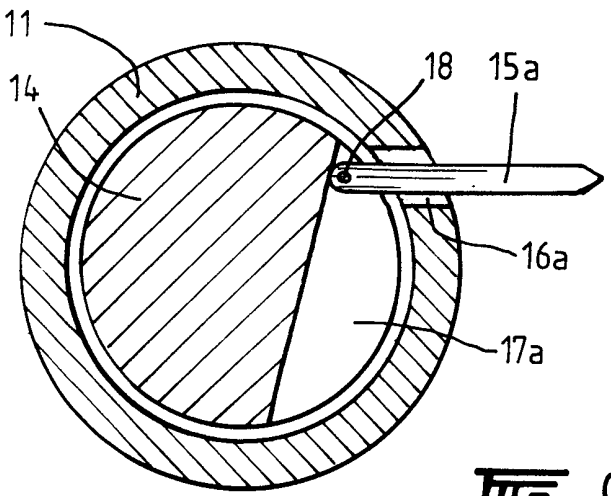


FIG. 9.

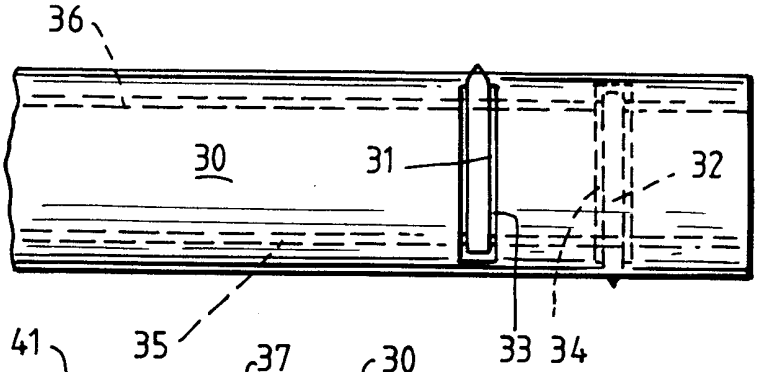


FIG. 10

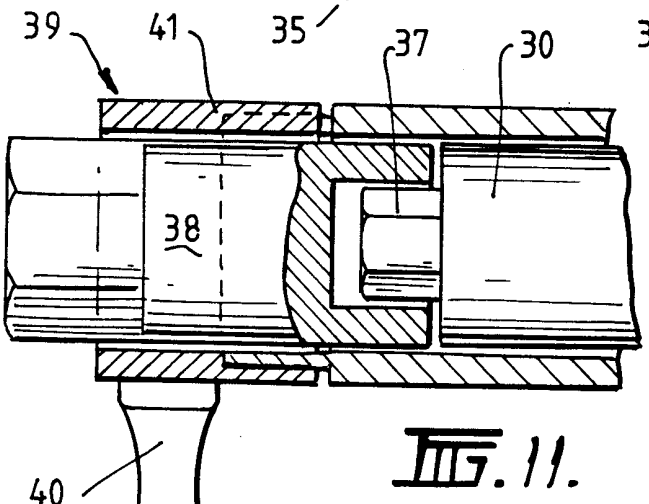


FIG. 11.

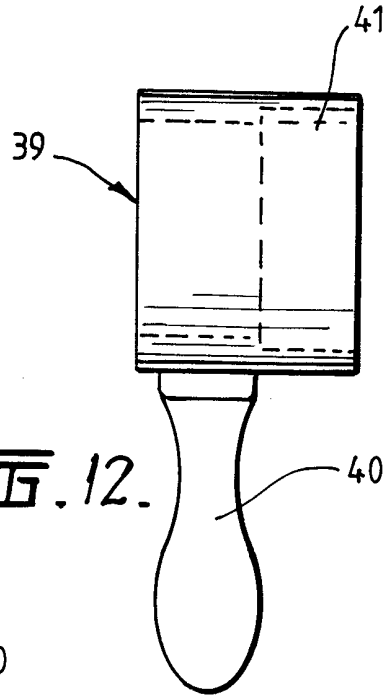


FIG. 12.

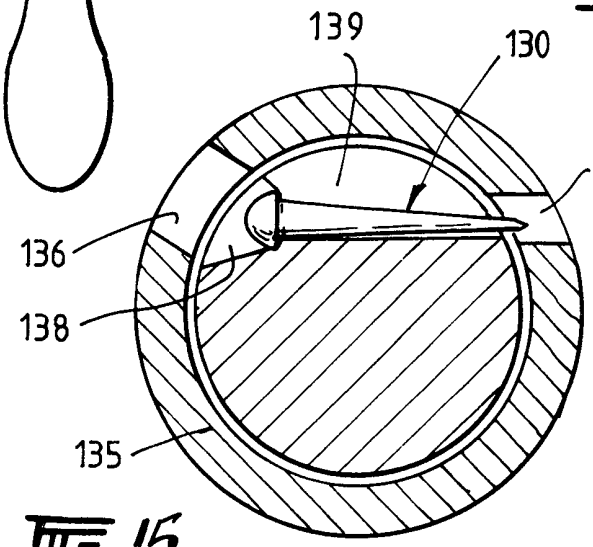


FIG. 15.

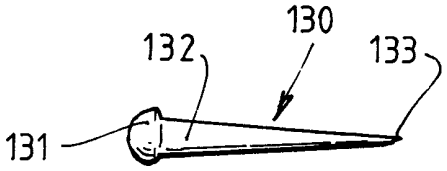


FIG. 14.

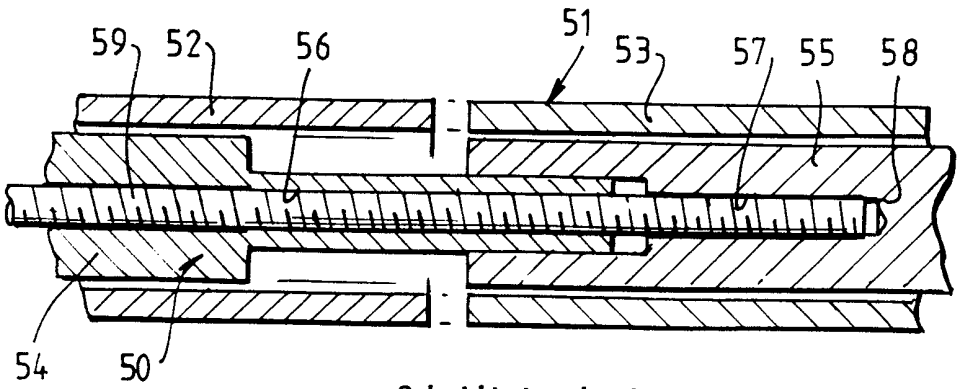


FIG. 13.

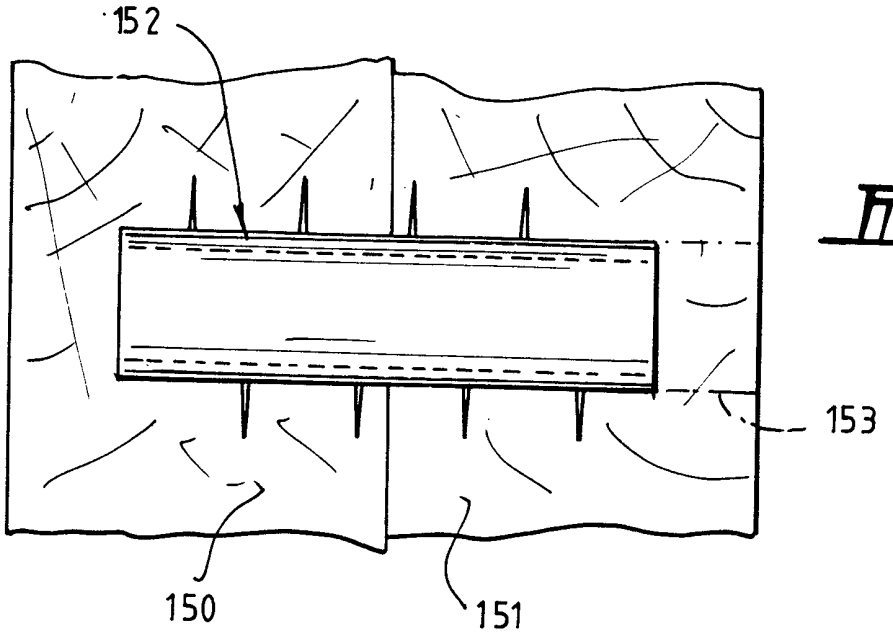


FIG. 16

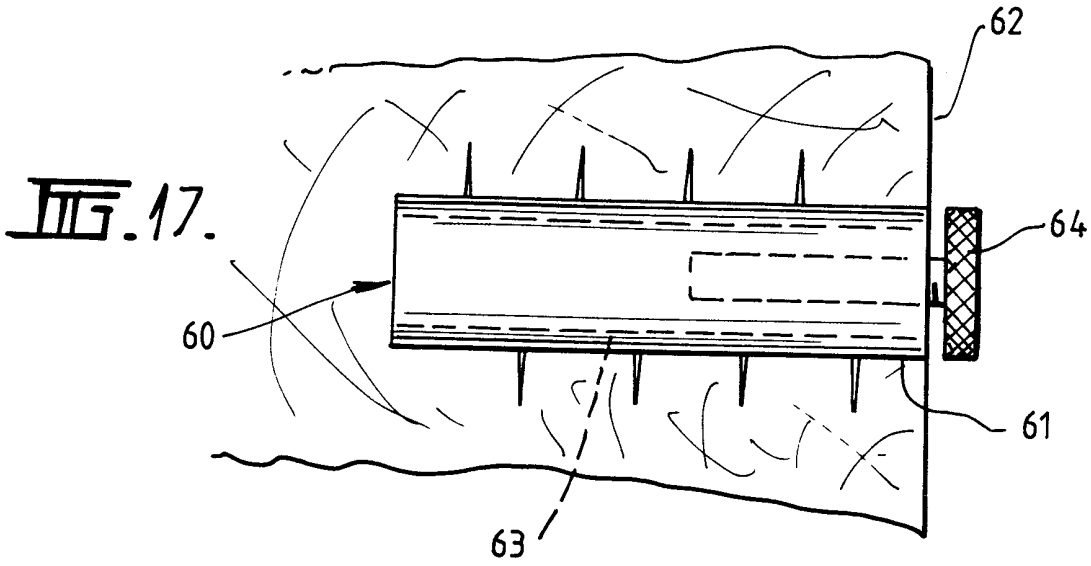


FIG. 17.

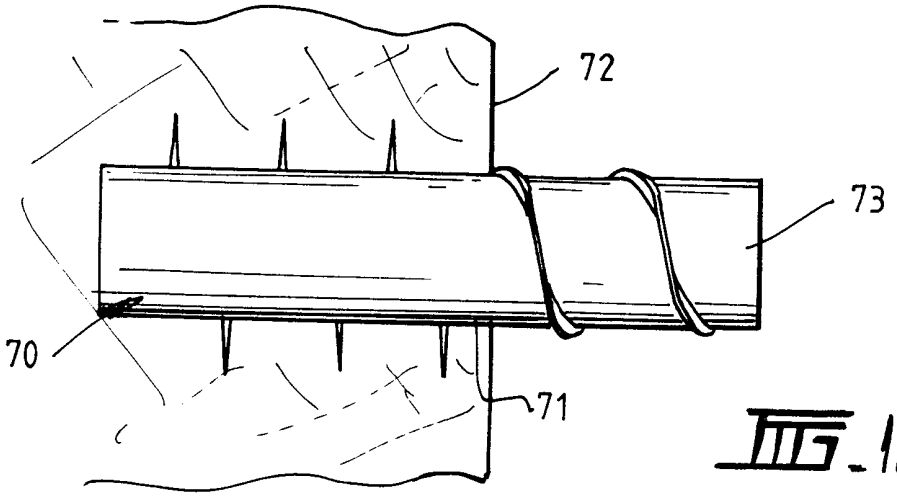


FIG. 18.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00937

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A61B 17/72, E04B 1/38, F16B 13/10

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)
A61B/IC, E04B 1/IC, F16B 13/IC, F16B 15/IC

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC AS ABOVE

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96/39584 A (LI MEDICAL TECHNOLOGIES INC) 12 December 1996 Pages 2-4, figures 1-3.	1-6, 12-15, 16-21, 27-33
Y		7-11, 22-26
X	WO 97/48352 A (KASRA et al.) 24 December 1997 See entire document.	1-8, 12-15, 31-33
P, X	WO 98/51228 A (UNIVERSITY OF ABERDEEN) 19 November 1998 Pages 3-4, figures 1-2.	1-6, 12-15, 31-33

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 December 1999	14 DEC 1999
Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	**JOHN HO** Telephone No.: (02) 6283 2329

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00937

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4237875 A (TERMANINI) 9 December 1980 Figures 1-4.	1-7, 12-15, 31-33
X	AU 28535/84 A (BERTSCHE) 29 November 1984 See entire document.	16-21, 27-30
Y	US 4411281 A (DOERN) 25 October 1983 See figures 1-9.	7-11, 22-26

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/00937

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member				
WO 96/39584	US 5702215	AU 707088	JP 11/507120		
WO 97/48352	CA 2229382	JP 11/510726			
WO 98/51228	AU 73459/98				
US 4411281	AU 549769	AU 86942/82	CA 1191763	DE 3204469	EP 85738
	ES 514629	FI 822694	GB 2114436	HK 70985	NO 822080
AU 28535/84	EP 127095	EP 127095	DE 3318751	DK 250584	JP 60/0085187
	NO 842063				
US 4237875	NIL				

END OF ANNEX