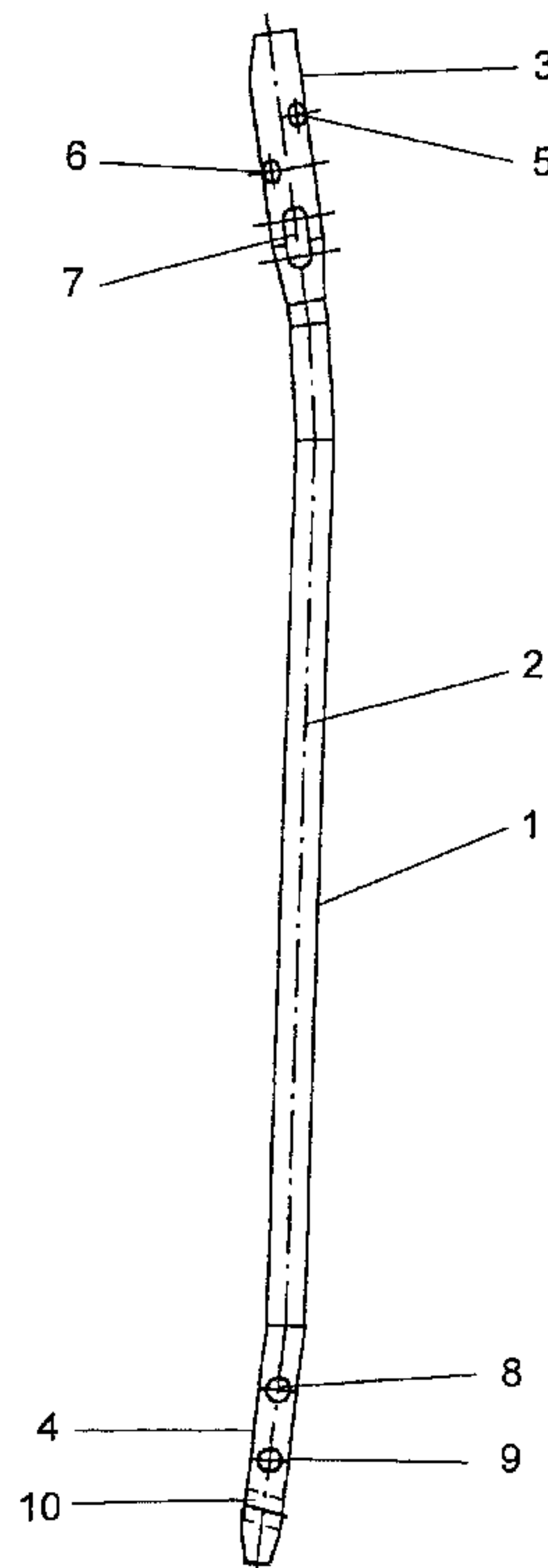




(86) Date de dépôt PCT/PCT Filing Date: 2000/05/18
(87) Date publication PCT/PCT Publication Date: 2000/11/30
(85) Entrée phase nationale/National Entry: 2001/11/13
(86) N° demande PCT/PCT Application No.: AT 2000/000139
(87) N° publication PCT/PCT Publication No.: 2000/071040
(30) Priorité/Priority: 1999/05/21 (GM 359/99) AT

(51) Cl.Int.⁷/Int.Cl.⁷ A61B 17/72
(71) Demandeur/Applicant:
I.T.S. IMPLANTAT-TECHNOLOGIE SYSTEME GMBH,
AT
(72) Inventeur/Inventor:
HERTZ, HARALD, AT
(74) Agent: MOFFAT & CO.

(54) Titre : CLOU MEDULLAIRE, NOTAMMENT CLOU MEDULLAIRE POUR TIBIA
(54) Title: INTRAMEDULLARY NAIL, IN PARTICULAR, INTRAMEDULLARY NAIL FOR THE TIBIA



(57) **Abrégé/Abstract:**

The invention relates to an intramedullary nail, in particular, an intramedullary nail for the tibia, comprising orifices (5, 6, 8, 9) which extend transversally to the nail for accommodating locking screws in the proximal (3) and the distal (4) areas of the intramedullary nail. The axis of at least one orifice (10) in the distal area (4) runs at an incline in relation to the shaft axis in said distal area.

Abstract:

Intramedullary Nail, especially Tibial Intramedullary Nail

The invention describes an intramedullary nail, especially a tibial intramedullary nail, with pierces (5, 6, 7, 8, 9) extending across the nail for the accommodation of locking screws in the proximal (3) and distal (4) areas of the intramedullary nail, in that the axle of at least one of the pierces (10) in the distal area (4) extends at an angle to the sheath axle in the distal area. (Fig. 1)

- 1 -

Intramedullary Nail, especially Tibial Intramedullary Nail

The invention involves an intramedullary nail, especially a tibial intramedullary nail, with pierces extending across the nail for the accommodation of locking screws in the proximal and distal areas of the intramedullary nail.

Intramedullary nails, and especially tibial nail systems mostly consist of a tibial nail made of titanium. Such intramedullary nails are used in particular with transversal fractures, oblique, and spiral fractures, segment fractures, comminuted fractures, open fractures, and especially fractures with bone loss, or pathological fractures, as well.

Additional uses relate to the correction of leg length differences, reconstructions after tumor sections, pseudo-arthrosis, metaphysis, and epiphysis fractures. Known intramedullary nails contain possibilities for accommodating locks in the proximal and distal areas, whereby two locking screws each are usually arranged in the proximal and distal areas for a complete lock. During an application, the suitable nail length is first determined, and a proximal target device is then attached on a nail of proper length with the aid of an adapter. A sliding hammer is slid over a driving rod, and screwed onto the adapter. Then the nail is inserted into the entry cavity of the proximal marrow area by hand, and driven by blows to the hammer. In case of a tibial nail, the distal positioning should ideally be 1 to 2 cm above the tibiotalar system.

The adapter is first tightened for the proximal locking, and the proximal locking screw position is determined by a double guiding cannula system. Drilling sheaths are then placed on the corticalis by a stab incision, and the respective drilling is performed. When the rear of the corticalis has been noticeably drilled all the way through, the correct

- 2 -

position is checked, and the required screw length is read on the drill scale. After removing the inner drilling sheath, an appropriate self-screwing corticalis screw can be fastened. The respective drilling for distal locks is usually performed free-handedly. For a complete lock in the proximal area it is particularly beneficial if the drilling holes in the nail for the accommodation of the locking screw are arranged at intersecting axles.

The known nails, and in particular the known tibial nails, are not suitable for all situations, especially not relating to indications of a metaphysis and epiphysis fracture. Bone fragments can only be positioned correctly with the locking screws arranged at the distal end, which are also located in this area so that especially small bone fragments at the bone end, the fissure of which only extends across a small axial length of the bone, cannot be seized by such devices. The invention aims to expand the universal usability of an intramedullary nail, and especially of a tibial intramedullary nail to other cases in which a successful stabilization of bone fractures may not necessary be possible after shearing fractures of the peripheral tibia, and which are unable to improve the healing success with regard to epiphysis fractures in particular.

As a solution to this task, the inventive intramedullary nail essentially consists of the axle of a pierce at its distal area that extends at an angle to the sheath axle in the distal area. Due to the fact that a pierce at its distal area extends to the sheath axle at the distal area, it is possible to arrange a locking screw, or possibly a clamping screw in this area in such a way that even smaller bone fragments in the epiphysis area are positioned safely, and can be maintained in their correct positions. The angle of this pierce at the distal area to the respective sheath screw enables screws to be positioned with an angle pointed back and

- 3 -

down, and to seize even small fragments in this way. Known tibial nail designs have several sections with axles different from each other, and angled towards each other. Designs are known in particular, in which the axles of the proximal and the distal sections of the intramedullary nail, which contain the pierces for the locking screws, are bent, or arranged at an angle, respectively, in the same direction to the axle of the center section. Here it is also important that the axle of at least one pierce extends at an angle in the distal area to the sheath axle in the distal area. The pierces in the distal area in conventional tibial nails are usually arranged in such a way that they are still oriented orthogonally to the axle in the center area despite of their angle to the axle of the nail in the distal area relative to the axle of the nail.

A benefit of the inventive design is that the angle of the axle of the pierce is between 65 and 80°, preferably approximately 75°, towards the rear, which ensures that even small bone fragments in the epiphysis area can be seized. The ability to seize such small fragments is further improved by the arrangement of the pierce with an angled axle in close vicinity of the distal end of the intramedullary nail.

An additional improvement of the inventive intramedullary nail is achieved by the fact that at the proximal end in addition to at least two pierces with intersecting axles, at least one additional distally arranged pierce is intended as an elongated hole with a longer axle of the pierce extending in the direction of the axle of the intramedullary nail. Such an additional pierce designed as an elongated hole serves to stabilize the dynamics in order to avoid possible pseudo-arthritis. In addition to the rotational stability achieved by the two other drill holes for the insertion of the locking screws, this also enables axial

- 4 -

movement, and micro movements are allowed by this stabilization of the dynamics, which encourage bone growth.

The rotational stability can be achieved by this in a known method, in that at least two of the proximal pierces with intersecting axles are locked together by locking screws, whereby the proximal end of the tibial nail can be designed at an angle for the protection and decrease of irritations of the patellar tendon.

The pierce arranged at the distal end, and angled toward the rear, also enables fixation of these bone fragments with shearing fractures of the peripheral tibia, in particular. A particularly beneficial simplification in the handling can be achieved by designing the inside width of all pierces for locking screws with the same diameter. In conventional tibial intramedullary nail systems, screws with a lesser diameter in the distal area than in the proximal area are used.

In order to ensure that such locking screws guarantee the required forces, and especially the required rotational stability and the distal lock at the lowest outer diameter, the design is beneficial such that the locking screws in their center area are designed as a thread-less bolt section with a diameter corresponding to the inside width of the pierces. Such locking screws designed as thread-less bolt sections in their center area possess a higher bending strength, and an increased force absorption of forces applied in the direction across the axle of the screw, than screws with continuous threads, whereby the lock is successful when the diameter of the thread-less bolt section essentially corresponds to the inside width of the pierces.

- 5 -

In order to also clamp small bone fragments in shearing fractures of the peripheral tibia into the desired position, the design is beneficial in such way that the screw for the pierce angled toward the axle of the distal section is designed as a clamping screw, whereby such a clamping screw is characterized by two thread sections with different thread angles.

The invention is described in more detail in the example schematically illustrated in the drawing below. Figure 1 shows a side view of the inventive tibial nail, figure 2 shows a section through the distal end area of the tibial nail according to figure 1, figure 3 shows a view of a locking or clamping screw, and figure 4 shows the view in direction of the arrow IV of the locking or clamping screw in figure 3.

In figure 1 a tibial intramedullary nail 1 is illustrated, the axle of which is identified as 2 in a semicolon line. The axle of the tibial intramedullary nail 1 is designed as a multiple dropped axle, and is angled in the direction of the proximal end 3, as well as in the direction of the distal end 4 equally as to axle 2 in the center area of the tibial intramedullary nail.

The proximal end has intersecting drill holes 5 and 6 for the rotational lock. An elongated hole 7 is additionally intended at the proximal end area, over which an additional locking screw can be inserted, whereby an axial movement of the tibial nail 1, and therefore a dynamic movement is enabled due to the design of the pierce as an elongated hole 7.

The distal end 4, also has two drill holes 8 and 9 with a drill axle essentially extending orthogonally to the axle 2 for the accommodation of the locking screws. Item 10 in

- 6 -

figure 1 insinuates a drill hole at the distal end area which is angled to the rear, and which is clearly visible in the sectional view in figure 2.

In figure 2 this drill hole 10 is arranged at an angle of approximately 70° towards the axle 11 of the distal area 4 of the tibial nail so that there is a total angle to the axle 2 at the center area of the tibial nail of approximately 65° . With the aid of these drill holes, or pierces 5, 6, 7, 8, 9, and 10, respectively, conventional locking screws or clamping screws can now be inserted, in order to ensure the secure anchoring of the tibial nail, and possibly also to firmly affix fragments in this way. A clamping, or locking screw suitable for the use of such a tibial nail according to figures 1 and 2 is illustrated in figures 3 and 4.

Figure 3 shows a locking screw 12, which has a first thread section 14, a center thread-less bolt section 15, and a final thread section 16 subsequent to a thread head 13. A cutting head 17 is intended at the free end of the locking screw subsequent to the thread 16, for which, particularly in figure 4, clearance areas 18 are designed for the transport of the cut material, in order to ease the insertion of the screw into the bone fragment, or into the corticalis.

In this example, the center section 15 of the locking screw is of a thread-less design, and has an outer diameter a, which essentially corresponds to the inner cross section of the pierce of the tibial intramedullary nail. In order to enable the insertion of the locking screws through the pierces, the end thread is designed with an outer diameter equal to this diameter a of the thread-less area in the center part at a maximum, whereby the fixed attachment is ensured in the bone at the side opposite of the free end by the respective

- 7 -

larger diameter thread 14. When the locking screw 12 is to be inserted as a clamping screw, the thread 15 must be designed at a lower angle than the thread 16 so that a tightening of the bone fragments in the direction of the center, thread-less area 15 of the screw 12 occurs when it is inserted.

- 8 -

Claims:

1. Intramedullary nail, especially a tibial intramedullary nail (1), with pierces (5, 6, 7, 8, 9, 10) extending across the nail for the accommodation of locking screws (12) in the proximal (3) and distal (4) areas of the intramedullary nail (1), in that the axle of at least one of the pierces (10) in the distal area (4) extends at an angle to the sheath axle (11) in the distal area (4).
2. Intramedullary nail according to claim 1, in that the angle of the axle of the pierce (10) is between 65 and 80°, preferably approximately 75°, towards the rear.
3. Intramedullary nail according to claims 1 or 2, in that the pierce (10) with an angled axle is arranged in close vicinity of the distal end (4) of the intramedullary nail (1).
4. Intramedullary nail according to one of the claims 1, 2 or 3, in that at the proximal end (3) in addition to at least two pierces (5, 6) with intersecting axles, at least one additional distally arranged pierce (7) is intended as an elongated hole with a longer axle of the pierce (7) extending in the direction of the axle of the intramedullary nail.
5. Intramedullary nail according to one of the claims 1 through 4, in that at least two of the proximal pierces (5, 6) with intersecting axles are locked together by locking screws (12).
6. Intramedullary nail according to one of the claims 1 through 5, in that the proximal end (3) of the intramedullary nail (1) is designed at an angle.
7. Intramedullary nail according to one of the claims 1 through 6, in that the inside width of all pierces (5, 6, 7, 8, 9, 10) for locking screws (12) is designed with the same diameter.

- 9 -

8. Intramedullary nail according to one of the claims 1 through 7, in that the locking screws (12) in their center area (15) are designed as a thread-less bolt section with a diameter corresponding to the inside width of the pierces (5, 6, 7, 8, 9, 10).
9. Intramedullary nail according to one of the claims 1 through 8, in that the axles of the proximal and the distal sections (3, 4) of the intramedullary nail (1), which contain the pierces for the locking screws, are bent, or arranged at an angle, respectively, in the same direction to the axle (2) of the center section.
10. Intramedullary nail according to one of the claims 1 through 9, in that that the screw for the pierce (10) angled toward the axle (11) of the distal section (4) is designed as a clamping screw.

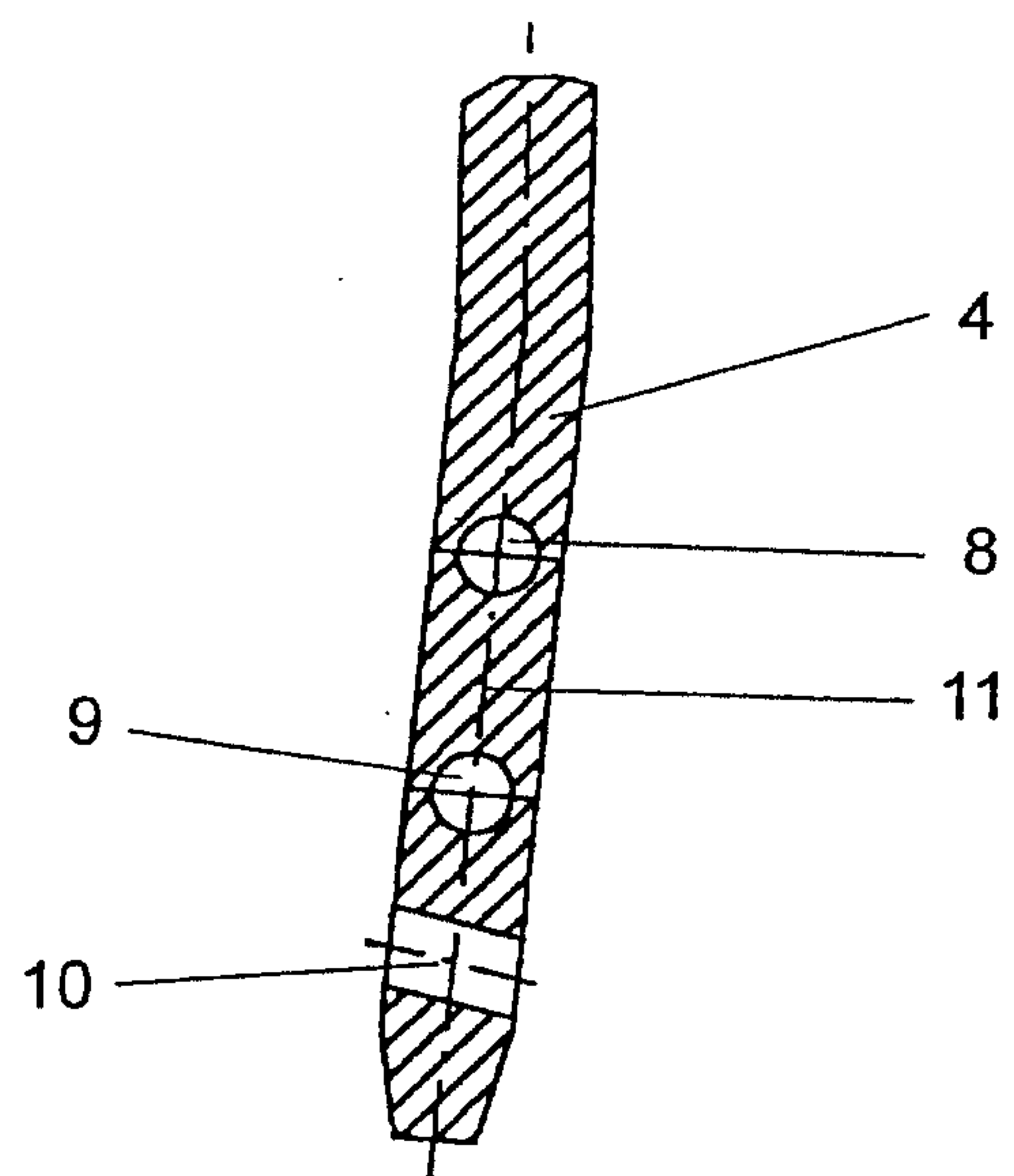
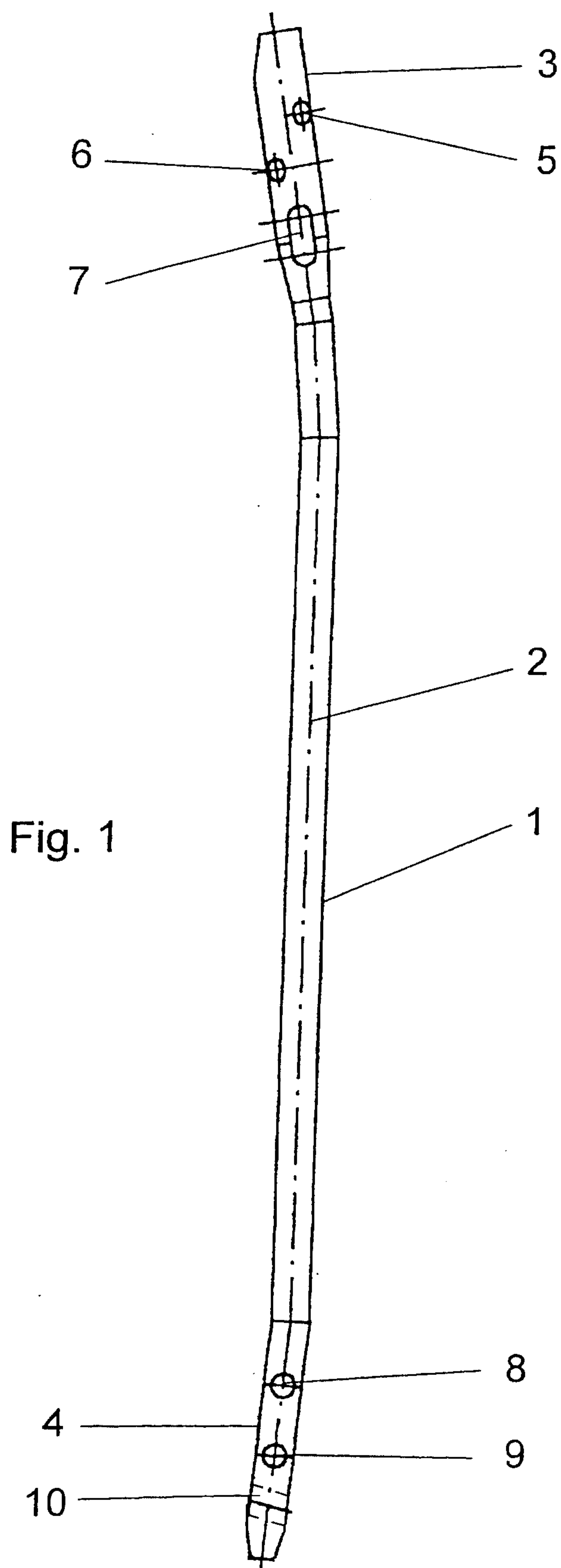


Fig. 2

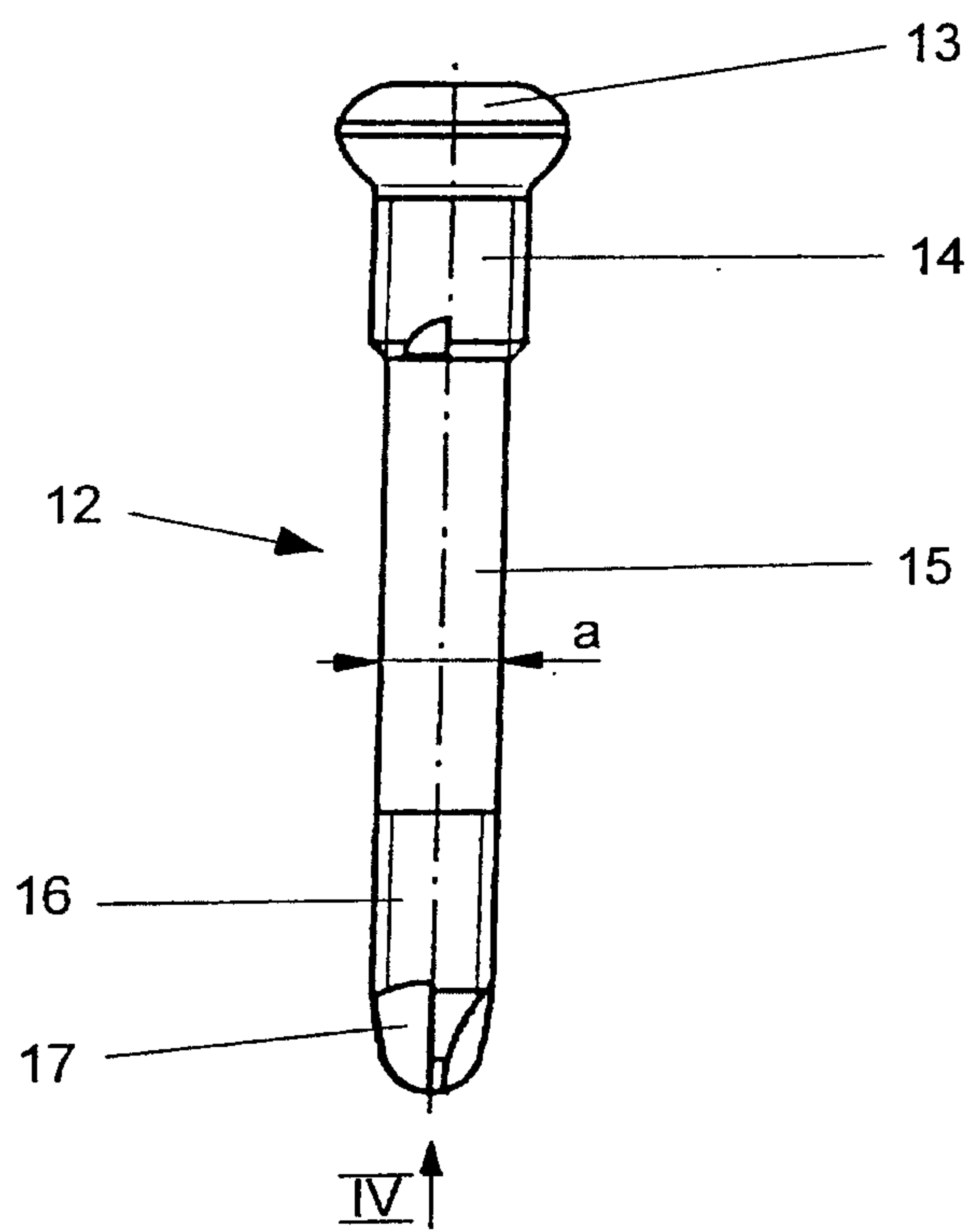


Fig. 3

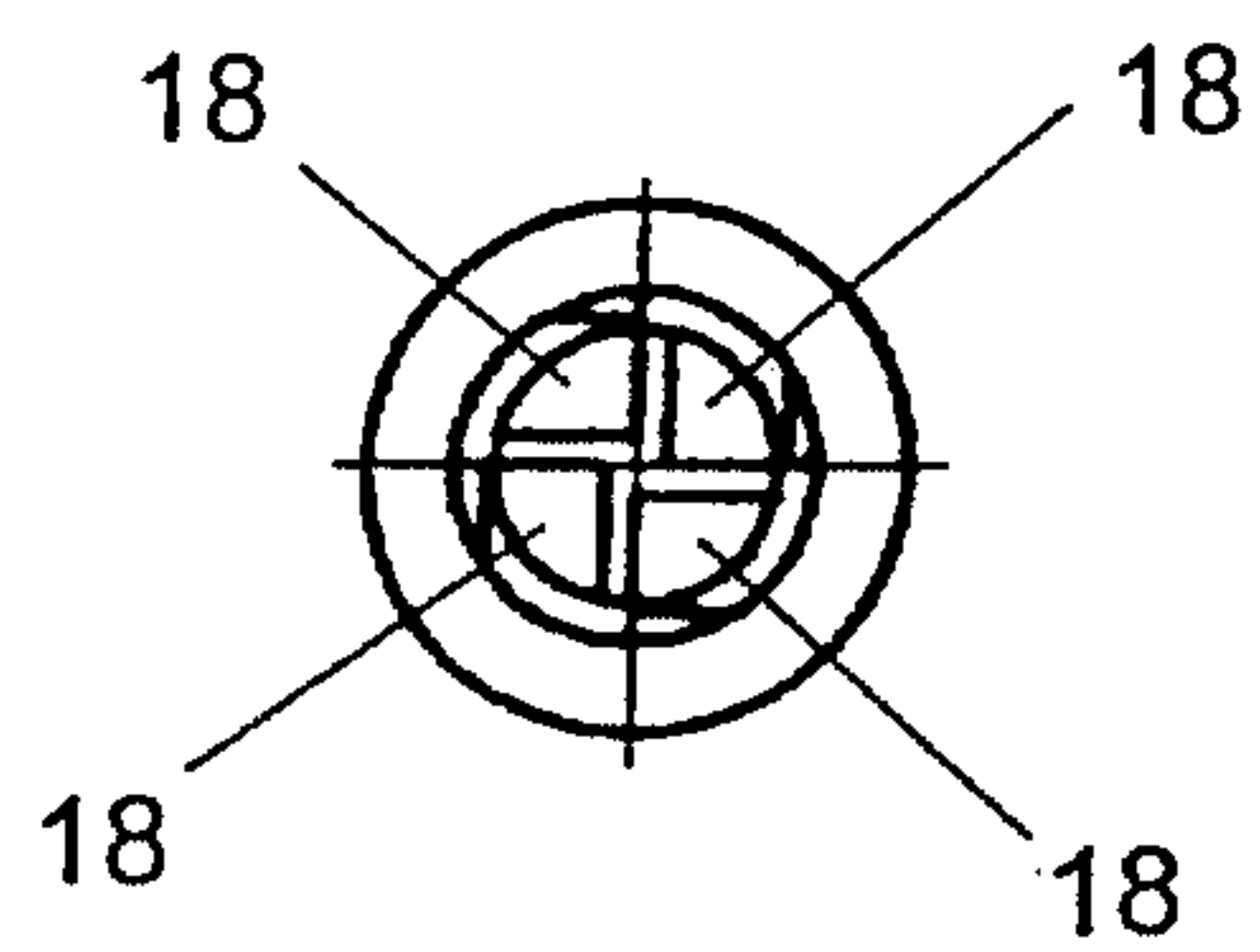


Fig. 4

