

April 29, 1969

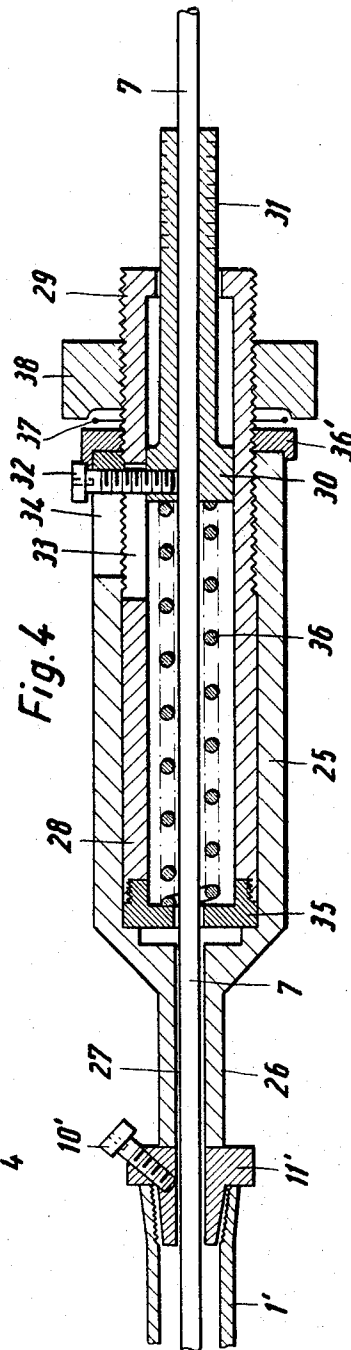
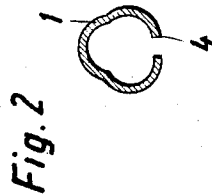
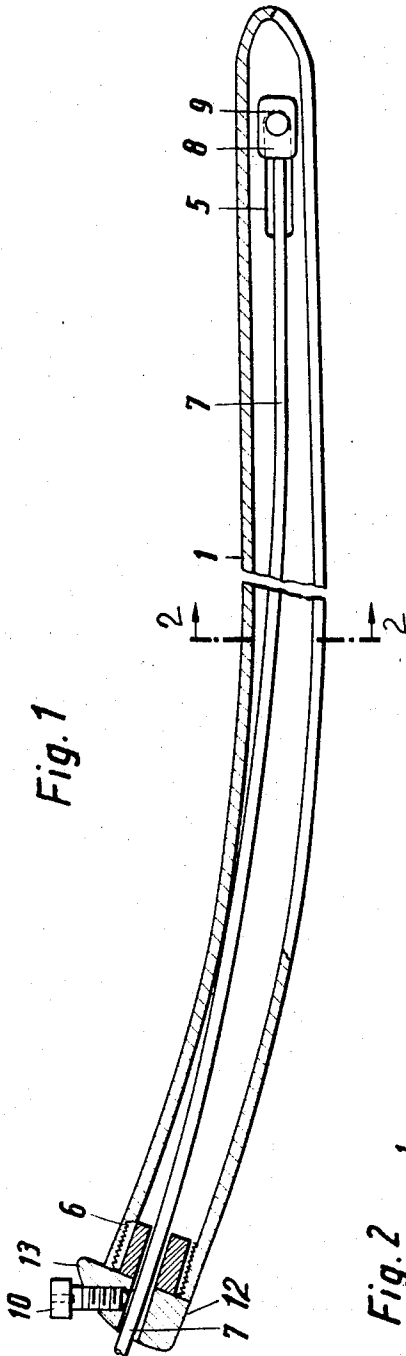
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3,441,017

APPARATUS FOR THE TREATMENT OF FRACTURES OF TUBULAR BONES

Filed March 24, 1966

Sheet 1 of 2



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Sheet 2 of 2

Fig. 3

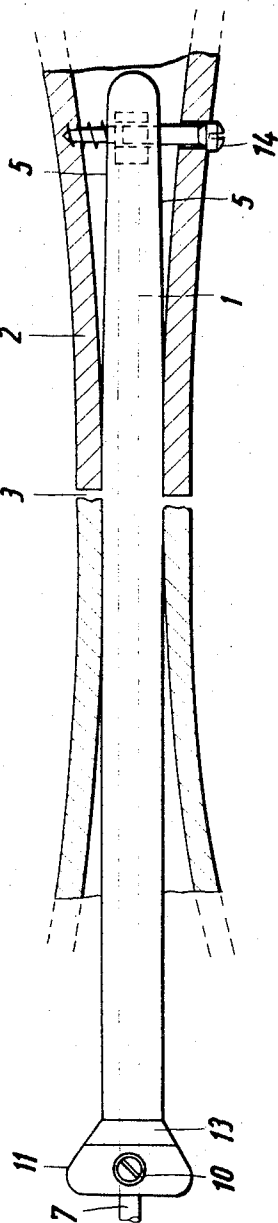


Fig. 5

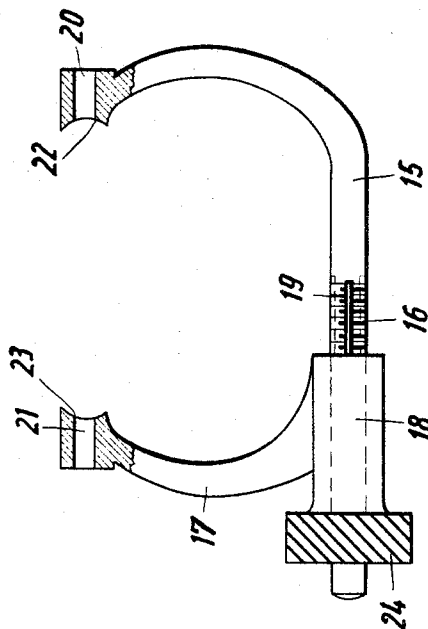
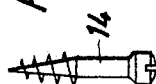


Fig. 6



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3,441,017

APPARATUS FOR THE TREATMENT OF FRACTURES OF TUBULAR BONES

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2 Claims

ABSTRACT OF THE DISCLOSURE

An elongated hollow elastic nail member for the treatment of fractures of tubular bones, having a marrow hollow which has opposed longitudinal slots at its distal end. A counter bearing is provided at its proximal end, and carries a locking means. A wire spanner is positioned within the nail member and has its distal end provided with an anchor member. The anchor member has a transverse bore positioned adjacent the opposed longitudinal slots, and the proximal end of the wire spanner extends outwardly through the counter bearing, the opposed longitudinal slots and the anchor member being adapted to receive a transverse pin for anchoring the distal ends of the anchor member to the bones, and the locking means are adapted to lock the wire spanner against longitudinal movement when proper tensioning has been applied thereto.

The present invention relates to an apparatus for the treatment of fractures of human limbs.

The results obtained during the last years in the accident surgery concerning the operative treatment of bone fractures are based on the knowledge, that an absolute mechanical rest position in the fracture range can be obtained by application of pressure and that by such an arrangement, the most economical and fastest fracture healing can be brought about, namely the so-called primary bone healing, in which no more callus formation can be shown in the X-ray picture. Until now, different types of nails have been used, in order to bring about a rest position in the fracture range. With the marrow nails used thereby, an absolute rest position cannot be obtained, so that often a plaster treatment was required, which, however, again led to the feared joint stiffenings and muscle weakenings. Also with the so-called "Küntscher nail," which is inserted as a hollow marrow nail into the inside of the tubular bone, the described drawbacks cannot be completely removed.

In most of the cases, it was not possible to avoid an additional outer railing by means of a plaster cast. The indication of the marrow nail is relatively narrow. Since the marrow hole is not a tube of equal open diameter, rather is slightly widened in the neighborhood of the joints, fractures cannot be stabilized sufficiently in these ranges by means of the "Küntscher nail," and most also then, when the narrowest point is widened in the median third of the tubular bone by drilling and, thereby, the contact face between the nail and the inner wall of the bone is increased. The fracture piece adjacent the joint rotates about the nail not completely filling the marrow hole because the hole has at that point a widened hole portion, and becomes bone fast, not seldom in a stronger wrong position.

In order to obtain a stabile osteosynthesis within the framework of the fracture treatment on the large tubular bones, resort is taken today in many cases to a new AO-instrumentarium. By this arrangement, pressure plates are secured laterally to the bone and the pressure plates are connected with each other by means of Cordicallis

screws, or bone-skin screws, such that the fracture faces are pressed upon each other within the fracture range. The fracture healing takes place faster thereby, as well as with the only application of draw-pressure screws for the stabilization of inclined fractures. Furthermore, the fractured extremity can be moved immediately after applying the pressure osteosynthesis. A drawback of this method resides, however, in the fact that the closed fracture must be changed into an open one. Many surgeons see by such a process a danger for infection and an additional traumatization of the skin- and bone-pieces. This method is characterized as nonphysiological by critics.

It is therefore one object of the present invention to provide an apparatus for the treatment of fractures of human limbs, wherein all drawbacks inherent in the known methods and apparatus are removed, by applying a hollow nail or marrow nail inserted into the inside of the bone, which nail receives a spanner extending longitudinally therein, which carries at its forward end an anchor to be secured in the bone beyond the fracture and at its other end has a counter bearing supporting itself on the edge of the hollow nail and the bone, respectively, on the other side of the fracture. The spanner comprises substantially a mandrel or wire, which is connected, on the one hand, rigidly with the anchor and on which the counter bearing is longitudinally displaceable and securable, on the other hand. In order to press toward each other rigidly the fracture faces and to stabilize the bone, a clamping device is applied, which is mountable on the spanner behind the counter bearing for adjustable tensioning of the wire or mandrel forming the spanner and for the setting of the counter bearing supporting itself on the edge of the hollow nail, respectively, whereby the counter bearing is securable upon reaching the desired longitudinal tension on the wire forming the spanner and the clamping device is removed. In order to obtain a continuous pressing towards each other of the fracture faces, the spanner can also be elastic in longitudinal direction or resilient, whereby preferably a draw spring is inserted in the wire or mandrel forming the spanner. The securing of the nail can also be obtained by a cross-wise disposed screw.

It is still another object of the present invention to provide an apparatus for the treatment of fractures of human limbs, wherein the hollow nail, which is applied, is equipped furthermore at its forward end on opposite sides with wide longitudinal slots, while the anchor has a cross-bore through which, as well as through the longitudinal slots of the hollow nail, a screw is inserted into the bone. By this arrangement, the rotational instability of the fracture is completely removed. The fracture piece, which is remote from the body, is rigidly connected with the nail clamped in the marrow nail. The additional application of pressure effective in longitudinal direction of the extremity and the resting position obtained thereby warrants in addition the so-called primary bone healing. By the arrangement, in accordance with the present invention, the indication of the conventional "Küntscher nail" is appreciably widened. It is now possible to perform a stabile pressure osteosynthesis without requiring that the closed fracture is transformed into an open one. On the other hand, the marrow nail can be inserted in nearly all cases without difficulty into the fracture, particularly if the surgeon avails himself of the conventional technical means, as image amplifier or remote X-ray screen and has also available the complete marrow nail instrumentarium.

By a target device mounted on the outside of the bone, in the form of a fork, adjustable as to its open width and insertable for viewing of the bore provided in the anchor and for the guidance of the drill in accordance with the measurement, an exact treatment and an exact insertion of the required screws can be secured.

With these and other objects in view which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a longitudinal section of the hollow nail improved in accordance with the present invention;

FIG. 2 is a section along the lines 2—2 of FIG. 1;

FIG. 3 is a top plan view of a tubular bone, partly in section, with inserted hollow nail;

FIG. 4 is a longitudinal section of the clamping device;

FIG. 5 is a side elevation of the target device, designed in accordance with the present invention; and

FIG. 6 is a side elevation of the screw applied to the device.

Referring now to the drawings and in particular to FIG. 1, a hollow nail 1 is used in connection with the device according to the present invention. The nail of the upper limb is straight, while a nail angularly bent is used at the proximal end on the lower limb. The hollow nail is elastical in cross direction and has substantially, preferably, a cloverleaf profile, as shown in FIG. 2 of the drawings. It is driven into the tubular bone 2 (FIG. 3), which has been widened to a certain extent for this purpose, in order to secure a possibly long contact face between the inner face of the bone and the nail 1 on both sides of the fracture range 3. Due to the longitudinal slot 4, provided in the nail 1, the latter is crosswise elastic, so that it adheres well to the bone. At the distal end parallel longitudinal slots 5 are provided in the side faces of the hollow nail 1, the purpose of which slots is disclosed below. At the proximal end, however, the nail is widened to a certain extent and equipped with an inner thread 6, in which a device can be screwed in, which serves the purpose of inserting and removing again the nail. It is to be understood that the hollow nail 1 is produced in different lengths and thicknesses, so that it is fitted for the most different length measurements.

A spanner 7 is provided inside of the nail, which spanner 7 comprises a correspondingly long bendable core or wire and which carries at its forward end an anchor 8, having a cross bore 9. At the upper end of the core or wire 7, which is longer for an appreciable amount than the nail 1, is securably mounted a counter bearing 11 which is equipped with a set screw 10, which counter bearing 11 is insertable into the inside of the hollow nail 1 by means of a collar 12 and which sits at its upper edge, whereby still a forwardly projecting nose 13 is arranged. As already mentioned, the proximal end of the nail can be fixed also by means of a crosswise disposed screw, which projects through the counter bearing 11 and the wall of the bone on both sides of the marrow channel. The hollow nail, shown in FIG. 1, which is bent to a certain extent, finds application in lower limb bones, which must be widened for the purpose of insertion of the nail below the knee. Due to the curvature of the nail, the counter bearing 11 engages with its nose 13 the lower bone edge of the insertion point. The clamping device, as shown in FIG. 4, is then mounted on the core 7.

The hollow nails 1' which are applied for the upper limb bones, are straight. In this case, a pressure member 11' having a correspondingly enlarged annular collar and a set screw 10' can be used.

After insertion of the hollow nail 1 into the bone 3, at first the anchor 8 and, thereby, simultaneously also the forward end of the hollow nail 1 can be secured in the bone 2. This is brought about by turning over a screw 14 laterally through the bone, the slots 5 and the bore 9 of the anchor 8 and in particular from the median to the lateral direction. In order to bore through the bone 2 at the right point, the target device, shown in FIG. 5 is applied. The latter comprises a bowed portion 15 equipped with a thread 16, on which is guided a counterholder 17 by means of a guide bushing 18 and a groove securing means 19. The two parts 15 and 17 have a bore 20 and 21, respectively, at their forward ends, whereby the part 15 is equipped with a recess 22 and the part 17 with a

prism-shaped edge 23. The open width of the bowed parts 15 and 17 can be changed by means of a setting screw 24.

Prior to boring the bone at the height of the anchor 8 for the purpose of insertion of the screw 14, the target device 15 and 17 is mounted. By means of conventional technical means, as image amplifier or remote X-ray screen, the target device must be brought in such a position that the bores 20 and 21 of the latter coincide exactly with the longitudinal slots 5 in the nail and the bore 9 and in the anchor 8, respectively. If this position is obtained, a drilling can take place finally through the openings 20 and 21 of the target device and finally the screw 14 can be inserted through the nail 1 and the anchor 8 and can be screwed in into the bone. Thus, the spanner 7 is anchored rigidly with its distal end in the fracture piece of the bone remote of the body. Now the core 7 must be brought under tension, in order to press towards each other rigidly the fracture faces. For this purpose, a tensioning device is provided as shown in FIG. 4 of the drawings. The tensioning device is guided over the end of the core 7, until it is mounted on the counter bearing 11 and 11', respectively, the set screw 10 and 10', respectively, of which is not yet tightened.

The tensioning device comprises substantially a cylindrical housing 25, which leads at its forward end into a bushing 26 of smaller diameter than that of the housing 25. A bore extends longitudinally through the bushing 26 and the housing 27, which bore has a larger diameter than the diameter of the core 7. Another bushing 28 is inserted inside of the bushing 25, which bushing 28 has thread 29 at its forward end and carries inside a piston 30. The piston rod 31 secured thereto, which likewise has a longitudinal bore corresponding with the diameter of the core 7, extends beyond the end of the threaded bushing 29 for a certain amount and carries here on the outer periphery a scale gauged to the spring force and spring tension, respectively. The piston 30 is secured on the core 7 by means of a set screw 32. The screw 32 projects thereby to a slot 33 of the threaded bushing 29 and through the slot 34 of the outer housing 25, respectively, and takes care of the guiding of the parts on each other. Between the piston 30 and the bottom 35 of the bushing 28, a pressure spring 36 is inserted.

The bushing 25 has at its outer edge a collar 36' which serves as a bearing for a pressure ball bearing 37, on which a setting ring 38 is supported, on the other hand.

If the tensioning device has been moved up to the counter bearing 11 and 11', respectively, on the core 7, the screw 32 must be tightened. Now, by rotation of the ring 38 on the thread 29, the bushing 28 can be withdrawn against the force of the spring 36. The core or wire 7 is then put under tension, the size of which can be read on the scale of the piston rod 31. If the desired tension is obtained, the setting screw 10 and 10', respectively, provided in the counter bearing 11 and 11', respectively, is finally tightened, and thereby the spanner 7 is tensioned in the desired manner. The fracture faces are rigidly disposed towards each other. Now, upon loosening of the screw 32, the tensioning device, as disclosed in FIG. 4, can be removed from the wire 7 and the latter can be pinched off tightly over the counter bearing 11 and 11', respectively.

In order to obtain a continuous resilient tension, a correspondingly strong draw spring can be inserted into the core 7 and wire, respectively, or the entire core can be formed of a single correspondingly narrowly wound spring.

By application of the just described tensioning device, an exactly predetermined and readable pressure can be transmitted to the fracture faces by means of a gauged spring. Furthermore, the entire nail is rigidly anchored and secured to the bone. In case of a lower limb bone, the counter bearing 11 is used with the nose projection 13, which fits exactly into the head of the nail and which abuts with its nose within the range of the nail driving point behind the forward Corticalis. The nose 13 does not ex-

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tend beyond the level of the Tuberositas and thus does not lead to a mechanical irritation of the wound sewn over in the softer parts.

If no X-ray image exists, after previous application of the spanner to the bone surface, the position of the bore 9 is marked on the skin. On this marking the bone is drilled upon driving in the nail 1 and insertion of the spanner 7 with a relatively strong drill and is probed with a thin wire (Kirschner wire) and thereby to determine the screw seat.

Furthermore, the anchor sitting on the spanner can be located prior to the nail in the bone. The nail is then set as a guide core over the spanner.

All individual parts are produced, as the marrow nail, of V4A-steel.

In summary, the following advantages can be observed compared with the previous marrow nailing and the plate/screw osteosynthesis:

(1) The indication of the "Küntscher nail" is appreciably widened, due to the fact that also fractures near the joints can be nailed in a stabile manner.

(2) The boring of the marrow hollow is no more required with an inner railing through the nail and additional application of axial pressure.

(3) By application of a dosed and readable pressure of about 60 kg., an absolutely mechanical rest position is obtained in the fracture split and thereby the most economical fracture healing is obtained which is achieved in the shortest possible time.

(4) The screw running through the end of the nail and the fracture piece remote from the body warrants a rotation stability of the distal fragment. By this arrangement, all position errors are avoided.

(5) A moving of the nail within the marrow hollow, as well as a rotation about its longitudinal axis is no more possible, since it is rigidly secured to the bone at its upper and lower end.

(6) The nail, in accordance with the present invention, makes possible in any case a nonconditioned exercise of stability, so that immediately after the operation the functional aftertreatment can be started. An additional outer railing by plaster is not required.

(7) A transformation of a noncomplicated into a complicated fracture can be avoided, in contradistinction to the plate- and screw-osteosynthesis.

(8) A very low infection danger can be counted on.

I claim:

1. An elongated hollow elastic nail member for the

treatment of fractures of tubular bones, having a marrow hollow,

said nail having opposed longitudinal slots at its distal end,

a counter bearing provided at its proximal end, and carrying a locking means,

a wire spanner positioned within said nail member and having its distal end provided with an anchor member,

said anchor member having a transverse bore positioned adjacent said opposed longitudinal slots, and the proximal end of said wire spanner extending outwardly through said counter bearing, said opposed longitudinal slots and said anchor member being adapted to receive a transverse pin for anchoring the distal ends of said anchor member to said bones, and said locking means being adapted to lock said wire spanner against longitudinal movement when proper tensioning has been applied thereto.

2. The elongated hollow elastic nail member, as set forth in claim 1, which includes

a clamping device attached to said free proximal end of said wire spanner.

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U.S. Cl. X.R.

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