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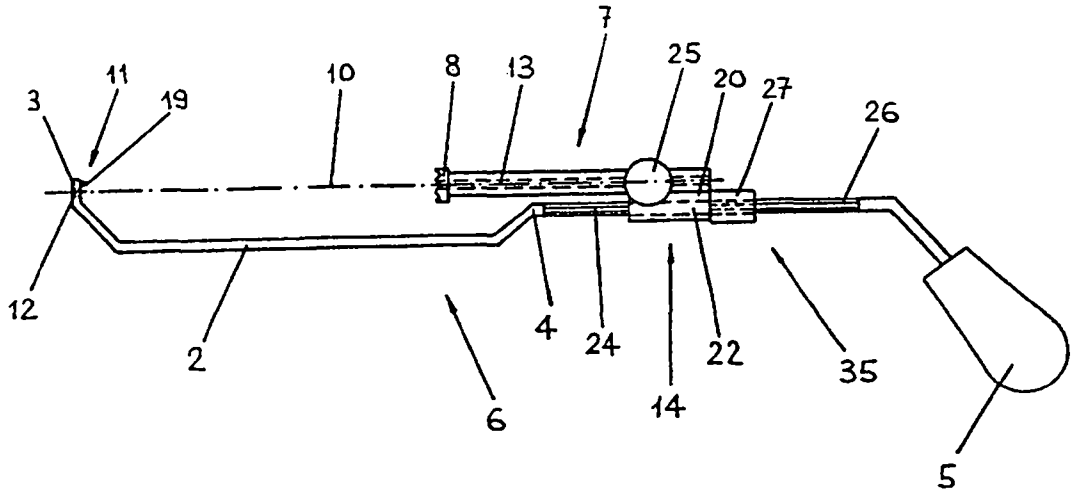

(57) Abstract: The invention relates to a device for reducing bone fragments, especially at the pelvic bone or the tubular bone. The inventive device comprises A) a first clamping element (6) comprising a bow (2) with a front end piece (3) for placing against a bone fragment and a rod (24) that joins the bow (2) at the outside and at the rear end piece (4) thereof; B) a second longitudinal clamping element (7) comprising a longitudinal axis (10) as well as a front end (8) for placing against an additional bone fragment; C) a connecting element (14) for connecting the second clamping element (7) to the first clamping element (6) in such a way that the second clamping element (7) can be displaced in parallel in relation to the longitudinal axis (10) and relative to the first clamping element (6); a handle (5) and D) clamping means (35) by means of which the second clamping element (7) can be detachably fixed in relation to the first clamping element (6), whereby E) the front end piece (3) of the bow (2) and the second clamping element (7) are provided with bores (12; 13) parallel in relation to the longitudinal axis (10), whereby said bores can receive a guide wire and a Kirschner wire (23) respectively or a trocar.

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Repositioning Device for Bone Fragments

The invention relates to a device for repositioning bone fragments, particularly in long bones or in the pelvis, as claimed in the precharacterising part of claim 1.

In order to be able to use minimally invasive surgery in traumatological medicine and in orthopaedics it is often necessary to use repositioning instruments or devices which require only narrow access openings to be made in the human or animal body. Both the repositioning itself and the keeping in place of the set bone are often problematic. Most repositioning forcipes function according to the principle of a pair of scissors, consisting of two crossed levers connected to each other by means of a joint, which open and close in an x-shaped manner, thus occupying a wide, planar area. Particularly in the case of fractures occurring in the depth of the pelvis, the presence of soft tissues and the slot-like access often make it impossible for such a forceps to be inserted perpendicularly to the plane of the fracture. For this reason, clamping devices having an axial locking mechanism are in many cases advantageous.

A pelvic clamp for emergency surgery having clamping elements which are displaceable rectilinearly along a

single axis is known from CH 680,561 GANZ. This known pelvic clamp consists of an oblong rail and of two arms movable on said rail. The arms are provided with tips, designed to be brought to bear against a bone, which are lead-screw actuated and may be used to exert compressive force during the reduction of the pelvic bone. However, in cases in which the bone surfaces are obliquely oriented relative to the clamping direction, the pointed tips are prone to slip off the bone surfaces.

The invention is intended to provide a remedy for this. It is accordingly an object of the invention to create a repositioning device provided with an axial locking mechanism which offers increased security and better prevents the tension members from slipping off as the compression force required for bone reduction is applied.

The invention solves this problem by providing a device for repositioning bone fragments, particularly in long bones and in the pelvis, which shows the features of claim 1.

The repositioning device for bone fragments according to the invention comprises a first and a second tension member which are connected by means of a connecting member in such a way that the second tension member is rectilinearly displaceable relative to the first tension member. In order to allow the device to be moved around a bone, the first tension member is provided with a bow the ends of which are in alignment with the longitudinal axis of the second tension member, so that an axial clamping mechanism is created which may be locked by means of a clamping means. In addition to this bow including a front end piece and a rear end, the first tension member comprises a pyramidal or

conical protrusion situated on the front end piece and directed towards the inside of the bow, said protrusion being designed to be brought to bear against a bone fragment. On the other end portion of the bow, a rod is provided which extends parallel to the axis of displacement and is attached to the connecting member. The device also comprises a operating handle. The second tension member is prismatic or cylindrical and is arranged in such a way that its front end may be brought to bear against another bone fragment. The clamping means make it possible to exert an axial compressive force on the bone fragments clamped between the tension members and to releasably lock the tension members in their positions relative to each other. The protrusion on the front end of the bow is provided with a pointed tip which may be pressed into the surface of the bone and which equally serves to reduce the risk of slipping off said bone surface, particularly if it extends obliquely relative to the longitudinal axis.

In a preferred embodiment of the device according to the invention, the front end of the second tension member is shaped in the form of a crown provided with frontal spikes which may be pressed into the surface of a bone. This reduces the risk of slipping off a bone surface extending obliquely relative to the longitudinal axis.

In yet another embodiment of the device according to the invention, the front end piece of the first tension member comprises a bore extending concentrically to the longitudinal axis and provided with an internal screw thread as well as a straining screw which may be driven from outside the bow into the internal screw thread and which comprises, directed towards the inside of the bow, a

front end portion including means to be brought to bear against a bone. Instead of the insertable straining screw it is also possible to envisage the use of inserts which are axially lockable by means of a resilient latch or a bayonet locking. These embodiments have the advantage that the bow may be guided around the soft tissues and that only the straining screw or the insert needs to be passed through the soft tissue surrounding the bone by means of a stab incision so as to be brought to bear against the bone.

The means designed to be brought to bear against a bone may be realised as conical or pyramidal tips extending coaxially to the longitudinal axis, as a ball extending coaxially to the longitudinal axis and having a conical or pyramidal tip equally extending coaxially to the longitudinal axis, as a top part having a conical or pyramidal tip connectable to the front end portion by means of a ball-and-socket joint, or as a crown provided with frontal spikes.

In another embodiment of the device according to the invention, the front end piece of the first tension member and the second tension member are each provided with a bore extending concentrically to the longitudinal axis so as to be capable of receiving a guide wire or Kirschner wire. In the embodiments in which the front end piece includes a straining screw or an insert, said straining screw or said insert are provided with a bore extending concentrically to the longitudinal axis which serves for receiving the guide wire or Kirschner wire.

In other embodiments of the device according to the invention, these bores formed in the first and/or the

second tension member may have a diameter adequately dimensioned so as to permit a bone screw passing through the hole to be guided to the bone surface and screwed into the bone. The bore may also be realised as having a diameter capable of receiving a trocar. The function of the trocar during the stab incision necessary for the insertion of the second tension member, the straining screw or the insert is to fill the cavity present in the hollow tension member so as to protect the soft tissues from being injured. After the insertion of the device through the soft tissues, the trocar is removed from the device and Kirschner wires / guide wires or bone screws, as required, are inserted into the bone.

In another embodiment of the device according to the invention, the front end portion of the second tension member is provided with means for latching a bone plate. These means preferably consist of resilient arms arranged parallel to the longitudinal axis and resiliently deformable in the radial direction. For latching the bone plate, the arms are radially compressed while being inserted into a bore or a counter-bore formed in the bone plate, so that the bone plate will be firmly kept in place as the arms on the front end portion of the second tension member resiliently regain their initial, uncompressed condition. Once the bone plate has been screwed onto a bone or bone fragment, the second tension member may be drawn back so as to remove the resilient arms from the counter-bore or bore formed in the bone plate. Preferably, these arms are obtained by cutting slots into the hollow, cylindrical outer wall of the second tension member, beginning from the front end thereof and extending parallel to the longitudinal axis.

In one embodiment of the device according to the invention, the connecting member consists essentially of a sleeve connected to the second tension member and provided with a bore extending parallel to the longitudinal axis thereof and penetrating the sleeve for displaceably receiving the rod. In addition, the connecting member comprises a set screw by means of which the guide wire or Kirschner wire is releasably lockable within the bore. Furthermore, the rod is provided with an external screw thread, so that by means of an adjusting nut which may be screwed over the external screw thread the connecting member and the second tension member fastened thereto may be pressed against the front end portion of the bow in a direction parallel to the longitudinal axis.

In another embodiment of the device according to the invention, the connecting member comprises a connecting piece fixedly connected with the rod and a bore wherein the second tension member is mounted in such a way that it is displaceable coaxially to the longitudinal axis. The clamping means consist essentially of a clamping disk arranged concentrically to the longitudinal axis on the second tension member, a readjusting spring for pulling back the clamping disk when in unstrained condition, equally arranged concentrically to the longitudinal axis on the second tension member, and a catch lever for locking the second tension member relative to the first tension member when the device is in a strained condition. For straining the device, an operating lever is integrated in the handle by means of which, when actuated, the clamping disk may be brought into a wedged position on the second tension member and, while the operating lever is maintained

in its actuated position, the second tension member is displaceable towards the front end piece of the bow in a direction parallel to the longitudinal axis.

Further advantageous embodiments of the invention are characterised in the dependent claims.

The advantages achieved by the present invention consist essentially in the fact that due to the axial locking mechanism the device according to the invention allows a repositioning of fractures which necessitates only narrow access openings in the human body. In addition, a guide wire or Kirschner wire which may be inserted through the hollow cylindrical, second tension member prevents the tension members from slipping off oblique bone surfaces. The guide wire or Kirschner wire may be driven so far as to penetrate the bone. Subsequently, the guide wire or Kirschner wire is received in the front end portion of the first tension member. Thus, it is possible to rigidly brace the device on the bone. This stable connection between the device according to the invention and the bone fragments permits a controlled fragment manipulation.

In the following, the invention and improvements of the invention will be illustrated in greater detail with reference to the partially diagrammatic representations of several embodiments.

In the drawings:

Fig. 1 is a representation of the preferred embodiment of the device according to the invention;

Fig. 2 is a sectional view of the front end portion of the first tension member;

Fig. 3 is a sectional view of the preferred embodiment of the second tension member;

Fig. 4 is a sectional view of another embodiment of the second tension member and of a bone plate latched to the front end portion thereof;

Fig. 5 is an illustration of the way in which the device according to the invention is used in a fractured pelvic bone;

Fig. 6 is an illustration of the way in which the device according to the invention is used in a long bone;

Fig. 7 is a representation of another embodiment of the device according to the invention;

Fig. 8 shows a further embodiment of the front end piece of the first tension member, including a straining screw;

Fig. 9 shows a further embodiment of the front end piece of the first tension member, including an insert and a resilient latch;

Fig. 10 shows a further embodiment of the front end piece of the first tension member, including an insert and a bayonet locking;

Fig. 11 shows a further embodiment of the means designed to bear against a bone;

Fig. 12 shows a further embodiment of the means designed to bear against a bone;

Fig. 13 shows a further embodiment of the means designed to bear against a bone, including a ball-and-socket joint; and

Fig. 14 shows a further embodiment of the means designed to bear against a bone.

Fig. 1 shows the preferred embodiment of the device according to the invention for repositioning bone fragments, particularly long bones or the pelvic bone. The device comprises a first tension member 6, a second tension member 7, and a connecting member 14 for releasably connecting the two tension members 6;7. The first tension member 6 comprises a bow 2 which has a front end piece 3, a rear end piece 4, and a conical protrusion 11 situated on the front end piece 3 and directed towards the inside of the bow 2, and, directed towards the outside of the bow 2, a rod 24 attached to the rear end piece 4 thereof, extending vertically to the first end piece 3, as well as a handle 5. The protrusion 11 serves for bringing the bow 2 to bear against a bone fragment. The second tension member 7 is cylindrical and has a longitudinal axis 10 and a front end portion 8 which serves for bearing against another bone fragment. By means of the connecting means 14, the two tension members 6;7 are connectable in such a way that the longitudinal axis 10 intersects the front end piece 3 of the bow 2 and that the second tension member 7 is displaceable relative to the first tension member 6 in a direction parallel to the longitudinal axis 10. Furthermore, the front end piece 3 and the second tension

member 7 are provided with bores 12;13 extending concentrically to the longitudinal axis 10 which permit the reception of a guide wire or Kirschner wire 23 (Fig. 5). The protrusion 11 has a pointed tip 19 which may be pressed into the surface of a bone. The connecting member 14 consists of a sleeve 20 which is connected to the second tension member 7 and provided with a bore 22 extending parallel to the longitudinal axis 10 thereof and penetrating the sleeve 20 for displaceably receiving the rod 24. In addition, the connecting member 14 comprises a set screw 25 by means of which the guide wire or Kirschner wire 23 (Fig. 5) is releasably lockable within the bore 13 of the second tension member 7 and an adjusting nut 27 which may be screwed over the external screw thread 26 formed in the rod 24 so that due to said nut the connecting member 14 and the second tension member 7 may be pressed against the front end piece 3 of the bow 2 in a direction parallel to the central axis 23.

Fig. 2 shows the protrusion 11 on the front end piece 3 of the bow 2. The protrusion 11 is conically shaped, directed towards the inside of the bow 2, and is arranged next to the bore 12 on the front end piece 3.

Fig. 3 shows the second tension member 7 with a front end portion 8 shaped in the form of a crown. This crown-shaped front end portion 8 is provided with frontal spikes 15 which may be pressed into a bone surface.

Fig. 4 shows an embodiment of the second tension member 7 including arms 18 arranged on the front end portion 8 and extending parallel to the longitudinal axis 10. The arms 18 are resilient and radially deformable and serve for

latching a bone plate 16. For this purpose, the arms 18 are radially compressed while being inserted into a bore or a counter-bore 29 formed in the bone plate 16, so that the bone plate 16 will be firmly kept in place as the arms 18 on the front end portion 8 of the second tension member 7 resiliently regain their initial, uncompressed condition. Once the bone plate 16 has been screwed onto a bone or bone fragment, the second tension member 7 may be drawn back so as to remove the resilient arms 18 from the counter-bore 29 or from the bore formed in the bone plate 16. These arms 18 are obtained by cutting slots 28 into the hollow, cylindrical outer wall of the second tension member 7, beginning from the front end portion 8 thereof and extending parallel to the longitudinal axis 10.

Fig. 5 shows the device according to the invention used in connection with a fracture of the pelvis, the fracture line extending horizontally in a patient 30 lying on his back. By means of an ilio-inguinal access, the fracture may be repositioned by pulling the distant, lower fragment in an approximately vertical direction towards the upper fragment. The protrusion 11 on the front end piece 3 of the first tension member 6 of the device 1 according to the invention is put against the lower fragment of the pelvic bone and adjusted thereon. Then the second tension member 7 is advanced together with the connecting member 14 until its front end portion 8 touches the upper bone fragment, whereupon the adjusting nut 27 is tightened so that the fractured pelvic bone is compressed between the protrusion 11 of the first tension member 6 and the crown-like front end portion 8 of the second tension member 7. In order to prevent the protrusion 11 and/or he crown-like front end portion 8 from slipping off the oblique bone surfaces, a

drill passed through the bore 13 (Fig. 1) formed in the second tension member 7 may be used to drill a bore into the pelvic bone for receiving a guide wire or Kirschner wire 23 in such a way that said guide wire or Kirschner wire 23 may be received in the bore 12 (Figs. 1 and 2) of the front end piece 3 of the first tension member 6. Thus, the guide wire or Kirschner wire 23 penetrates the bone concentrically to the longitudinal axis 10 and is received on the lower end of the pelvic bone by the front end piece 3 of the first tension member 6, whereas the second tension member 7 receives the guide wire or Kirschner wire 23 on the upper end of the pelvic bone. The guide wire or Kirschner wire 23 may be releasably locked in the second tension member 7 by means of the set screw 25. In this way, a rigid bracing of the device 1 according to the invention on the pelvic bone is realised. By means of the adjusting nut 27, pressure may be exerted on the two bone fragments and the fractured bone may thus be compressed.

Fig. 6 shows a further application of the embodiments of the device according to the invention described in connection with the preceding figures, referring to its use on a long bone 33. In the case of greater fragments of long bones, the front end piece 3 of the first tension member 6 may be advanced close to the bone in such a way that it is passed ventrally or dorsally around said fragments and the fragments are then compressed by means of the second tension member 7. Sagittal fractures of long bones may thus be compressed by means of a lateral approach. The insertion of a guide wire or Kirschner wire 23 passed through the second tension member 7 into a bone fragment without bridging the fracture gap results in a solid hemicerclage-type connection between the bone and the device. Thus, it

is possible to manipulate the fragment in all six degrees of freedom.

Fig. 7 shows another embodiment of the device according to the invention. The device 1 equally comprises a bow 2 including a rod 24 attached to the rear end piece 4 thereof and a front end piece 3 including a protrusion 11 directed towards the inside of the bow 2. The device 1 is positioned by passing the bow 2 around the bone. The embodiment of the device 1 described hereinafter further equally comprises a second tension member 7 having a longitudinal axis 10 and a connecting member 14 for connecting the second tension member 7 to the rod 24. This connecting member 14 consists essentially of a plate-like connecting piece 38 which is attached to the rod 24 and includes a bore 47 penetrating said connecting piece 38 for receiving the second tension member 7. This bore 47 is aligned in such a way within the connecting piece 38 that the longitudinal axis 10 of the second tension member 7 intersects the front end piece 3 of the bow 2 and that the second tension member 7 is displaceable parallel to the longitudinal axis 10 relative to the first tension member 6. Furthermore, a handle 5 is releasably connected with the connecting piece 38. An operating lever 39 is releasably attached to the handle 5 by means of a first axle 40 (said operating lever being pivotable about said first axle 40 relative to the handle 5) so that the operating lever 39 and the handle 5 are detachable from the device 1. An annular clamping disk 36 provided with a bore 49 and a catch lever 41 serve as clamping means 35. The clamping disk 36 is placed over the second tension member 7 concentrically to the longitudinal axis 10, the bore 49 being adequately dimensioned so that the clamping disk 36 may be, with little play, axially

displaced on the second tension member 7. For straining the device 1, the actuating lever 39 is pressed against the handle 5, which causes the end portion 44 of the actuating lever 39 located on the side of the clamping disk to press eccentrically on the clamping disk 36. This compressive force exerted eccentrically on the clamping disk 36 causes the bore 49 thereof to get wedged on the second tension member 7 and to push said tension member subsequently in the direction of the front end piece 3 of the bow 2 until the straining force ceases to act on the actuating lever 39. If no straining force is exerted on the actuating lever 39, the readjusting spring 37, which is equally arranged concentrically to the longitudinal axis 10, presses from the opposite side against the clamping disk 36 and consequently pushes the clamping disk 36 and the actuating lever 39 back into their initial, rearward position. The second tension member 7 is locked in the desired position by the catch lever 41. A spring 42 presses the catch lever 41 against the lateral face of the second tension member 7. The second tension member 7 may only be pushed backwards once the locking exerted by the catch lever 41 has been released. This may be done by actuating an unlocking lever 45. By pressing said unlocking lever 45, the catch lever 41 is pressed against the spring 42 and the contact with the second tension member 7 is discontinued. The movement of the unlocking lever 45 is limited by a peg 46 arranged in a corresponding recess 50 formed in the unlocking lever 45. The catch lever 41 is mounted so as to pivot about a second axle 43 and is arranged within the connecting piece 38, together with the spring 42, the unlocking lever 45, and the peg 46. The clamping disk 36 and the readjusting spring 37 are mounted concentrically to the bore 47 within a cavity 48 arranged in the connecting piece 38.

Fig. 8 shows an embodiment of the front end piece 3 of the first tension member 6 which differs from the embodiment shown in Fig. 7 only in so far as the front end piece 3 has a bore 52 with an internal screw thread 53 extending concentrically to the longitudinal axis 10. This embodiment of the device according to the invention further comprises a straining screw 51 having a front end portion 54 directed towards the inside surface 81 of the bow 2 and a rear end portion 55. Beginning from the rear end portion 55, the straining screw 51 comprises a knurled screw head 56 adjoined by a threaded portion 57 the thread of which corresponds to the internal screw thread 53 of the bore 52, and a cylindrical shaft portion 58 extending to the front end portion 54. The means 80 designed to bear against a bone which are provided on the front end portion 54 are realised in the form of a pointed tip 59 arranged concentrically to the longitudinal axis 10. The straining screw 51 may be screwed into the front end piece 3 by means of the threaded portion 57, so that means for adjusting the parts of the device 1 which are in contact with the bone are provided on both sides of the device 1. This embodiment of the front end piece 3 as well as the utilisation of a straining screw 51 as described above are also possible in other embodiments of the device according to the invention, for example in the embodiment illustrated in Fig. 1.

Fig. 9 shows a further embodiment of the front end piece 3 of the bow 2. The front end piece 3 is provided with a bore 60 extending concentrically to the longitudinal axis 10. An additional insert 61 comprises a first shaft portion 62 including the front end 54 directed towards the inside 81 of the bow 2 and a second cylindrical shaft portion 64 on

the rear end 66 of the insert 61. The shaft portion 64 is insertable from the inside of the bow 2 into the bore 60 so as to tightly fit therein. An intermediate shaft portion 63 arranged between the first shaft portion 62 and the second shaft portion 64 and provided with a greater diameter than the second shaft portion 64 serves as an axial stop permitting the insert 61 to rest against the inside 81 of the bow 2. By way of axially securing the insert, a bore 67 is arranged in the front end piece 3 perpendicularly to the longitudinal axis 10 and extends from the bore 60 into the front end piece 3 without piercing it completely. A spring 68 is inserted in the bore 67 which from the base of the bore 67 presses on a ball 69 protruding partially into the bore 60. The ball 69 may be secured against falling out of the bore 67 by pressing in the edges of the bore 67 formed at the line of intersection between said bore 67 and the bore 60. The shaft portion 64 is provided with an annular groove 65 having a profile shaped in the form of a segment of a circle and extending concentrically and vertically to the longitudinal axis 10. As the shaft portion 64 is inserted into the bore 60, the ball 69 is forced by the action of the spring to engage with the annular groove 65 so as to axially secure the insert 61 within the bore 60. The means 80 designed to bear against a bone which are provided on the front end portion 54 are realised in the form of a pointed tip 59 arranged concentrically to the longitudinal axis 10.

Fig. 10 shows a further embodiment of the front end piece 3 of the bow 2. The front end piece 3 is provided with a bore 60 extending concentrically to the longitudinal axis 10. By way of axially securing the insert, a bore 67 is arranged in the front end piece 3 perpendicularly to the

longitudinal axis 10 which, starting from the bore 60, penetrates the front end piece 3 and into which a peg 72 is inserted. An additional insert 71 comprises a front shaft portion 76 with a front end 54 directed towards the inside 81 of the bow 2, an intermediate shaft portion 77, and a rear shaft portion 78. The front shaft portion 76 and the intermediate shaft portion 77 are insertable coaxially into the bore 60 from the outside of the bow 2. The front shaft portion 76 and the intermediate shaft portion 77 are both shaped in the form of a circular cylinder, the diameter of the front shaft portion 76 being inferior to that of the intermediate shaft portion 77. The intermediate shaft portion 77 is provided with a groove 73 having a first section 74 extending parallel to the longitudinal axis 10 continued by a second section 75 extending perpendicularly to the longitudinal axis 10. The first section 74 leads to the end face 79 of the intermediate shaft portion 77 adjoining the front shaft portion 76, so that the groove 73 is open towards the front shaft portion 76, enabling an engagement of the peg 72 with the groove 73, as the insert 71 is introduced into the bore 60. As soon as the insert 71 is sufficiently inserted into the bore 60 that the peg may engage with the section 75, the insert 71 is turned about the longitudinal axis 10 so as to be axially secured within the bore 60. The means 80 designed to bear against a bone which are provided on the front end portion 54 are realised in the form of a pointed tip 59 arranged concentrically to the longitudinal axis 10.

Figs. 11 to 14 show various different embodiments of the means 80 designed to bear against a bone provided on the front end 54 of the straining screw 51. In the variant according to Fig. 11, said means 80 comprise a ball 82

extending concentrically to the longitudinal axis 10 and provided with a conical tip 59. The diameter of the ball 52 is superior to the diameter of the cylindrical shaft portion 58 of the straining screw 51. The advantage achieved by this is that even without using a trocar, the straining screw 51 may be pushed through the soft tissues without injuring said soft tissues. In the variant shown in Fig. 13 the means 80 comprise a top part 84 having a conical tip 83 and a ball-and-socket joint 85 connecting the top part 84 with the front end 54 of the straining screw 51. This embodiment of the means 80 presents the advantage that even though the device may bear against the bone in an oblique way, the tip 83 which is pressed into the bone is nevertheless oriented vertically to the bone surface. The variants shown in Figs. 12 and 14 disclose means 80 comprising frontal spikes 88;89 in a crown-like arrangement extending coaxially to the longitudinal axis. In the variant according to Fig. 12 the spikes 89 are provided directly on the front end 54 of the straining screw 51, whereas in the variant according to Fig. 14 the front end 54 is provided with a shoulder 87 the diameter of which is superior to the diameter of the cylindrical shaft portion 58 of the straining screw 51. The spikes 88 are provided on the end face of the shoulder 87 distant from the front end 54. The variants shown in Figs. 12 and 14 present the advantage that the straining screw 51 may be perforated by a bore 90 extending coaxially to the longitudinal axis 10 into which, depending on the diameter of the bore 90, a Kirschner wire / guide wire or a screw may be inserted.

Although the embodiments of the means 80 shown in Figs. 11 to 14 are represented, by way of example, in connection

with the variant including the straining screw 51 (Fig. 8), they may be used identically together with the inserts 61 (Fig. 9) and 71 (Fig. 10). The front end portion 8 of the second tension member 7 may equally be shaped according to one of these variants.

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Claims

1. A device for repositioning bone fragments, particularly in the pelvic bone or in long bones, including

A) a first tension member comprising a front end piece to be brought to bear against a bone fragment and a rear end piece and

B) a second tension member comprising a front end to be brought to bear against another bone fragment; and

C) a connecting member by means of which the first and the second tension members are connected with each other in such a way as to be rectilinearly displaceable relative to each other, whereby

D) the first tension member comprises a bow situated between the front end piece and the rear end piece which may be moved around a bone or a bone fragment;

E) the second tension member is longitudinally shaped and has a longitudinal axis

F) the connecting member is arranged in such a way that the longitudinal axis intersects the front end piece of the bow and that the second tension member is displaceable relative to the first tension member in a direction parallel to the longitudinal axis ; and

G) the device comprises clamping means by means of which the second tension member may be pressed against the front end piece of the first tension member in a direction parallel to the longitudinal axis and releasably locked relative to the first tension member

characterized in that

H) the device comprises a handle for holding the device and that the handle is releasably connected with the device

2. A device as claimed in claim 1, characterised in that the first tension member comprises a rod attached to the rear end piece

3. A device as claimed in claim 1 or 2, characterised in that the front end piece of the bow and the second tension member include bores extending parallel to the longitudinal axis for receiving a guide wire or Kirschner wire

4. A device as claimed in claim 1 or 2, characterised in that the second tension member includes a bore extending parallel to the longitudinal axis which is apt for receiving a trocar.

5. A device as claimed in claim 1 or 2, characterised in that the second tension member includes a bore extending parallel to the longitudinal axis so that a bone screw may be passed therethrough coaxially to the longitudinal axis and, on the front end portion be screwed into an adjacent bone fragment.

6. A device as claimed in any of the claims 1 to 5, characterised in that the front end portion of the second tension member is shaped in the form of a crown provided with frontal spikes which may be pressed into the surface of a bone.

7. A device as claimed in any of the claims 1 to 5, characterised in that the front end portion of the second tension member comprises means for releasably latching a bone plate .

8. A device as claimed in claim 7, characterised in that the front end portion of the second tension member comprises radially resilient arms extending parallel to the longitudinal axis which permit to releasably latch a bone plate

9. A device as claimed in any of the claims 1 to 8, characterised in that on its front end piece the bow comprises a protrusion directed towards the

inside of the bow and provided with a pointed tip which may be pressed into the surface of an adjacent bone fragment.

10. A device as claimed in claim 9, characterised in that the protrusion is of pyramidal or conical shape.

11. A device as claimed in any of the claims 2 to 10, characterised in that the connecting member comprises a sleeve which is connected with the second tension member and includes a through bore extending parallel to the longitudinal axis for displaceably receiving the rod

12. A device as claimed in any of the claims 2 to 11, characterised in that the rod includes an external screw thread and that the clamping means comprise an adjusting nut which may be screwed over the external screw thread .

13. A device as claimed in any of the claims 1 to 10, characterised in that the connecting member comprises a connecting piece fixedly connected with the rear end piece and a bore wherein the second tension member is mounted in such a way that it is displaceable coaxially to the longitudinal axis .

14. A device as claimed in any of the claims 2 to 10, characterised in that the connecting member comprises a connecting piece fixedly connected with the rear end piece and a bore wherein the second tension member is mounted in such a way that it is displaceable coaxially to the longitudinal axis

15. A device as claimed in claim 13 or 14, characterised in that the clamping means comprise a clamping disk arranged concentrically to the longitudinal axis on the second tension member a readjusting spring for pulling back the clamping disk when in unstrained condition,

equally arranged concentrically to the longitudinal axis , on the second tension member and a catch lever for locking the second tension member relative to the first tension member when the device is in a strained condition.

16. A device as claimed in claim 15, characterised in that an operating lever is integrated in the handle by means of which, as the operating lever is strained, the clamping disk may be brought into a wedged position on the second tension member and, while the operating lever is maintained in its actuated position, the second tension member is displaceable parallel to the longitudinal axis towards the front end piece of the bow .

17. A device as claimed in any of the claims 1 to 16, characterised in that the connecting member comprises a set screw by means of which the guide wire or Kirschner wire is releasably lockable within the bore .

18. A device as claimed in claim 1 or 2, characterised in that the front end piece comprises a bore with an internal screw thread extending concentrically to the longitudinal axis and a straining screw with a threaded portion , the thread of the threaded portion corresponding to the internal screw thread , so that the straining screw may be screwed into the front end piece coaxially to the longitudinal axis

19. A device as claimed in claim 1 or 2, characterised in that the front end piece comprises a bore extending concentrically to the longitudinal axis a resilient latch extending into said bore and an insert insertable coaxially into said bore and provided with an annular groove extending concentrically and vertically to the longitudinal axis , so that by the engagement of the latch with the annular groove a releasable, axial fixation of the insert in the front end piece may be realised.

20. A device as claimed in claim 1 or 2, characterised in that the front end piece comprises a bore extending concentrically to the longitudinal axis , a peg protruding radially into the bore , and an insert coaxially insertable into the bore and provided with a groove said groove having a first section extending parallel to the longitudinal axis continued by a second section extending perpendicularly to the longitudinal axis said groove and said peg forming a bayonet locking so that a releasable, axial fixation of the insert in the front end piece may be realised.

21. A device as claimed in claim 18, characterised in that the bow has an inside and that the straining screw comprises a front end portion directed towards said inside and including means designed to bear against a bone.

22. A device as claimed in claim 19 or 20, characterised in that the bow has an inside and that the insert comprises a front end portion directed towards said inside and including means designed to bear against a bone.

23. A device as claimed in claim 21 or 22, characterised in that the means consist of a conical tip arranged concentrically to the longitudinal axis

24. A device as claimed in claim 21 or 22, characterised in that the means consist of a pyramidal tip arranged coaxially to the longitudinal axis

25. A device as claimed in claim 21 or 22, characterised in that the means consist of a ball arranged coaxially to the longitudinal axis and having a conical tip arranged concentrically to the longitudinal axis .

26. A device as claimed in claim 21 or 22, characterised in that the means comprise a top part with a conical tip and a ball-and-socket joint

the ball-and-socket joint connecting the top part with the front end portion

27. A device as claimed in claim 21 or 22, characterised in that the means consist of spikes in a crown-like arrangement extending coaxially to the longitudinal axis

28. A device as claimed in claim 21 or 22, characterised in that the means consist of a shoulder extending coaxially to the longitudinal axis and provided with spikes in a crown-like arrangement.

29. A device as claimed in any of the claims 18, 27 or 28, characterised in that the straining screw is perforated by a bore extending coaxially to the longitudinal axis.

30. A device as claimed in any of the claims 19 or 20, characterised in that the insert is perforated by a bore extending coaxially to the longitudinal axis

31. A device for repositioning bone fragments substantially as described herein and with reference to any one of the figures 1 to 14.

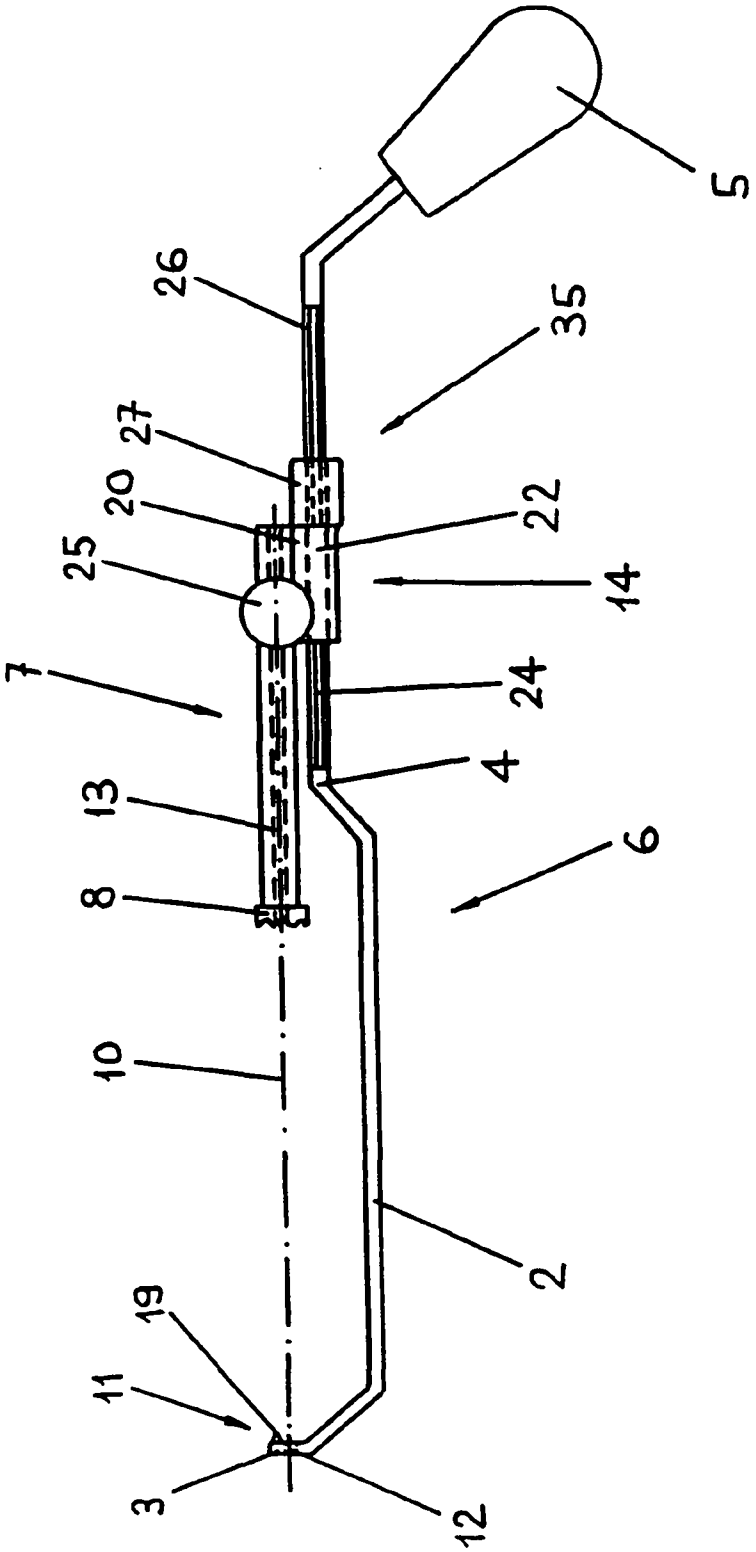

Fig. 1

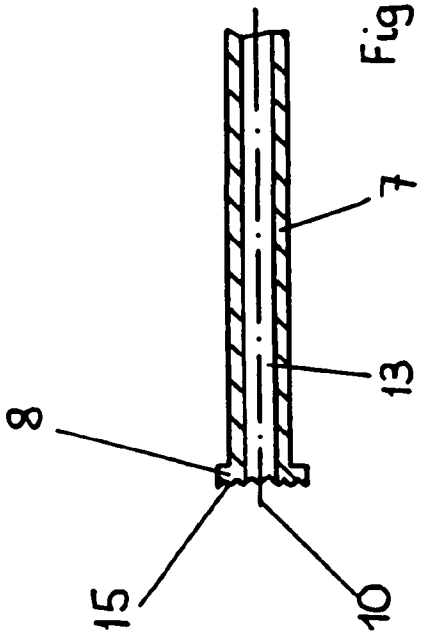

Fig. 3

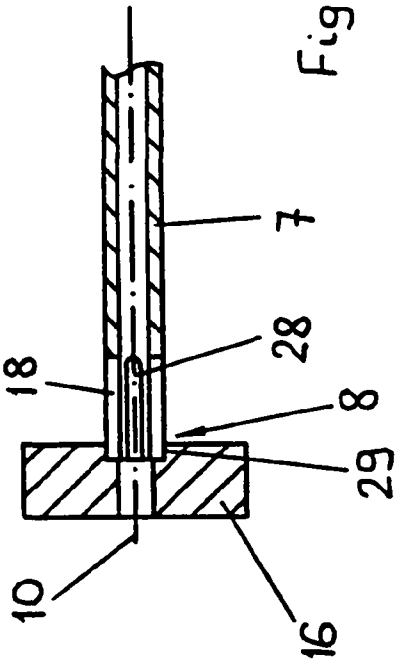

Fig. 4

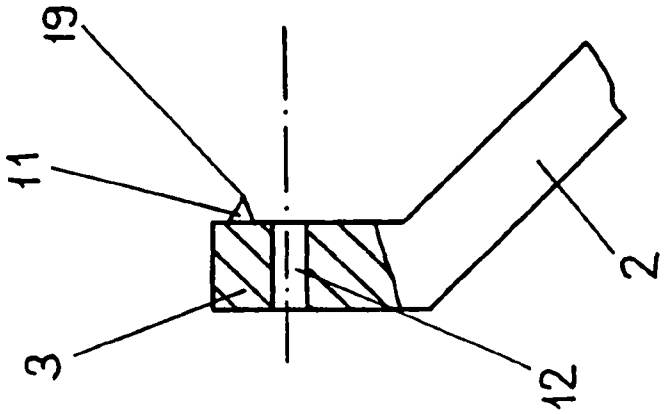

Fig. 2

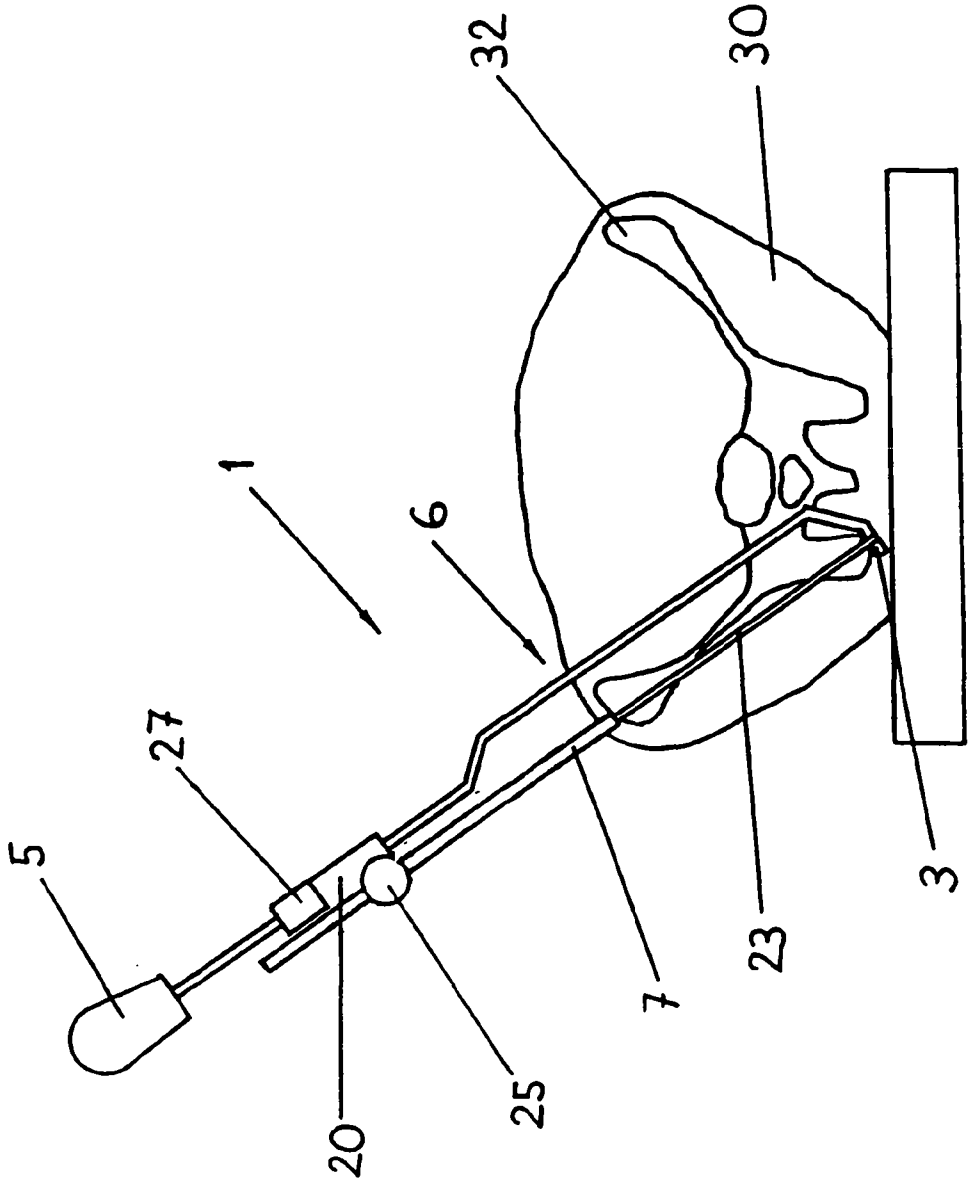

Fig. 5

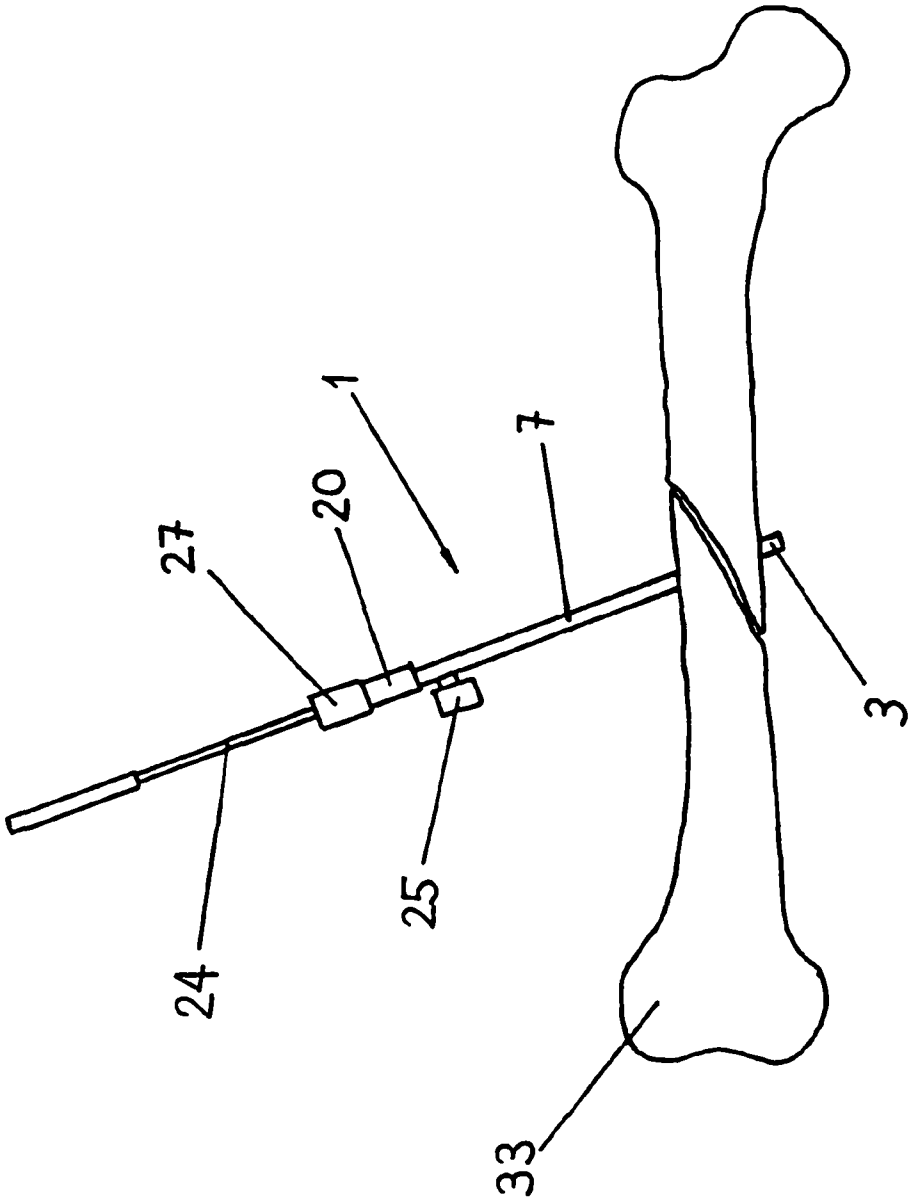

Fig.6

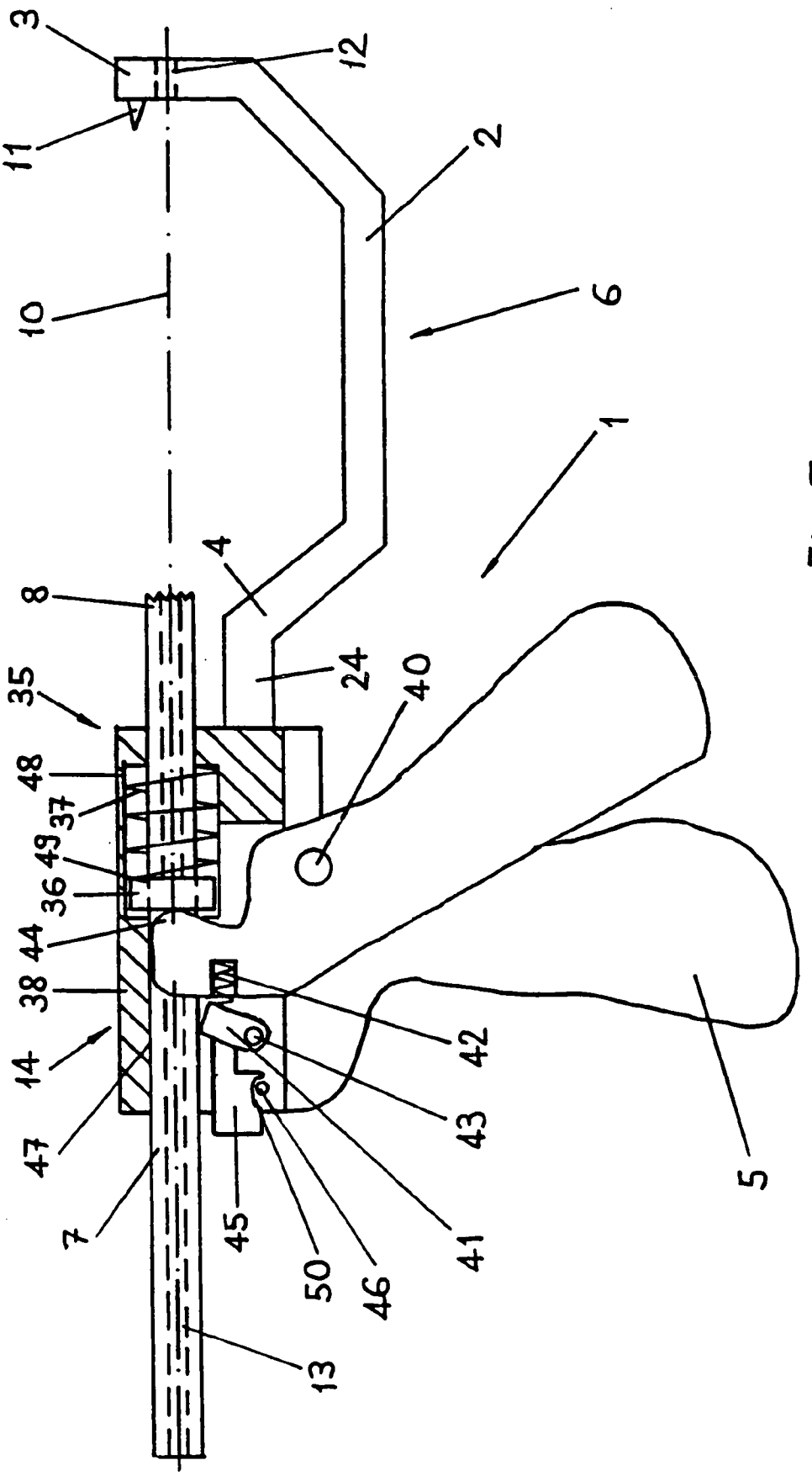
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Fig. 7

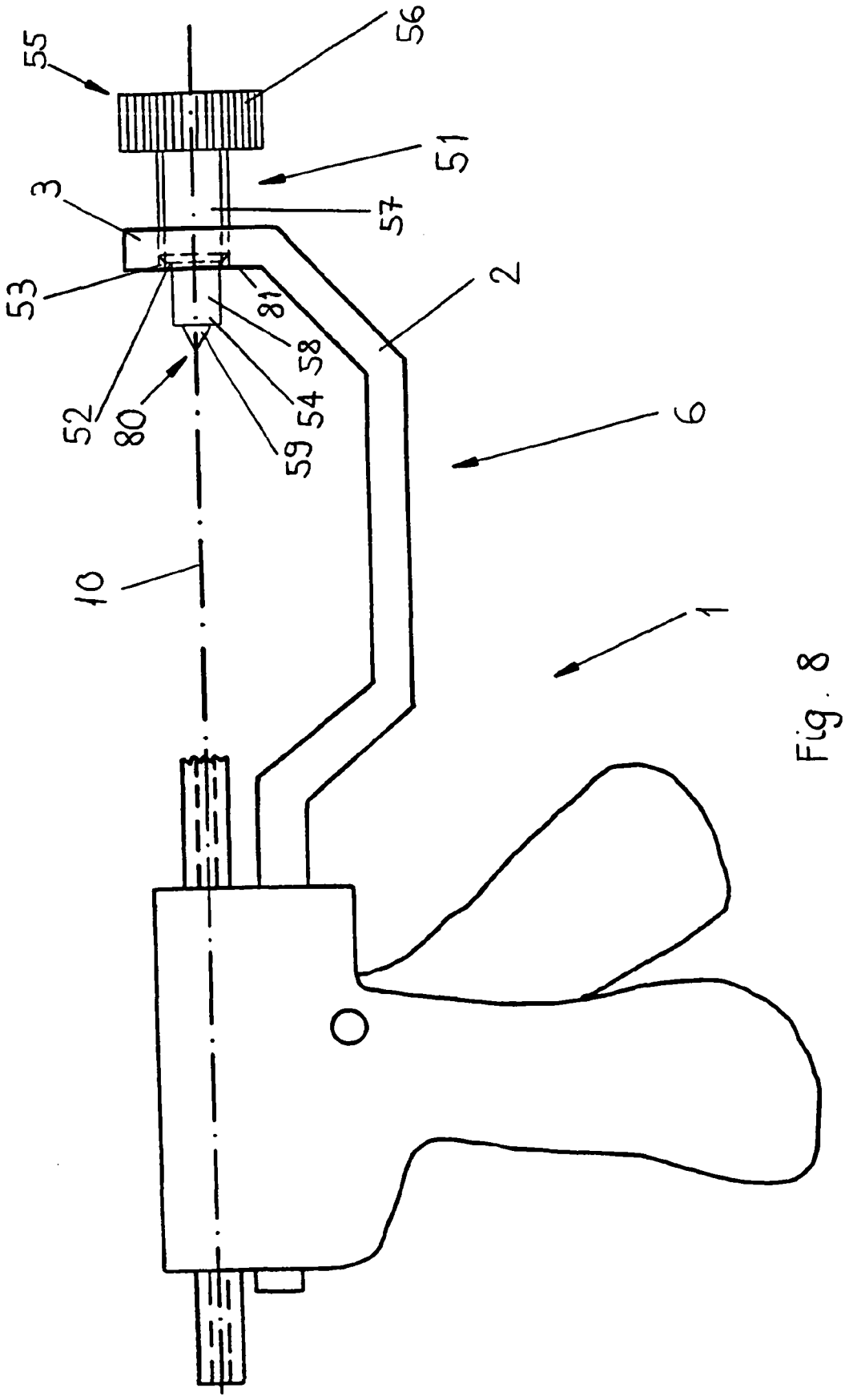

Fig. 8

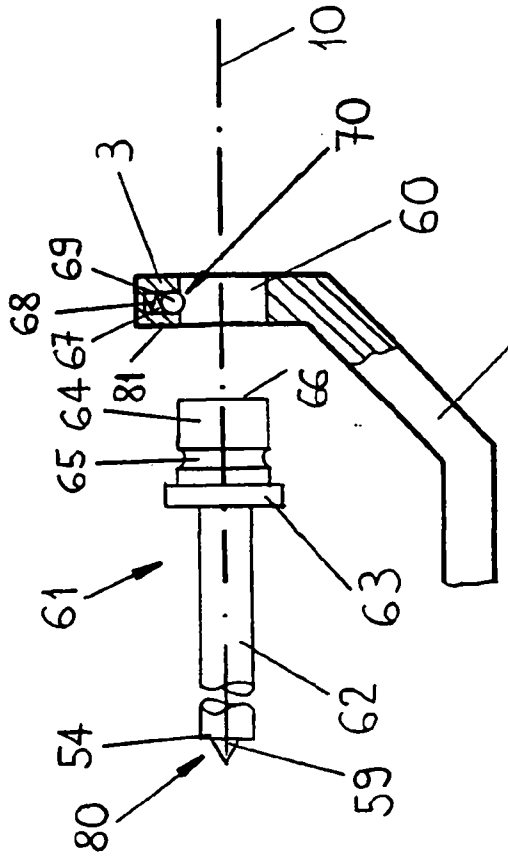
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Fig. 9

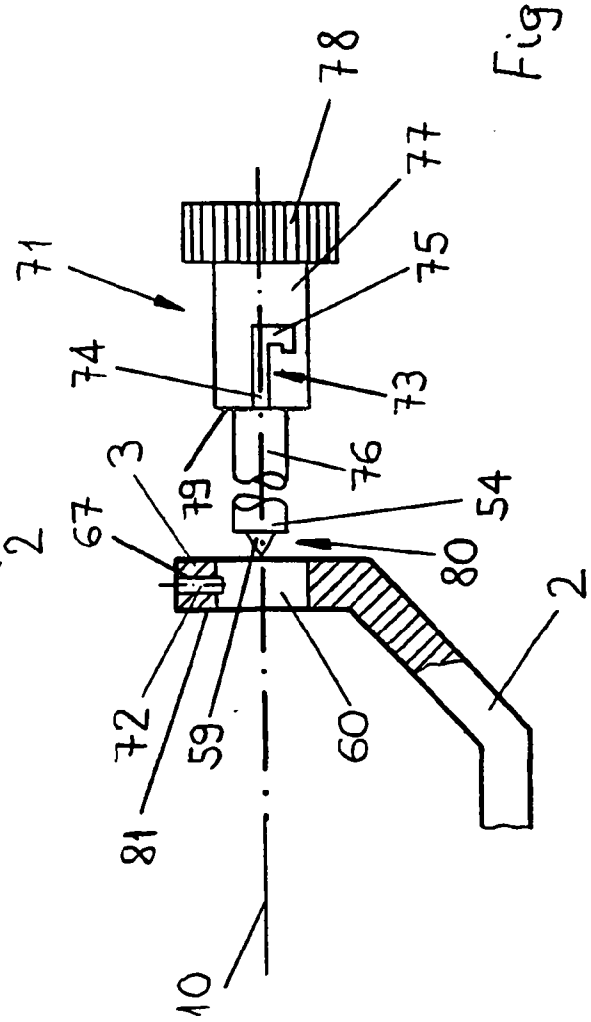
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Fig. 10

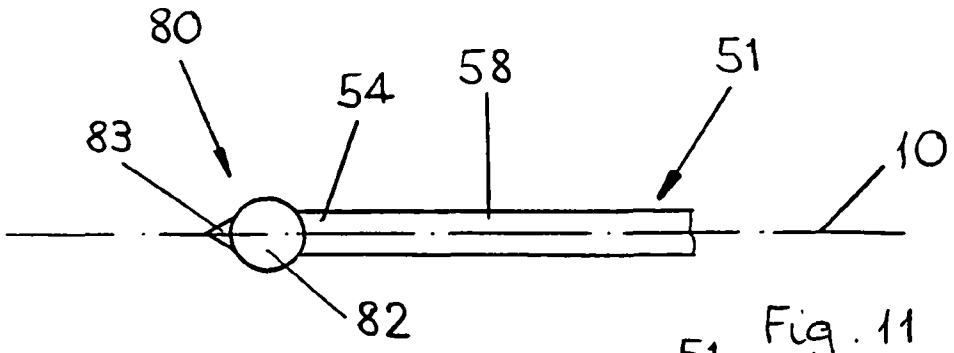

Fig. 11

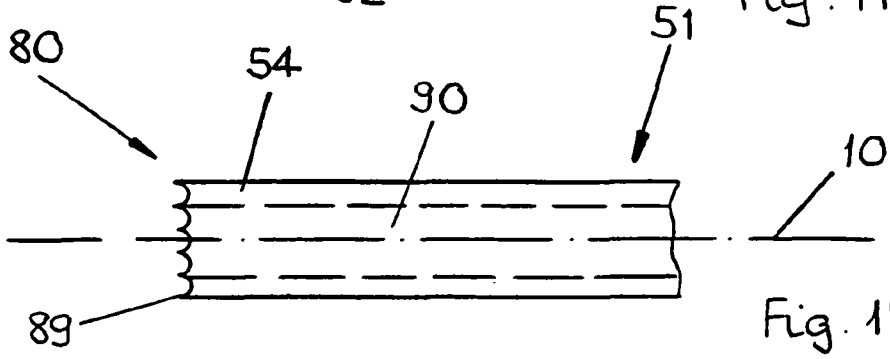

Fig. 12

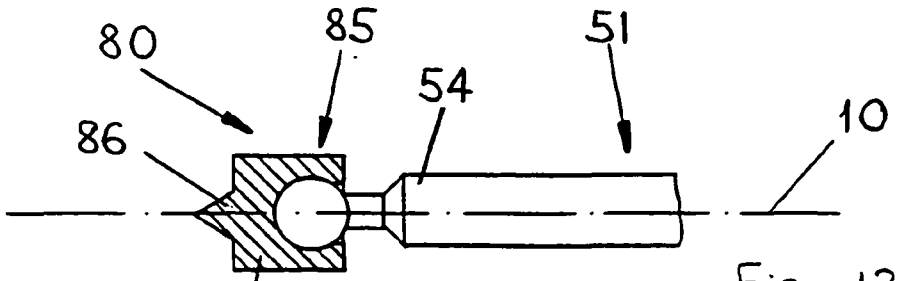

Fig. 13

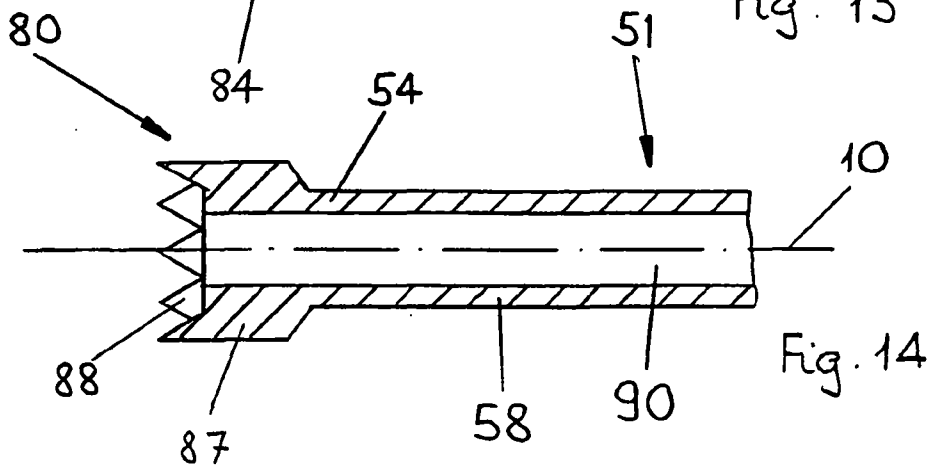

Fig. 14