(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 June 2012 (14.06.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/076695 A1

(51) International Patent Classification:
A61B 17/64 (2006.01) *A61B 17/66* (2006.01)

(21) International Application Number:
PCT/EP2011/072348

(22) International Filing Date:
9 December 2011 (09.12.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10194328.0 9 December 2010 (09.12.2010) EP

(71) Applicant *(for all designated States except US)*: **STRYKER TRAUMA SA** [CH/CH]; Bohnackerweg 1, CH-2545 Selzach (CH).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **VERMA, Umesh** [IN/IN]; C-404/2, 17A Street, Main Market, Bhajan Pura, Delhi 110 053 (IN). **MATHUR, Usha** [IN/IN]; 216 Village Kirari Suleman Nagar, Pst Office Sultan Puri, New Delhi 110 086 (IN). **DORAWA, Klaus** [DE/CH]; Gürweg 11, CH-2553 Safnern (CH).

(74) Agent: **LIEBETANZ, Michael**; Isler & Pedrazzini AG, Postfach 1772, CH-8027 Zurich (CH).

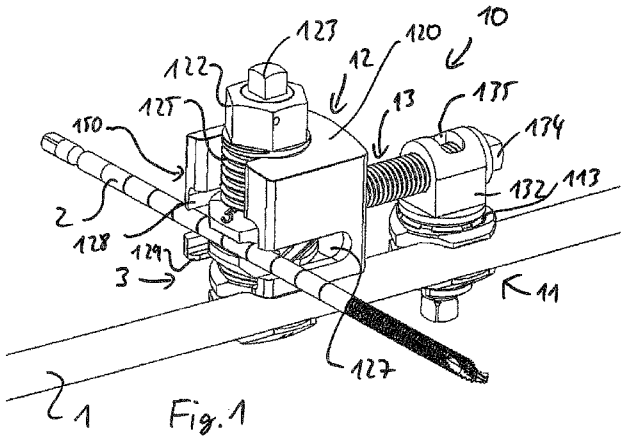
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: ADJUSTMENT TOOL FOR EXTERNAL FIXATOR



(57) **Abstract**: An adjustment tool (10) for an external fixator for exerting a compression or distraction on a broken bone fixed by bone pins (2) spanned over such a fracture comprises: a fitting element (12) for holding fast a clamping assembly (3) of the external fixator, a positioning clamp (11) for fixing the adjustment tool on a rod (1) of the external fixator near said clamping assembly (3), and a connecting element (13) attached to the fitting element (12) and the positioning clamp (11) adapted to move the fitting element (12) towards to or away from the positioning clamp (11). The fitting element (12) comprises a blocking sleeve (122) adapted to push the uppermost jaw of the clamping assembly (3) in the direction of the longitudinal axis of the clamping assembly (3) to block the second upper most jaw against an abutment portion (129) of the fitting element (12) and further comprises an actuation element (123) within the blocking sleeve (122) to actuate the locking element of the clamping assembly (3) for releasing the rod (1) of the external fixator within the clamping assembly (3) without releasing the bone pin (3).

WO 2012/076695 A1

TITLE

Adjustment tool for external fixator

TECHNICAL FIELD

The present invention relates to an adjustment tool for an external fixator adapted for securing a first bone portion in a position relative to a second bone portion, wherein the adjustment can comprise a compression or a distraction.

PRIOR ART

An external fixator in use with a patient is usually a device comprising at least two clamping assemblies for receiving at least one bone pin each, wherein, in a preferred embodiment, each clamping assembly comprises a second clamp for receiving a rod of an external fixator which extends over the fracture. If a compression or a distraction is to be applied, at least one clamping assembly has to loosened with the risk that the angular orientation of the corresponding bone pin engaging the bone from one side of the fracture looses it's orientation.

US 5,304,177 discloses an integrated adjustable fixator having two clamping assemblies within which each receives a bone pin to be entered into a bone of a patient of on each side of a fracture. Between the two clamping assembling holding the bone pins there is provided a main body having a worm in order to allow varying the distance between the two clamping assemblies. The device allows adjusting the distance between such two bone pins and therefore can be considered as a compression and/or distraction tool itself.

US 7,261,713 discloses another bone fixator which is adjustable, wherein two multipin clamping assemblies are attached to a longitudinal main body. Said main body allows different orientations of the clamping bodies and comprises a longitudinal translation

element which allows shifting the positions of the two multipin clamping assemblies.

The prior art allows an easier adaptation of the distance between the clamping assemblies providing bone pins on each side of a fracture in a bone of a patient but they fail to provide a rigid frame. The existence of pivoting joints between the clamping assemblies necessitates some forces to block the universal joints.

SUMMARY OF THE INVENTION

Based on this prior art it is an object of the present invention to provide a compression and distraction tool allowing a more secure and easy variation of the distance of such two bone pins of an external fixator.

It is a further object of the invention to provide a compression and distraction tool which can be used with a variety of clamping assemblies.

A further object of the invention is to provide a compression and distraction tool which is not part of the external fixator, i.e. which is only used when the length variation is to be adjusted but is not part of the external fixator which is, e.g. worn by a person having a broken limb.

The object of the invention is achieved with a tool having the features of claim 1.

The adjustment tool is to be used for an external fixator for exerting a compression or distraction on a broken bone fixed by bone pins spanned over such a fracture. Therefore the adjustment tool comprises

- a fitting element for holding fast a clamping assembly of the external fixator,
- a positioning clamp for fixing the adjustment tool on a rod of the external fixator near said clamping assembly, and
- a connecting element attached to the fitting element and the positioning clamp, adapted to move the fitting element towards to or away from the positioning clamp.

Thereby the fitting element comprises a blocking sleeve adapted to push the uppermost jaw of the clamping assembly of the external fixator in the direction of the longitudinal axis of the clamping assembly to block the second upper most jaw against an abutment portion of the fitting element and an actuation element within the blocking sleeve to actuate the locking element of the clamping assembly for releasing the rod of the external fixator within the clamping assembly without releasing the bone pin.

Further embodiments of the invention are laid down in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described in the following with reference to the drawings, which are for the purpose of illustrating the present preferred embodiments of the invention and not for the purpose of limiting the same. In the drawings,

Fig. 1 shows a perspective view of the device according to the invention in connection with one clamping assembly, one rod and one bone pin,

Fig. 2 shows a partial prosecution of Fig. 1 along the middle axis of the extension element,

Fig. 3 shows an exploded view of the compression tool according to Fig 1,

Fig 4 shows a section of the compression tool according to Fig. 3, and

Fig 5 shows a view from above on the compression tool according to Fig. 3.

DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 shows a partial explanatory view of the compression tool 10 used with an external fixator and shows some parts of such an external fixator. Throughout the following specification tool 10 is always mentioned as compression tool, since compression of a fracture is the most common adjustment of the distance between two bone pins over a fracture, but the tool is also usable an distraction tool, since the distance between such bone pins can also be enlarged. The tool is therefore in fact a combined compression and

distraction tool, an adjustment tool.

The external fixator for which the tool 10 is intended to be used with comprises a first clamping assembly, which is not shown in the drawings. Said first clamping assembly to attach a bone pin on one side of the fracture of a limb is then connected with rod 1 to span over the fracture. On the other side of the fracture a second clamping assembly 3 is attached to rod 1 and comprises a second bone pin 2 which is intended to be entered into the bone on the other side of the fracture in view of the above mentioned bone pin in connection with the first clamping assembly of the external fixator, which is not shown in the drawings. Clamping assembly 3 has several elements which are shown in the cross-section of Fig. 2. The second clamping assembly 3 is a clamping assembly according to co-pending US application 12/780.231 for applicant. It can also be a clamping assembly according to EP 0 700 664.

In any case it has two pairs of jaw, a lower pair of jaws 30 and 31 providing receptions 36 to accommodate rods 1 and pins 2. A further upper pair of jaws 32 and 33 also comprises reception 36 to accommodate rods 1 and pins 2. The pairs of jaws 30, 31, 32 and 33 are connected with a connection screw 34 which is actuated through head 35. Said screw 34 extends along the longitudinal axis of the second clamping assembly 3. Such a clamping assembly 3 is also known from EP 700 664 having a similar design. In this context it is only important that said clamping assembly has at least two pairs of jaws 30, 31, 32, 33 allowing accommodating a rod 1 and a bone pin 2 at the same time. They are embodiments on the market within which the middle jaws 31 and 32 can be replaced by one single jaw. It is preferred that there are different receptions 36 or inserts to adapt the receptions 36 at different levels in height in view of the rods 1 and pins 2 which should not be positioned at the same level.

The outer form of such a clamping assembly 3 is usually cylindrical or nearly cylindrical. However in a view from above it can also have a square or rectangular cross-section. As mentioned above first and second clamping assemblies are used to fix two or more bone pins 2 on two sides of a fracture, wherein a rod 1 is used to establish a rigid frame and a defined distance, position and orientation of the bone pins 2.

During the use of such an external fixator it is now contemplated that the two fractured bone parts have to be displaced one in the direction of the other (i.e. a compression movement) or they have to be displaced in the opposite direction (i.e. a distraction). According to prior art solutions a worm bridging the clamping assemblies has to be actuated to vary the distance.

In the present context having a rigid and fixed rod 1 giving a higher strength to the external fixator, such a compression or distraction would not be possible without loosening the actuator screw 34 through turning the head 35. However, this not only enables gliding of the lower jaws 30 and 31 along the rod 1 but also opens the clamping jaws 32 and 33 holding the bone pin 2.

According to the invention it is suggested to use compression tool 10 as follows:

As it can be seen in Fig. 1 to 5 compression tool 10 comprises a positioning clamp 11, adapted to be clamped on rod 1, a connection element 13, connecting the positioning clamp 11 with the fitting element 12 which is adapted to hold fast the clamping assembly 3.

The positioning clamp 11 comprises a lower jaw 110 and an upper jaw 111 providing receptions 114. In the embodiment shown in the figures there are three receptions 114 of different sizes. It is important that one reception 114 is adapted to accommodate rod 1. Through actuating the longitudinal screw 112 against the washer 116 jaws 110 and 111 are closed and clamp rod 1. Screw 112 extends beyond jaw 111 into the connection body 132 of the connecting element 13.

In a simple embodiment it would be possible to combine jaw 111 and connecting body 132 in one single element. However it is preferred to have two different elements to have a lower structured surface 113 on jaw 111 and a complementary structured surface on the complementary connecting body 132. This enables turning the jaws 110 and 111 around the longitudinal axis of screw 112, thus choosing the reception 114 of corresponding size to accommodate rod 1.

The connecting body 132 has a through bore having an inner thread 133 which is

orientated perpendicular to the axis of the above mentioned fixing screw 112 of positioning clamp 11. The connection body 132 also has an upper opening 135 in the vicinity of the longitudinal axis of screw 112.

The connecting element 13 comprises a worm 130 having an outer thread adapted to be rotated in the bore of the connecting body 132 comprising an inner thread 133. The worm 130 has a flange 137 and a turning knob 134 at one end. It is not necessary that the bore of the connecting body 132 separated into two parts on both sides of upper opening 135 has a complementary inner thread 133. In the embodiment shown in Fig. 2 it can be seen that the bore adjacent to flange 137 has no inner thread.

On the other side of the worm 130 it has a central bore 138 and a thread-free cylindrical sleeve 139 of smaller diameter intended to be introduced and to make the connection with the casing 120 of the fitting element 12. The casing 120 of the fitting element 12 has – in a view form above – the form of the letter C, wherein the closed portion of the fitting element is oriented towards the connecting body 132. The casing 120 has a bore to accommodate the complementary sleeve 139 of worm 130. The worm 130 is fixed within said bore with the counter screw 136 to allow rotation of worm 130. Counter screw 136 has a larger head than the bore within casing 120. It is thus clear that rotation of worm 130 changes the position of connection body 132 between the casing 120 and the flange 137 of worm 130. The fixed relationship between counter screw 136 and worm 130 can be especially achieved through gluing or it can be blocked by using a pin or welding etc. .

The fitting element 12 comprises beside casing 120 which is in a fixed rotational relationship with worm 130 a blocking sleeve 122 having an outer thread 125 being complementary to an inner thread 121 of casing 120 which is located near the top of the casing 120. Within blocking sleeve 122 there is provided an actuation screw 123 having a hollow cylinder 152 with a reception hole 124 at its lower end. Said hollow cylinder 152 is complementary for a positive fit to accommodate head 35 of the clamping assembly for which it is the adjustment tool.

Casing 120 further comprises a transverse slit 127 being at right angles to the longitudinal axis of blocking sleeve 122. The port of the transverse slit 127 is on the side of the open

end of the "C" in the lower portion of the connecting casing 120 below inner thread 121. Below the transverse slit 127 – on both sides of the open "C" - there is provided a lower shoulder 129 protruding into the lower reception opening 154 and providing a flange on the lower end of the casing 120. As mentioned above the C-form of the sleeve comprises a lower reception opening 154 opposite to the inner thread 121. On the other side of the lower shoulder 129 near the inner thread there is provided a further reception shoulder 128 protruding into the opening partially filled by the blocking sleeve 122 from above.

The function of the device is therefore as follows. Two bone pins from which only one bone pin 2 is shown in Fig. 1 or 2 are lodged in the bone of a patient on both sides of a fracture. The rod 1 spans the fracture and is connected to the bone pins 2 on said both sides through two clamping assemblies 3. In order to move one bone pin 3 in the direction of the longitudinal axis of the underlying rod 1, either compressing or distracting the fracture region, one of the clamping assemblies 3 is to be moved and there the use of the adjustment tool 10 is shown in Fig. 1 and 2. The two jaws 30 and 31 of the clamping assembly 3 of the external fixator clamp the rod and the two jaws 32 and 33 of the clamping assembly 3 hold the bone pin 2.

The adjustment tool 10 is presented with the open "C", i.e. from the lateral opening 150 towards the upper two jaws 32 and 33 of the clamping assembly 3. The fitting element 12 is pushed over the upper two jaws 32 and 33 so that these are located between the upper and lower shoulders 128, 129. The bone pin 2 is therewith lodged within the lateral slit 127, wherein the length of the slit permits different orientations of the bone pin 2 in the horizontal axis; it is not necessary that the bone pin 2 is perpendicular to rod 1 as shown in Fig. 1. The orientation of bone pin 1 depends on the position of the upper jaws 32, 33 (more particularly the reception 36 receiving the bone pin 2) in relationship to the position of the lower jaws 30, 31 (more particularly the reception 36 receiving the rod 1).

When the upper portion of the clamping assembly 3 is within the casing 120 of the fitting element 12, then the blocking sleeve 122 is rotated through action of the threads 121, 125 down onto the head 135 of the clamping assembly 3. This allows introducing the head 35 into the reception hole 124 of the blocking sleeve 122. When there is a positive fit through pushing the blocking sleeve 122 down on the upper jaw 33, where the underside 126 of the

blocking sleeve 122 contacts said upper jaw 33, then the fitting element 12 is fixed to the clamping assembly 3 of the external fixator.

Then, subsequently, the positioning clamp 11 is also attached to rod 1 through jaws 110, 111 by actuation of screw 112. Then positioning clamp 11 and fitting element 12 with the clamping assembly 3 are securely fixed to the rod 1. When said fitted clamping assembly 3 and positioning assembly 11 are now fixed on the rod 1, then the head of worm 134 is turned until a force would be exercised on positioning clamp 11 and fitting element 12 by worm 130 which can be detected by the user of the adjustment tool.

After this moment actuation head 123 is turned to loosening the clamping assembly 3. Since jaw 32 is pushed against the lower shoulder 129, said opening of screw 34 does not liberate the bone pin 2, which is still pinched through the pressure of the underside 126 on the upper jaw and the abutment action of the lower shoulder 129; but only opens the lower jaws 30 and 31 in order to release rod 1 allowing a movement of the clamping assembly 3 as a whole in the direction of the axis of rod 1.

This can be effected through turning the worm head 134 so that rotation of worm 130 in the connection body 132 pulls the fitting element 12 with the clamping assembly 3 being in a positive fit within the fitting element 12. This pulling action is acting in direction of the positioning clamp 11. Of course the head 134 can also be rotated in the opposite position thus pushing the fitting element 12 with the clamping assembly 3 away from the positioning clamp 11. The kind of motion, i.e. distraction or compression, depends on the side where the positioning clamp 11 is fixed on the rod, either between the two clamping assemblies 3 or on the opposite side.

The displacement of the one bone pin 2 in the direction of the longitudinal axis of the underlying rod 1 is equivalent to a movement of the worm 130 towards the head 134 of the worm 130.

The embodiment of the fitting element 12 shows the lateral opening 150 opposite to the positioning bore of the worm 130. In other embodiment it is possible to provide the opening in an 90 degree angle to the worm 130 thus allowing to open the "C" not in the

direction of the distraction or compression movement. However then the pin 3 has to be accommodated at a different level, e.g. lower than the worm 130.

In a different motorized embodiment not shown in the drawings, the fitting element 12 and the connecting element 13 can be combined in one single servo-motor assembly providing the same longitudinal displacement as in the embodiment of the drawings. Such a servo-motor assembly would have a fixed connection with the casing 120 and would provide or have a fix connection with the upper structured surface 115. In fact the servo-motor assembly replaces the worm in the embodiment shown in the drawings. In other words, the connecting element 13 comprises an extendable element connected to the fitting element 12 and being in a fixable connection with the positioning clamp 11 allowing thus a translatory movement between the fitting element 12 and the positioning clamp 11, acting as a. mechanical translation means.

It is preferred that the positioning clamp 11 is in a fixable connection with the connecting element 13 and not in a fixed connection. A fixable connection allows e.g. a rotation of the positioning clamp 11 and their receptions 114 around an axis.

Pins 151 allow maintaining the hollow cylinder 152 inside and the actuation head 123 outside the blocking head 122. It would also be possible to use a different blocking means allowing a longitudinal movement of the hollow cylinder to come into engagement with the screw head 35. In principle ut could also be allowed that the element 123/152 can be dissociated from the blocking sleeve 122.

It is clear for someone skillde in the art that the interior cross-section of the blocking sleeve 122 as well as the shoulders 129 as well as the reception 128 has to be adapted to the specific clamping assembly 3. However, it is also clear, that any clamping assembly intended to be used for a rod-to-rod or rod-to-pin coupling can be used in such a structure to to block the second upper most jaw of the clamp against an abutment portion of the fitting element, wherein the actuation element within the blocking sleeve is provided to actuate the locking element of the clamping assembly for releasing the rod of the external fixator within the clamping assembly without releasing the bone pin.

LIST OF REFERENCE SIGNS

1	rod
2	bone pin
3	clamping assembly
10	compression tool
11	positioning clamp
12	fitting element
13	connecting element
30	lower jaw
31	lower middle jaw
32	upper middle jaw
33	upper jaw
34	screw / blocking shaft
35	blocking element head
36	reception
110	lower jaw
111	upper jaw
112	screw / blocking shaft
113	lower structured surface
114	reception
115	upper structured surface
116	washer
120	casing
121	inner thread
122	blocking sleeve
123	actuation head
124	reception hole
125	outer thread
126	underside
127	transverse slit
128	reception
129	lower shoulder
130	worm
132	connection body
133	inner thread
134	head of worm
135	opening
136	counter screw
137	flange
138	central bore
139	sleeve
150	lateral opening
151	pin
152	hollow cylinder
153	lower opening
154	lower reception opening

CLAIMS

1. Adjustment tool (10) for an external fixator for exerting a compression or distraction on a broken bone fixed by bone pins (2) spanned over such a fracture, characterized in that the adjustment tool (10) comprises: a fitting element (12) for holding fast a clamping assembly (3) of the external fixator, a positioning clamp (11) for fixing the adjustment tool on a rod (1) of the external fixator near said clamping assembly (3), and a connecting element (13) attached to the fitting element (12) and the positioning clamp (11) adapted to move the fitting element (12) towards to or away from the positioning clamp (11), wherein the fitting element (12) comprises a blocking sleeve (122) adapted to push the uppermost jaw (33) of the clamping assembly (3) of the external fixator in the direction of the longitudinal axis of the clamping assembly (3) to block the second upper most jaw (32) against an abutment portion (129) of the fitting element (12) and an actuation element (123) within the blocking sleeve (122) to actuate the locking element (34, 35) of the clamping assembly for releasing the rod (1) of the external fixator within the clamping assembly (3) without releasing the bone pin (3).

2. Adjustment tool (10) according to claim 1, wherein the positioning clamp (11) comprises a pair of jaws (110, 111) providing at least one reception (114) to accommodate a rod (1) of an external fixator.

3. Adjustment tool (10) according to claim 2, wherein the positioning clamp (11) comprises a structured surface (113) and wherein the connecting element (13) comprises a complementary structured surface (115) allowing a rotation of the connecting element (13) against the positioning clamp (11) around an axis provided by the longitudinal axis of the positioning clamp (11).

4. Adjustment tool (10) according to one of claims 1 to 3, wherein the connecting element (13) comprises an extendable element (130) connected to the fitting element (12) and being in a fixable connection with the positioning clamp (11) allowing thus a translatory movement between the fitting element (12) and the positioning clamp (11).

5. Adjustment tool (10) according to one of claims 1 to 4, wherein the connecting element (13) comprises a worm (130) being rotatably fixed within the fitting element (12) and a connecting casing (132) to accommodate the worm (130), wherein the connecting casing (132) comprises an inner thread (133) complementary to the thread of the worm (130) allowing a translatory movement between the fitting element (12) and the positioning clamp (11) being in a fixable connection with the connecting element (13).

6. Adjustment tool (10) according to one of claims 1 to 4, wherein the connecting element (13) comprises a servo motor fixedly connected to the fitting element (12) and being in a fixable connection with the positioning clamp (11) allowing a translatory movement between the fitting element (12) and the positioning clamp (11).

7. Adjustment tool (10) according to one of claims 1 to 6, wherein the fitting element (12) comprises a lateral opening (150) to receive the upper jaws (32, 33) holding a bone pin (2) of an external fixator between the blocking sleeve (122) and the abutment portion (129), the lateral opening being parallel to said longitudinal axis of the clamping assembly (3) of the external fixator to be introduced into the lateral opening (150).

8. Adjustment tool (10) according to claim 7, wherein the fitting element (12) comprises a transverse opening (127) to accommodate said bone pin (2) of an external fixator, the transverse opening (127) being transverse to said longitudinal axis of the clamping assembly (3) of the external fixator to be introduced into the lateral opening (150).

9. Adjustment tool (10) according to claim 7 or 8, wherein the blocking sleeve (122) comprises an outer thread (125), being complementary to an inner thread within the casing (120) of the fitting element (12) to move the blocking sleeve (122) in the direction of said longitudinal axis, and a blocking underside (126) complementary to the upper surface of the upper jaw (33) of the clamping

assembly (3), wherein the abutment portion (129) of the fitting element (12) is a protruding flange into the lower reception opening (154).

10. Adjustment tool (10) according to claim 7, 8 or 9, wherein the actuation element (123) of the blocking sleeve (122) is an inner rotatable shaft (123) having a reception (124) for receiving the actuation head (35) of the locking element (34) of the clamping assembly (3) for releasing the rod (1) of the external fixator.

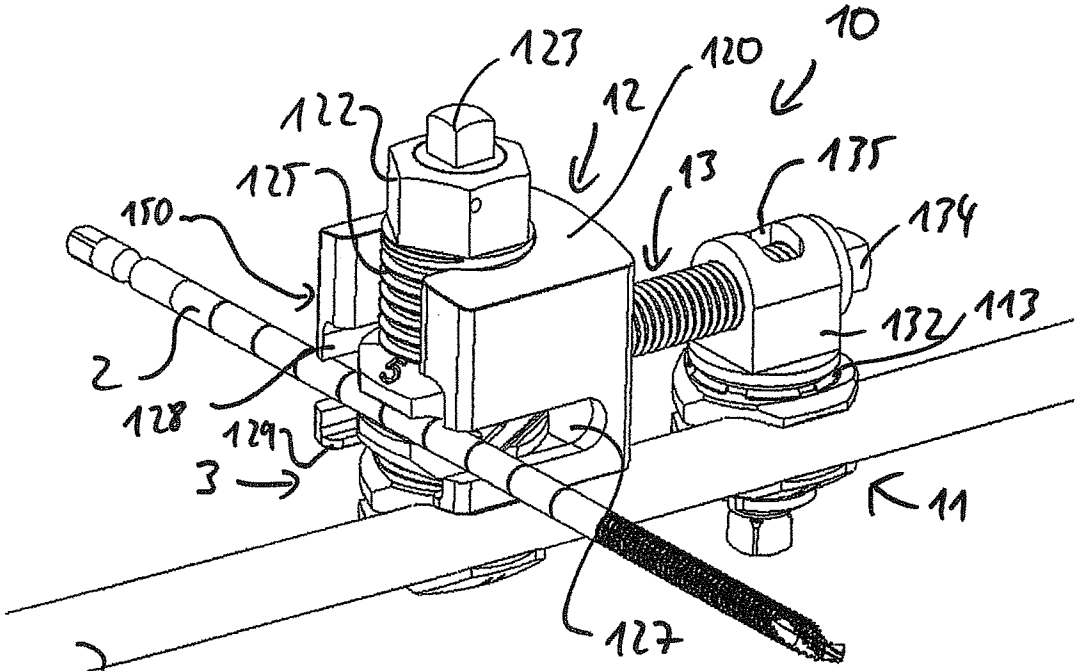

123
120
10
12
122
125
13
135
150
134
132
113
2
128
129
3
11
127
1

Fig. 1

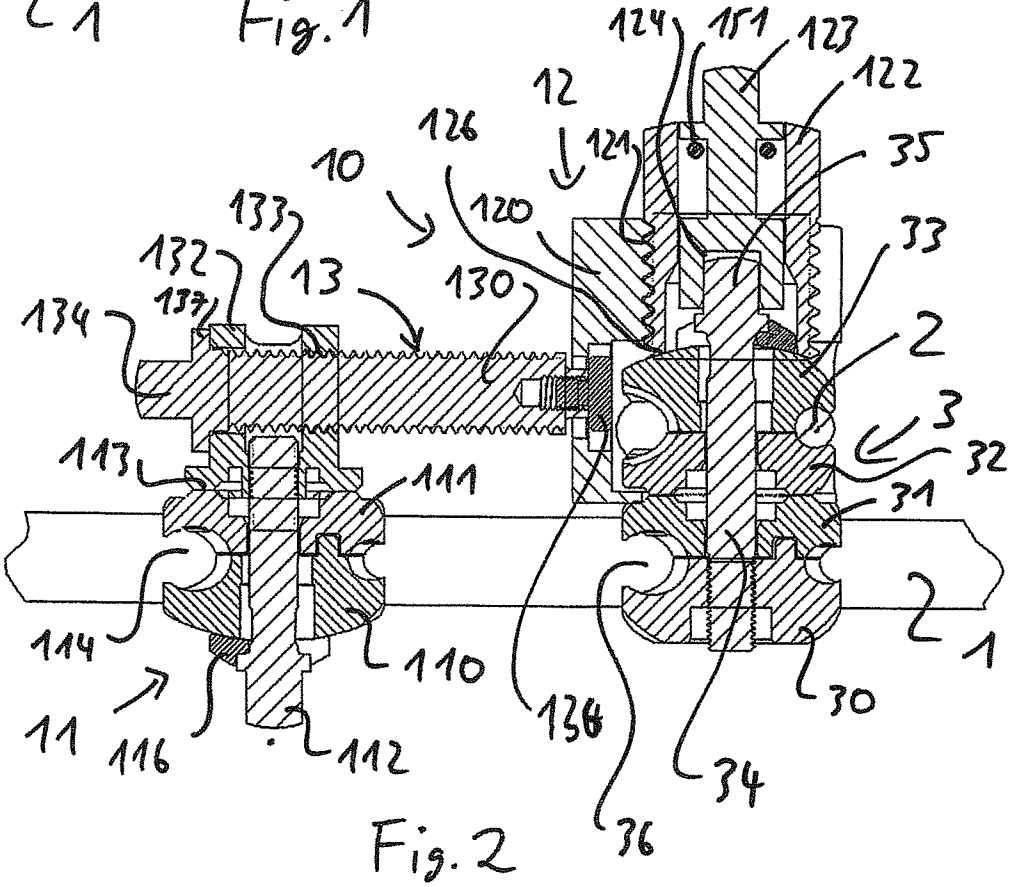

124
151
123
122
12
126
121
35
10
120
133
132
13
130
33
137
134
2
3
113
111
32
31
114
110
1
11
116
112
138
30
34
36

Fig. 2

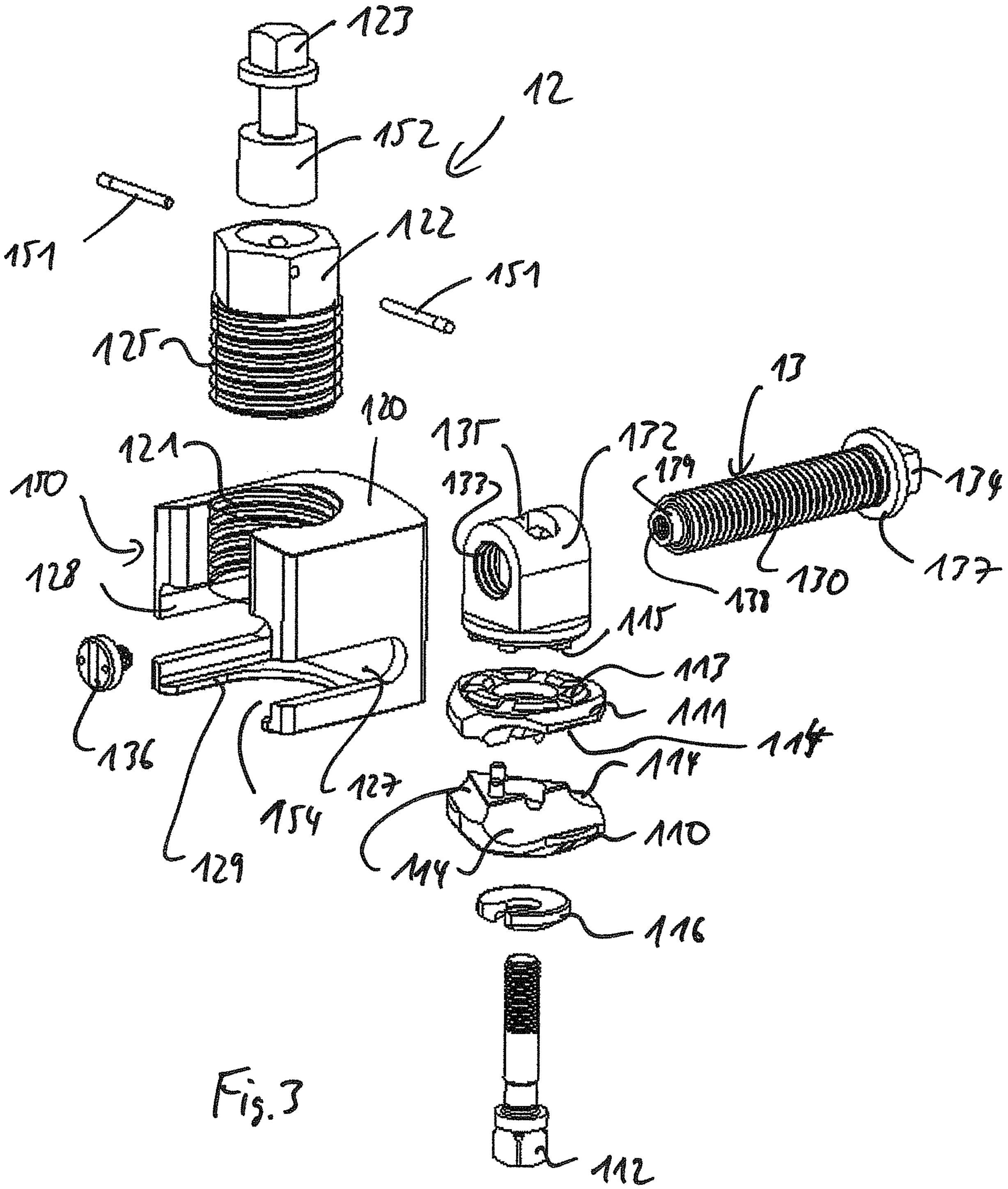
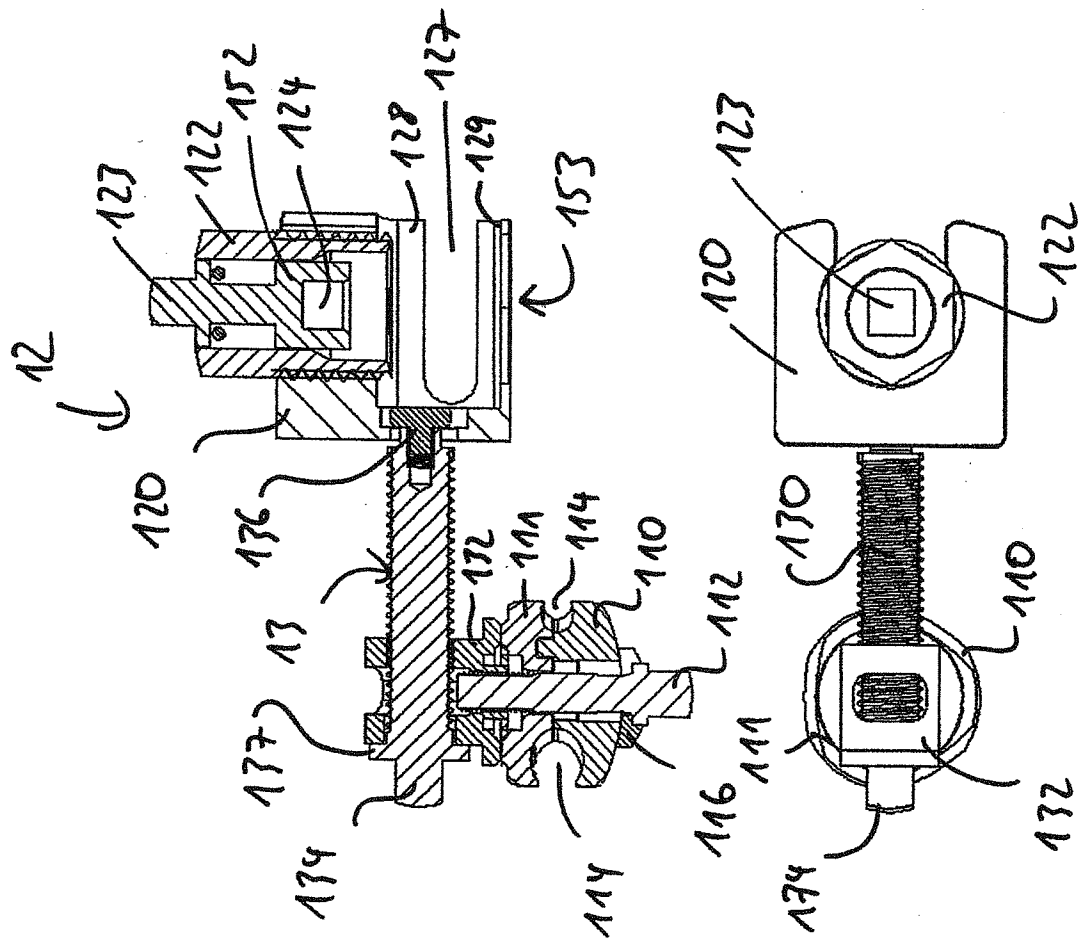

123
12
152
151
122
151
125
120
13
121
135
132
110
133
179
134
128
138
130
137
115
113
136
111
114
114
127
154
110
114
129
116
112

Fig.3


12
120
123
122
152
124
128
127
129
153
176
13
172
111
114
110
112
177
174
116
114
Fig.4
120
123
122
130
110
111
116
174
132
Fig.5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/072348

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/64 A61B17/66
ADD.

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

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/123858 A1 (STRUB BEAT [CH] ET AL) 31 May 2007 (2007-05-31) figures 1,2 paragraphs [0026], [0027] -----	1
A	US 5 810 814 A (NEWSON CHARLES JAMES [GB]) 22 September 1998 (1998-09-22) figure 18 column 5, lines 30-42 column 5, line 61 - column 6, line 2 column 6, lines 14-24 -----	1
A	US 3 961 854 A (JAQUET HENRI) 8 June 1976 (1976-06-08) figure 18 column 3, line 47 - column 4, line 12 ----- -/--	1

[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 document 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
23 January 2012	06/02/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fourcade, Olivier

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/072348

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 698 534 A1 (HARDY JEAN MARIE [FR]) 3 June 1994 (1994-06-03) figures 43,44 -----	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2011/072348

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007123858 A1	31-05-2007	AU 2004317510 A1	06-10-2005
		BR PI0418625 A	29-05-2007
		CA 2559497 A1	06-10-2005
		CN 1925802 A	07-03-2007
		EP 1725176 A1	29-11-2006
		JP 4601664 B2	22-12-2010
		JP 2007528250 A	11-10-2007
		US 2007123858 A1	31-05-2007
		WO 2005092220 A1	06-10-2005
US 5810814 A	22-09-1998	NONE	
US 3961854 A	08-06-1976	AT 348653 B	26-02-1979
		AT 352857 B	10-10-1979
		CH 579438 A5	15-09-1976
		FR 2322579 A1	01-04-1977
		GB 1480167 A	20-07-1977
		JP 1270565 C	25-06-1985
		JP 52024657 A	24-02-1977
		JP 59047162 B	17-11-1984
		NL 7509299 A	08-02-1977
		US 3961854 A	08-06-1976
FR 2698534 A1	03-06-1994	EP 0630214 A1	28-12-1994
		FR 2698534 A1	03-06-1994
		WO 9412113 A1	09-06-1994