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(71) Applicant and

(72) Inventor: GLASTRA, Hendrik [NL/NL]; 65,
Derkinkweg, NL-7535 PG Enschede (NL).

(74) Agent: TIMMERS, C., H., J.; Exter Polak & Charlouis
B.V., P.O. Box 3241, NL-2280 GE Rijswijk (NL).

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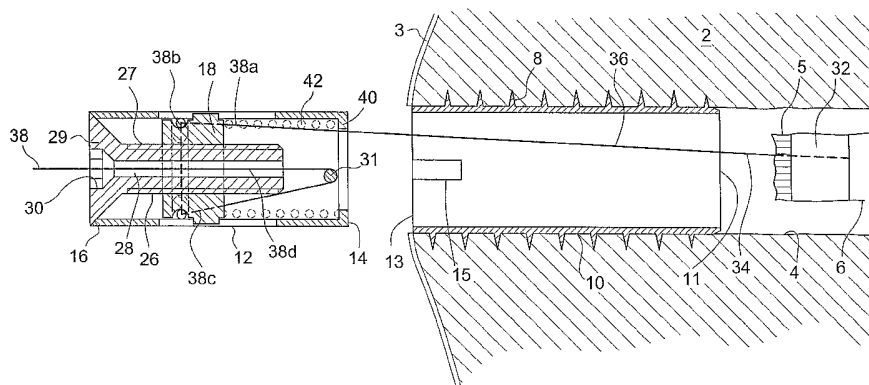
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(54) Title: ORTHOPAEDIC SECURING ASSEMBLY



(57) Abstract: The invention provides an assembly of very small dimensions for effecting a connection between a (natural or synthetic) ligament or tendon, on the one hand, and a bone part, on the other hand, comprising a housing whose first end is directed to the ligament and which is to be fixed in the bone part, containing a controllably displaceable carrier which can be coupled to the ligament and interacts with an actuator which can be reached from the second housing end, and having a flexible stretch-free element, the first end of which can be fastened to the free ligament end and the second end of which can be inserted into the second housing end, can be guided around the displaceable carrier in a U-shaped loop and finally fixed to the housing.



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Short title: Orthopaedic securing assembly.

5 The invention relates to an assembly for connecting a (natural or synthetic) ligament or tendon to a bone part, comprising a housing which is to be fixed in the bone part with a first end directed to the ligament and comprising a controllably displaceable carrier which can be coupled to the ligament and co-operates with an
10 actuator.

Devices and assemblies for fixing a natural or synthetic ligament or tendon to a bone part with all the related problems thereof have been described in detail in the prior art. Thus, the German Laid-Open Specification 37 10 587 describes an elongated
15 fixing element which can be placed in a bore formed in the bone and of a length at least equal thereto, having a non-rotatably guided carrier which can be displaced in the longitudinal direction by means of a screw element, in such a manner that the axial position thereof, and thus also the tension generated in the ligament or
20 tendon, can be adjusted as desired. The International Patent Application WO97/36557 describes a similar fixing element having elongated, interacting parts provided with internal and external screw thread, the inner part, which is connected to the ligament, being displaceable in the longitudinal direction by rotation about
25 the longitudinal axis thereof. Furthermore, reference may be made to French patent application 2 663 837 and German Utility Model G8701123.

It is obvious that such an assembly, which after all is a "foreign body" in the bone, has to have minimal dimensions so that
30 the surgical procedure required to put it into place exerts only as little pressure on the bone as possible, while, despite these small dimensions, the range of adjustment, in other words the distance over which the end of the ligament or tendon connected to the assembly can be displaced, has to be as large as possible. It is
35 desirable that only a force acting in the longitudinal direction is exerted on this ligament or tendon end and that no reaction torque is exerted.

This object is achieved according to the invention in that the assembly comprises a flexible stretch-free element, the first end of

which can be fastened to the free ligament end and the second end of which can be inserted into the second housing end, and to be guided around the carrier in a U-shaped loop and ultimately to be fixed to the housing.

5 The flexible stretch-free element, the first end of which is to be fastened to the free ligament end, can easily be manoeuvred in a small space and be guided and fixed in the above-described manner, while the fact that it is guided around the carrier to be displaced by the actuator in a U-shaped loop leads to a displacement of this
10 carrier over a specific distance a resulting in the end of the stretch-free element, fastened to the ligament or tendon, being displaced over double this distance, 2a. In this manner, a maximum adjustment range is achieved at minimal dimensions. The entire unit can be made using simple and inexpensive elements.

15 An advantageous embodiment is characterized by a second return guide for the stretch-free element and arranged near the second housing end, the free end of which can be fixed on or near the second housing end after having been looped around this guiding element. Here, the manoeuvring and fixing of the stretch-free
20 element are greatly facilitated.

 A particularly advantageous embodiment is characterized in that the housing has a cylindrical bore in which the carrier is guided non-rotatably and displaceably in the longitudinal direction, the carrier has an axial bore and a recess for guiding the stretch-free
25 element around the carrier and the second return guide is arranged between the carrier and the second housing end, in such a way that once the second end of the stretch-free element has been inserted into the first housing end, this end can be guided around the carrier, can subsequently be guided around the second return guide
30 and can be fixed on or near the second housing end.

 Preferably, the actuator is formed by a screw element guided in an axial bore in the carrier and provided with screw thread, the top end of which screw element resting on the first housing end.

35 Preferably, the screw element in this case has a central bore for guiding the stretch-free element which can be fixed at the top end of said bore.

 The actuator may also be formed by a compression spring arranged between the second housing end and the carrier, so that a specific, substantially constant bias is exerted on the ligament or

tendon.

In one advantageous embodiment, the housing itself is not fixed in the bone, but is accommodated in an outer housing to be fixed in the bone part, which outer housing is preferably provided with external screw thread.

The invention is explained with reference to the drawing, in which an advantageous embodiment of the invention is illustrated. In this drawing:

Fig. 1 shows a partial cross section of a bone part incorporating a partly exploded view of the outer housing of the assembly according to the invention;

Fig. 2A shows an end view of the carrier used herein;

Fig. 2B shows a side view of this carrier;

Fig. 3 shows a partial section of the entire assembly according to Fig. 3.

Figs. 1 and 3 show a bone part 2, for example a part of the upper leg, in which the acting surgeon has drilled a duct 4 in order to be able to fasten the end 5 of the ligament 6 to this bone part 2 by means of the assembly proposed by the invention. The skin covering the bone 2 is denoted by reference numeral 3. The ligament 6 in this case may be a torn or severed natural ligament, but may also be a synthetic ligament, while the device according to the invention may also be used for re-attaching a torn tendon to a bone part. Reference is made to the aforementioned prior art, the contents of which are deemed to be incorporated herein by reference.

The embodiment of the assembly shown in the figures comprises a cylindrical outer housing or sleeve 10 provided with (optionally) self-tapping orthopaedic external screw thread 8 on the right hand end 11 and has a cut 14 on the left hand end 13 on which a tool used for screwing it in can engage. This outer housing 10 accommodates a cylindrical housing 12 having a first end 14 and a second end 16 fitting accurately and non-rotatable therein (for example by the co-operation of a projection and recess (both not shown). The cylindrical carrier 18 is accommodated in this housing 12 such that it is displaceable in the longitudinal direction, and is shown in front view in Fig. 2A and shown in side view in Fig. 2B. As Fig. 2A shows, this carrier 18 is partly flattened along its length, as indicated by reference numeral 20, and provided with two guide studs 22a, 22b, which fit into suitable elongated recesses (not shown) in

the wall of the housing 12, so that the carrier 20 can indeed move in the longitudinal direction but cannot rotate. This carrier has a first cylindrical part 19 and a second, shorter cylindrical part 21 with the groove 23 in between. In addition, the carrier has a central bore 24 provided with internal screw thread 25.

This internal screw thread corresponds to external screw thread 26 of a screw element 27 to be screwed therein, having a central bore 28, the bevelled head 29 of which resting on the second housing end 16. This head 29 has a hexagonal opening 30 into which a suitable tool 50 can engage (see Fig. 3).

A diametrical return guide pin 31 is arranged between the carrier 18 and the first housing end 14.

The end 6 of the ligament or tendon to be fixed is fastened to the first end 34 of an elongated, flexible stretch-free element 36, hereinafter to be referred to as "tensioning element", via a suitable securing element 32; the free, second end 38 of this tensioning element 36 is inserted into the first end 14 of the housing 12, is subsequently guided over the flattened section 20 of the carrier 18 by the part 38a, follows the groove 23 with part 38b, is subsequently guided again over the flattened section 20 of the carrier 18 through part 38c, then goes around the return guide pin 31 and subsequently exits with its part 38d through the central bore 27 in the screw element 26 to the outside.

Fig. 3 shows how, while the housing 12 is in the outer housing 10, a knot 39 is tied in this end 38 after the tensioning element has been tightened, which knot is larger than the diameter of the bore, so that the tensioning element remains tensioned. Thereafter, and using a suitable tool 50 which fits into the hexagonal opening 30, the tension in the ligament 6 can be adjusted to the desired value by displacing the carrier 18 by means of the screw element 26.

In the figures, a coil spring 42 is shown with dashed lines in the housing 12 as present between an annular stop 40 and the carrier 18.

Obviously, this is only active when the carrier 18 is no longer coupled to the screw element 27. To this end, the screw element 27 may be provided with screw thread over only a part of its length, for example on the left-hand part in the figure, so that only the spring provides bias when the carrier is over the remaining part which is not threaded. If the threaded parts 25, 26 are completely

omitted, no re-adjustment is possible. Obviously, the spring 42 is not essential.

Manoeuvring the device proposed by the invention is very simple. A guide wire which follows the above-described path has
5 already been looped around the components in the housing 12. One end of this guide wire is attached by the surgeon to the tensioning element 36 which has been attached to the ligament or tendon 6 and subsequently, the end which exits on the other, left-hand side is pulled. The housing 12 is in this case at such a distance from the
10 bone 2, that manoeuvring thereof is no problem at all. By tensioning the guide wire and the tensioning element 36 connected thereto, the housing 12 will eventually slide into the outer housing 10 screwed into the bone, the tensioning element 36 exiting on the left-hand housing end. When the housing 12 completely bears against the outer
15 housing 10, the tensioning element 36 is tensioned until the desired tension is achieved in the ligament 6 and the knot 39 is tied as closely as possible to the exit point, thereby completing the fitting procedure. Retensioning can be effected in a very simple manner. If this retensioning is carried out after a relatively long
20 time period, only a small incision of the size of the outer diameter d of the tool 50 has to be made in the skin 3.

The dimensions of the assembly can be minimal: in a practical embodiment, the length of the outer housing was 90:18 mm and the outer diameter was 9.5 mm. The operating tool 50 has a diameter $d =$
25 3 mm, so that the incision required for retensioning is minimal.

Obviously, modifications are possible within the scope of the invention, in particular with regards to the shape of the carrier 18 and the manner in which the tensioning element 36 is guided around it. Also, the screw element may be placed eccentrically and the
30 second end of the tensioning element 38 may be fastened to the housing in a manner different to that as described. It is possible, for example, for a small rod to be provided across the hexagonal opening 30 to which the tensioning element 38 - for example consisting of two wires - is tied. Likewise, it is possible to use a
35 slot for co-operation with a screwdriver, rather than a hexagonal opening.

C L A I M S

1. Assembly for connecting a (natural or synthetic) ligament or tendon to a bone part, comprising a housing which is to be fixed in
5 the bone part with a first end directed to the ligament and, comprising a controllably displaceable carrier which can be coupled to the ligament and co-operates with an actuator, characterized by a flexible stretch-free element, the first end of which is to be fastened to the free ligament end and the second end of which is to
10 be inserted into the second housing end, to be guided around the carrier in a U-shaped loop and ultimately to be fixed to the housing.

2. Assembly according to claim 1, characterized by a second,
15 return guide, arranged near the first housing end, around which is looped the stretch-free element, of which the free end can be fixed at or near the second housing end after having been looped around this return guide.

3. Assembly according to claim 2, characterized in that the
20 housing has a cylindrical bore in which the carrier is guided non-rotatably and displaceably in the longitudinal direction, the carrier has an axial bore and a recess for guiding the stretch-free element around the carrier and the second, return guide is arranged
25 between the carrier and the second housing end, all this in such a way that, when the second end of the stretch-free element has been inserted into the first housing end, this end can be guided around the carrier, can subsequently be guided around the second return guide and can be fixed at or near the second housing end.

30

4. Assembly according to claim 3, characterized in that the actuator is formed by a screw element guided in an axial bore in the carrier and provided with screw thread, the top end of which screw element rests on the first housing end.

35

5. Assembly according to claim 4, characterized in that the screw element has a central bore for guiding the stretch-free element which can be fixed at the top end of said bore.

6. Assembly according to claim 1-3, characterized in that the actuator is formed by a compression spring arranged between the second housing end and the carrier.

5 7. Assembly according to claim 1-6, characterized in that the housing is accommodated in an outer housing to be fixed in the bone part.

8. Assembly according to claim 7, characterized in that the outer
10 housing is provided with external screw thread.

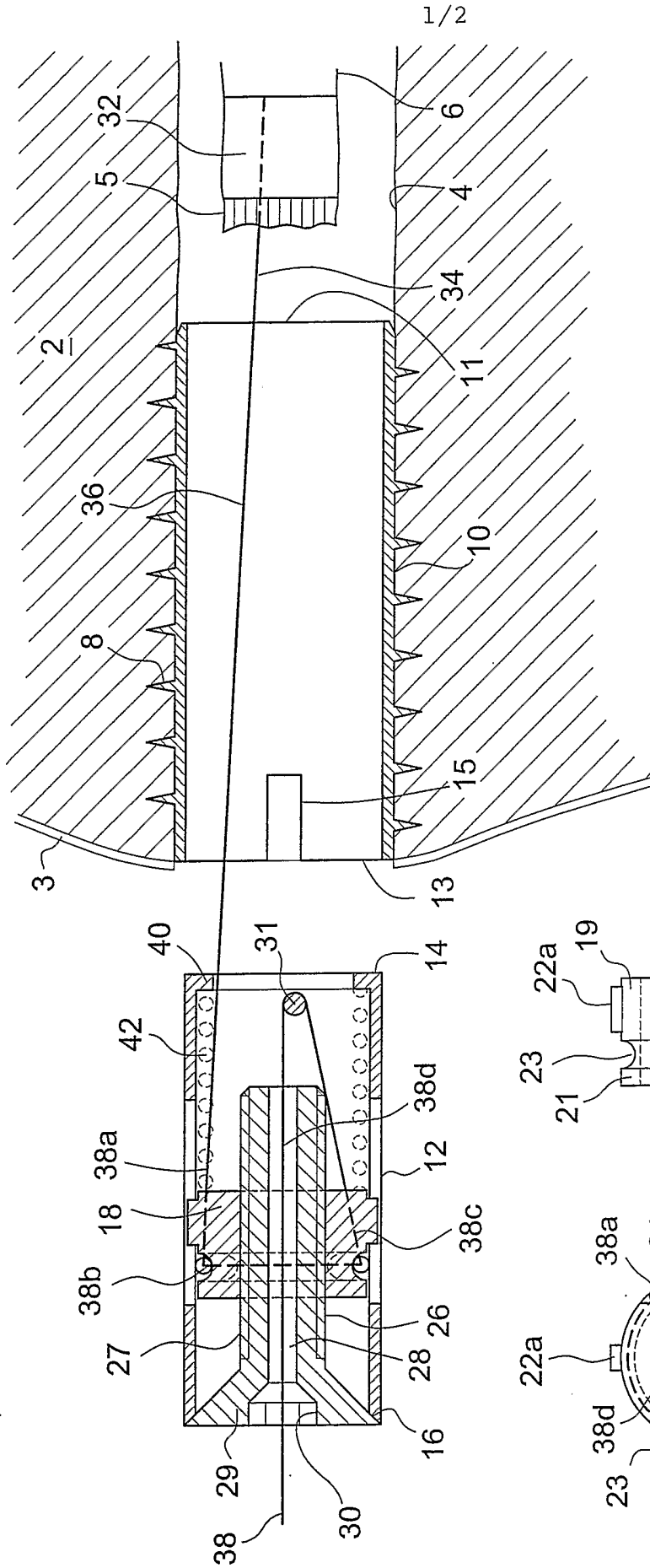


FIG.1

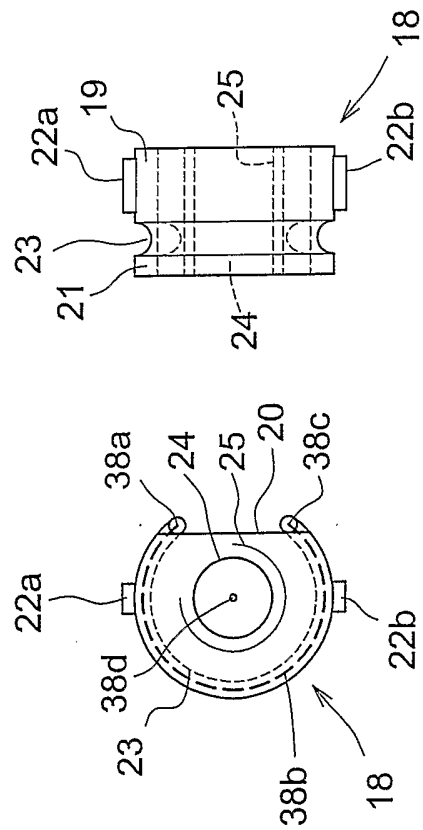


FIG.2B

FIG.2A

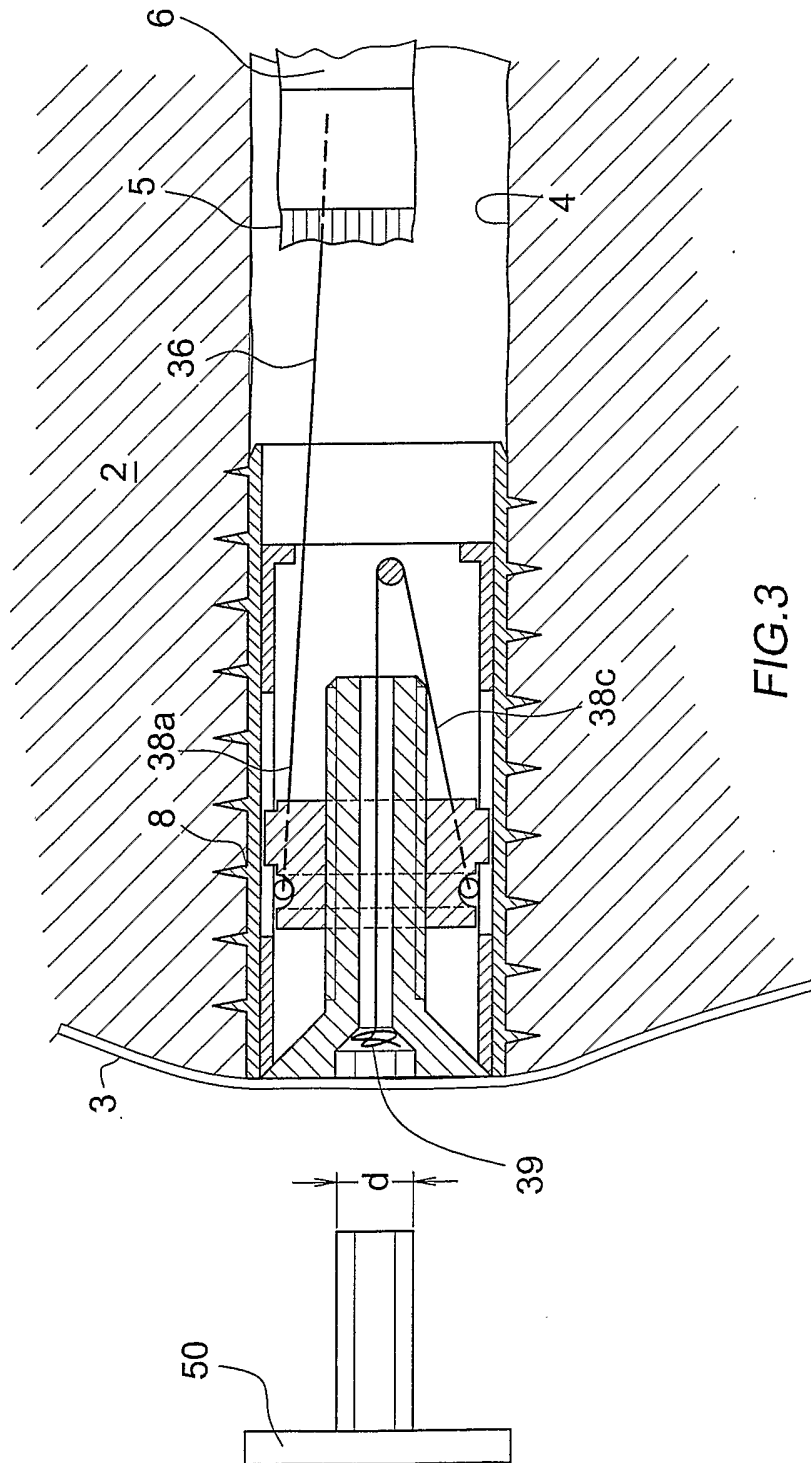


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F2/08

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)
IPC 7 A61F

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)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	US 2002/188298 A1 (CHAN KWAN-HO) 12 December 2002 (2002-12-12) paragraph '0043! - paragraph '0069!	1
A	US 2002/173788 A1 (BOJARSKI RAYMOND A ET AL) 21 November 2002 (2002-11-21) paragraph '0036! - paragraph '0062!	1

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Patent family members are listed in annex.

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NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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Information on patent family members

International Application No

PCT/NL2005/000522

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