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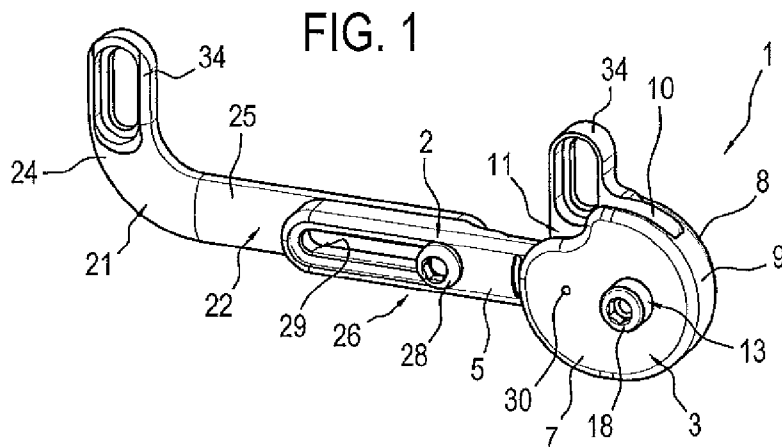
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(54) Title: ARTICULATED JOINT FOR ORTHOPAEDIC DEVICES



(57) Abstract: An articulated joint for orthopaedic devices comprises a first and a second member (2,3) mutually coupled and both connected to an orthopaedic wrist device (4); one of either the first or the second member (2,3) comprises a guide (12), and the other comprises a first pin (13) adapted to engage the guide (12); the second member (3) is movable relative to the first member (2) along a curved trajectory (T) whose instantaneous centre of rotation (C) lies on a straight line parallel to an axis (L) of main longitudinal extension of the articulated joint (1).

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DESCRIPTION

ARTICULATED JOINT FOR ORTHOPAEDIC DEVICES

Technical field

This invention relates to an articulated joint for orthopaedic devices.

The term "orthopaedic devices" is used to mean, for example, external fixators and braces for the wrist.

5

Background art

Generally speaking, external fixators for the wrist are used in the orthopaedic field for treating injuries of the hand, such as articular and periarticular fractures.

10 External fixators for the wrist joint are known which comprise a first and a second fixing member having respective bone screws designed to connect the selfsame fixing members to the bones of the wrist joint.

Usually, the first fixing member is connected to the radius bone by the respective bone screws and the second fixing member is connected to the
15 metacarpus by the respective bone screws.

In external fixators of simple type, the first and second fixing members are connected to a single middle member which is adapted to keep the wrist joint stretched and immobile.

In other external fixators, the first and second fixing members are
20 connected to respective supporting members which are mutually connected by a spherical joint or by a simple hinge.

The spherical joint and the simple hinge allow medical staff to position the supporting members of the first and second fixing members relative to each other in such a way as to set the external fixator so it stretches the
25 joint in a predetermined configuration.

The external fixators described above, once applied to the wrist to be treated, constrain the joint to remain immobile in a stretched position.

Keeping the joint in the stretched and immobile position for the entire duration the external fixator is applied means that the wrist will subsequently require lengthy rehabilitation and motor re-education.

5 **Disclosure of the invention**

This invention therefore has for an aim to overcome the above mentioned disadvantages by providing an articulated joint applicable to an external fixator for the wrist and which allows the patient to move his/her wrist along a trajectory as near as possible to the natural movement of the wrist joint.

10 According to the invention, this aim is achieved by an articulated joint comprising the technical features described in independent claim 1.

A further aim of the invention is to provide an external fixator to which the articulated joint can be applied.

15

Brief description of the drawings

The technical features of the invention, with reference to the above aims, are clearly described in the claims below and its advantages are more apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate a preferred non-limiting example embodiment of the invention, and in which:

- Figure 1 is a front perspective view of the articulated joint according to the invention;
- Figure 2 is an exploded, front perspective view of the articulated joint of Figure 1;
- 25 - Figure 3 is an exploded, rear perspective view of the articulated joint of Figure 1;
- Figure 4 is a rear view of the articulated joint of Figure 1;
- Figure 5 is a perspective view of an external wrist fixator equipped with the articulated joint according to the invention;
- 30 - Figure 6 is a perspective view of the external fixator of Figure 5, with

some parts cut away.

Detailed description of preferred embodiments of the invention

5 With reference to Figures 1 to 4, the numeral 1 denotes an articulated joint for orthopaedic devices.

The articulated joint 1 comprises a first and a second member 2 and 3 which are mutually coupled.

Both of the members 2 and 3 are designed to be connected to an orthopaedic device 4 for the wrist.

10 Preferably, the second member 3 is connected directly to the orthopaedic device 4.

The first member 2 comprises a stem 5 and a head 6 located at one of the two ends of the stem 5.

The articulated joint 1 extends mainly along a longitudinal axis L.

15 More specifically, the stem 5 is elongate in shape and extends mainly along the axis L.

Preferably, the stem 5 has a transversal cross section which, relative to the longitudinal axis L, is substantially rectangular.

20 Preferably, the head 6 of the first member 2 is substantially circular in shape.

The second member 3 has the shape of a disc and is hollow inside.

The second member 3 comprises a front face 7 and a rear face 8, opposite to the front face 7, and a side perimeter wall 9 connecting the front face 7 to the rear face 8.

25 The second member 3 comprises chamber 10 for housing the first member 2 which is partly inserted therein.

The housing chamber 10 receives at least the head 6 of the first member 2, as illustrated in Figure 4.

30 The housing chamber 10 is defined by the front face 7, the rear face 8 and the side perimeter wall 9 and has an access opening 11 on the side opposite the side perimeter wall 9.

Through the access opening 11, the head 6 of the first member 2 may be inserted into the housing chamber 10 of the second member 3.

The coupling between the first and the second member 2 and 3 is a shape coupling which reproduces the same kinematics of the wrist joint.

5 In order to replicate the natural trajectory of the wrist, the second member 3 is movable relative to the first member 2.

More specifically, the first member 2 and the second member 3 respectively comprise a guide 12 and a first pin 13 engaged in the guide 12.

10 More specifically, the guide 12 is defined by a slot which the first pin 13 slides in.

The guide 12 is made in the head 6 of the first member 2. More specifically, the guide 12 is located at the free end of the head 6.

Thus, when the head 6 of the first member 2 is inserted into the chamber 15 10 of the second member 3, the guide 12 is positioned inside the housing chamber 10 itself.

The guide 12 has a curved trajectory, labelled T in Figures 2 and 4.

The second member 3 has a first and a second hole 14 and 15 made in its front face 7 and rear face 8, respectively.

20 The first and the second hole 14 and 15 are coaxial and are both through holes, in communication with the housing chamber 10.

The first and the second hole 14 and 15 are adapted to receive the first pin 13. More specifically, the first pin 13 comprises an opposing head 16 and a shank 17 which is at least partly threaded.

25 The first pin 13 is inserted into the first and second holes 14 and 15 in such a way that the shank 17 passes through both of the holes 14 and 15, while the opposing head 16 is inserted at least partly into the second hole 15.

30 A first lock nut 18 is screwed to the threaded shank 17 of the first pin 13, holding it inside the holes 14 and 15.

Preferably, the opposing head 16 of the first pin 13 is faceted in such a

way as to prevent the first pin 13 from turning about its axis during tightening of the first nut 18.

Preferably, the profile of the second hole 15 matches the faceted shape of the opposing head 16 of the first pin 13.

5 The profile of the first hole 14 is substantially circular.

It should be noted that the first and the second hole 14 and 15 are positioned on the second member 3 in such a way that the first pin 13, inserted therein, passes through and engages the guide 12 inserted in the housing chamber 10.

10 The first member 2 comprises a second pin 19.

The second member 3 comprises a slot 20 in which the second pin 19 is engaged.

More specifically, the second pin 19 is connected to the first member 2 and the slot 20 is formed on the rear face 8 of the second member 3.

15 Preferably, the second pin 19 is positioned near the juncture between the head 6 and the stem 5.

The slot 20 of the second member 3 communicates with the opening 11 of the housing chamber 10.

20 More precisely, the slot 20 is blind and has the shape of U which is elongate along the longitudinal axis L.

The articulated joint 1 comprises a third member 21 connecting the second member 3 to the orthopaedic wrist device 4.

The third member 21 and the first member 2 are mutually coupled along respective contact faces 22 and 23.

25 More specifically, the third member 21 comprises a first and a second arm 24 and 25. The arms 24 and 25 are positioned to form an L relative to each other, that is to say, they are substantially at right angles to each other.

30 The first arm 24 connects the articulated joint 1 to the orthopaedic wrist device 4.

The second arm 25 is in contact with the first member 2 along the contact

face 22.

In order to prevent the first member 2 from turning relative to the third member 21, the contact face 22 of the third member 21 is convex and the contact face 23 of the first member 2 is concave in such a way that the two parts fit together.

Adjustment means 26 allow adjusting the position of the first member 2 relative to the third member 21.

More precisely, the third member 21 has a hole 27 in which a screw 28 for connecting the first member 2 to the third member 21 can be screwed.

Preferably, the hole 27 is located near the free end of the second arm 25. The first member 2 has a slot 29 in which the screw 28 is inserted as a function of the position of the first member 2 relative to the third member 21.

Preferably, the slot 29 is formed on the stem 5 of the first member 2 and extends along the longitudinal axis L.

The slot 29, the hole 27 and the connecting screw 28 define the means 26 for adjusting the position of the first member 2 relative to the third member 21.

In use, the second member 3 can be moved relative to the first member 2, which remains fixed, by sliding the first pin 13 in the guide 12.

The second member 3 follows the curved trajectory T, which comprises a plurality of circular arcs, each having a respective centre.

During the movement of the second member 3 relative to the first member 2, the instantaneous centre of rotation C of the second member 3 varies according to the circular arc followed by the first pin 13 and coincides with the centre of the circular arc along which it travels.

More specifically, the instantaneous centre of rotation C lies on a straight line parallel to the longitudinal axis L of the articulated joint 1.

More specifically, the instantaneous centre of rotation C is defined by the second pin 19 engaged in the slot 20 of the second member 3.

In effect, during the sliding of the first pin 13 along the guide 12, the

second pin 19 slides in the slot 20 along the aforesaid straight line parallel to the longitudinal axis L.

It should be noted, in particular, that the curved trajectory T of the guide 12 reproduces the natural kinematics of the wrist. More specifically, the curved trajectory T is obtained by describing the trajectory followed by a point attached to the metacarpus, while the radius bone is used as fixed element.

In other words, the curved trajectory T of the guide 12 was obtained by regarding the wrist joint as similar to a double hinge mechanism and reproducing its double centre of rotation kinematics.

The curved trajectory T resulting from this study is a substantially circular arc, with a curvature change at its end points.

Preferably, the articulated joint 1 described herein is applied to an external wrist fixator 4. The external fixator 4 defines an orthopaedic wrist device.

Advantageously, during the movement of the second member 3 relative to the first member 2, the housing chamber 10 which receives the head 6 prevents sideways shifting of the head 6 which would negatively affect the correct operation of the articulated joint 1.

In order to position the articulated joint 1 correctly relative to the wrist joint, the first and the second member 2 and 3 have a respective through hole 30, coaxial with the second pin 19 and adapted for insertion of a synthesis means.

Preferably, the synthesis means is a marker wire.

To facilitate insertion of the marker wire into the hole 30, the first member 2 has a radio-opaque marker 41 located near the through hole 30.

The external fixator 4 comprises a first fastening member 31 for fixing to a first bone element and a second fastening member 32 for fixing to a second bone element.

The first and the second fastening member 31 and 32 comprise respective clamps 33.

The clamps 33 engage respective bone screws which are adapted to

removably connect the fastening members 31 and 32 to the respective bone elements.

The second and the third member 3 and 21 of the articulated joint 1 are connected to the first and the second fastening member 31 and 32,
5 respectively.

The second and the third member 3 and 21 comprise respective lobes 34 which allow the position of the articulated joint 1 to be adjusted relative to the external fixator 4.

Each lobe 34 comprises a respective adjustment slot 34a.

10 The second and the third member 3 and 21 are connected to the first and the second fastening member 31 and 32 by a respective screw 35.

More precisely, the screws 35 are inserted into the respective slots 34a of each lobe 34, screwed to the respective fastening members 31 and 32 and tightened in the slots 34a themselves.

15 A middle member 36 is interposed between the first and the second fastening member 31 and 32.

The two free ends 36a and 36b of the middle member 36 connect the middle member 36 itself to a respective free end 31a and 32a of the first and the second fastening member 31 and 32.

20 Advantageously, the middle member 36 is removably connected to the external fixator 4 to allow the articulated joint 1 to be moved.

In effect, the middle member 36 constrains the first fastening member 31 to the second fastening member 32, preventing the second member 3 of the articulated joint 1 from moving relative to the first member 2.

25 To remove the middle member 36 from the external fixator 4 and to keep the first and second fastening members 31 and 32 each in its respective position, the middle member 36 is coupled to the first and second fastening members 31 and 32 by a spherical coupling.

30 More specifically, each of the ends 31a and 32a of the first and second fastening members 31 and 32, designed to be connected to the middle member 36, comprises a connecting head 37.

The connecting head 37 is preferably spherical.

The ends 36a and 36b of the middle member 36 have respective cavities 38, each of which fits together with a respective connecting head 37.

To facilitate entry and exit of the connecting head 37 into and out of the
5 respective cavity 38, the middle member 36 has at least a lateral opening
39 in communication with the cavity 38.

Preferably, the middle member 36 has two lateral openings 39 in
communication with the cavity 38.

A lock screw 40 is screwed into each lateral opening 39 and tightens the
10 middle member 36 to the respective first and second fastening member 31
and 32.

Advantageously, the external fixator 4 as described above may be applied
to the patient without the articulated joint 1. That way, medical staff are
free to apply the external fixator 4 to the bones of the wrist joint to be
15 treated, and more specifically, to the radius and metacarpus, after setting
and immobilizing the joint in the required position.

Once the wrist joint has been immobilized, medical staff can apply the
articulated joint 1 to the external fixator 4, using the connecting screws 35
to fasten it.

20 Advantageously, the lobes 34 of the second and third members 3 and 21
and the means 26 for adjusting the first member 2 relative to the third
member 21 allow the articulated joint 1 to be adapted to the patient's wrist
joint.

Once the articulated joint 1 has been set in place and fastened to the
25 external fixator 4, removing the middle member 36 from the external
fixator 4 allows the patient to move his/her wrist correctly with the aid of
the articulated joint 1 following a curved trajectory T which is as near as
possible to the natural turning movement of the wrist.

Advantageously, the articulated joint 1 allows motor functionality of the
30 wrist to be rapidly recovered, improving the course of recovery and
rehabilitation.

CLAIMS

1. An articulated joint for orthopaedic devices comprising:
a first and a second member (2, 3) mutually coupled and both connected
to an orthopaedic wrist device (4);
one of either the first or the second member (2, 3) comprising a guide
5 (12), and the other comprising a first pin (13) adapted to engage the guide
(12);
the second member (3) being movable relative to the first member (2)
along a curved trajectory (T) defined by the sliding of the first pin (13) in
the guide (12) and whose instantaneous centre of rotation (C) lies on a
10 straight line parallel to an axis (L) of main longitudinal extension of the
articulated joint (1).
2. The articulated joint according to claim 1, characterized in that the
curved trajectory (T) comprises a plurality of circular arcs, each having a
respective centre (C); during the sliding of the first pin (13) in the guide
15 (12), the instantaneous centre of rotation (C) of the second member (3)
being the centre of the circular arc travelled by the first pin (13).
3. The articulated joint according to claim 1 or 2, characterized in that
the first member (2) comprises a second pin (19) and the second member
(3) comprises a slot (20); the second pin (19) being engaged in the slot
20 (20) and defining the instantaneous centre of rotation (C); during the
sliding of the first pin (13) in the guide (12), the second pin (19) sliding in
the slot (20) along the straight line parallel to the axis (L) of main
longitudinal extension of the articulated joint (1).
4. The articulated joint according to any of the claims from 1 to 3,
25 characterized in that the second member (3) comprises a chamber (10)
housing the first member (2); the first member (2) being partly inserted in
the housing chamber (10); the chamber (10) housing the guide (12) and at
least partly the first pin (13).

5 5. The articulated joint according to any of the claims from 1 to 4, characterized in that it comprises a third member (21) connecting the first member (2) to the orthopaedic wrist device (4); the third member (21) and the first member (2) being mutually coupled along respective contact faces (22,23).

10 6. The articulated joint according to claim 5, characterized in that the contact face (22) of the third member (21) is convex and the contact face (23) of the first member (2) is concave; the coupling between the two members (3,21) preventing rotation of the first member (2) relative to the third member (21).

7. The articulated joint according to claim 5 or 6, characterized in that it comprises means (26) for adjusting the position of the first member (2) relative to the third member (21).

15 8. The articulated joint according to any of the claims from 1 to 7, characterized in that the first and second members (2,3) each have a respective through hole (30) coaxial with the second pin (19) for insertion of a synthesis means.

20 9. The articulated joint according to claim 8, characterized in that the first member (2) has a radio-opaque marker (41) located near the through hole (30).

25 10. An orthopaedic device comprising a first fastening member (31) for fixing to a first bone element and a second fastening member (32) for fixing to a second bone element, characterized in that it comprises an articulated joint (1) according to claims 1 to 7 whose first and second members (2, 3) are adapted to be connected to one of the first and second fastening members (31, 32), respectively.

30 11. The orthopaedic device according to claim 10, characterized in that it comprises a middle member (36) interposed between the first and second fastening members (31,32); the middle member (36) being detachably connected to the orthopaedic device (4).

12. The orthopaedic device according to claim 11, characterized in that the middle member (36) is connected to the first and second fastening members (31,32) by a spherical coupling; the middle member (36) being tightened to the first and second fastening members (31,32) by connecting
5 screw means (40).

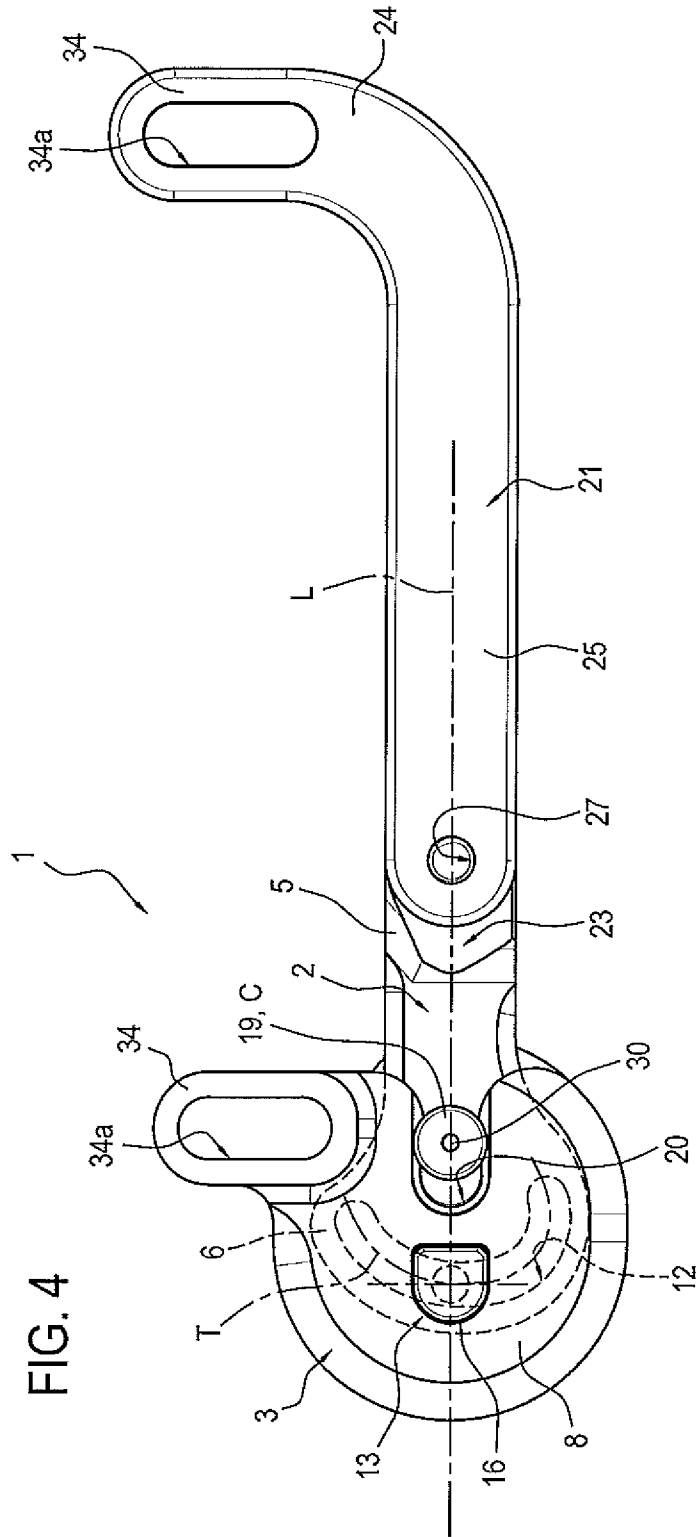


FIG. 5

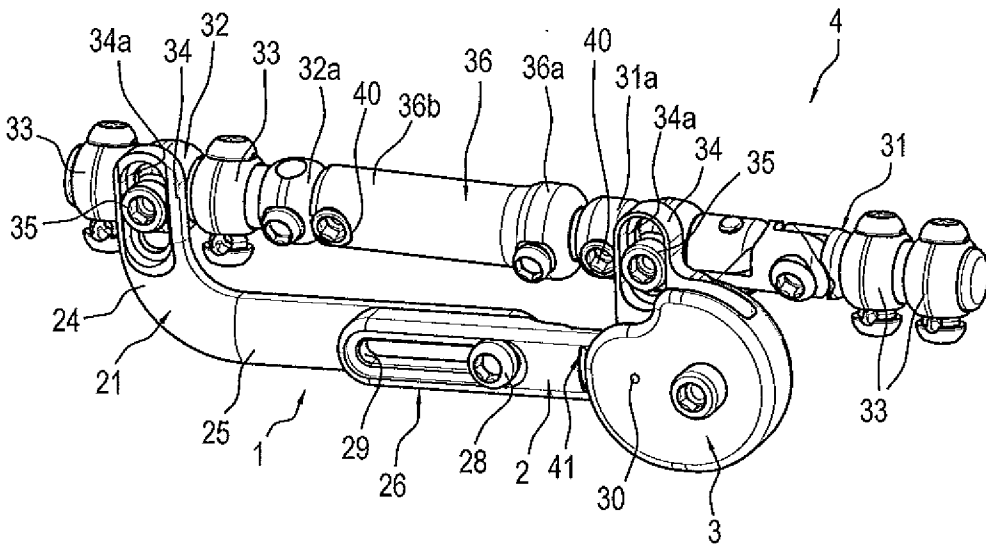
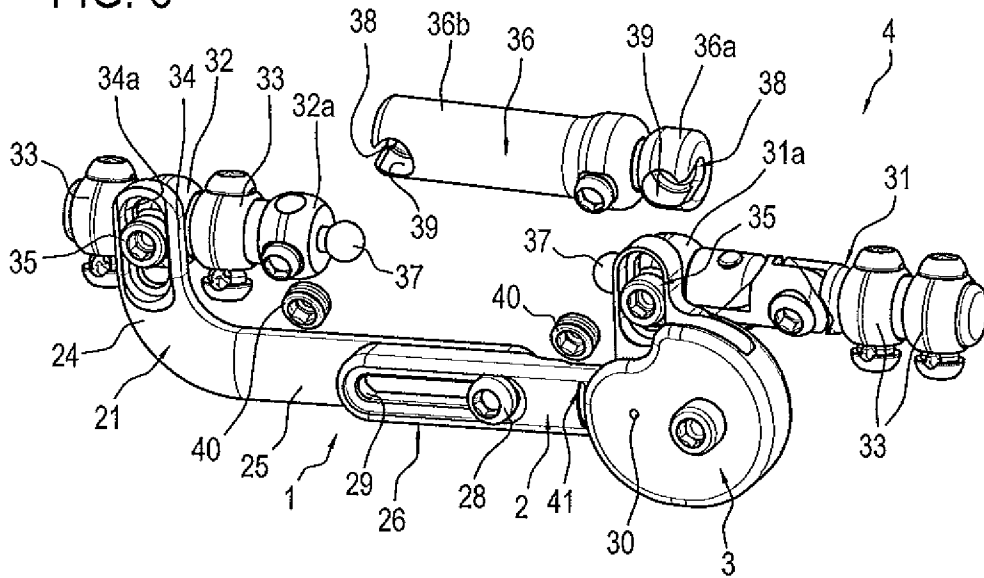


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No PCT/IB2013/059454

A. CLASSIFICATION OF SUBJECT MATTER INV. A61B17/64 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 practicable, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	US 5 122 140 A (ASCHE GERNOT [DE] ET AL) 16 June 1992 (1992-06-16) figures 3,4 -----	1,4-7,10
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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	"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	
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INTERNATIONAL SEARCH REPORT

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