(11) Application No. AU 2000272662 B2

(19) AUSTRALIAN PATENT OFFICE

(54) Title
Device for connecting surgical clearing or drilling tool components

(51)6 International Patent Classification(s)
A61B 017/16

(21) Application No: 2000272662 (22) Application Date: 2000.09.27

(87) WIPO No: WO02/26141

(43) Publication Date : 2002.04.08

(43) Publication Journal Date : 2002.06.20

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(56) Related Art
DE 29713920U
US 5693047A
US 5720749A

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
4. April 2002 (04.04.2002)

PCT

(10) Internationale Veröffentlichungsnummer
WO 02/26141 A1

(51) Internationale Patentklassifikation[7]: A61B 17/16

(21) Internationales Aktenzeichen: PCT/CH00/00527

(22) Internationales Anmeldedatum:
27. September 2000 (27.09.2000)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

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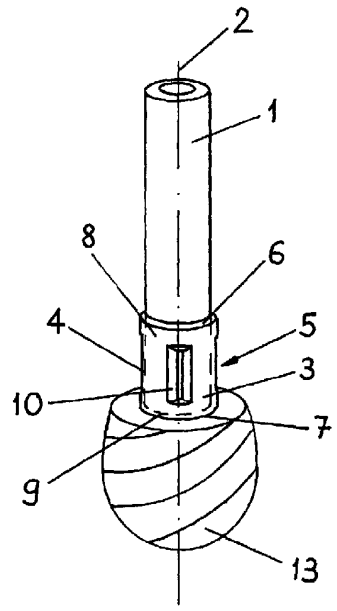
(81) Bestimmungsstaaten *(national)*: AU, CA, CN, JP, US.

[Fortsetzung auf der nächsten Seite]

(54) Title: DEVICE FOR CONNECTING SURGICAL CLEARING OR DRILLING TOOL COMPONENTS

(54) Bezeichnung: VORRICHTUNG ZUR VERBINDUNG CHIRURGISCHER RÄUM- ODER BOHRWERKZEUG-BESTANDTEILEN

WO 02/26141 A1



(57) Abstract: The invention relates to a device for connecting surgical clearing or drilling tools with a shaft, comprising the following: A) a shaft (1) with a central axis (2) and a front end (3); and B) a hollow body (5) comprising a first end (6), a second end (7), a wall (8) and a hollow space (4) which is coaxial to the central axis (2). The shaft (1) is guided into the hollow space (4) coaxially from the first end (6), with its front end (3), while the hollow body (5) can be or is connected to an implant or instrument component with its second end (7). After the shaft (1) has been guided coaxially into the hollow space (4) from the first, shaft-side end (6) of the hollow body with its front, drill head-side end (3), a stamping tool (not included in the drawing) is used to plastically deform the wall (8) of the hollow body (5) in such a way as to produce four impressions (10), each with a projection (11) in the hollow space (4). The projections (11) cause the shaft (1) to become deformed on the periphery in accordance with the projections (11), so that a form-fit fixture is created coaxially to the central axis (2) in terms of rotation about the central axis (2) and displacement between the shaft (1) and the hollow body (5).

(57) Zusammenfassung: Vorrichtung zur koaxialen Verbindung von chirurgischen Räum- oder Bohrwerkzeugen mit einer Welle, umfassend A) eine Welle (1) mit einer Zentralachse (2) und einem vorderen Ende (3); und B) einen Hohlkörper (5) mit einem ersten Ende (6), einem zweiten Ende (7), einer Wand (8) und einem zur Zentralachse (2) koaxialen Hohlraum (4). Die Welle (1) ist mit ihrem vorderen Ende (3) vom ersten Ende (6) her koaxial in den Hohlraum (4) eingeführt, während der Hohlkörper (5) mit seinem zweiten Ende (7) mit einem Implantaten- oder Instrumenten-Bestandteil verbindbar oder verbunden ist. Nachdem die Welle (1) mit ihrem vorderen, bohrkopfseitigen Ende (3) vom ersten, wellenseitigen Ende (6) des Hohlkörpers her koaxial in den Hohlraum (4) eingeführt wurde, wird mittels eines Prägewerkzeuges (nicht gezeichnet) die Wand (8) des Hohlkörpers (5) so plastisch verformt, dass vier Einprägungen

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(84) Bestimmungsstaaten *(regional)*: europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Veröffentlicht:
mit internationalem Recherchenbericht

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(10) entstehen, welche je eine Erhebung (11) im Hohlraum (4) aufweisen. Durch die Erhebungen (11) wird die Welle (1) an ihrem Umfang entsprechend zu den Erhebungen (11) verformt, so dass bezüglich Rotation um die Zentralachse (2) und bezüglich Verschiebung zwischen Welle (1) und Hohlkörper (5) koaxial zur Zentralachse (2) eine formschlüssige Fixierung hergestellt wird.

DEVICE FOR CONNECTING SURGICAL CLEARING OR DRILLING TOOL COMPONENTS

The invention relates to a device for coaxially connecting surgical clearing or drilling tools to a shaft.

In different instruments used in surgery, a transmission of torque and of force between two instrument components is required. The transmission of torque, for example, serves for rotationally driving a surgical instrument, while the transmission of force takes place in an axial direction. Advantageously, the transmission of torque and of force is realised by means of connections including positive engagement between the two parts in question. Such connections are used, for example, for coupling a flexible drilling shaft to the drilling heads which serve for reaming the medullary canals of bones.

A device of this type including connections with positive engagement for the transmission of torque and axial force between a drive means and a flexible shaft, on the one hand, and between said flexible shaft and a reaming tool, on the other, is disclosed in 5.720.749 RUPP. In one embodiment, cams are formed in the cylindrical bore section of a hollow body of the remaining tool which serves for axially receiving the flexible shaft, said cams being realised prior to fitting together the reaming tool and the flexible shaft by a process of plastic deformation. Subsequently, the flexible shaft is axially pressed into the bore section provided with cams, whereby the shaft is radially deformed by the cams so as to be tangentially in positive engagement with the hollow body, the axial engagement between shaft and hollow body being realised by means of a press fit. This known connection suffers from the disadvantage that due to the pressing of the flexible shaft into the bore of the hollow body provided with cams, said flexible shaft is considerably deformed by the cams, so that despite the axially conical centring, a concentric or coaxial connection cannot be ensured in the front end portion.

The above discussion of background art is included to explain the context of the invention. It is not to be taken as an admission or suggestion that any of the documents or other material referred to was published, known or part of the common general knowledge in Australia at the priority date of any one of the claims of this specification.

In view of the above, it would be desirable to create a positive connection for the transmission of torque and of axial force in which the joining together of the flexible shaft and the hollow body is realised with absolute precision, both concentrically and coaxially, by means of a close-sliding fit, and which permits to achieve a rotationally and axially positive engagement.

Broadly, the present invention provides a device for coaxially connecting surgical clearing or drilling tools with a shaft, including: a shaft with a central axis and a front end portion; and a hollow body having a first end portion, a second end portion, a wall, and a cavity extending coaxially to the central axis. The shaft is inserted into the cavity with the shaft front end portion entering the cavity coaxially from the first end portion of the hollow body, the hollow body being connectable, or being connected, with its second end portion to a tool or to a coupling member. The wall is provided with at least one plastically deformed impression having a projection sticking out into the cavity and the shaft is subject to an elastic deformation by means of the at least one projection; and the impression ensures a firm, axially and tangentially positive connection between the shaft and the hollow body.

Thus, in one embodiment the inventive device for coaxially connecting surgical clearing or drilling tools to a shaft comprise a shaft and a hollow body which has a cavity extending coaxially to the

central axis, the shaft being inserted into the cavity with the shaft front end portion entering the cavity coaxially from the first end portion of the hollow body, said hollow body being connectible with its second end portion to an instrument component such as a coupling member or a drilling head for intramedullary reaming. In addition, the wall of the hollow body is provided with at least one impression realised by plastic deformation and including a projection sticking out into the cavity. The deformation of the shaft caused by the at least one projection may be a plastic and/or an elastic deformation.

In the preferred embodiment of the device according to the invention, the front end portion of the shaft has the form of a regular cylinder extending coaxially to the central axis and has a diameter d. The cavity is equally shaped in the form of a regular cylinder extending coaxially to the central axis and has a diameter D, the diameters d and D being dimensioned in such a way that a close-sliding fit is formed between the shaft and the cavity. Said close-sliding fit allows an accurate, coaxial connection between the shaft and the hollow body which is not adversely affected by the application of impressive forces occurring during the formation of the plastic impressions on the hollow body, which takes place after the insertion of the shaft. Thus, it is possible to create a firm, axially and tangentially positive engagement between the shaft and the hollow body which ensures a concentric rotation of the instrument components.

In another embodiment of the device according to the invention, the cavity comprises an axial stop surface for contact with the shaft, said stop surface being located at

a depth T measured from the first end portion. In addition to the axially and tangentially positive engagement between the shaft and the hollow body achieved by the impressions, said axial stop surface provides a means for securely receiving great compressive forces that may be axially exerted on the device.

The wall thickness of the hollow body is preferably comprised between 0.1 mm and 1.0 mm, whereas the projections preferably protrude from the wall by an amount of between 0.05 mm and 0.7 mm.

Further advantageous embodiments of the invention will be characterised in the dependent claims.

The advantages achieved by the present invention consist essentially in the fact that the device according to the invention allows to create a firm connection between the shaft and the hollow body including an instrument component such as a coupling member or a drilling head for intramedullary reaming. The individual parts of the device according to the invention can be easily fabricated and the connection between the shaft and the hollow body, which is performed by a process of plastic deformation of the wall after the shaft has been inserted into the wall, may be realised by employing very simple means. Furthermore, it is possible to have smaller shaft diameters as well as both normal and reverse action of the drill.

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 perspective view of an embodiment of the device according to the invention shown in combination with a surgical clearing tool.

Fig. 2 is a sectional view of the shaft and hollow body of the embodiment of the inventive device shown in Fig. 1; and

Fig. 3 is a perspective view of another embodiment of the device according to the invention.

Figs. 1 and 2 show an embodiment of the device according to the invention which comprises a hollow body 5 that is fixedly connected with a surgical drilling head 13. The cylindrical shaft 1 coupled to the drive (not shown) is inserted coaxially to the central axis 2 into the cylindrical cavity 4 formed in the hollow body 5, the outside diameter of the shaft 1 and the inside diameter of the cavity 4 forming a close-sliding fit, so that the shaft 1 and the hollow body 5 are aligned in an accurately concentrical manner, the shaft 1 being nonetheless insertable without effort into the cavity 4. At a certain depth of the cavity 4, an axial stop surface 9 extending perpendicularly to the central axis 2 is arranged, which may, for example, coincide with the end face of the drilling head 13 facing the hollow body. The hollow body 5 is shaped in the form of a hollow cylinder extending concentrically to the central axis 2 and comprises a first end portion 6 facing the shaft, a second end portion 7 facing the drilling head, a wall 8, and a cavity 4 extending coaxially to the central axis 2. After the shaft

1 has been inserted into the cavity 4, with the shaft front end portion 3 facing the drilling head entering the hollow body concentrically from the first end portion 6 facing the shaft, the wall 8 of the hollow body 5 is plastically deformed by means of a stamping tool (not shown) in such a way that four impressions 10 are formed which have each one projection 11 sticking out into the cavity 4. The projections 11 cause the shaft 1 to be deformed on its circumference in a manner corresponding to said projections 11, so that a positive fixation is created both relative to rotation about the central axis 2 and relative to coaxial displacement with respect to the central axis 2 between the shaft 1 and the hollow body 5. In the embodiment of the inventive device shown here, the hollow body 5 and the drilling head 13 consist of a single piece.

The embodiment of the inventive device shown in Fig. 3 differs from the embodiment shown in Fig. 1 only in so far as the hollow body 5 on its second end portion 7 axially facing away from the shaft 1 is connected to a coupling member 12, said coupling member 12 serving for establishing a releasable connection with a surgical clearing or drilling tool (not shown).

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A device for coaxially connecting surgical clearing or drilling tools with a shaft, including:

a shaft with a central axis and a front end portion;

a hollow body having a first end portion, a second end portion, a wall, and a cavity extending coaxially to the central axis, the shaft being inserted into the cavity with the shaft front end portion entering the cavity coaxially from the first end portion of the hollow body, said hollow body being connectable, or being connected, with its second end portion to a tool or to a coupling member, wherein:

the wall is provided with at least one plastically deformed impression having a projection sticking out into the cavity and the shaft is subject to an elastic deformation by means of the at least one projection; and

the impression ensures a firm, axially and tangentially positive connection between the shaft and the hollow body.

2. A device as claimed in claim 1, wherein on its front end portion, the shaft is shaped in the form of a regular cylinder extending coaxially to the central axis and has a diameter d, the cavity is shaped in the form of a regular cylinder extending coaxially to the central axis and has a diameter D, and the diameters d and D are dimensioned in such a way that a close-sliding fit is formed between the shaft and the cavity.

3. A device as claimed in claim 1 or 2, wherein the shaft is subjected to elastic deformation by means of the at least one projection.

4. A device as claimed in claim 1 or 2, wherein the shaft is subjected to elastic and plastic deformation by means of the at least one projection.

5. A device as claimed in claim 1 or 2, wherein the shaft is subjected to plastic deformation by means of the at least one projection.

6. A device as claimed in any one of claims 1 to 5, wherein the cavity has an axial stop surface formed at a depth T as measured from the first end portion for the shaft to rest upon.

7. A device as claimed in any one of claims 1 to 6, wherein the wall thickness of the hollow body is comprised between 0.1 and 1.0 mm.

8. A device as claimed in any one of claims 1 to 7, wherein the at least one projection protrudes from the wall in the direction of the central axis by an amount of between 0.05 mm and 0.7 mm.

9. A device as claimed in any one of claims 1 to 8 wherein the hollow body is formed in a single piece with a surgical clearing or drilling tool.

10. A device for coaxially connecting surgical clearing or drilling tools substantially as herein described with reference to any one of the embodiments illustrated in the accompanying drawings.

DATED: 12 June 2003
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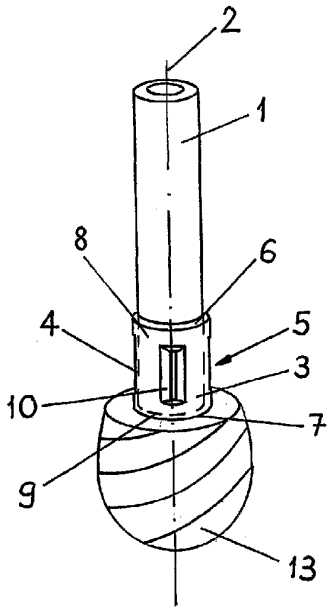

Fig. 1

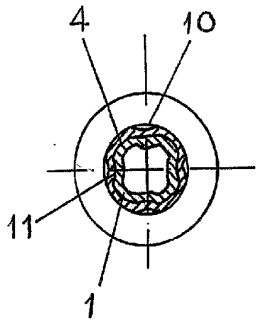

Fig. 2

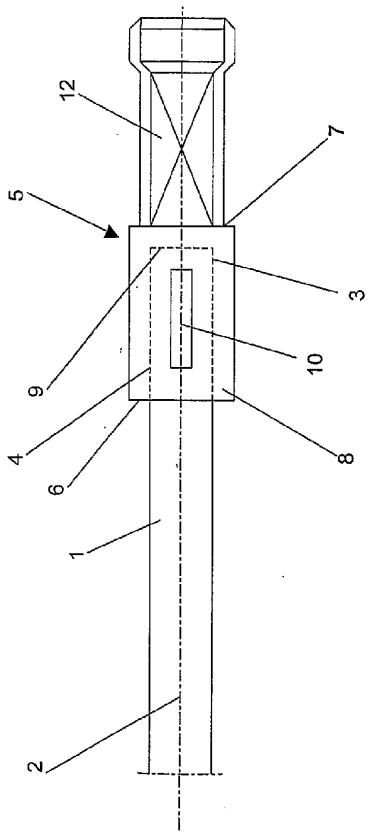

Fig. 3