(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199713643 B2
(10) Patent No. 725487

(54) Title
Device for connecting a longitudinal bar to a pedicle screw

(51)[6] International Patent Classification(s)
A61B 017/70

(21) Application No: 199713643

(22) Application Date: 1997.01.22

(87) WIPO No: WO98/32386

(43) Publication Date : 1998.08.18
(43) Publication Journal Date : 1998.10.01
(44) Accepted Journal Date : 2000.10.12

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(56) Related Art
US 5549608
US 5443467

OPI DATE 18/08/98 APPLN. ID 13643/97
AOJP DATE 01/10/98 PCT NUMBER PCT/CH97/00019

AU9713643

(51) Internationale Patentklassifikation 6 :
A61B 17/70

A1

(11) Internationale Veröffentlichungsnummer: WO 98/32386

(43) Internationales Veröffentlichungsdatum: 30. Juli 1998 (30.07.98)

(21) Internationales Aktenzeichen: PCT/CH97/00019

(22) Internationales Anmeldedatum: 22. Januar 1997 (22.01.97)

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(81) Bestimmungsstaaten: AU, CN, JP, KR, US, europäisches Patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

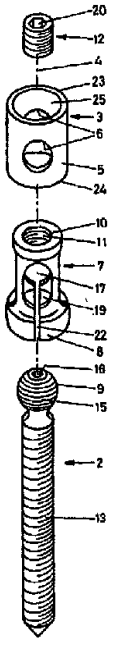
Veröffentlicht
Mit internationalem Recherchenbericht.
Mit geänderten Ansprüchen.

(54) Title: DEVICE FOR CONNECTING A LONGITUDINAL BAR TO A PEDICLE SCREW

(54) Bezeichnung: VORRICHTUNG ZUR VERBINDUNG EINES LÄNGSTRÄGERS MIT EINER PEDIKELSCHRAUBE

(57) Abstract

The invention relates to a device for connecting a longitudinal bar to a pedicle screw (2) which forms part of a system for fixing the spinal column. Said device comprises a body (3) having an upper end (23), a lower end (24), a hole which is open at least towards the bottom (25) and has an axis (4), and a through hole (6), positioned perpendicular to the axis (4) and extending through the hole (25), through which a longitudinal bar (1) extending perpendicular to the axis (4) can be inserted. The device also has a collet chuck (7) mounted coaxially on the inside of the body (3) in such a way that it can slide along the axis (4). Said collet chuck has a through hole (17) which is flush with the through hole (6) of the body (3), and a chamber (19) which faces at least downwards and is defined by tongues (8) spring-mounted against the cylinder axis (4). The head (9) of a pedicle screw (2) can be clicked into this chamber from below by spring-action. The device is easy to use and makes it possible for the pedicle screw to be inclined within a certain range.



(57) Zusammenfassung

Die Vorrichtung dient zur Verbindung eines Längsträgers (1) mit einer Pedikelschraube (2) innerhalb eines Wirbelsäulenfixationssystems. Sie umfasst einerseits einen Körper (3) mit einem oberen Ende (23), einem unteren Ende (24), einer zumindest nach unten offenen Bohrung (25) mit der Achse (4) und einer quer zur Achse (4) durch die Bohrung (25) angebrachten Durchgangsöffnung (6), durch welche ein quer zur Achse (4) verlaufender Längsträger (1) einführbar ist und andererseits eine koaxial im Inneren des Körpers (3) entlang der Achse (4) gleitbar angeordnete Spannzange (7), mit einer zur Durchgangsöffnung (6) des Körpers (3) fluchtenden Durchgangsöffnung (17) und mit einer zumindest nach unten gerichteten, durch gegen die Zylinderachse (4) federnd ausgebildete Zungen (8), begrenzten Kammer (19), in welche von unten der Kopf (9) einer Pedikelschraube (2) federnd einschnappbar ist. Die Vorrichtung lässt sich einfach handhaben und lässt eine Abwinkelung der Pedikelschraube innerhalb eines gewissen Bereichs zu.

DEVICE FOR CONNECTING A LONGITUDINAL BAR TO A PEDICLE SCREW

This invention concerns a device for connecting a longitudinal bar to a pedicle screw.

From the related art, a large number of pedicle screws for fixation of the spinal column are already known; these known pedicle screws have the advantage that the individual pedicle screw can be attached to or removed from the longitudinal bar at any time without having to dismantle the entire fixation system. Such a pedicle screw is known from European Patent No. 330,881 B, for example.

The disadvantage of the known pedicle screws consists of the relatively complicated locking mechanisms for securing the longitudinal bar inserted into the open pedicle screw head. Furthermore, in most cases the head of the screw can be aligned with the position of the longitudinal bar only to a limited extent, necessitating complicated bending of the longitudinal bar to the correct angle.

Another connecting device is disclosed in U.S. Patent No. 5,549,608 ERRICO. This known device also contains a device which makes it possible to connect a pedicle screw or, more generally, a bone anchoring element to a longitudinal bar. A two-part bushing is pressed by means of a tensioning nut along a central body against the externally conical collet chuck mounted on the lower end of the central body, so that by means of the lower bushing, the collet chuck is compressed and a screw head is secured in the collet chuck while the longitudinal bar is locked between the bushings. In another embodiment of this device, the lower bushing is screwed over the collet chuck by means of a separate threaded connection, which permits a separate locking of the pedicle screw and the longitudinal bar. Again with this known connecting device, the pedicle screw can be aligned with the position of the longitudinal bar only to a limited extent.

The above discussion of documents, acts, materials, devices, articles and the like is included in this specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any of these matters formed part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed in Australia before the priority date of each claim of this application.

This invention will provide a remedy in this regard. This invention is based on the problem of creating a device for connecting a longitudinal bar to a pedicle screw, said device being easy to handle and permitting bending of the pedicle screw within a certain range.

According to the present invention, there is provided a device for connecting a longitudinal bar to a pedicle screw within a system for fixation of the spinal column, including

a) a body having an axis and, relative to one orientation in which the axis is vertically disposed, the body further having an upper end, a lower end, a first hole which is open at least at the lower end, and a second, through hole provided through the body transversely across the axis so that a longitudinal bar can be inserted transversely through the body;

b) a collet chuck arranged coaxially in the interior of the body so that it can slide along the axis, with a through hole which is alignable with the through hole of the body, and with a chamber which is pointing downward at least and is bordered by tongues which are designed to have a spring action towards the axis, so that the head of a pedicle screw can be snapped into this chamber from below with a spring action; and

c) the outside surface of the collet chuck is designed in the area of the chamber as a convex surface which cannot be developed into a plane.

In one embodiment, the desired number of devices according to this invention can be aligned on a longitudinal bar and can be simply snapped onto the pedicle screw with a spherical head already implanted in the vertebrae, so that a primary connection between the longitudinal bar and the pedicle screw is

established. Other embodiments of the device according to this invention permit subsequent insertion of the longitudinal bar from the side or from above.

By screwing the set screw into the fixation device, the longitudinal bar is locked axially and relatively in the device at the same time, and the device is secured in a stable angular position. The set screw presses on the longitudinal bar inserted into the device, and the longitudinal bar presses on the bushing of the fixation device, and the bushing braces the collet chuck on the preferably spherical head of the pedicle screw by way of corresponding, preferably conical inside surfaces of the bushing and outside surfaces of the collet chuck.

Other embodiments in turn permit sequential and independent locking of the longitudinal bar and rotation of the device with respect to the pedicle screw.

Thus, in comparison with known devices, the device according to this invention offers the advantage that the pedicle screws can not only be secured exactly perpendicular to the longitudinal bar but also permit an angle bend of up to ±25°. This is especially important if the longitudinal bar has not been bent accurately, which leads to major problems in assembly with traditional systems.

A preferred refinement of the device according to this invention consists of the fact that it also includes a pedicle screw with a preferably spherical head. The head of the pedicle screw is preferably provided with structuring in the form of transverse grooves or transverse ribs to achieve better fixation (bracing against the collet chuck). To be able to screw these pedicle screws into the bone, they are preferably provided with a hexagon socket in the spherical head.

This invention and refinements on this invention are explained in greater detail below on the basis of embodiments.

The figures show:

Figure 1: an exploded perspective view of the device according to this invention together with a longitudinal bar, a pedicle screw with a spherical head and a set screw;

Figure 2: a slotted longitudinal section through the device according to this invention as shown in the plane of the drawing in Figure 1;

Figure 3: a perspective view of the device according to Figure 1 in the mounted state after locking the longitudinal bar and the pedicle screw by means of the set screw;

Figure 4: a perspective view of one variant of the device shown in Figure 1 with an adjusting nut and a divided bushing;

Figure 5: a perspective view of one variant of the device shown in Figure 4 with a channel on the collet chuck that is open at the top and with a securing pin;

Figure 6: a perspective view of one variant of the device shown in Figure 1 with an adjusting nut for securing the spherical head of the pedicle screw and a set screw for locking the longitudinal bar;

Figure 7: a longitudinal section through one variant of the device illustrated in Figure 6 with a set screw integrated into a locking screw;

Figure 8: a perspective view of one variant of the device shown in Figure 5 with a collet chuck that is open at the side to accommodate the longitudinal bar and an adjusting nut as a chucking means for locking the longitudinal bar while at the same time securing the spherical head of the pedicle screw;

Figure 9: a perspective view of the device shown in Figure 5 without a securing pin;

Figure 10: a perspective view of one variant of the device shown in Figure 5 with a set screw and an inside thread in the collet chuck;

Figure 11: a perspective view of one variant of the device shown in Figure 8 with an adjusting nut for securing the spherical head of the pedicle screw and with a set screw for locking the longitudinal bar;

Figure 12: a perspective view of one variant of the device shown in Figure 11 with a collet chuck that is open at the top;

Figure 13: a perspective view of one variant of the device shown in Figure 11 with a through hole which is open at the side in the bushing; and

Figure 14: a perspective view of one variant of the device shown in Figure 12 with a through hole which is open at the top in the bushing.

The device according to this invention illustrated in Figures 1 and 2 consists essentially of a body 3 in the form of a hollow cylindrical bushing with an axis 4 (axis of the hollow cylinder) and a hollow cylindrical collet chuck 7 arranged coaxially so it can slide in the interior of the body 3.

The body 3 has a through hole 6 running across the axis 4 - intersecting the cylindrical surface of the hollow cylinder at two points symmetrically with the axis 4 - and the collet chuck 7 has a through hole 17 running across the axis 4. Insertion of a longitudinal bar 1 running across the axis 4 is made possibly by the aligned arrangement of the through holes 6 and 17 as illustrated in Figure 2.

In its upper part, the collet chuck 7 is secured within the (hollow cylindrical) body 3 by a press fit and can be displaced axially with respect to the body 3 when the relatively high force of the press fit is overcome.

The (hollow cylindrical) body 3 and collect chuck 7 are preferably in a rotationally locked arrangement relative to one another, e.g., by means of suitable groove/channel guides running axially. The collet chuck 7 is designed with tongues 8 spring mounted against cylinder axis 4 and pointing downward; the spherical head 9 of a pedicle screw 2 can be snapped from below with a spring action into the chamber formed by these tongues.

A hole 10 with an inside thread 11 is provided in the upper part of collet chuck 7 to accommodate a set screw 12 with a hexagonal socket head 20 which can exert a force on a longitudinal bar 1 inserted into the device, so the longitudinal bar 1 is locked axially and rotationally with respect to body 3, as indicated in Figure 3. Collet chuck 7 is designed at its lower end such that the screw shaft 13 of pedicle screw 2 connected to the spherical head 9 can be locked at an angle α of -25° to +25° with respect to axis 4.

At its lower end 24, body 3 has a conical inside surface 14 which becomes wider toward the lower end. The outside surface 18 of the collet chuck 7 is part spherically shaped in the area of the chamber 19, so that the conical inside surface 14 of the body can be brought into linear contact with this outside surface 18. As soon as the set screw 12 abuts against the longitudinal bar 1 inserted into the device, collet chuck 7 begins to push upward against body 3. This process is illustrated in Figure 2, where the left half of the figure shows the condition

before pushing collet chuck 7 upward, and the right half shows conical surfaces 14 and 18 slipping past one another as the collet chuck 7 is pushed upward, with the tongues 8 of the collet chuck 7 which are designed with a spring action due to the slot 22 being pushed toward cylinder axis 4, so that the hollow spherical cavity 19 is reduced in size, and the head 9 of the pedicle screw 2 inserted into it is gripped securely. To optimize the locking of the head 9, it is provided with a structuring 15, preferably in the form of transverse grooves or transverse ribs. Otherwise, pedicle screw 2 corresponds to the known screw designs and is expediently provided with a hexagonal socket head 16.

The hollow spherical cavity 19 may in turn be provided with a structuring 21, preferably in the form of transverse grooves or transverse ribs. A combination of structuring 21 and structuring 15 is possible to further improve the fixation effect of head 9 in hollow spherical cavity 19. Hollow spherical cavity 19 is preferably designed with a shape complementary to that of the head 9 of pedicle screw 2 to be accommodated in it.

The variant shown in Figure 4 of the device according to this invention illustrates the use of a body 3, which is divided into a bottom part 52 and a top part 53 across the axis 4 in the middle of through hole 6, in combination with an adjusting nut 26. The bottom part 52 of body 3 must be so tall that the longitudinal bar 1 is always in contact with the bottom part 52.

The collet chuck 71 differs from the collet chuck 7 shown in Figure 1 only in that the inside thread 11 on the upper end has been replaced by an outside thread 27 for use of an adjusting nut 26. When tightened, the adjusting nut 26 presses on the top part 53 of body 3, which subsequently presses directly on longitudinal bar 1. The longitudinal bar 1 is subsequently pressed against the bottom part 52 of the body 3, and then it locks the spherical head 9, as shown in Figure 2.

The variant shown in Figure 5 of the device according to this invention differs from the variant illustrated in Figure 9 only in that one peg 55 prevents the collet chuck 72, which has been weakened by the channel 54, from collapsing when the adjusting nut 26 is tightened. To prevent this peg 55 from falling out, it is advantageously provided with an outside thread and screwed in.

The variant shown in Figure 6 of the device according to this invention differs from the variant illustrated in Figure 4 only in that

a) the collet chuck 73 has an inside thread 11 in addition to outside thread 27, and

b) the body 3, which is in one piece, and the through hole 6 are positioned with respect to the through hole 17 so that only the spherical head 9 is locked when the adjusting nut 26 is tightened. This permits distraction or compression with a stable angular position. The adjusting nut 26 presses on the body 3,

and the resulting bracing of the body 3 with the collet chuck 73 ensures fixation of the spherical head 9 of the pedicle screw 2 without locking the longitudinal bar 1. The longitudinal bar 1 is pressed separately with the help of the set screw 12 against the lower edge of the through hole 6 of the body 3. Therefore, the body 3 is further wedged with the collet chuck 73, which leads to a greater clamping effect on the spherical head 9. The through hole 6 must be positioned in the body 3 so that the longitudinal bar 1 also rests on the lower edge of the through hole 6 after tightening the adjusting nut 26.

The variant illustrated in Figure 7 of the device according to this invention differs from the device illustrated in Figures 1 through 3 only in the design of the locking screw 91 and the positioning of the through hole 6 with respect to the through hole 17. The collet chuck 7 is provided with an inside thread 11. A locking screw 91 which is screwed into the inside thread 11 and a set screw 12 which is integrated into the locking screw 91 serve to lock the spherical head 9 and the longitudinal bar 1. The body 3, which is designed in one piece by analogy with Figures 1 through 3, is provided with a turning 94 at the top, accommodating the shoulder 93 of the locking screw 91. The through hole 6 is positioned in body 3 with respect to the through hole 17 in the collet chuck 7 in such a way that only spherical head 9 is locked when locking screw 91 is tightened. The longitudinal bar 1 is secured afterwards by means of the set screw 12. As long as this set screw 12 is screwed completely into the locking screw 91, and

the locking screw 91 has been screwed back to the extent that the longitudinal bar 1 touches the lower edge of the through hole 6 in the body 3, the spherical head 9 can be secured or removed. Furthermore, the collet chuck 7 is released again from the tightened state when the locking screw 91 is screwed back. To accommodate the longitudinal bar 1, the collet chuck 7 may be provided with a through hole 17 according to Figure 4, with a channel 54 which is open at the top according to Figure 9, or with a channel 42 according to Figure 8 which is open at the side. In these two cases, either a two-piece design of body 3 or a design according to Figures 11 and 12 is advantageous to facilitate insertion of the longitudinal bar. However, with the two-piece design, the two parts of the body 3 must be designed so that the top part 53 presses directly on the bottom part 52 and not on the longitudinal bar 1 even after bracing.

The variant shown in Figure 8 of the device according to this invention differs from the variant illustrated in Figure 4 only in that, in contrast with the collet chuck 71, the collet chuck 74 has a channel 42 that is open at the side instead of having a through hole 17 to accommodate the longitudinal bar 1, but the slot 22 does not extend into this open channel.

The variant shown in Figure 9 of the device according to this invention differs from the variant illustrated in Figure 4 only in that, in contrast with the collet chuck 71, the collet chuck 72 has a channel 54

that is open at the top instead of a through hole 17 to accommodate the longitudinal bar 1, and the slot 22 does not extend into this open channel. To prevent the collet chuck 72 from collapsing when the adjusting nut 26 is tightened, the thread must be designed so that negligible radial forces occur in tightening. A sawtooth thread, for example, would meet this requirement.

The variant shown in Figure 10 of the device according to this invention illustrates the use of a collet chuck 75, which is provided with an inside thread 11 instead of an outside thread 27, in contrast with the collet chuck 72 illustrated in Figures 5 and 9. A set screw 56 with an outside thread 57 and a flange 58 serves as the clamping means. When tightened, the set screw 56 presses against the longitudinal bar 1, which presses in turn on the bottom part 52 of the body 3. This bracing of the bottom part 52 and the collet chuck 75 locks the spherical head 9 of the pedicle screw 2, as illustrated in Figure 2. The top part 53 of the body 3 prevents widening of the collet chuck 75 when the set screw 56 is tightened. The top part 53 rests on the shoulder 63.

The variant shown in Figure 11 of the device according to this invention differs from the variant illustrated in Figure 6 only in that the collet chuck 76, in contrast with the collet chuck 73, has a channel 42 that is open at the side instead of a through hole 17, and the slots 22 do not extend into the channel.

According to Figure 13, the through hole 6 in the body 3 is preferably open at the side (80) to permit unhindered insertion of longitudinal bar 1.

The variant shown in Figure 12 of the device according to this invention differs from the variant illustrated in Figure 11 only in that, in contrast with the collet chuck 76, the collet chuck 77 has a channel 54 that is open at the top to accommodate the longitudinal bar 1. According to Figure 14, the through hole 6 in the body 3 is open toward the top (81) for unhindered insertion of the longitudinal bar 1.

The variant shown in Figure 13 of the device according to this invention differs from the variant illustrated in Figure 11 only in that a through hole 80 which is open at the side is provided in the body 3.

The variant shown in Figure 14 of the device according to this invention differs from the variant illustrated in Figure 12 only in that a through hole 81 which is open at the top is provided in the body 3.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A device for connecting a longitudinal bar to a pedicle screw within a system for fixation of the spinal column, including

a) a body having an axis and, relative to one orientation in which the axis is vertically disposed, the body further having an upper end, a lower end, a first hole which is open at least at the lower end, and a second, through hole provided through the body transversely across the axis so that a longitudinal bar can be inserted transversely through the body;

b) a collet chuck arranged coaxially in the interior of the body so that it can slide along the axis, with a through hole which is alignable with the through hole of the body, and with a chamber which is pointing downward at least and is bordered by tongues which are designed to have a spring action towards the axis, so that the head of a pedicle screw can be snapped into this chamber from below with a spring action; and

c) the outside surface of the collet chuck is designed in the area of the chamber as a convex surface which cannot be developed into a plane.

2. A device according to Claim 1, wherein the chamber is designed as a hollow spherical cavity.

3. A device according to Claim 1 or 2, wherein the convex outside surface of the collet chuck is part spherical in shape in the area of the chamber.

4. A device according to any one of Claims 1 to 3, wherein a set screw is integrated into the collet chuck or into a chucking means so that it locks the longitudinal bar when screwed down.

5. A device according to any one of Claims 1 to 4, wherein the collet chuck is designed to have rotational symmetry about the axis.

6. A device according to any one of Claims 1 to 5, wherein the body is designed with rotational symmetry about the axis.

7. A device according to any one of Claims 1 to 6, wherein the body is divided into a top part and a bottom part, with the dividing surface therebetween running transversely across the axis in the area of the through hole, and the hole is designed to be continuous at least in the bottom part.

8. A device according to any one of Claims 1 to 7, wherein a chucking means is provided and can move the body relative to the collet chuck.

9. A device according to Claim 8, wherein the chucking means is able to press on the longitudinal bar and thereby pull the collet chuck into the body and thus causes the head of the pedicle screw and the longitudinal bar to be clamped securely.

10. A device according to Claim 8 or Claim 9, wherein the chucking means presses on the longitudinal bar by way of the top part of the body.

11. A device according to any one of Claims 8 to 10, wherein the height of the second, through hole is designed so that in any position of the chucking means the longitudinal bar is always able to be in contact with the lower edge of the second, through hole.

12. A device according to any one of Claims 1 to 11, wherein the body and the collet chuck are arranged so that they are rotationally locked but axially displaceable relative to one another.

13. A device according to any one of Claims 1 to 12, wherein the collet chuck is arranged in the body by means of a press fit, and it is separable from the body by tightening the chucking means.

14. A device according to any one of Claims 1 to 13, wherein an internally threaded hole is provided in the top part of the collet chuck for accommodating a set screw, whereby a force can be extended on a longitudinal bar inserted into the device such that the longitudinal bar can be locked axially and rotationally with respect to the body.

15. A device according to Claim 14, wherein the chamber and the threaded hole are in communication.

16. A device according to any one of Claims 1 to 15, wherein the collet chuck is designed so that a preferably spherical head of a pedicle screw inserted into the device can be locked rotationally if a longitudinal bar is inserted into the device.

17. A device according to Claim 16, wherein the collet chuck is designed so that the screw shaft of the pedicle screw connected to the preferably spherical head can be locked at an angle α of -25° to +25° with respect to the axis.

18. A device according to any one of Claims 1 to 17, wherein at its lower end the body has a conical inside surface which becomes wider at the bottom, and a suitably designed conical outside surface of the free ends of the tongues of the collet chuck can be brought into sliding contact with the conical inside surface.

19. A device according to Claim 18, wherein the collet chuck is designed in its contact area with the body so that it is in contact tangentially with the conical inside surface of the body.

20. A device according to any one of Claims 1 to 19, further including a pedicle screw with a preferably spherical head.

21. A device according to Claim 20, wherein the head of the pedicle screw is provided with a structuring, preferably in the form of transverse grooves or transverse ribs.

22. A device according to Claim 20 or 21, wherein the head of the pedicle screw is provided with a hexagonal socket head.

23. A device according to any one of Claims 1 to 22, wherein the chamber is designed as a hollow spherical cavity, preferably with a shape that is

complementary to the shape of the head of the pedicle screw which is to be accommodated.

24. A device according to any one of Claims 1 to 23, wherein the chamber is provided with a structuring, preferably in the form of transverse grooves or transverse ribs.

25. A device according to any one of Claims 1 to 24, wherein the body is designed as a hollow cylindrical bushing.

26. A device according to Claim 25, wherein the body is designed in one piece.

27. A device according to Claim 25, wherein the body consists of a bottom part and a top part.

28. A device according to Claim 27, wherein the separation between the bottom part and the top part is in the area of the through hole.

29. A device according to any one of Claims 1 to 28, wherein the second, through hole of the body is positioned with respect to the through hole of the collet chuck in such a way that the longitudinal bar is able to rest on the lower edge of the through hole of the body.

30. A device according to any one of Claims 1 to 28, wherein the second, through hole of the body is positioned relative to the through hole of the collet chuck so that the longitudinal bar rests on the lower edge of the through hole of the collet chuck.

31. A device according to any one of Claims 27, 28 or Claim 29 or 30 as appended to Claim 27 or 28, wherein the top part of the body rests on the longitudinal bar.

32. A device according to any one of Claims 26 to 28, or Claim 29 or 30 as appended to any one of Claims 26 to 28, wherein the upper edge of the through hole of the body does not come to rest against the longitudinal bar.

33. A device according to any one of Claims 1 to 31, wherein the through hole of the collet chuck is defined by a channel that opens laterally of the collet chuck to accommodate the longitudinal bar.

34. A device according to any one of Claims 1 to 31, wherein the through hole of the collect chuck is defined by a channel that opens at the top of the collet chuck to accommodate the longitudinal bar.

35. A device according to any one of Claims 1 to 34, wherein the collet chuck is externally threaded at its upper end.

36. A device according to Claim 35, wherein a nut engageable with the external thread is used for fixation of the pedicle screw and the longitudinal bar.

37. A device according to any one of Claims 1 to 34, wherein the collet chuck is internally threaded at its upper end.

38. A device according to Claim 37, wherein a set screw engageable with the internal thread is used for fixation of the pedicle screw and the longitudinal bar.

39. A device according to Claim 38, wherein the collet chuck has a shoulder on the upper end, and the top part of the body rests on the shoulder and thus prevents the collet chuck from widening when the set screw is tightened.

40. A device according to Claim 39, wherein a set screw with an external thread is used as chucking means.

41. A device according to Claim 40, wherein the set screw is provided with a flange having an outside diameter which is preferably greater than the inside diameter of the body.

42. A device according to Claim 35, wherein the collet chuck is provided with an internal thread at its upper end.

43. A device according to Claim 42, wherein the through hole in the body is positioned with respect to the through hole in the collet chuck such that only the spherical head is locked when the chucking means is tightened.

44. A device according to Claim 37, wherein the through hole in the body is positioned with respect to the through hole in the collet chuck in such a way that only the spherical head is locked when the chucking means in tightened.

45. A device according to any one of Claims 43 to 44, wherein the body is designed in one piece.

46. A device according to Claim 43, wherein the body includes a bottom part and a top part.

47. A device according to any one of Claims 43 to 46, wherein the through hole in the body is positioned with respect to the through hole in the collet chuck such that the longitudinal bar rests on the lower edge of the through hole before and after tightening the chucking means.

48. A device according to any one of Claims 43 to 46, wherein the through hole in the body is positioned with respect to the through hole in the collet chuck such that the longitudinal bar rests on the lower edge of the through hole in the collet chuck even after tightening the chucking means.

49. A device according to any one of Claims 43 to 48, wherein the second, through hole in the body opens laterally at the side of the body.

50. A device according to any one of Claims 43 to 48, wherein the second, through hole in the body opens at the top of the body.

51. A device according to any one of Claims 43 to 50, wherein a set screw is integrated into the chucking means in such a way that it locks the longitudinal bar when tightened down.

52. A device according to Claim 51, wherein the body is connected to the chucking means with tensile and compressive strength, preferably by a notch, the chucking means can be tightened and unscrewed without hindrance, and the body can be withdrawn by unscrewing the chucking means, thus releasing the collet chuck again.

53. A device according to any one of Claims 43 to 50, wherein the collet chuck is provided with an internal thread in the upper end into which a set screw can be screwed to lock the longitudinal bar separately.

54. A device according to Claim 48 or any one of Claims 49 to 51, wherein the through hole in the body is shaped so that the top part does not come to rest on the longitudinal bar.

55. A device according to Claim 36, wherein a peg prevents the collet chuck, which is weakened by the channel, from collapsing when the adjusting nut is tightened, and the peg is preferably provided with an external thread and is screwed into the collet chuck.

56. A device according to any one of Claims 1 to 55, wherein the first hole in the body is designed to be continuous from bottom to top.

57. A device for connecting a longitudinal bar to a pedicle screw according to any one of the embodiments substantially as herein described and illustrated.

DATED: 11 August 2000
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SYNTHES AG CHUR

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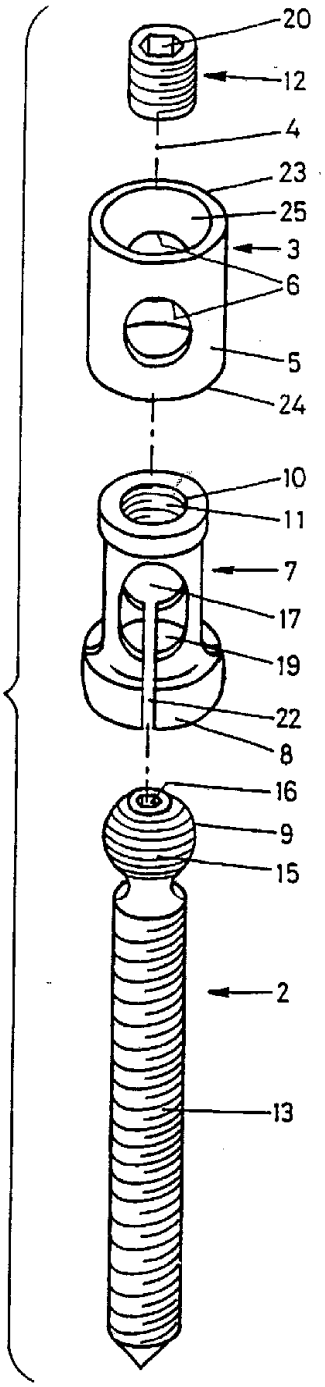


Fig.1

Fig. 2

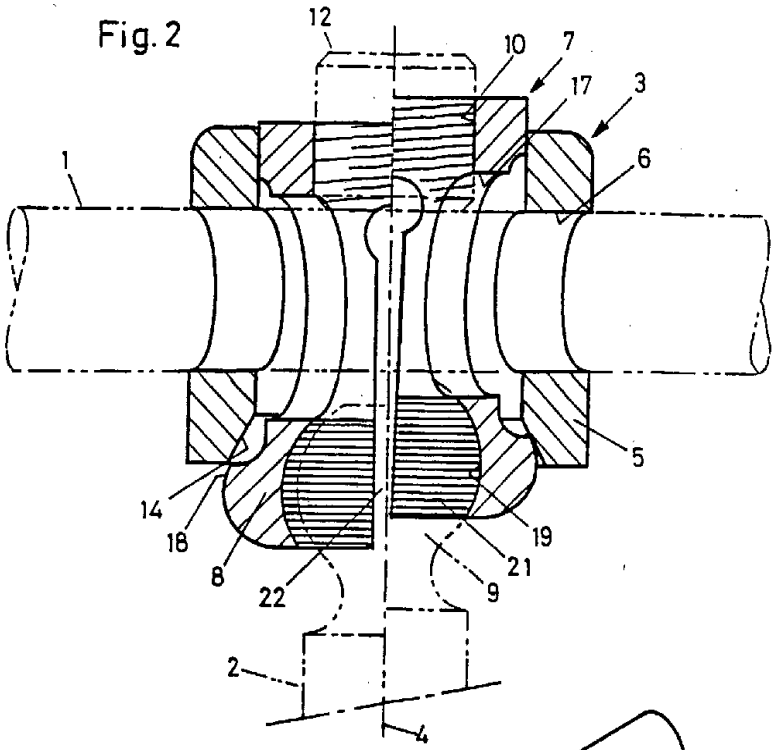
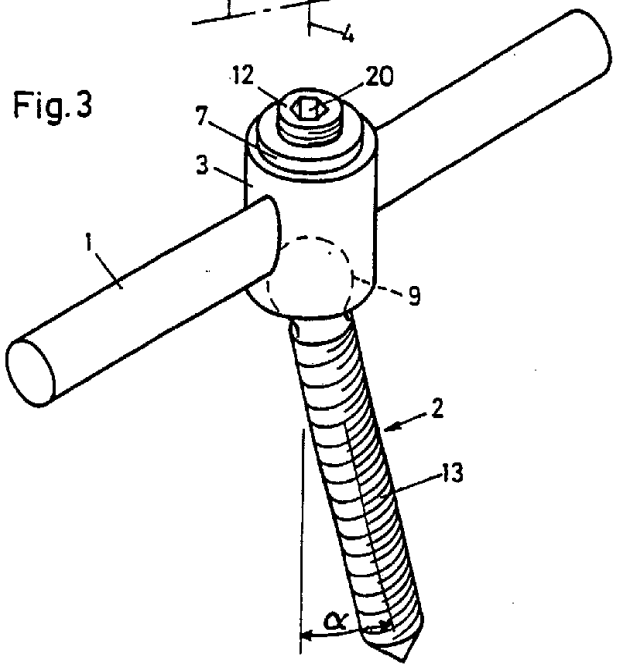


Fig. 3



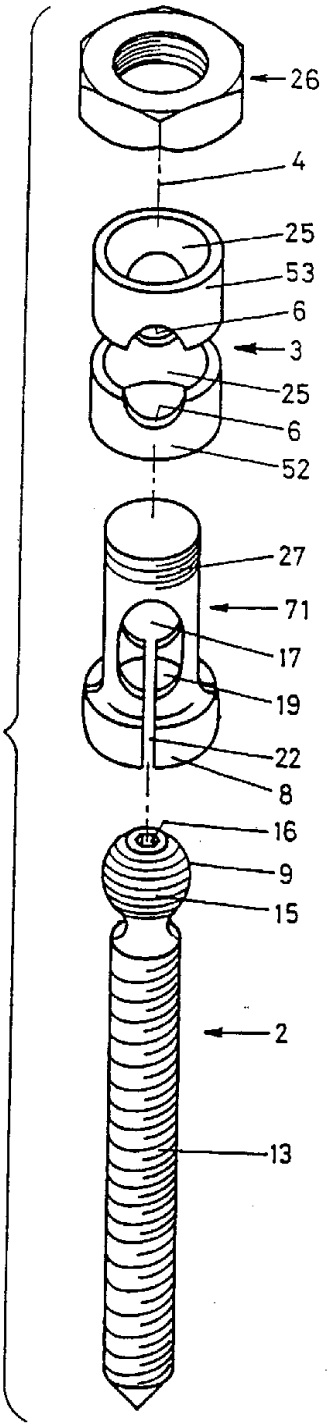

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Fig. 4

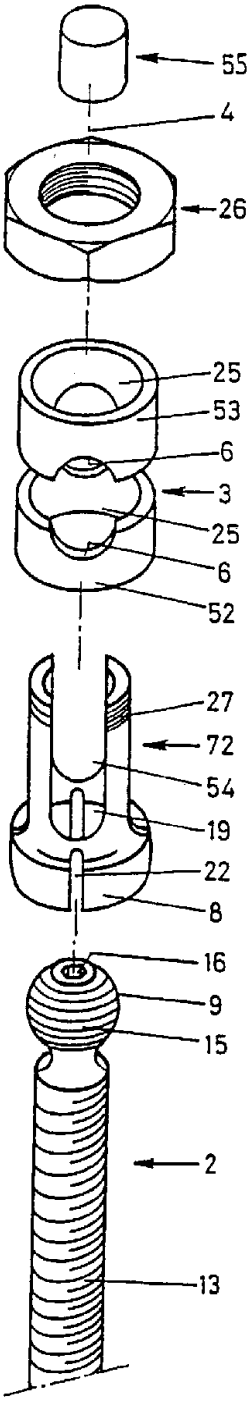
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Fig. 5

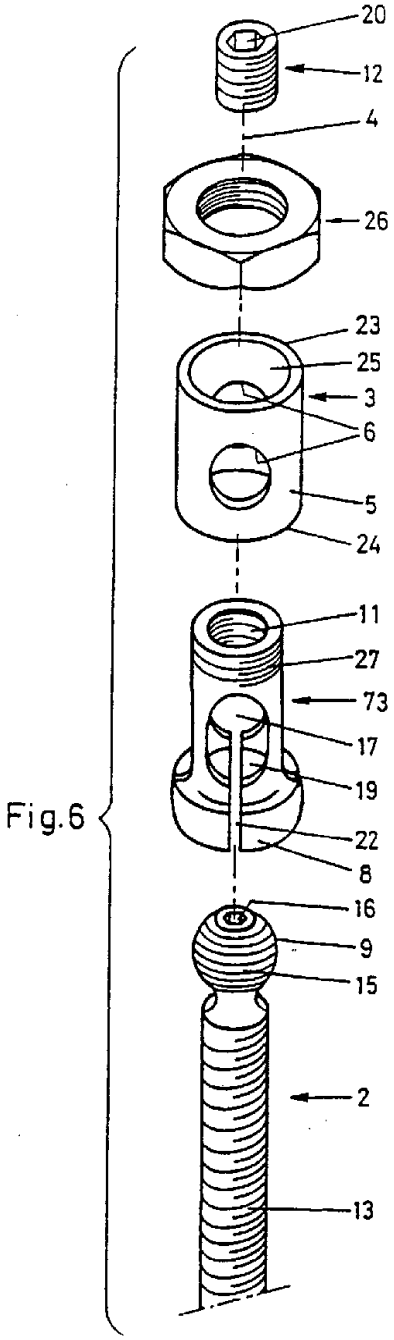
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Fig.6

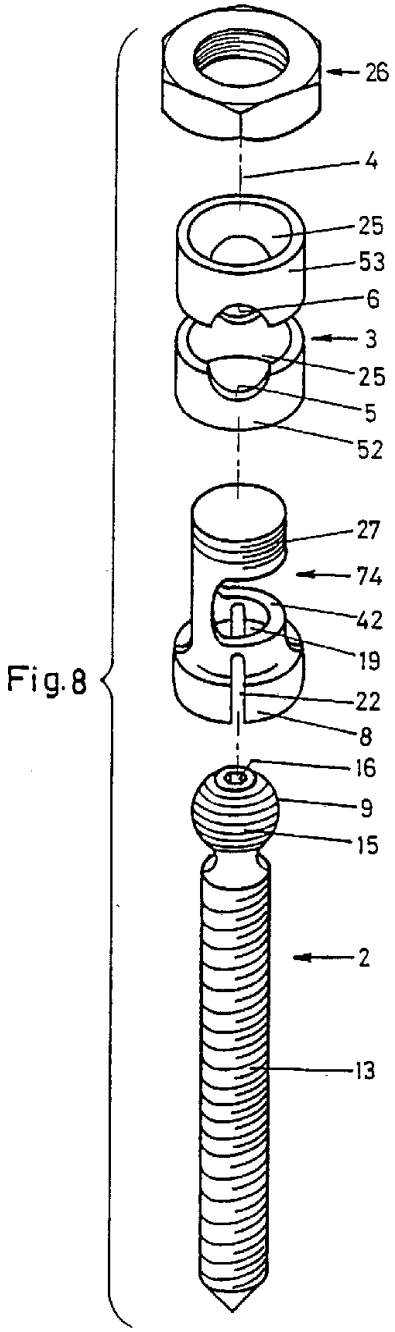
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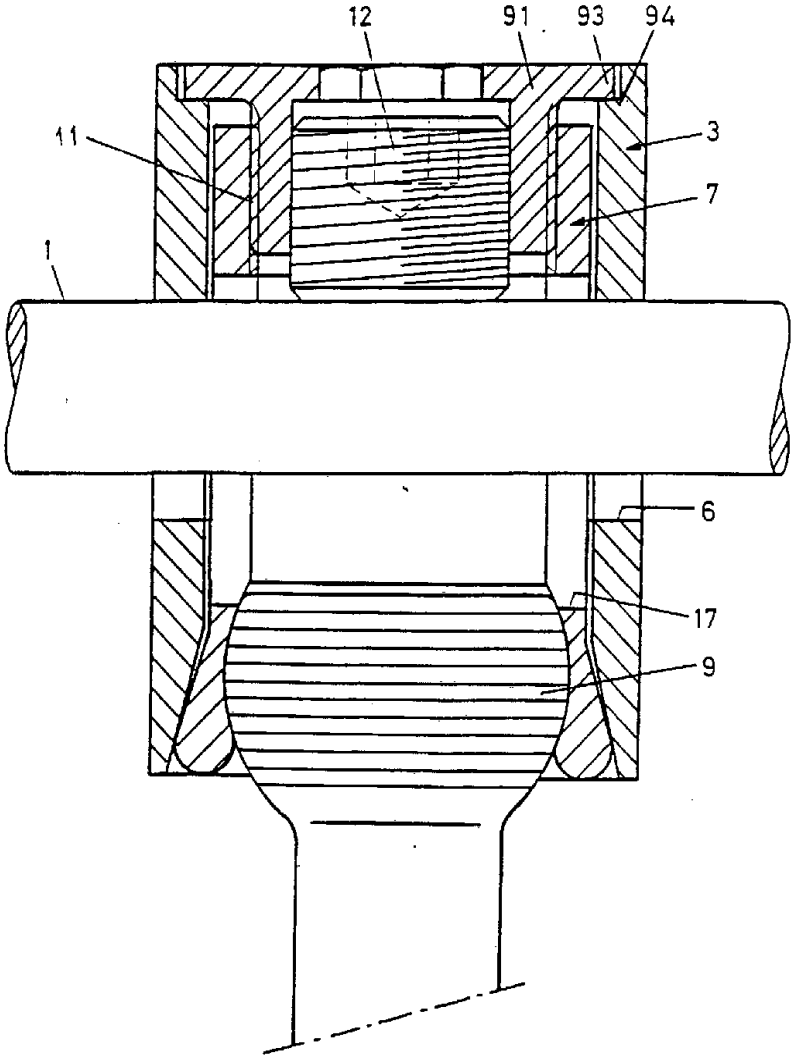
Fig.8

Fig. 7



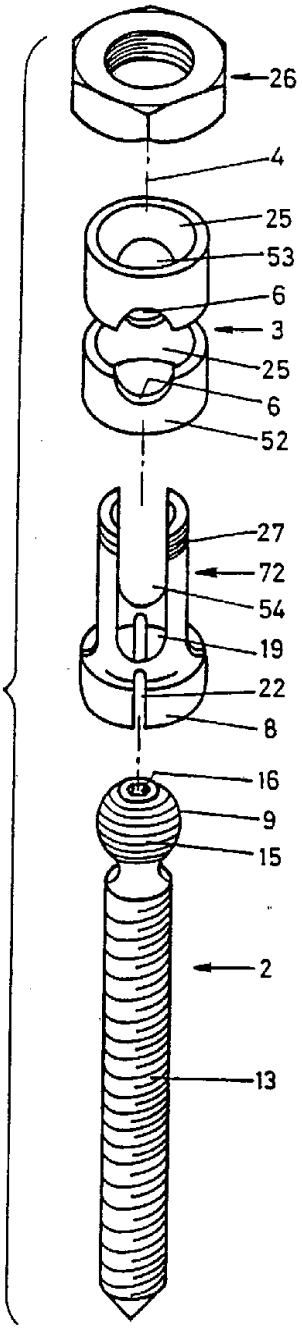

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Fig. 9

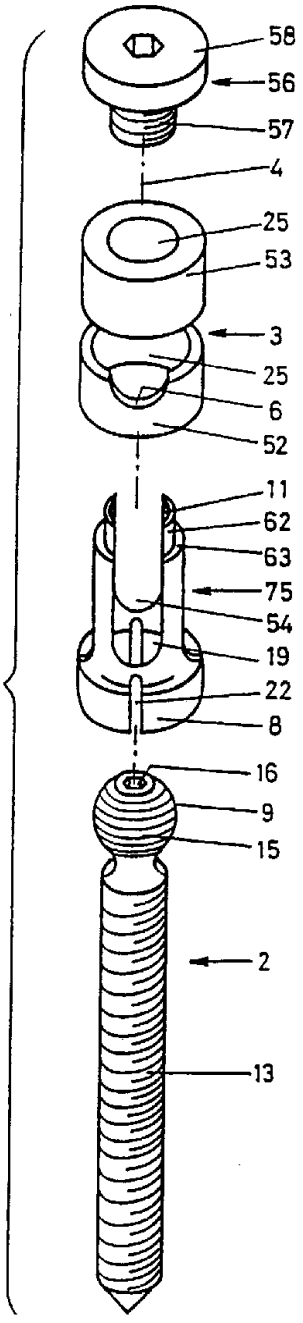
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Fig. 10

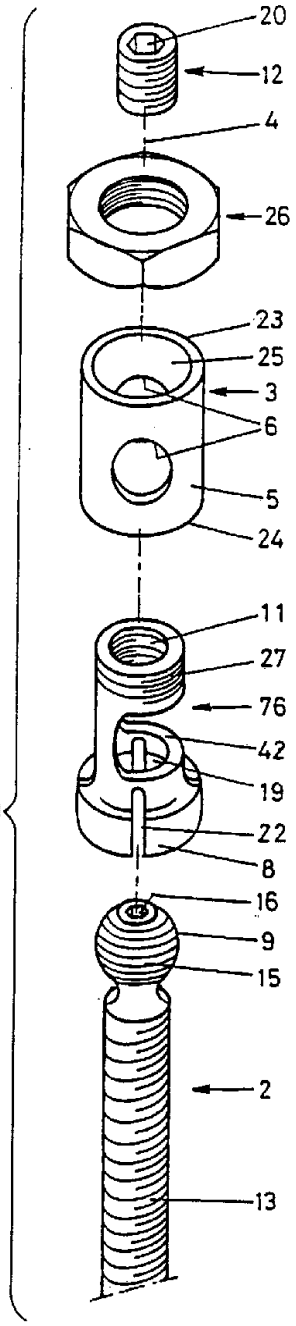
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Fig.11

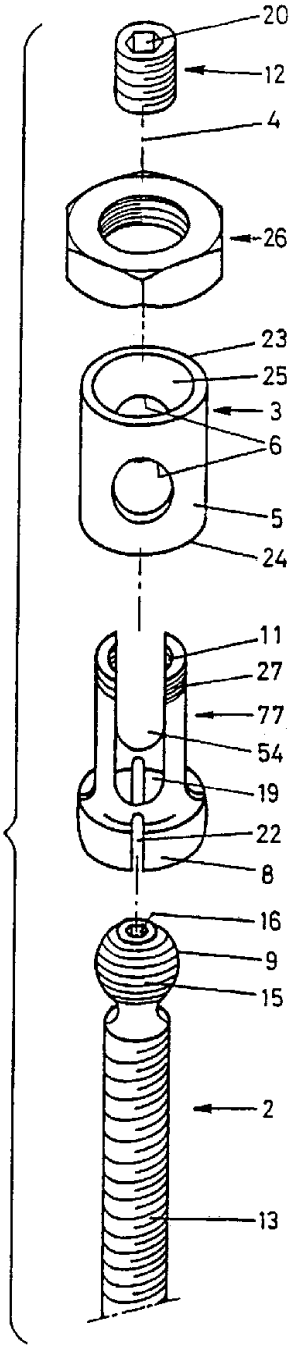
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Fig.12

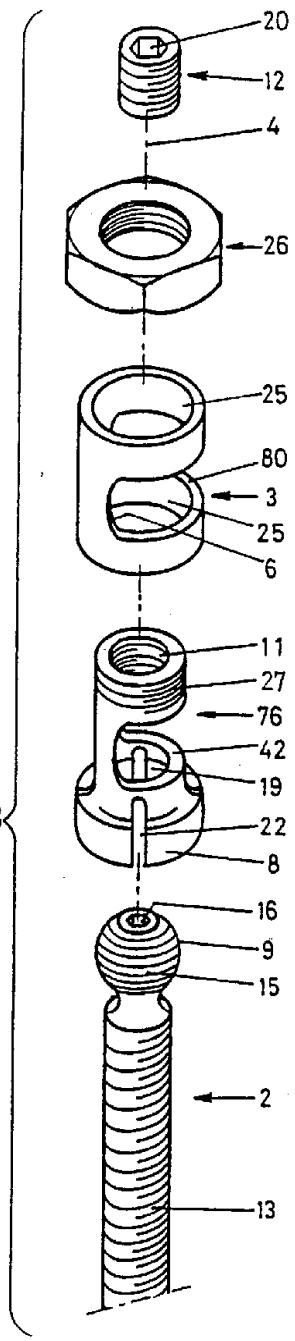
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Fig. 13

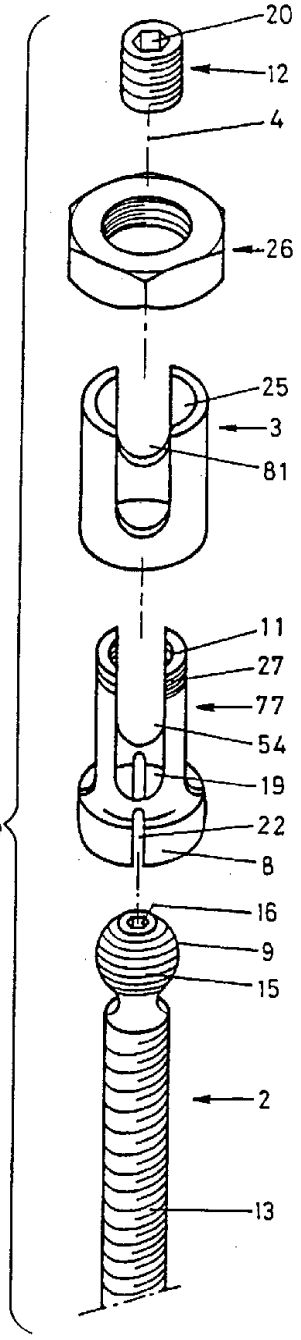
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Fig. 14