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(72) Inventeurs/Inventors:
SCHLAPFER, JOHANNES FRIDOLIN, CH;
HESS, MARTIN, CH;
SCHELKER, RENE, CH;
HAGMANN, RALF, CH

(73) Propriétaire/Owner:
SYNTHES (U.S.A.), US

(74) Agent: BORDEN LADNER GERVAIS LLP

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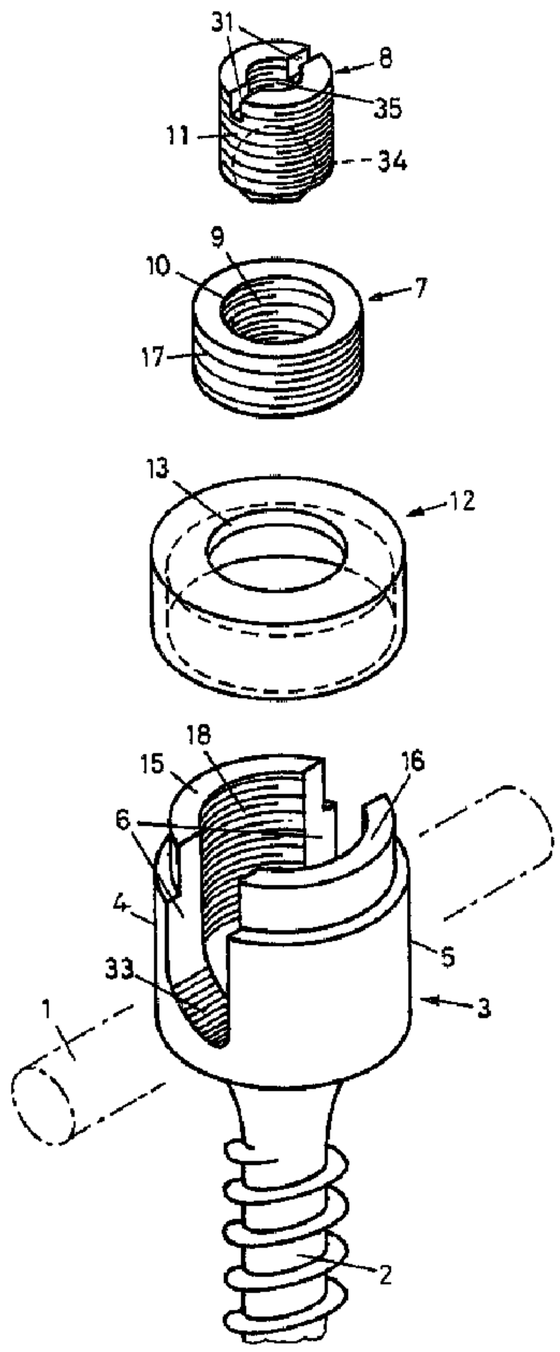


(57) Abrégé/Abstract:
The posterior spinal implant is used in a device supporting the spinal column. It comprises a spinal screw or hook which has slotted head to receive a support rod. A two-piece rod retainer is provided with an outer ring-like collar locked into the interior of the slotted head and a fastener extending through the collar to contact a support rod in the bottom of the slot.

ABSTRACT

The posterior spinal implant is used in a device supporting the spinal column. It comprises a spinal screw or hook which has a slotted head to receive a support rod. A two-piece rod retainer is provided with an outer ring-like collar locked into the interior of the slotted head and a fastener extending through the collar to contact a support rod in the bottom of the slot.

POSTERIOR SPINAL IMPLANT

The present invention concerns a posterior spinal implant.

Posterior spinal implants serve to correct sagittal spinal deformities (kyphosis, spondylolisthesis) or to act as stabilizers when there is no correction (degenerative instabilities). As a rule they comprise an affixing head, an anchoring segment connected to said head and a tightening screw pressing on a support bar received in a slot of the affixing head. Also a stabilizing rest may be present on the affixing head.

The anchoring segment may be a screw or hook, the screw being fastened directly above the pedicle of the vertebra body, whereas the hook will be suspended from the vertebra. In relation to the number of vertebra to be corrected or stabilized, several screws or hooks solidly joined to the support rod and thus fixed in place are required for spinal correction or stabilization.

As regards these known spinal implants, the tightening screw as a rule is directly screwed into the affixing head after the support rod was inserted into the slot. The following drawbacks are incurred thereby:

Because the U-shaped slot receives the support rod, the end of the affixing head will consist of only two tulip-shaped jaws so that the tightening screw shall rest only in the threads of these jaws. When the tightening screw must be screwed-in while being pressed, the surgeon has trouble sensing whether the screw is being properly inserted into the thread. Furthermore, to prevent the slot and hence the thread from widening, a stabilizing rest must be set up.

An implant already is known from the French patent document

FR-A 2,624,720 wherein the two legs of the affixing head forming a U-shaped slot comprise an external thread which may receive a screw-on cap through the central threaded part of which the actual affixing part can be screwed-in. However the manufacture of this known device is unsatisfactory and moreover it results in undesired enlargement of the affixing head both with respect to height and diameter.

The object of the present invention is to avoid the above drawbacks.

According to the invention, there is provided a spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising (a) an anchoring segment for attachment to the spine, (b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving a support rod, (c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs, (d) a fastener adapted to be inserted through said aperture and to clamp within said slot at least the largest diameter cylindrical support rod capable of passing through said slot, and (e) a safety bush adapted to surround at least a portion of said legs; said head further comprising a stop located at a position preventing said safety bush from clamping any cylindrical support rod capable of passing through said slot.

Further, the invention provides a spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising (a) an anchoring segment for attachment to the spine, (b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving said support rod, (c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs, and (d) a fastener comprising an externally threaded member adapted to be inserted in said aperture and a rotatable contacting element.

The invention offers the substantial advantage that the fastener can be inserted into a closed thread. As regards an open, slotted thread, high friction arises because of the lack of congruence between the inner and outer threads. Depending on the case, this friction may be so high that cold-welding takes place between the fastener and the affixing head.

The invention offers another advantage in that the fastener does not increase the volume of the affixing head and therefore the implant is more compatible.

Several embodiment modes of posterior spinal implants of the invention are elucidated in relation to the drawing. Only screw shanks are shown as the anchoring segments, though they may also be replaced by hooks.

Fig. 1 is an exploded perspective of a spinal implant of the invention,

Figs. 2 - 5 are exploded perspectives of further embodiments of spinal implants of the invention,

Fig. 6 is a longitudinal section of the affixing head of the spinal implant, and

Fig. 7 is a longitudinal section of the closure-part and fastener of the spinal implant.

In the spinal implant shown in Fig. 1, the affixing head 3 and the anchoring segment 2 constitute a pedicle-screw which can be screwed into a vertebra. To receive a support rod 1, the affixing head 3 is fitted with a U-shaped slot 6 formed by two legs 4, 5. An inner thread 18 is present in the upper part of the affixing head 3. A cylindrical closure-component 7 rotatable into the U-slot 6 of the affixing head 3 comprises an outer thread 17 matching the inner thread 18 and further a central borehole 10 fitted with an inner thread 9.

A fastener 8 comprising an outer thread 11 matching the inner thread 9 can be screwed into the borehole 10. For easier handling, the fastener 8 is fitted with a slot 31 at the top. A movable ball-segment 34 is installed at the bottom.

Lastly a safety bush 12 is provided and comprises a collar 13 at the top. The safety bush 12 is slipped over the upward-narrower leg ends 15, 16 of the affixing head 3. The safety bush 12 also may be made integral with the closure-part 7.

Appropriately the core diameter of the inner thread 18 in the affixing head 3, correspondingly, the outer diameter of the outer thread 17 in the closure-part 7, is in the range of 12 to 14 mm, preferably 12.5 to 13.5 mm. The outer diameter of the fastener 8 is in the range of 7 - 9 mm, preferably 7.5 to 8.5 mm. The width of the U-slot 6 in the affixing head 3, and the diameter of the support rod 6 in the affixing head, is in the

range of 5 - 7 mm, preferably 5.5 - 6.5 mm.

In the course of surgery, the pedicle screw is screwed by the anchoring segment 2 into the vertebra to be corrected or stabilized and the support rod 1 is inserted into the U-slot 6 of the affixing head. Thereupon the closure-part 7 is rotated axially from above into the U-slot 6 until the upper edge is flush with the two legs 15, 16. The fastener 8 already may have been slightly screwed into the closure-part 7. In the light of clinical experience so far, the screws in the various vertebra always are mounted in such manner that enough space is available to axially screw-in the closure-part 7. This is also the case when hooks are used.

Unless the safety bush 12 be rigidly joined to the closure-part 7, this is the time it must be mounted before tightening the fastener 8. Said bush prevents the legs 4, 5 from spreading.

Next the fastener 8 together with its (graphically not represented) and temporarily linked extension piece is screwed into the closure-part 7 until the ball-segment 34 rests on the support rod 1, and then the fastener is tightened. As a result the support rod 1 is clamped in the U-slot 6. The ball-segment 34 is of such a shape that the clamping force increases proportionally when the support rod 1 is loaded in its longitudinal direction. Following clamping, the extension-piece

is removed from the fastener 8. The same procedure is repeated in the other implants.

The above described spinal implant of the invention offers many advantages. Illustratively the fastener 8 clamping the support rod 1 is guided in a closed thread and is screwed-in only after the support rod 1 has been properly positioned. Contrary to conventional implants with posterior aperture, the slotted thread 18 in the affixing head 3 is not used for tightening but only to affix the closure-part 7. The fastener 8 already may be slightly screwed into the closure-part 7 before latter itself is handled. The outside diameter of the fastening devices 7, 8 and the safety bush 12 being less than or equally large as the outside diameter of the affixing head 3, the implant diameter will not enlarge.

In Figs. 5-7, the closure-part 7 is affixed to the affixing head 3 not by screw-means but in bayonet-fashion. As already shown in Fig. 1, the fastener 8 is screwed into a full inner thread 9 in the closure-part 7.

In the modified spinal implant shown in Fig. 2, the closure-part 7 is fitted with two mutually opposite studs 20, 21 at its surface 19. The two legs 4,5 of the U-slot 6 of the affixing head 3 comprise circular channels 24, 25 for said studs at their

insides 22, 23. After the closure-part 7 has been axially inserted, it will be screwed into the U-slot 6 and in the process the studs 20 and 21 are inserted into the channels 24, 25.

In this embodiment mode the fastener 8 also may comprise at its bottom a rotatable, spherical contacting element in the form of a ball segment 34 to achieve a better fit to the surface geometry of the support rod 1. Details concerning this contacting element 34 are described in the European patent application 93 106520.5, published as EP 0 572 790 A1.

The base of the U-slot 6 comprises a concave clearance extending in the longitudinal direction of said base and receiving a movable element 36 with longitudinal serration 33, the displacement of the element 36 being determined by the geometry of the concave clearance.

In Fig. 3 the closure-part 7 is fitted with a circular transverse channel 26 and two mutually opposite longitudinal channels 27, 28 in its surface 19. The longitudinal channels 27, 28 coincide in position and direction with studs 29, 30 located on the inner sides 22, 23 of the legs 4, 5. After the closure-part 7 has been axially inserted into the U-slot 6, the studs 29, 30 can be inserted by rotation into the incomplete circular transverse channel 26. Preferably the circular transverse channel 26 shall run less than the full circumference of the closure-part 7.

A safety bush is not mandatory in the embodiments shown in Figs. 2 and 3 because the two legs 4, 5 do not tend to spread when the fastener 8 is tightened because the closure is a bayonet-type.

Fig. 4 shows an embodiment mode in which the closure-part 7 and the safety bush 12 are integral. The closure-part 7 is locked in the affixing head 3 in a manner similar to that shown by Figs. 2 and 3. The transverse channel 26 with longitudinal arms 27, 28 is present in this case on the outer surface of the upward-narrower leg ends 15, 16 of the affixing head 3 instead of being present on the inside of the legs 4, 5. The longitudinal arms 27, 28 coincide in position and direction with studs 29, 30 inside the safety bush 12. After the closure-part 7 has been axially inserted into the U-slot 6, the studs 29, 30 can be rotated into the circular transverse channel 26.

Fig. 5 shows an embodiment reciprocal to that of Fig. 4 wherein the circular transverse channel 26 together with its longitudinal channels 27, 28 is present in the safety bush 12 and the studs 29, 30 are present on the outer surface of the upward-narrower leg ends 15, 16 of the affixing head.

Fig. 6 shows how the base of the U-slot 6 of the affixing head 3 comprises a double radius R_a, R_b to allow receiving support rods 1 of different diameters.

Lastly Fig. 7 shows a preferred embodiment mode of the fastener 8 which is fitted with a flange 37 at its end facing the support rod 1. At its side away from the support rod 1, the flange 37 subtends an angle 30 of α between 0 and 90°, preferably between 45 and 60°. The closure-part 7 comprises a corresponding bevel 38.

The flange 37 and the bevel 38 serve to strongly and mutually brace the closure-part 7 and the fastener 8 prior to implantation in such manner that the closure-part 7 and the fastener 8 shall act as a unit up to a given torque and will separate only after this torque has been exceeded. Separation takes place when the closure-part 7 or the stabilizing bush 12 are stopped when being screwed-in and only the fastener 8 being able to penetrate further until coming to rest against the support rod 1 which it then starts clamping.

Claims:

1. A spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising

(a) an anchoring segment for attachment to the spine,

(b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving a support rod,

(c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs,

(d) a fastener adapted to be inserted through said aperture and to clamp within said slot at least the largest diameter cylindrical support rod capable of passing through said slot, and

(e) a safety bush adapted to surround at least a portion of said legs;

said head further comprising a stop located at a position preventing said safety bush from clamping any cylindrical support rod capable of passing through said slot.

2. The implant kit claimed in claim 1 wherein the aperture is centrally located in said closure element and has an internal thread.

3. The implant kit claimed in claim 1 or 2 wherein the fastener has an external thread matching the internal thread of the aperture.

4. The implant kit claimed in claim 1, 2 or 3 wherein the outside diameter of the closure element is not greater than the outer diameter of the head.

5. The implant kit claimed in any one of claims 1 to 4 wherein each of said legs has an end remote from said anchoring segment, the ends of the legs are narrowed, and the saftey bush has an inner diameter such that it can be

slipped over the ends of the legs and an outer diameter no greater than the outer diameter of the head.

6. The implant kit claimed in claim 5 wherein the safety bush comprises a collar having an opening large enough to allow passage of the fastener.

7. The implant kit claimed in claim 5 wherein the safety bush comprises a flange having a aperture large enough to accommodate the fastener.

8. The implant kit claimed in any one of claims 1 to 7 wherein the safety bush and closure element are formed integrally.

9. The implant kit claimed in any one of claims 1 to 7 wherein the safety bush and closure element are connected to one another.

10. The implant kit claimed in claim 1 wherein the closure element has an outer thread and the slot has a matching inner thread.

11. The implant kit claimed in claim 1 wherein the closure element comprises a stud and a leg of the slot has a matching arcuate transverse channel to receive said stud thus to form a bayonet type closure element.

12. The implant kit claimed in claim 1 wherein the closure element comprises a transverse channel and two longitudinal channels connecting to said transverse channel and the inner surfaces of the legs have studs for insertion into said channels to lock said closure element in said slot.

13. The implant kit claimed in claim 11 wherein the transverse channel extends over less than the full circumference of the head.

14. The implant kit claimed in claim 12 wherein the transverse channel extends over less than the full circumference of the closure element.

15. The implant kit claimed in claim 1 wherein the fastener is a set screw having a central aperture.

16. The implant kit claimed in claim 15 wherein the aperture of the fastener is threaded.

17. The implant kit claimed in claim 15 wherein the set screw comprises a convex surface.

18. The implant kit claimed in claim 17 wherein the convex surface has a countersink.

19. The implant kit claimed in claim 18 wherein the countersink is conical.

20. The implant kit claimed in claim 15, wherein the set screw tapers to a point.

21. The implant kit claimed in claim 1 wherein the base of the slot is serrated.

22. The implant kit claimed in claim 1 wherein the base of the slot has a first, relatively small radius in a central region at the bottom of the slot and a second, relatively larger radius on either side of said central region.

23. The implant kit claimed in any one of claims 1 to 22 wherein the diameter of the closure element is in the range of 8 to 12 mm.

24. The implant kit claimed in claim 23 wherein the diameter of the closure element is in the range 9.5 to 10.5 mm.

25. The implant kit claimed in any one of claims 1 to 22 wherein the diameter of the fastener is in the range of 7 to 9 mm.

26. The implant kit claimed in claim 25 wherein the diameter of the fastener is in the range 7.5 to 8.5 mm.

27. The implant kit claimed in any one of claims 1 to 22 wherein the width of the slot is in the range of 5 to 7 mm.

28. The implant kit claimed in claim 27 wherein the width of the slot is in the range 5.5 to 6.5 mm.

29. The implant kit claimed in claim 1 wherein the base of the slot comprises a recess for receiving a movable element for contacting a support rod inserted in said slot.

30. A spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising

(a) an anchoring segment for attachment to the spine,

(b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving a support rod,

(c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs,

(d) a fastener adapted to be inserted through said aperture and to clamp within said slot at least the largest diameter cylindrical support rod capable of passing through said slot, and

(e) a safety bush adapted to surround at least a portion of said legs;

said head further comprising a stop located at a position preventing said safety bush from clamping any cylindrical support rod capable of passing through said slot, wherein the fastener comprises a rotatable, spheroidal contacting element.

31. The implant kit claimed in claim 30 wherein the fastener comprises a spherical contact element having a portion cut away to provide a surface for contacting said support rod.

32. A spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising

(a) an anchoring segment for attachment to the spine,

(b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving a support rod,

(c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs,

(d) a fastener adapted to be inserted through said aperture and to clamp within said slot at least the largest diameter cylindrical support rod capable of passing through said slot, and

(e) a safety bush adapted to surround at least a portion of said legs;

said head further comprising a stop located at a position preventing said safety bush from clamping any cylindrical support rod capable of passing through said slot, wherein the fastener comprises a flange at the end of said fastener closest to the anchoring segment.

33. The implant kit claimed in claim 32, wherein the flange has a chamfered surface on the side away from the anchoring element comprising an angle between 0 and 90°.

34. The implant kit claimed in claim 33 wherein the angle is between 45° and 60°.

35. The implant kit claimed in claim 33 or 34 wherein the closure element comprises a countersink matching the chamfered surface of the flange.

36. A spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising

(a) an anchoring screw for attachment to the spine,

(b) a cylindrical head attached at one end to and coaxial with said anchoring screw, said head comprising (1) two legs defining a transverse slot for receiving a support rod, and (2) an internally threaded recess between said legs,

(c) a cylindrical closure element having a central, axial aperture and having external threads adapted for engagement with said internally threaded recess,

(d) a fastener adapted for insertion through said aperture to clamp a support rod within said slot, and

(e) a safety bush adapted for surrounding at least a portion of the legs, said safety bush having an outer diameter no greater than the outer diameter of the head,

and said head further comprising a stop adapted to prevent said safety bush from contacting the largest diameter cylindrical support rod which can be clamped in said slot by said fastener.

37. A spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising

(a) an anchoring segment for attachment to the spine,

(b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving said support rod,

(c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs, and

(d) a fastener comprising an externally threaded member adapted to be inserted in said aperture and a rotatable contacting element.

38. The implant kit claimed in claim 37 wherein said fastener being adapted to clamp within said slot at least the largest diameter cylindrical support rod capable of passing through said slot.

39. The implant kit claimed in claim 37 wherein a major portion of said contacting element is spherical.

40. The implant kit claimed in claim 37 wherein a portion of said contacting element is cut away to provide a surface for contacting said support rod.

41. The implant kit claimed in any one of claims 37 to 40 wherein the base of said slot is serrated.

42. The implant kit claimed in any one of claims 37 to 40 wherein the base of the slot has a first, relatively small radius in a central region at the bottom of the slot and a second, relatively larger radius on either side of said central region.

43. The implant kit claimed in claim 37 wherein said fastener is adapted to clamp within said slot at least the largest diameter cylindrical support rod capable of passing through said slot, a major portion of said contacting element is spherical and a portion of said contacting element is cut away to provide a surface for contacting said support rod.

44. The implant kit claimed in claim 43 wherein the base of said slot is serrated.

45. The implant kit claimed in claim 43 wherein the base of said slot has a plurality of radii.

46. A spinal implant kit for attachment of an implant to a spine and for clamping a support rod, said implant kit comprising

(a) an anchoring segment for attachment to the spine,

(b) a head attached to said anchoring segment, said head comprising two legs defining a transverse slot for receiving a support rod,

(c) a cylindrical closure element having an aperture and locking means adapted for engagement with said legs, and

(d) a fastener adapted to be inserted in said aperture and to clamp within said slot at least the largest diameter cylindrical rod capable of passing through said slot, and wherein the fastener comprises a flange at the end of said fastener closest to the anchoring segment.

47. The implant kit claimed in claim 46 wherein the flange has a chamfered surface on the side away from the anchoring element comprising an angle between 0 and 90°.

48. The implant kit claimed in claim 47 wherein the angle is between 45° and 60°.

49. The implant kit claimed in claim 47 wherein the closure element comprises a countersink matching the chamfered surface on said flange.

50. The implant kit claimed in claim 48 wherein the closure element comprises a countersink matching the chamfered surface on said flange.

Fig. 1

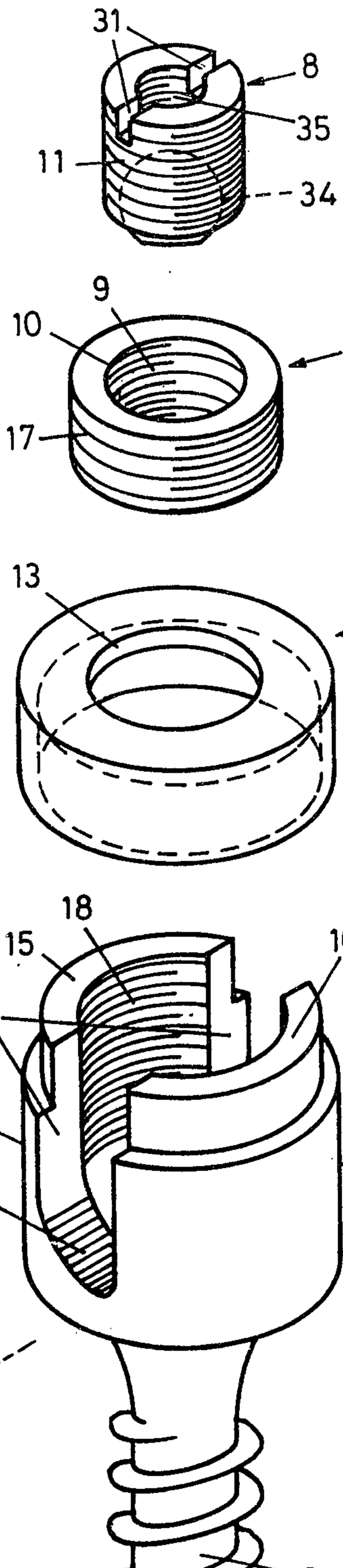


Fig. 2

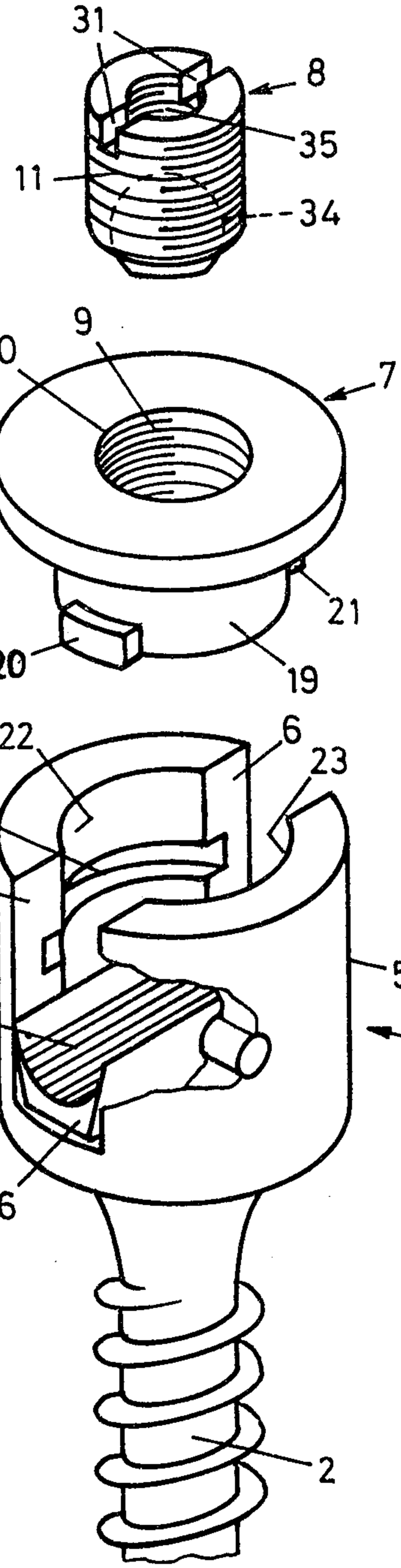


Fig. 3

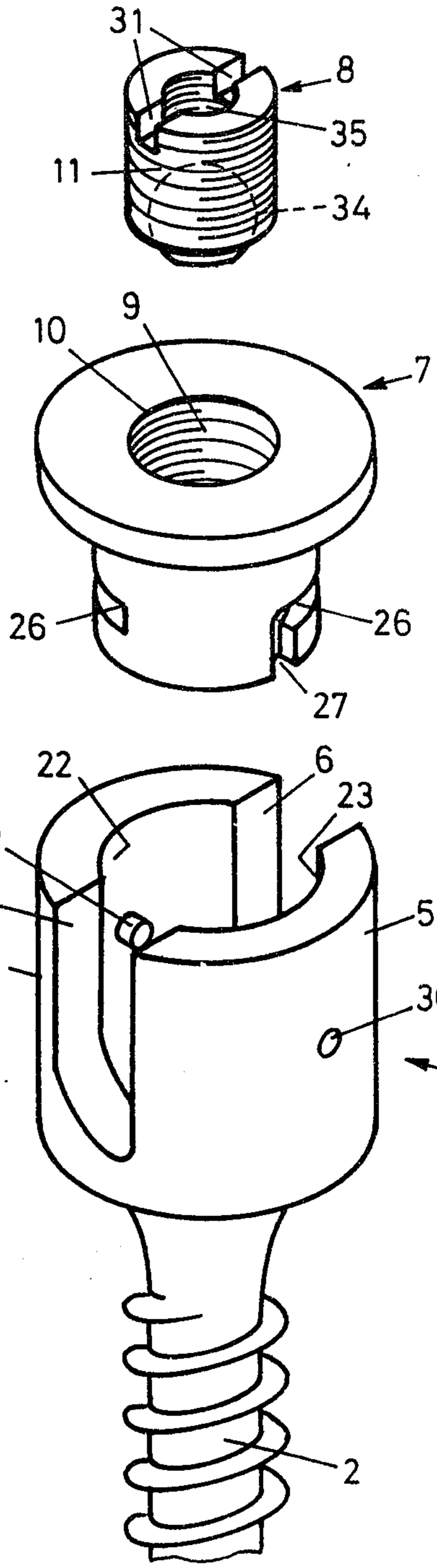


Fig. 4

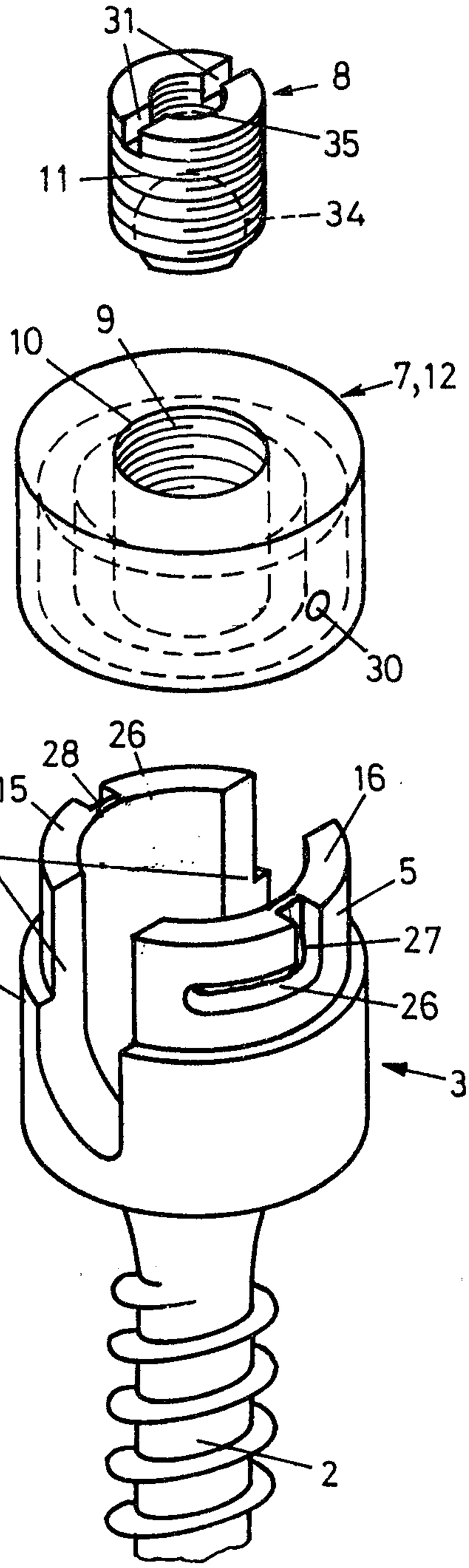


Fig. 5

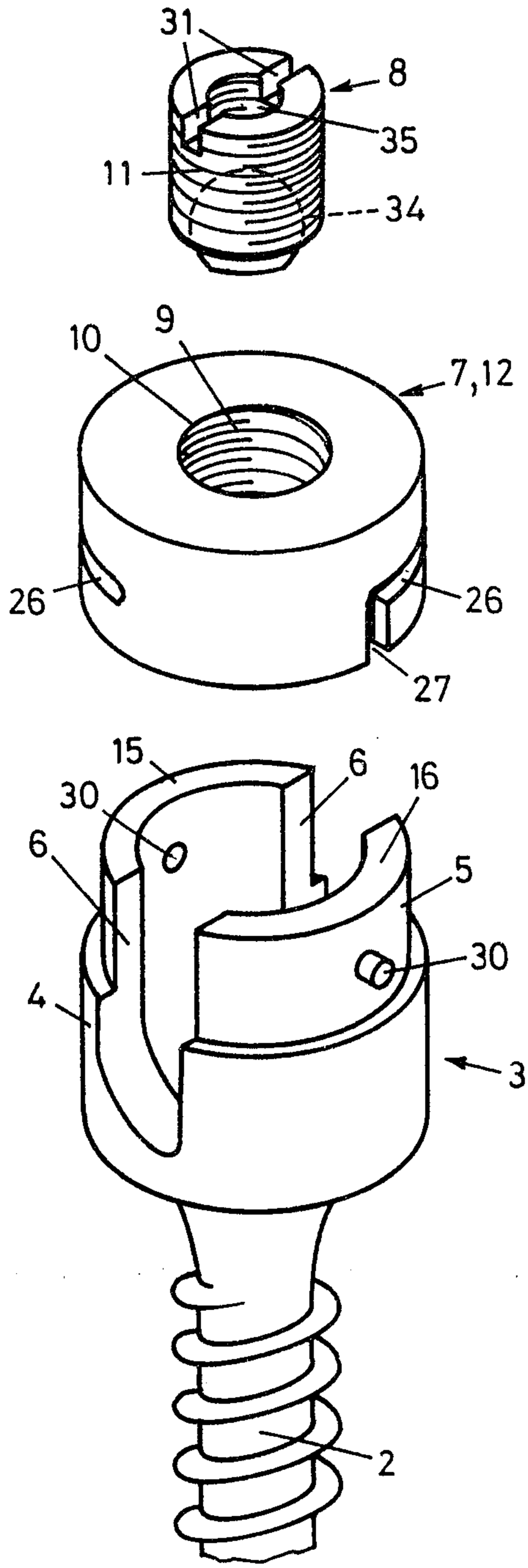


Fig. 6

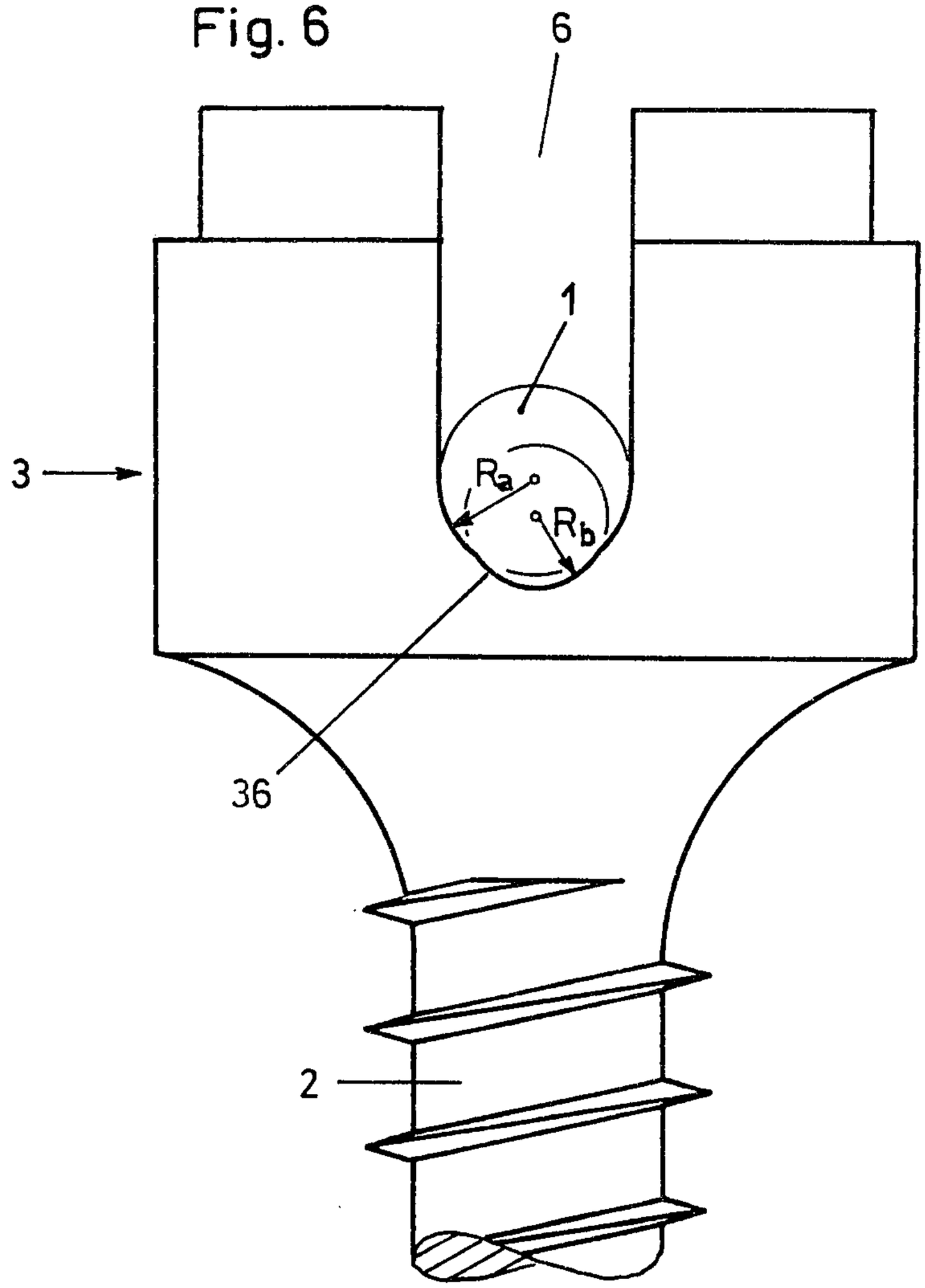
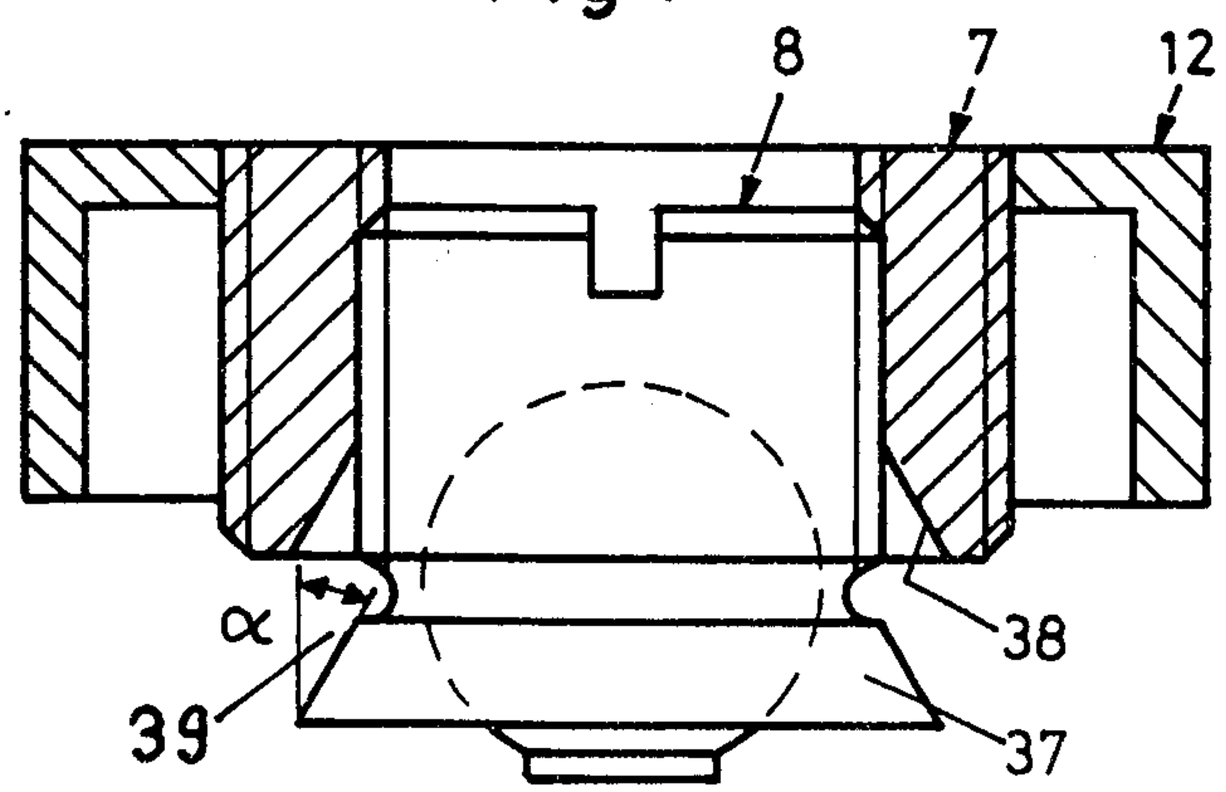
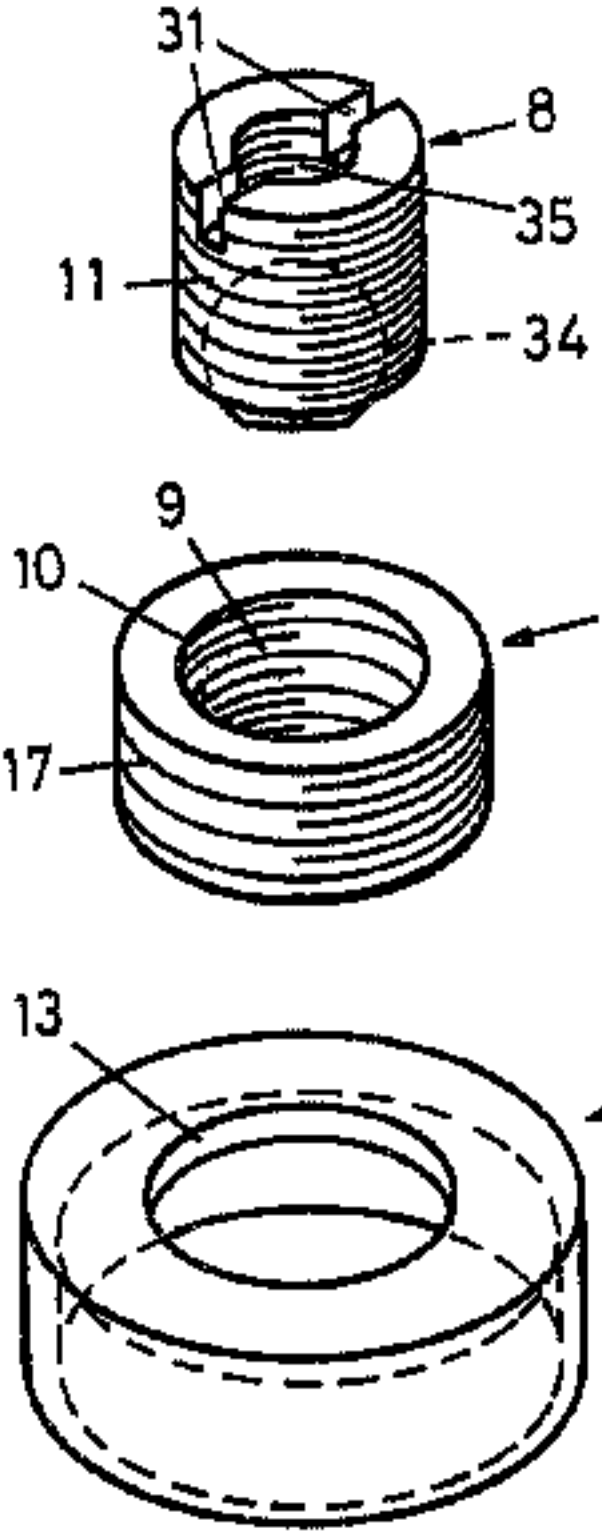


Fig. 7

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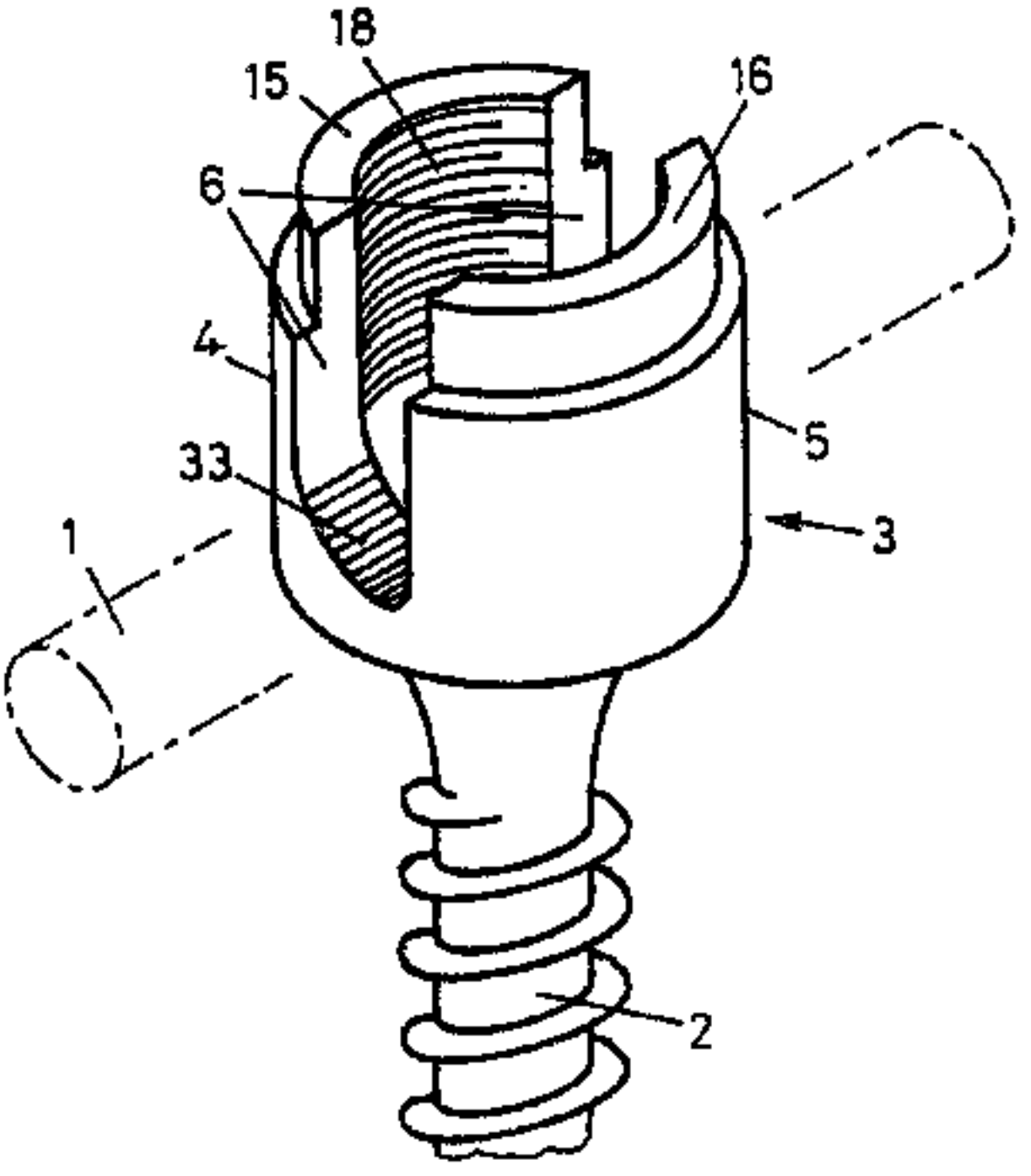
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