



(86) Date de dépôt PCT/PCT Filing Date: 2008/05/21
 (87) Date publication PCT/PCT Publication Date: 2008/12/04
 (85) Entrée phase nationale/National Entry: 2009/11/27
 (86) N° demande PCT/PCT Application No.: IB 2008/051994
 (87) N° publication PCT/PCT Publication No.: 2008/146199
 (30) Priorité/Priority: 2007/05/29 (FR0703783)

(51) Cl.Int./Int.Cl. *A61B 17/86* (2006.01)
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(54) Titre : VIS D'OS, EN PARTICULIER POUR UNE OSTEOSYNTHESE
 (54) Title: BONE SCREW, IN PARTICULAR FOR OSTEOSYNTHESIS

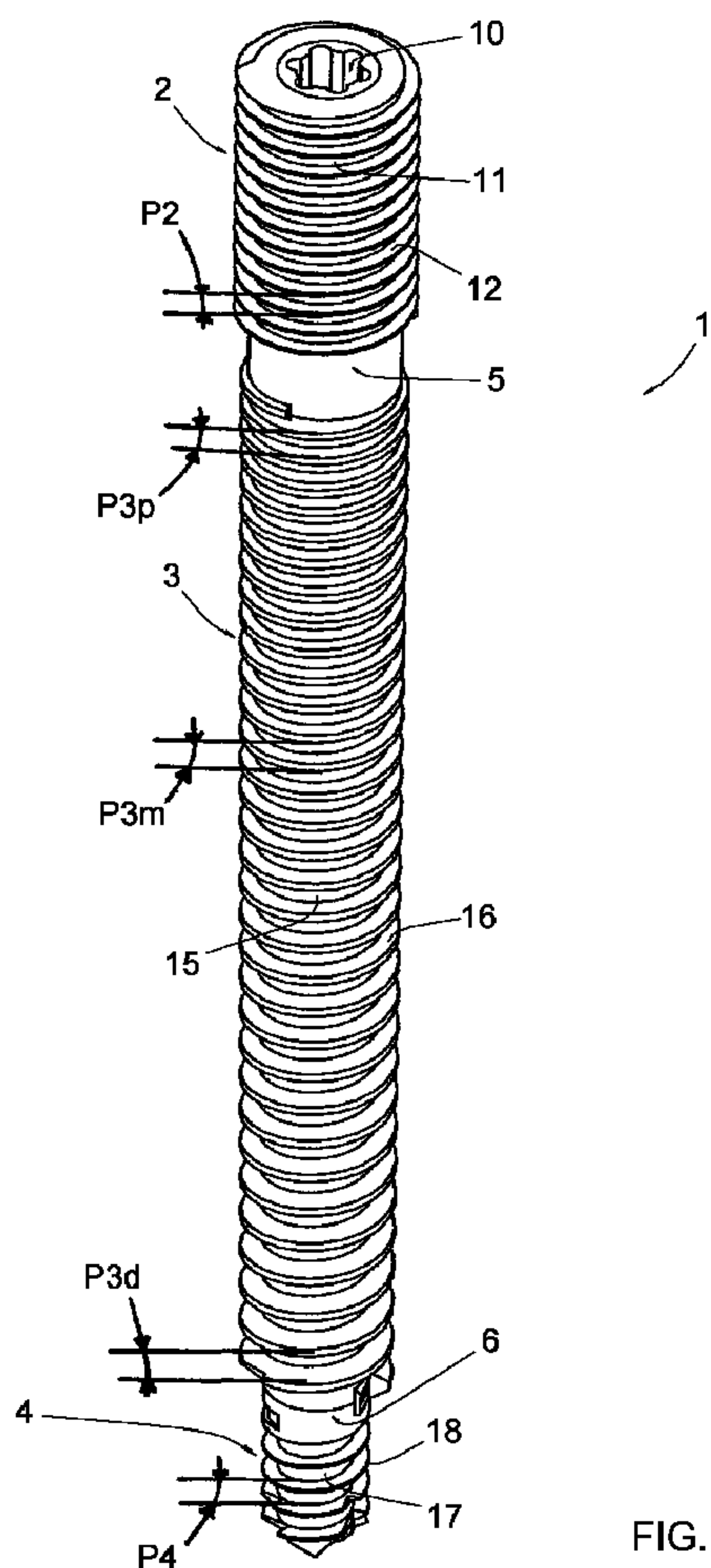


FIG. 1

(57) **Abrégé/Abstract:**

According to the invention, this screw (1) includes: - a threaded proximal portion (2), the core (11) and thread (12) of which have a constant diameter; - a threaded median portion (3), the core (15) of which is conical, having a diameter becoming increasingly

(57) **Abrégé(suite)/Abstract(continued):**

larger from the distal end of this threaded median portion (3) to the proximal end of this threaded median portion (3), and the thread (16) of which has a constant diameter, smaller than the diameter of the thread (12) of the proximal threaded portion (2); the pitch of the thread (16) of this threaded median portion (3) becomes increasingly smaller from said distal end towards said proximal end, and, at the proximal end of this threaded median portion (3), this pitch is larger than the pitch of the thread (12) of the proximal threaded portion (2); - a threaded distal portion (4), the core (17) and the thread (18) of which have a constant diameter and the thread (18) of which has a diameter smaller than the diameter of the thread (16), the pitch of the thread (18) of this threaded distal portion (4) being larger than the pitch of the thread (16) at the distal end of this threaded median portion (3).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
4 December 2008 (04.12.2008)

PCT

(10) International Publication Number
WO 2008/146199 A3(51) International Patent Classification:
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Peronnas (FR).(21) International Application Number:
PCT/IB2008/051994(74) Agent: JEANNET, Olivier; 40 rue Raulin, F-69007 Lyon
(FR).

(22) International Filing Date: 21 May 2008 (21.05.2008)

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA,
CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE,
EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID,
IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC,
LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN,
MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH,
PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV,
SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN,
ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0703783 29 May 2007 (29.05.2007) FR(71) Applicant (for all designated States except US): SMALL
BONE INNOVATIONS INTERNATIONAL [FR/FR];
Z.A Les Bruyères, F-01960 Peronnas (FR).(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

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[Continued on next page]

(54) Title: BONE SCREW, IN PARTICULAR FOR OSTEOSYNTHESIS

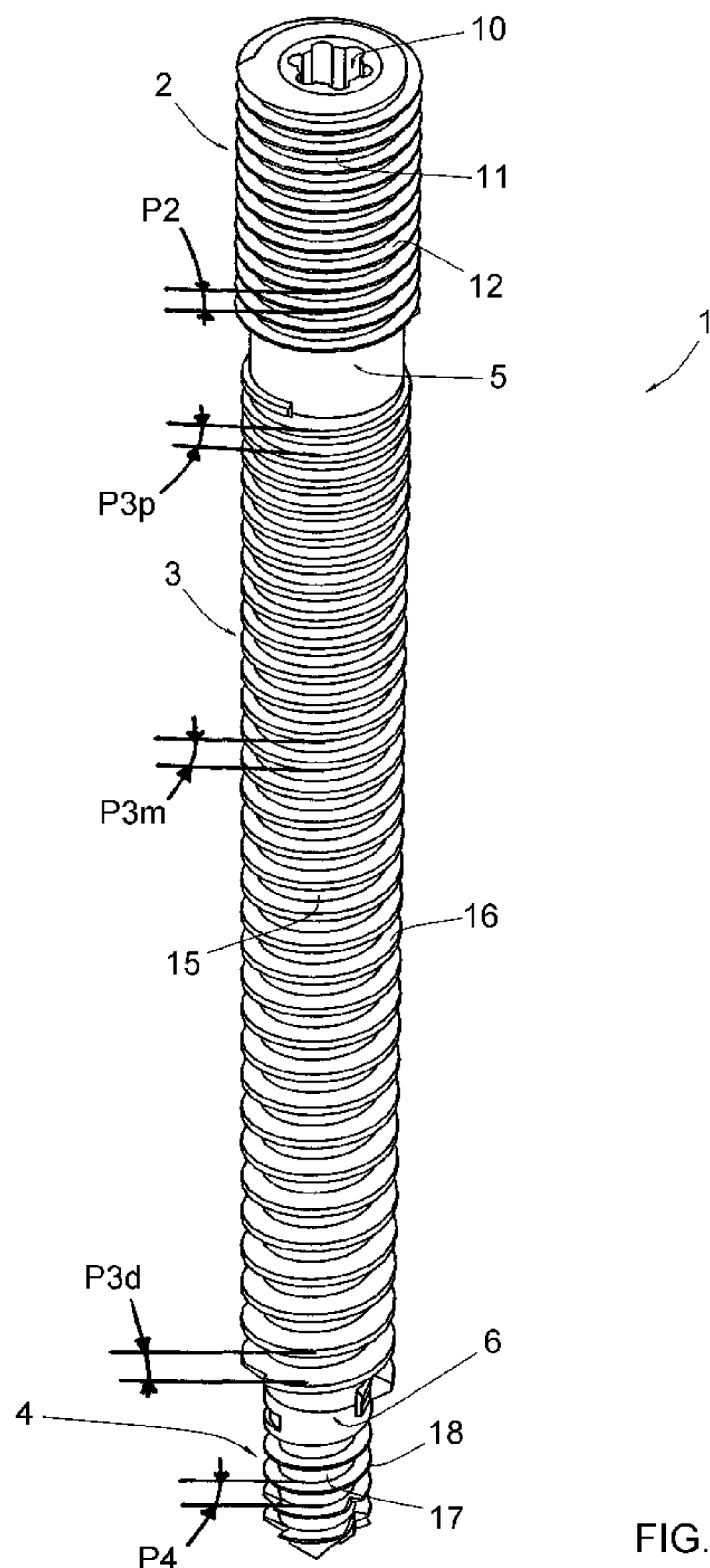


FIG. 1

(57) Abstract: According to the invention, this screw (1) includes: - a threaded proximal portion (2), the core (11) and thread (12) of which have a constant diameter; - a threaded median portion (3), the core (15) of which is conical, having a diameter becoming increasingly larger from the distal end of this threaded median portion (3) to the proximal end of this threaded median portion (3), and the thread (16) of which has a constant diameter, smaller than the diameter of the thread (12) of the proximal threaded portion (2); the pitch of the thread (16) of this threaded median portion (3) becomes increasingly smaller from said distal end towards said proximal end, and, at the proximal end of this threaded median portion (3), this pitch is larger than the pitch of the thread (12) of the proximal threaded portion (2); - a threaded distal portion (4), the core (17) and the thread (18) of which have a constant diameter and the thread (18) of which has a diameter smaller than the diameter of the thread (16), the pitch of the thread (18) of this threaded distal portion (4) being larger than the pitch of the thread (16) at the distal end of this threaded median portion (3).

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FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,
NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG,
CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments*

Published:

— *with international search report*

(88) Date of publication of the international search report:

30 April 2009

BONE SCREW, IN PARTICULAR FOR OSTEOSYNTHESIS

This invention relates to a bone screw, in particular for osteosynthesis.

Several types of bone screws are known, in particular for osteosynthesis, which combine two or more of the following characteristics:

- 5 - with or without a head;
- threaded over the entire length of the screw body or over only a portion of this body;
- having a thread with a constant pitch or a larger pitch in the distal portion; in this second case, the screw enables the reduction of a fracture
- 10 through which it is implanted, the rotation of the screw moving the distal bone fragment towards the proximal bone fragment, taking into consideration the difference in pitch;
- having a thread with a constant diameter or a diameter becoming increasingly larger from the distal end to the proximal end.

15 Existing screws do not give complete satisfaction as concerns carrying out an osteosynthesis, and this invention has the objective of remedying this disadvantage.

To that effect, the bone screw according to the invention includes:

- 20 - a threaded proximal portion, the core and thread of which have a constant diameter;
- a threaded median portion, the core of which is conical, having a diameter becoming increasingly larger from the distal end of this threaded median portion to the proximal end of this threaded median portion, and the thread of which has a constant diameter, smaller than the diameter of the
- 25 thread of the proximal threaded portion; the pitch of the thread of this threaded median portion becomes increasingly smaller from said distal end towards said proximal end, and, at the proximal end of this threaded median portion, this pitch is larger than the pitch of the thread of the proximal threaded portion;
- a threaded distal portion, the core and the thread of which have a
- 30 constant diameter and the thread of which has a diameter smaller than the diameter of the thread of the median threaded portion, the pitch of the thread of this threaded distal portion being larger than the pitch of the thread of the threaded median portion at the distal end of this threaded median portion.

35 The screw according to the invention thus includes a threaded proximal portion and a threaded distal portion with straight threads, suited to being

perfectly supported in the cortical or subchondral bone, and a threaded median portion of constant diameter but with a continuously increasing core diameter in the proximal direction, thus with a continuously increasing thread height from the distal end towards the proximal end of this threaded median portion; furthermore, the pitch of the threads of the threaded distal, median and proximal portions decreases from the distal end of the screw towards the proximal end of this screw.

During positioning of the screw through two bone portions or fragments having to undergo osteosynthesis, the threaded distal portion is inserted into the distal cortical or subchondral bone of the distal fragment, the threaded median portion intended to take position in the cancellated bone by gradually pushing this cancellated bone back radially, owing to the increase in the diameter of its core in the proximal direction, thereby compacting this cancellated bone, and the threaded proximal portion of the screw is inserted into the proximal cortical bone of the proximal fragment. The continuous decrease in the thread pitch of said threaded median portion also enables axial compression of the cancellated bone.

The insertion of the threaded distal portion into the subchondral or cortical bone and the radial and axial compaction of the cancellated bone around the threaded median portion enable the screw to be perfectly supported in the distal bone portion or fragment; symmetrically, the threaded proximal portion is inserted into the proximal cortical bone and enables this threaded proximal portion to be perfectly supported in the proximal bone portion or fragment; these perfect supports, combined with the decrease of the thread pitch from the distal end towards the proximal end of the screw, enable a reduction of the fracture to be achieved and the two bone portions or fragments to be held perfectly under light compression, and therefore osteosynthesis to be carried out under the best conditions, by simply inserting one or more screws according to the invention into these bone portions or fragments.

When the subchondral bone is still of good quality, the thread of the threaded median portion itself alone enables sufficient support in the bony portions or fragments to bring them together and compress them; insertion of the threaded distal portion into the distal cortical bone is then not particularly necessary; conversely, when the subchondral bone is depleted, or even

nonexistent, the support inside the distal bone portion or fragment is made by inserting the threaded distal portion into the distal cortical bone.

The screw advantageously includes at least one transverse hole intended to receive a screw or a pin ensuring that the screw is blocked in rotation in relation to a bone portion or fragment.

The screw according to the invention is thus suited to ankle arthrodesis, as a replacement for an interlocking nail. It enables compression of the bone portions before locking is carried out.

Each transverse hole can be a through-hole or not, smooth, or tapped, perpendicular to the longitudinal axis of the screw or oblique in relation to this axis.

The screw according to the invention preferably includes at least two transverse holes, one of which is arranged in the proximal portion of the screw and the other of which is arranged in the distal portion of the screw.

Thus, one transverse hole is intended to run near a proximal bone portion or bony fragment and the other transverse hole is intended to run near a distal portion or bony fragment, whereby the screw can be immobilised in rotation in relation to the two bony portions or fragments.

The screw can include an intermediate portion between the threaded distal portion and the threaded median portion and/or between the threaded median portion and the threaded proximal portion.

This or these intermediate portions can be flared or not, and/or threaded or smooth.

Said transverse hole(s) is (are) preferably arranged near said intermediate portion(s).

The invention will be well understood, and other characteristics and advantages of it will become apparent, with reference to the appended schematic drawing, showing, for non-limiting illustrative purposes, several embodiments of the bone screw to which it relates.

Figure 1 is a perspective view of the screw according to a first embodiment;

Figures 2 to 5 are perspective views of it as it is being positioned in two bone fragments having to undergo osteosynthesis;

Figure 6 is a perspective view of the screw according to another embodiment; and

Figure 7 is a perspective view of it, according to yet another embodiment.

For the sake of simplifying matters, the portions or elements of one embodiment which are found to be identical or similar in another embodiment will be identified by the same numeric references and will not be described again.

Figure 1 shows a bone screw 1 including a threaded proximal portion 2, a threaded median portion 3 and a threaded distal portion 4, separated, respectively, by intermediate portions 5 and 6.

The threaded proximal portion 2 includes an axial cavity 10 for manoeuvring the screw 1 in rotation and is threaded over its entire height. The core 11 and the thread 12 of this portion 2 have a constant diameter, and the pitch P2 of this thread 12 is constant.

The threaded median portion 3 is likewise threaded over its entire height. The core 15 of this portion 3 is conical, having a diameter which decreases continuously from the distal end of this threaded median portion 3 towards the proximal end of this portion 3, and the thread 16 of this portion 3 has a constant diameter, smaller than the diameter of the thread 12 of portion 2. The pitch of the thread 16 decreases continuously and gradually from said distal end towards said proximal end, the portion 3 thus having a distal pitch P3d larger than a median pitch P3m, itself larger than the proximal pitch P3p. This proximal pitch P3p is larger than the pitch of the thread P2 of the threaded proximal portion 2.

The threaded distal portion 4 is likewise threaded over its entire height. The core 17 and the thread 18 of this portion 4 have a constant diameter, and the pitch of the thread 18 has a diameter smaller than the diameter of the thread 16 of the threaded median portion 3. The pitch P4 of this portion 4 is larger than the distal pitch P3d of portion 3.

The intermediate portions 5 and 6 are cylindrical and smooth.

Figures 2 and 3 show the positioning of the screw 1 in two bone fragments 100 and 101, proximal and distal respectively, before and after reduction of the fracture by means of the screw 1. In these fragments 100 and 101, the cancellated bone and the subchondral bone are of good quality.

The screw 1 is screwed into the proximal fragment 100 and then into the distal fragment 101 until the portion 4 is supported in the subchondral bone and the portion 3 in the cancellated bone of the distal fragment 101. These

supports operate securely, owing to the large pitches of the portion 4 and of the distal portion of portion 3.

Continued screwing until insertion of the portion 2 into the proximal cortical (see figure 3) makes it possible to carry out the reduction of the fracture separating the fragments 100 and 101, due to the gradual decrease in the pitch of the portion 3 in the proximal direction, this decrease leading to a more rapid advance of the screw 1 into the distal fragment 101 than into the proximal fragment 100, and therefore to a movement of this distal fragment 101 in relation to the proximal fragment 100.

Owing to the increase in the diameter of its core in the proximal direction, the portion 3 pushes the cancellated bone back radially and thereby produces a radial compaction of this cancellated bone and, owing to the gradual decrease in the pitch of its thread 16, produces an axial compression of this cancellated bone. This dual compression makes it possible to further strengthen the support of the screw 1 in the distal fragment 101 and to lightly compress the fragments 100 and 101, in order to perform the osteosynthesis under the best conditions; together with the insertion of the portion 2 into the cortical of the proximal fragment 100, it also ensures proper immobilisation of the screw 1 in rotation.

Figures 4 and 5 show the case of two bone fragments 100, 101 in which the cancellated bone and the subchondral bone are depleted, or have even disappeared; positioning of the screw 1 occurs in a similar manner, except that it is then necessary to insert the threaded distal portion 4 into the distal cortical.

Figure 6 shows another embodiment of the screw 1, in which the intermediate portions 5 and 6 are drilled with smooth transverse holes 20, which pass straight through the screw 1, perpendicular to the longitudinal axis thereof. Each of these holes 20 is intended to receive a screw or a pin ensuring that the screw 1 is blocked in rotation in relation to the bone fragments 100, 101.

In the embodiment according to this figure 6, the distal intermediate portion has a flared shape, ensuring a gradual transition between the proximal end of the portion 4 and the distal end of the portion 3.

Figure 7 shows yet another embodiment of the screw 1, in which the holes 20 are arranged through the portion 2 and through the distal portion of

the portion 3. In this example, the screw 1 is devoid of any distal intermediate portion 6.

As is apparent from the preceding, the invention provides a bone screw, for osteosynthesis in particular, which, in comparison with equivalent screws of the prior art, has the decisive advantage of enabling positioning in a bone, in particular for carrying out an osteosynthesis, under the best conditions, i.e., with a perfect hold on the bony fragments and the possibility of compressing these bony fragments, even in cases of cancellated or subchondral bones which are of poor quality or which have disappeared.

It stands to reason that the invention is not limited to the embodiment described above for illustrative purposes, but that it extends to all embodiments covered by the claims appended hereto.

CLAIMS

1 – Bone screw (1), in particular for osteosynthesis, characterized in that it includes:

5 - a threaded proximal portion (2), the core (11) and thread (12) of which have a constant diameter;

10 - a threaded median portion (3), the core (15) of which is conical, having a diameter becoming increasingly larger from the distal end of this threaded median portion (3) to the proximal end of this threaded median portion (3), and the thread (16) of which has a constant diameter, smaller than the diameter of the thread (12) of the proximal threaded portion (2); the pitch of the thread (16) of this threaded median portion (3) becomes increasingly smaller from said distal end towards said proximal end, and, at the proximal end of this threaded median portion (3), this pitch is larger than the pitch of the thread (12) of the proximal threaded portion (2);

15 - a threaded distal portion (4), the core (17) and the thread (18) of which have a constant diameter and the thread (18) of which has a diameter smaller than the diameter of the thread (16) of the median threaded portion (3), the pitch of the thread (18) of this threaded distal portion (4) being larger than the pitch of the thread (16) of the threaded median portion (3) at the distal end of this threaded median portion (3).

2 – Bone screw according to claim 1, characterized in that it includes at least one transverse hole (20) intended to receive a screw or a pin ensuring that the screw (1) is blocked in rotation in relation to a bone portion or fragment (100, 101).

25 3 – Bone screw according to claim 1 or 2, characterized in that each transverse hole (20) is a through-hole or not.

4 – Bone screw according to claim 2 or 3, characterized in that each transverse hole (20) is smooth, or tapped.

30 5 – Bone screw according to any of claims 2 to 4, characterized in that each transverse hole (20) is perpendicular to the longitudinal axis of the screw (1) or oblique in relation to this axis.

35 6 – Bone screw according to any of claims 2 to 5, characterized in that it includes at least two transverse holes (20), one of which is arranged in the proximal portion of the screw (1) and the other of which is arranged in the distal portion of the screw (1).

7 – Bone screw according to any of claims 1 to 6, characterized in that it includes an intermediate portion (5, 6) between the threaded distal portion (4) and the threaded median portion (3) and/or between the threaded median portion (3) and the threaded proximal portion (2).

5 8 – Bone screw according to claim 7, characterized in that the intermediate portion(s) (5, 6) is (are) flared or not.

9 – Bone screw according to claim 7 or 8, characterized in that the intermediate portion(s) (5, 6) is (are) threaded or smooth.

10 10 – Bone screw according to any of claims 7 to 9, characterized in that said transverse hole(s) (20) is (are) arranged near said intermediate portion(s) (5, 6).

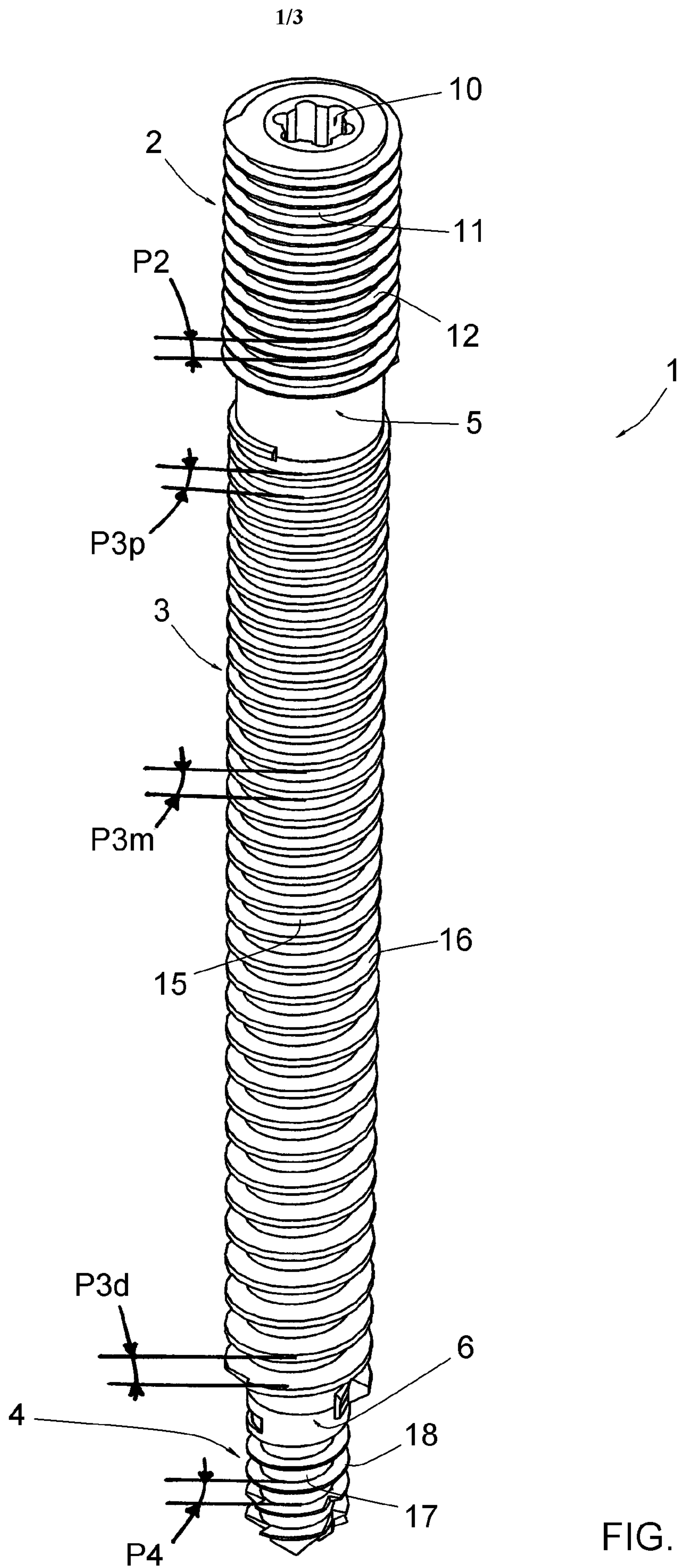


FIG. 1

FIG. 2

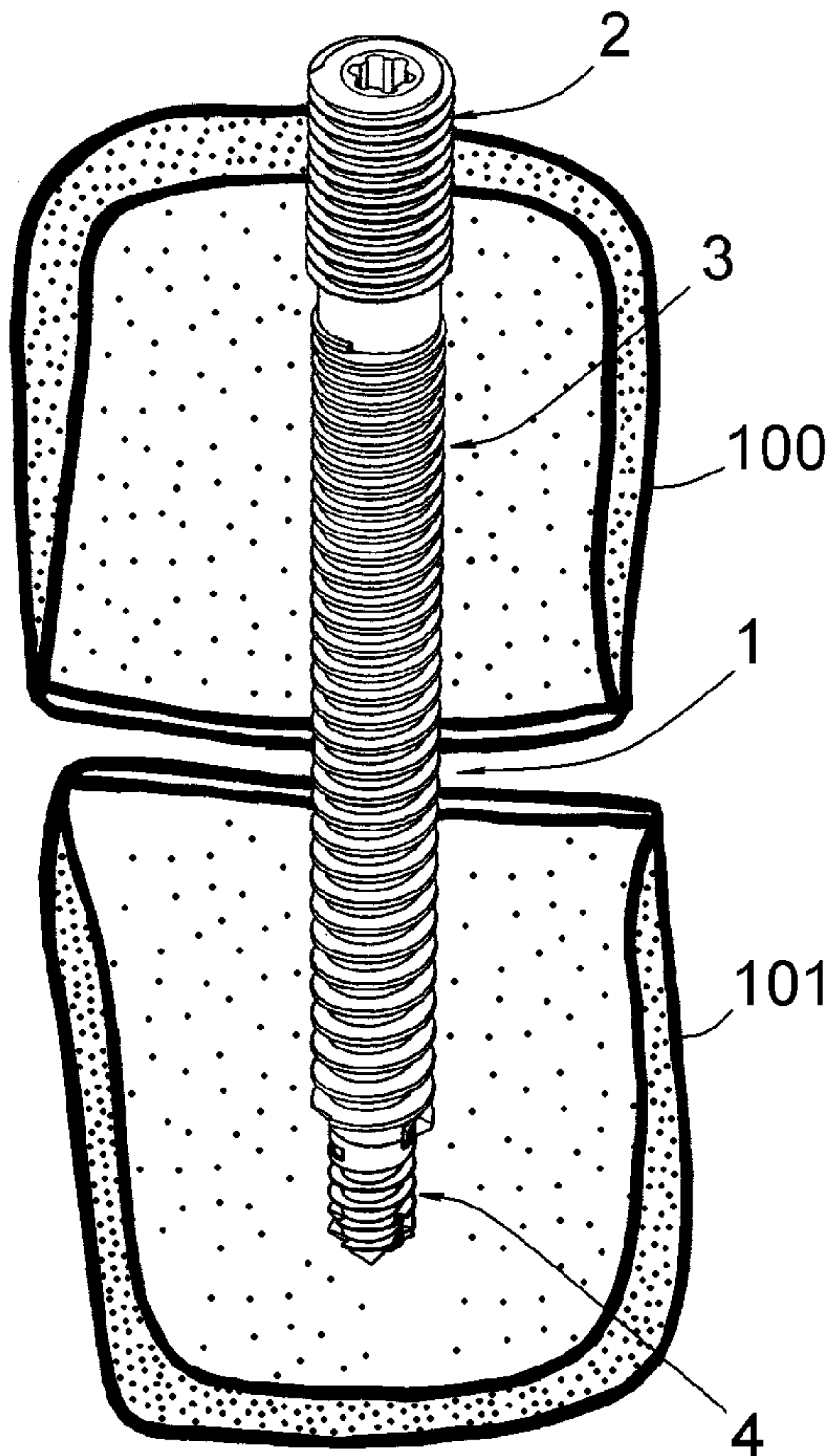


FIG. 3

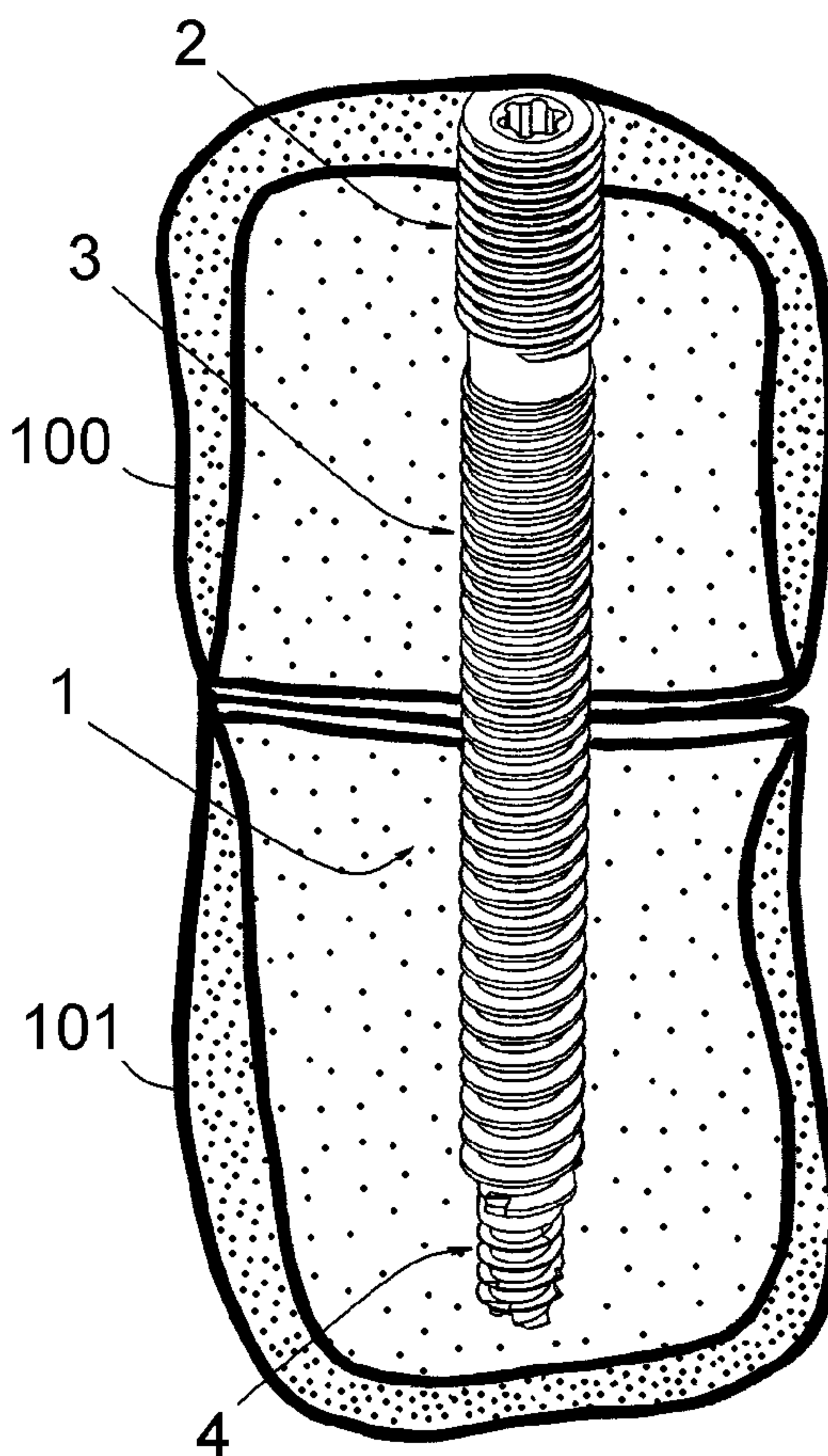


FIG. 4

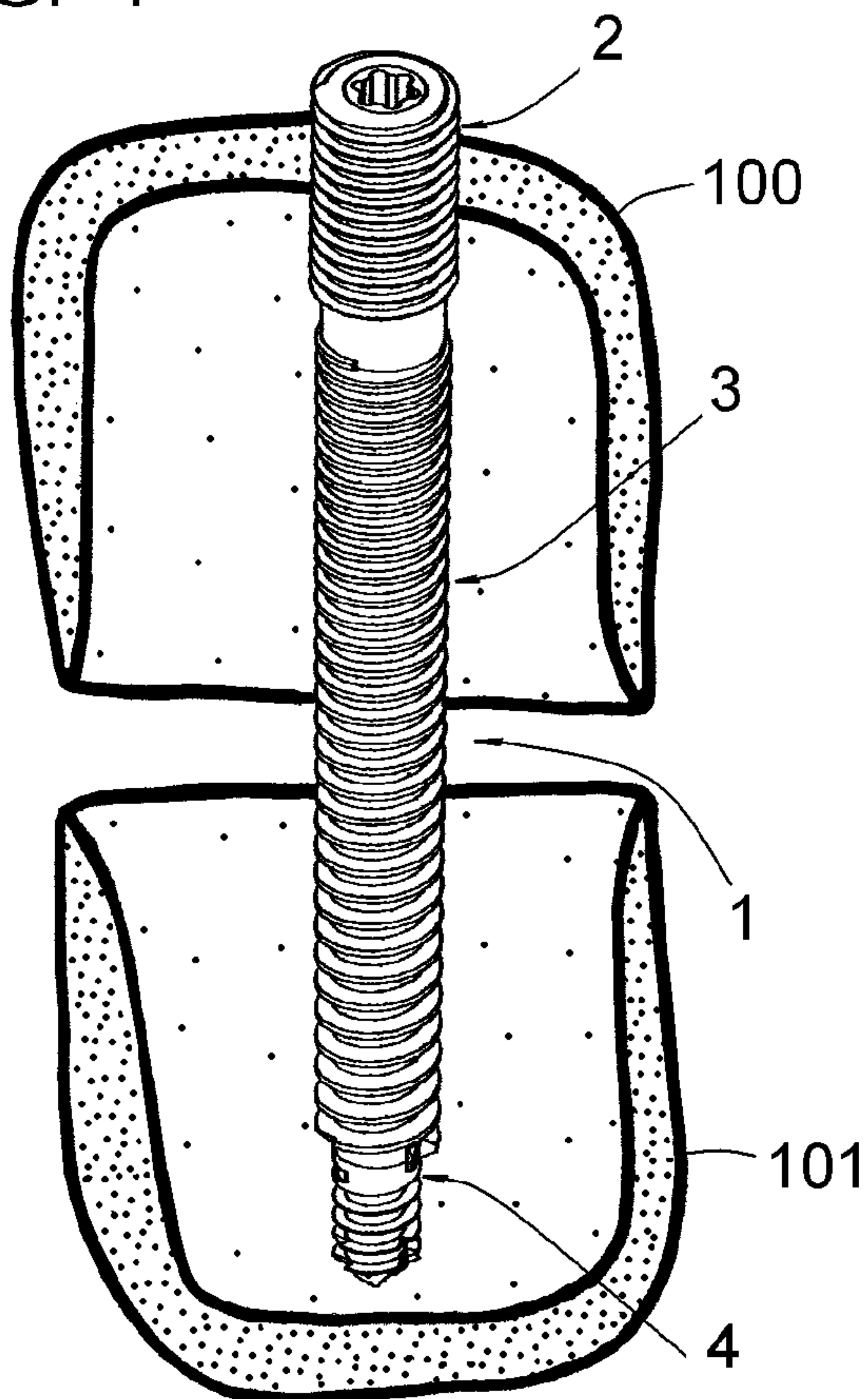
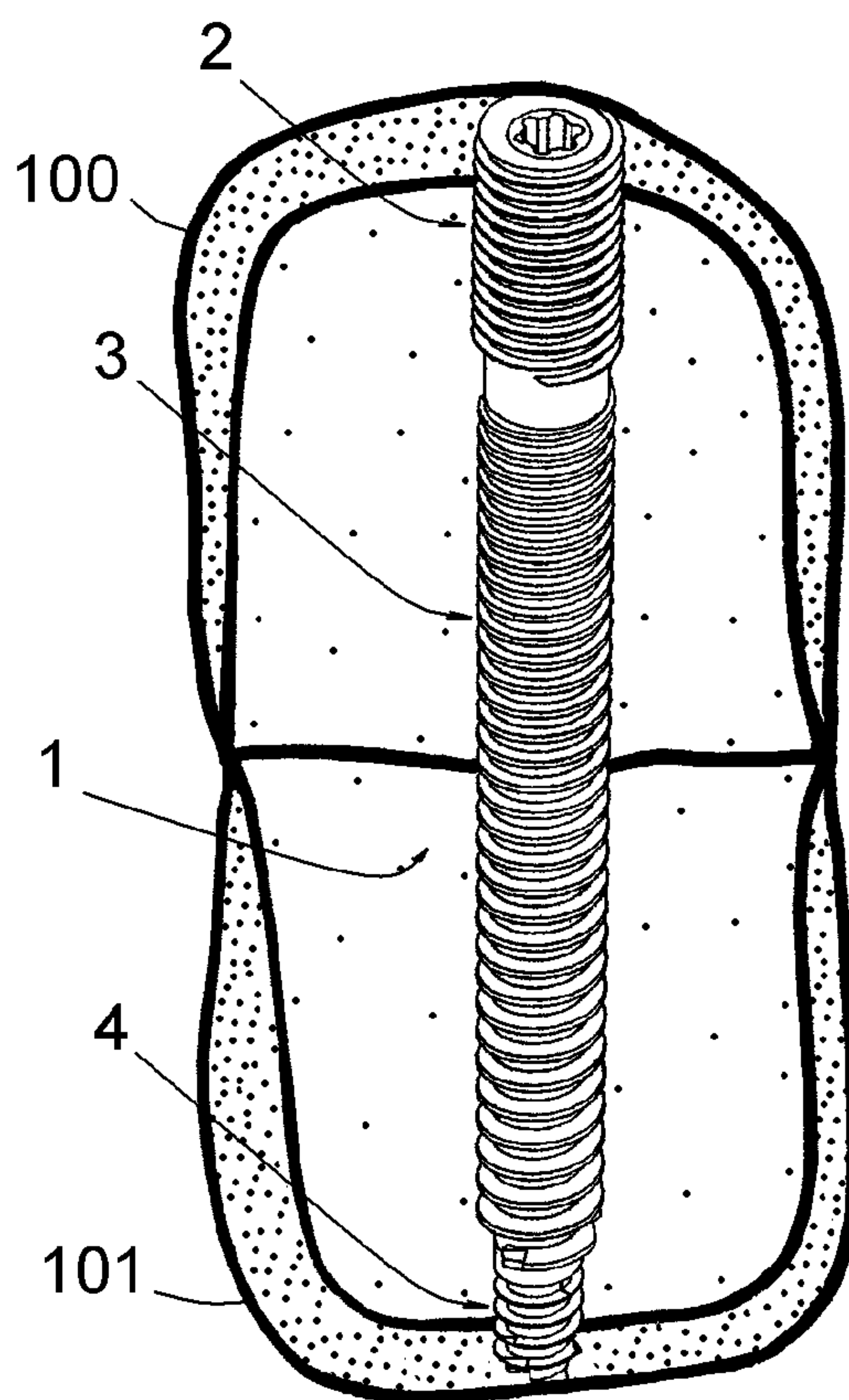


FIG. 5



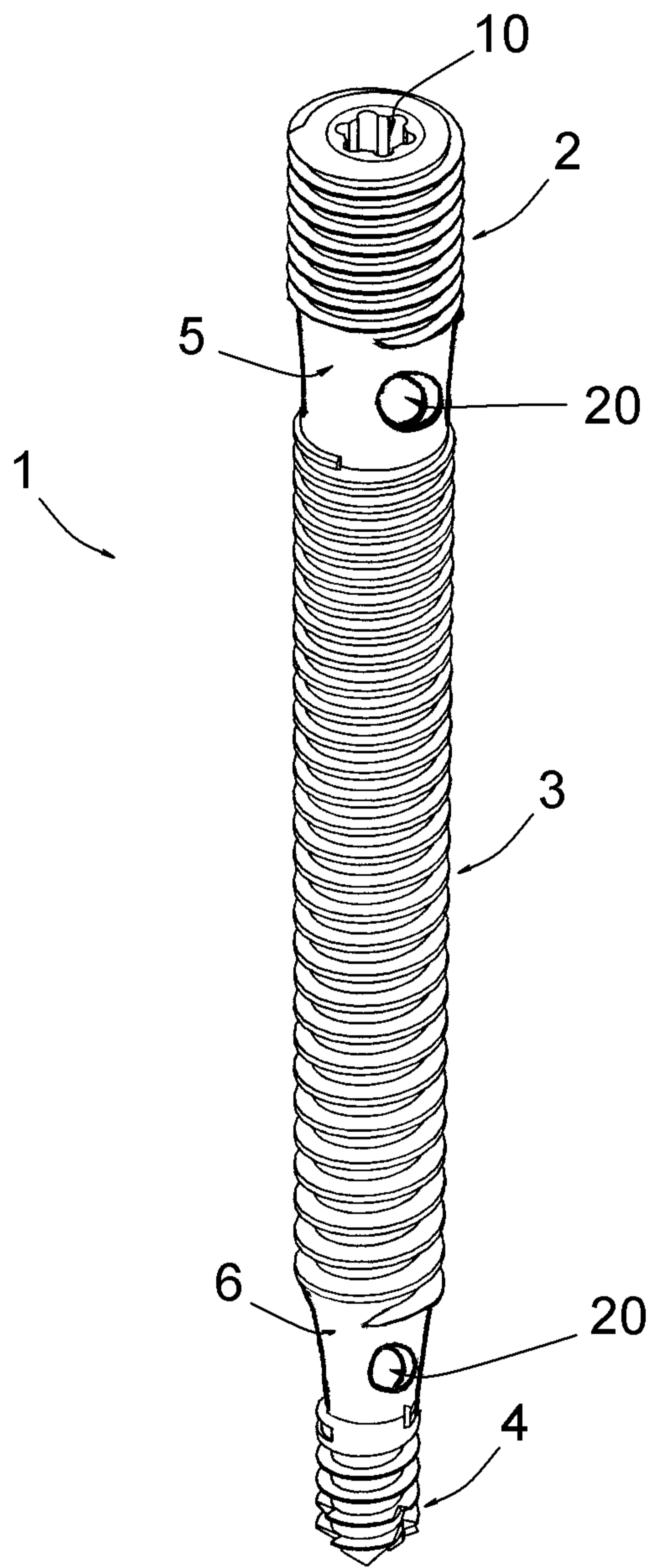


FIG. 6

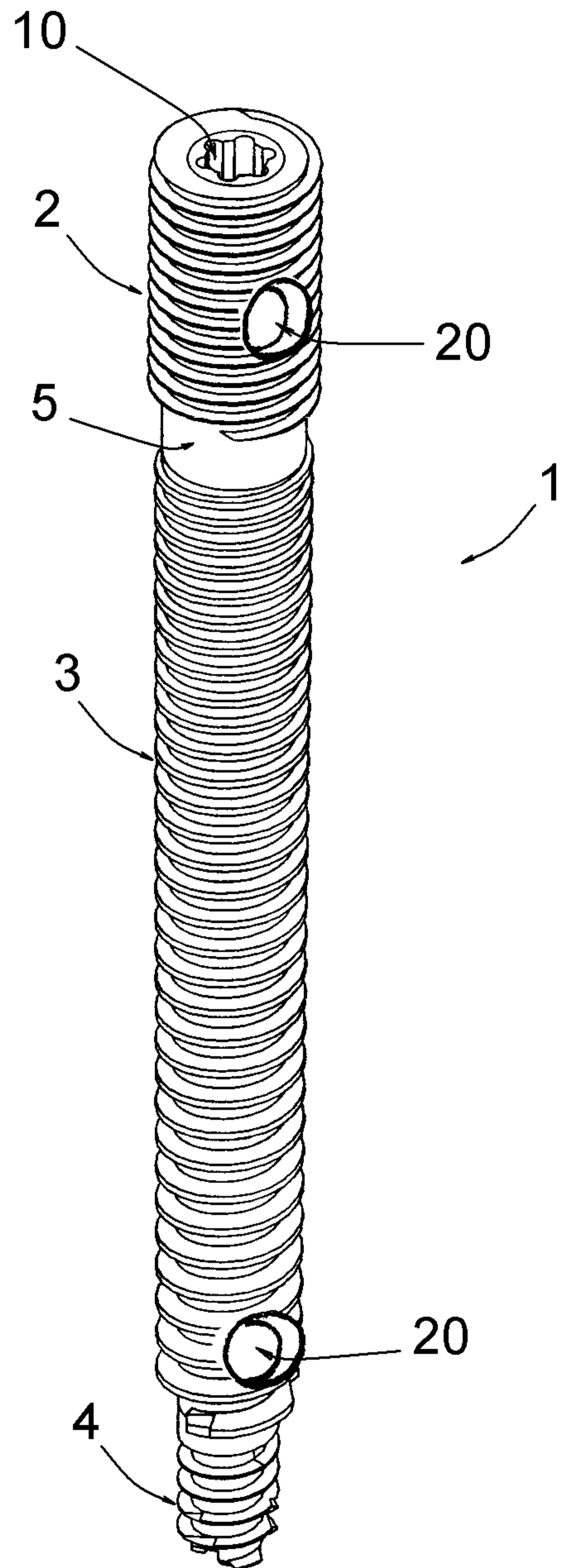


FIG. 7

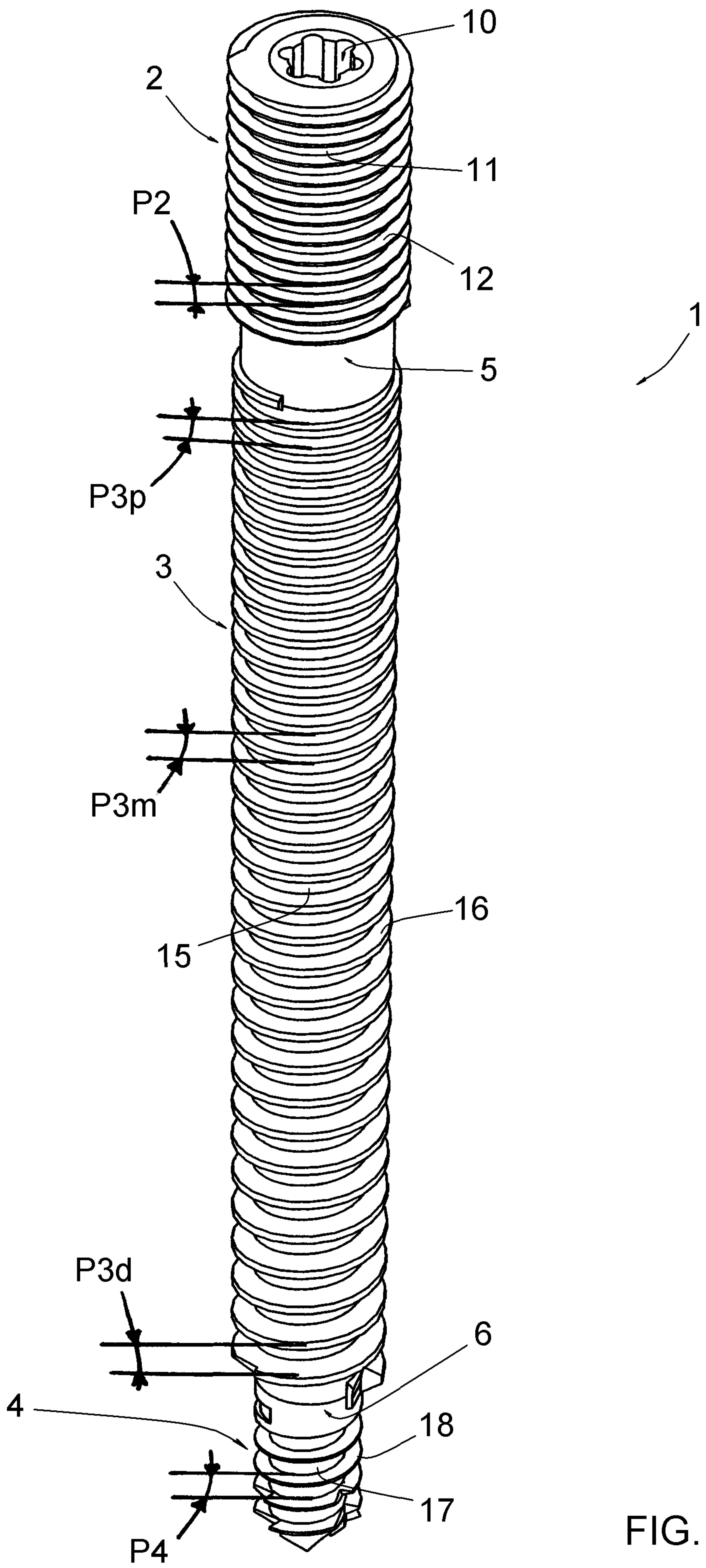


FIG. 1