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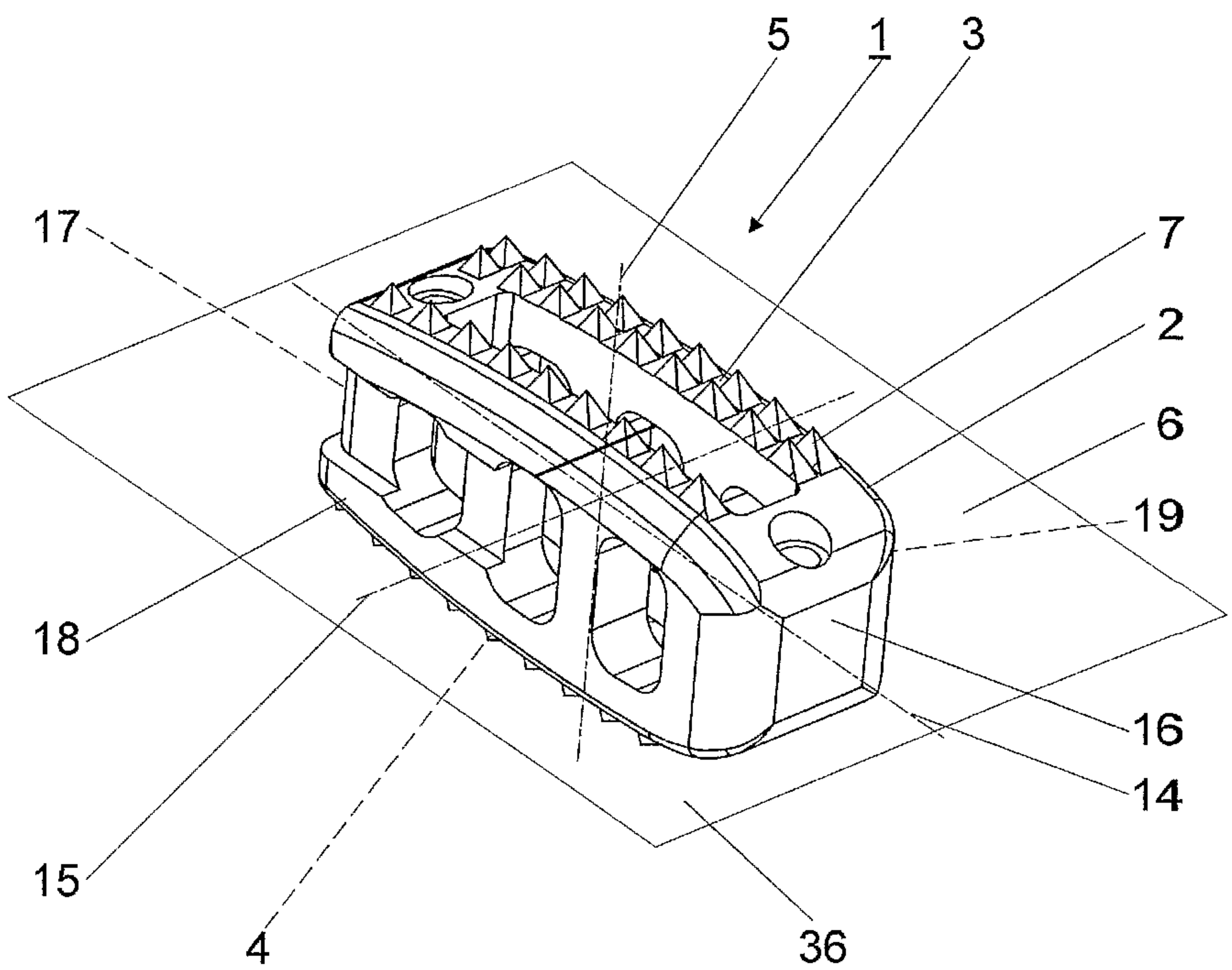

(57) Abrégé/Abstract:
The invention relates to an implant (1) for the intervertebral space, comprising a body (2) with: A) an upper contact surface (3) for resting against the base plate of a vertebral body that adjoins the implant (1) on top, a lower contact surface (4) for resting against the cover plate of a vertebral body that adjoins the implant (1) underneath; B) two lateral side surfaces (18; 19), a front and rear side surface (16, 17), and a central axis (5) that intersects the two contact surfaces (3; 4), a longitudinal axis (14) that intersects the front and the rear side surface (16; 17), and a transversal axis (15) that intersects the lateral side surfaces (18; 19), and; C) a central plane (36), which is located between the contact surfaces (3; 4) and which is perpendicular to the central axis (5) of the body (2), whereby; D) the contact surfaces (3; 4) have, at least in part, macroscopic teeth (7) with central axes (34), whereby; E) the central axes (34) of the teeth (7) are at an angle to the central plane (36) whereby promoting a rotation of the body (2) about the longitudinal axis (14) in one direction of rotation and hindering a rotation in the other direction of rotation.

Abstract

An implant (1) for the intervertebral space comprising a body (2) with

A) a top contact surface (3) to be placed on the base plate of a body of the vertebra adjoining the implant (1) from above, a bottom contact surface (4) to be placed on the cover plate of a body of the vertebra adjoining the implant (1) below it;

B) two lateral surfaces (18, 19), a front lateral and a rear lateral surface (16, 17) as well as a central axis (5) intersects the two contact surfaces (3, 4), a longitudinal axis (14) that intersects the front and rear lateral surfaces (16, 17) and a transverse axis (15) that intersects the lateral surfaces (18, 19), and

C) a central plane (36) situated between the contact surfaces (3, 4) and at right angles to the central axis (5) of the body (2), while

D) the contact surfaces (3, 4) have at least partly macroscopic teeth (7) with central axes (34), while

E) the central axes (34) of the teeth (7) are inclined relative to the central plane (36) in such a manner, that a rotation of the body (2) about the longitudinal axis (14) is facilitated in one direction and impeded in the other direction.

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English translation of the specification of the International Patent Application No. PCT/CH03/00412 "Implant for the intervertebral space" in the name of Synthes AG Chur

Implant for the intervertebral space

The invention concerns an implant for the intervertebral space, according to the preamble of patent claim 1.

Various intervertebral implants are known for the use in a posterior lumbar fusion of two adjoining bodies of the vertebra. Such an implant for the intervertebral space is known from WO 95/08306 Beckers. This known implant comprises a body with a flat lens-shaped profile, while both convex surfaces serve the purpose of placing them on the superior and inferior, respectively, surfaces of the adjoining bodies of the vertebra, so that the greatest part of this profile coincides with the biconcave shape of the sagittal interface of the intervertebral space. In the other two planes the body has parallel flat sides. Furthermore, an opening passes through the body parallel to its central axis, i.e. from one contact surface to the other one, so that the body can be filled with bony substance. The roundings at the front of the body, as well as the convex contact surfaces, do not require any mechanical machining, for example milling or chiselling of the superior and inferior, respectively, surfaces of the adjoining bodies of the vertebra. The cross-sectional surface, that is perpendicular to the longitudinal axis, has two roundings, which are executed on diagonally situated corners, so that the implant can be introduced into the intervertebral space transversely, i.e. with its contact surfaces transversely to the longitudinal axis of the vertebra, and following this rotated by 90° with a suitable tool until the contact surfaces of the body come into contact with the superior and inferior, respectively, surfaces of the adjoining bodies of the vertebra. It is a disadvantage of this known implant that the contact surfaces can have a structure, with ribs extending either parallel to the longitudinal axis or transversely to it. By virtue of this structure, with the teeth having symmetrical flanks, either the introduction of the implant into the intervertebral space as well as its slipping out is equally facilitated or made difficult or the rotation of the body is equally prevented or made difficult in both directions.

A further generic intervertebral implant is known from US 4,834,757 Brantigan. This known intervertebral implant comprises a frame-like body, that has an asymmetric structure on the contact surfaces as well as on both lateral surfaces, whereby this structure comprises saw-tooth like teeth, the flanks of which are directed against the front end of the body and consequently they push both adjoining bodies of the vertebra apart during the introduction of the implant into the intervertebral space, whereas the steep flanks hook in and thus prevent a slipping out of the implant. A disadvantage of this implant is that the teeth make the rotation difficult in both directions.

The invention wants to provide remedy here. The object of the invention is to produce an implant for the intervertebral space that makes a rotation of the implant about the longitudinal axis of the body possible in one direction and prevents it in the opposite direction.

This objective of the invention is achieved with an implant for the intervertebral space having the features of claim 1.

The advantages achieved by the invention are essentially that by virtue of the implant according to the invention

- a simple implanting is possible by simply inserting and rotating the implant,
- an undesirable shifting, in particular a slipping out of the implant from the intervertebral space can be prevented,
- an undesirable reverse rotation of the implant in the intervertebral space can be prevented, and
- a lateral slipping of the implant within the intervertebral space, particularly towards the centre of the bodies of the vertebra, can be prevented.

In a preferred embodiment the macroscopic teeth are so constructed, that in sectional planes, extending perpendicularly to the longitudinal axis of the body, their central axes are inclined relative the central plane of the body. This brings with it the advantage, that the preferred, with regard to the direction of rotation made difficult, is favoured exactly about the longitudinal axis of the implantation of the body.

In a further embodiment the teeth are so constructed, that their central axes are inclined also in the sectional planes through the body, which are perpendicular to the transversal axis, so that a preferred direction of shifting can also be achieved, thus facilitating the introduction of the implant into the intervertebral space, whereas a slipping out is prevented.

The teeth are preferably constructed as inclined pyramids or inclined tapers, inclined truncated pyramids or inclined truncated tapers.

In another embodiment the teeth are so constructed, that their central axes are parallel at least on one contact surface. Preferably, however, the teeth are so constructed, that their central axes are parallel on each of the two contact surfaces. This will reinforce the advantages mentioned above.

In yet another embodiment the teeth are so constructed, that in the sectional planes, extending perpendicularly to the longitudinal axis, their central axes include an angle $+\varphi$ on the top contact surface and an angle $-\varphi$ on the bottom contact surface. The result of this is the advantage, that the rotation of the implant about its longitudinal axis is facilitated in one direction, whereas the rotation is considerably impeded in the other direction.

The height of the teeth relative to the relevant contact surfaces is preferably between 0.15 mm and 1.5 mm.

In a further embodiment in two sectional planes, which are at right angle to one another and are perpendicular to the central axis, the teeth have a steep and a shallow flank each. Thus the teeth are essentially constructed as inclined pyramids, due to which a reverse rotation as well as a lateral movement of the implanted implant can be prevented.

According to yet another embodiment the implant is made from an X-ray permeable material, that can be chosen, for example, from the following group:

- polyaryl etherketone (PAEK), polyetherimide (PEI), polyoxymethylene (POM), liquid crystal polymer (LCP), polymethyl pentene (PMP), polysulfone (PSU), polyethersulfone (PESU or PES), polyethylene terephthalate (PETP), polymethyl methacrylate (PMMA) or ultrahigh-molecular polyethylene (UHMW-PE);
- polymers, which are reinforced with long or short fibres of, for example, carbon.

By producing the implant from an X-ray permeable material the advantage is achieved, that the surgeon or the radiologist can follow better the restructuring of the bone.

In another embodiment the surface of the implant is roughened, achieving advantages in the behaviour of the bone adhesion. The surface roughness is preferably between 2 µm and 10 µm. Experience indicates, that the bone cells grow best on the surface of the implant in this range of surface roughness.

In yet another embodiment, when viewed in sectional planes which are perpendicular to the transversal axis, the shallow flanks of the teeth enclose with a straight line that is parallel to the central axis of the body, an angle α between 30° and 80°, while the steep flanks enclose with the same straight line an angle ß between 5° and 30°.

In a further development, when viewed in sectional planes which are perpendicular to the longitudinal axis, the shallow flanks of the teeth on the top contact surface enclose with a straight line that is parallel to the central axis of the body, an angle γ between +30° and +80°, while the steep flanks enclose with the central axis of the body an angle δ between +5° and +30°. On the bottom contact surface the angle γ is between -30° and -80° and the angle δ between -5° and -30°.

The flank angles of the teeth listed above are advantageous to secure the teeth in the end plates of the adjoining bodies of the vertebra.

The angles α and γ of the shallow flanks as well as the angles ß and δ of the steep flanks are preferably the same, so that the resistance of the teeth against turning out or moving is at optimum.

The geometry of the teeth is preferably such, that the volume V of a projection is between 0.15 mm^3 and 1.2 mm^3. Preferably the entire contact surfaces are covered by teeth.

In a further embodiment the steep flanks of the teeth are provided in parallel planes. By virtue of this an optimum resistance against turning out or moving of the implant can be achieved.

According to yet another embodiment the essentially cuboid-shaped body is constructed in such a manner, that the second cross-sectional surface, which is perpendicular to the longitudinal axis, is rectangular and has a unilateral rounding. The advantage of this construction is that the implant can be rotated only in one direction and the contact surface, situated on the side opposite to that provided with the rounding, can be used to fit further teeth. Consequently the number of teeth can be still kept high.

In another embodiment the radius of the rounding is to be so dimensioned, that the contact surface to the bone is reduced by the rounding by less than half, preferably by less than a third, so that the number of teeth on the contact surfaces can be kept high.

In yet another embodiment the essentially cuboid-shaped body is constructed in such a manner, that the second cross-sectional surface, which is perpendicular to the longitudinal axis, is rectangular and has two diagonally positioned rounding. Thus the manual rotation of the implant during the operation is facilitated.

In a further embodiment the radii of the two roundings are so dimensioned, that the second cross-sectional surface of the body is reduced by less than half, preferably by less than one quarter. The advantage of this construction is that notwithstanding the roundings a high structural strength for the implant can be realised, i.e. as little as possible material is eliminated to realise the roundings.

In yet another embodiment the roundings have an elliptical shape. The elliptical shape allows a simple start for the rotation of the implant. The resistance to rotation builds up during the rotation, so that in the final position the resistance against a reverse rotation is at its maximum.

In another embodiment the roundings have two different radii. By virtue of the larger radius, joining the lateral surfaces, the rotation of the implant is simplified at the start. By virtue of the adjoining smaller radius, joining the contact surfaces, the resistance to rotation is increased, so that in the final position the resistance to reverse rotation is at its maximum.

The body, that has a first and a second lateral surface which intersect the contact surfaces as well as the front lateral surface, has preferably roundings arranged between the first lateral surface and the top contact surface as well as between the second lateral surface and the bottom contact surface.

In yet another embodiment the body has second roundings, which are arranged between the front lateral surface, intersecting the contact surfaces, and the contact surfaces. The advantage of these second roundings is, that in contrast to sharp edges, the bony structure of the adjoining body of the vertebra will not get damaged. In addition, during the introduction of the implant into the intervertebral space the roundings facilitate the shifting of the implant and prevent it from getting stuck.

In a further embodiment the implant comprises at least one, but preferably a plurality of X-ray markers. This provides the advantage, that the position and orientation of the implant in the intervertebral space is visible in X-ray pictures during the operation and post-operatively. In an advantageous manner the number of X-ray markers is between one and six, depending on the application of the implant.

In yet another further development the body has at least one bore, so that the X-ray marker, constructed as a pin, can be pressed into the bore. The pin is made from an X-ray impermeable material. Preferably the at least one bore is so arranged in the implant, that its axis is parallel to the central axis and is situated in a plane extending through the central axis and the longitudinal axis.
In another embodiment the at least one pin has at least one radially protruding protuberance arranged circumferentially and axially centrally, that is plastically deformed when pushed into the bore, so that the pin is secured in the bore by means of a press fit.

In yet another embodiment the pin is made from a metal, preferably steel, titanium, tantalum or gold.

The invention and its developments are explained in the following in detail based on the partly schematic illustrations of several embodiments.

They show in:

Fig.1 - a perspective view of an embodiment of the implant according to the invention,

Fig.2 - a first cross-section through the embodiment of the implant according to the invention, illustrated in Fig.1,

Fig.3 - a longitudinal section through the embodiment of the implant according to the invention illustrated in Figs.1 and 2, with means to accommodate a holding tool,

Fig.4 - a longitudinal section through an embodiment of the implant according to the invention with X-ray markers, and

Fig.5 - a top view on the rear end of the embodiment of the implant according to the invention, illustrated in Fig.4.

In Figs.1-3 an embodiment of the implant 1 is illustrated, that comprises an essentially cuboid-shaped body 2 with a top and bottom convex contact surface 3, 4 to be placed on the superior and inferior surface, respectively, of the two adjoining bodies of the vertebra and a central axis 5 intersecting the contact surfaces 3, 4. There are two lateral surfaces 18, 19 arranged at right angles to the contact surfaces 3, 4, as well as a front lateral surface 16 and a rear lateral surface 17. The longitudinal axis 14, that is perpendicular to the central axis 5, intersects both lateral surfaces 16, 17, while the transverse axis 15, that is also perpendicular to the central axis 5 of the body 2, intersects the two lateral surfaces 18, 19. The longitudinal axis 14, as well as the transverse axis 15, define a central plane 6 situated between the contact surfaces 3, 4, this plane being perpendicular to the central axis 15.

An opening 20, that is parallel to its central axis 5, passes through the body 2 from the top contact surface 3 to the bottom contact surface 4. Three perforations 21, parallel to the transverse axis 15, pass through the body 2 from the first lateral surface 18 to the second lateral surface 19. Consequently, the body 2 has a frame-shaped construction with a central cavity, while the front and rear lateral surfaces 16, 17 do not have bores or openings opening into the cavity. A first cross-sectional surface 10 is defined by the central axis 5 of the body and the longitudinal axis 14, the intersection line of which with the second cross-sectional surface 11, defined by the central axis 5 of the body 2 and the transverse axis 15, coincides with the central axis 5 of the body 2.

The contact surfaces 3, 4 are fitted with teeth 7, the central axes 34 of which are inclined relative to the central plane 36 of the body 2. At the same time the teeth 7 are so constructed, that on the top contact surface 3 their central axes 34 include an angle $+\varphi$ in the sectional planes, which are sectioning the body 2 perpendicular to the longitudinal axis 14, and on the bottom contact surface 4 an angle $-\varphi$ with the central plane 36. In the sectional planes, that are parallel to the first cross-sectional surface 10, each tooth 7 has unidirected steep and shallow flanks 8, 9 and in the sectional planes, that are parallel to the second cross-sectional surface 11, unidirected steep and shallow flanks 12, 13 for each contact surface 3, 4, whereby

- in the sectional planes, that are parallel to the first cross-sectional surface 10, the steep flanks 8 include an angle ß with a straight line that is parallel to the central axis 5 of the body 2,
- in the sectional planes, that are parallel to the first cross-sectional surface 10, the shallow flanks 9 include an angle α with a straight line that is parallel to the central axis 5 of the body 2,
- in the sectional planes, that are parallel to the second cross-sectional surface 11, the steep flanks 12 on the top contact surface 3 include an angle +δ with a straight line that is parallel to the central axis 5 of the body 2 and an angle -δ on the bottom contact surface 4, and
- in the sectional planes, that are parallel to the second cross-sectional surface 11, the shallow flanks 13 on the top contact surface 3 include an angle +γ with a straight line that is parallel to the central axis 5 of the body 2 and an angle -γ on the bottom contact surface 4.

The steep flanks 8 on the teeth 7 of both contact surfaces 3, 4 are on that side which faces the rear lateral surface 17. In the second cross-sectional surface 11 the steep flanks 12 of the teeth on the top contact surface 3 are provided on the right side of the teeth 7 when viewed from the front lateral surface 16 parallel to the longitudinal axis 14, while the steep flanks 12 of the teeth 7 on the bottom contact surface 4, also viewed from the front lateral surface 16 parallel to the longitudinal axis 14, are provided on the left side of the teeth 7.

In the embodiment illustrated here the angles ß and δ between the steep flanks 8, 12 and the straight lines, that are parallel to the central axis 5, are the same. Similarly, the angles α and γ between the shallow flanks 9, 13 and the straight lines, that are parallel to the central axis 5, are the same.

The arrangement of the steep flanks 8 in the first cross-sectional surface 10 is such, that when the implant 1 is pushed forward with its front lateral surface 16 into an intervertebral space, the superior and inferior surface, respectively, of the adjoining bodies of the vertebra are pushed apart by the shallow flanks 9 of the teeth 7, while a possible slipping out of the implanted body 2 is prevented by the steep flanks 8. Furthermore, the arrangement of the steep flanks 12 in the second cross-sectional surface 11 is such, that in the case of turning the implant 1, pushed into the intervertebral space, to the right, the superior and inferior surface of the adjoining bodies of the vertebra are pushed apart by the shallow flanks 13 of the teeth 7, whereas a turning to the left of the implanted body 2 is prevented by the steep flanks 12.

To simplify the turning to the right during the implantation, the body 2 has roundings 23 with two different radii between the contact surfaces 3, 4 and the lateral surfaces 18, 19. The roundings 23 are so arranged, that in the second cross-sectional surface 11, that is perpendicular to the longitudinal axis 14, they are situated only on a diagonal, so that the roundings 23 are arranged between the top contact surface 3 and the first lateral surface 18 and between the bottom contact surface 4 and the second lateral surface 19. With regard to the teeth 7 on the two contact surfaces 3, 4 the roundings 23 are executed on the sides having the shallow flanks 9, 13. Likewise, for a simple introduction of the implant 1 into the intervertebral space the body 2 has second roundings 24 between the contact surfaces 3, 4 and the front lateral surface 16.

On its rear end 28 the implant 1 further comprises means 22 for a rotation-preventing accommodation of the holding tool. In the embodiment shown in Fig.3 these means 22 to accommodate a holding tool comprise a bore 25, that is coaxial with the longitudinal axis 14 and has an inside thread 26, that penetrates into the implant 1 from its rear lateral surface 17. So that the holding tool could be joined with the implant 1 in a rotation-preventing manner, a groove 27, extending parallel to the transverse axis 15 and also executed in the rear lateral surface 17, is located in the implant 1. For a rotation-preventing joint between the holding tool and the implant 1 a segment of the holding tool, having an external thread, is screwed into the inside thread 26, and subsequently a corresponding segment is introduced into the groove 27.

Description of the progress of the operation:

So that the surgeon could advance with the instruments, necessary for the operation, in the space of the disk, first the adjoining facet joints and the laminae are partly removed. Following this, by means of probes, the required size of the implant 1 is determined. The implant 1, selected in this manner, is then joined with the corresponding holding tool (not illustrated), that can be fastened on the rear end 28 of the implant 1. The introduction of the implant 1 is carried out in such a manner, that the lateral surfaces 18, 19, not having teeth 7, are aligned parallel to the superior and inferior surface, respectively, of the two adjoining bodies of the vertebra. The implant 1 can be introduced into the intervertebral space through the partly removed dorsal structures of the bodies of the vertebra. After the implant 1 was introduced into the intervertebral space up to the desired depth, the surgeon rotates the implant 1 by means of the holding tool by 90° about the longitudinal axis 15, so that the contact surfaces 3, 4, provided with teeth 7, will be fixed on the superior and inferior plates. By rotating the implant 1, the surgeon achieves a traction in the anterior structures of the spinal column. By this the lordosis, inter alia, can be restored. Finally, using the same operation steps, a second implant 1 is introduced, so that an implant 1 is provided on both sides of the spinal marrow cord.

The embodiment of the implant 1 according to the invention, shown in Figs.4 and 5, comprises two X-ray markers 35. These X-ray markers 36 are executed as pins 31, which are introduced into bores 32. For the fastening of the pins 31 in the bores 32, the pins 31 have three protuberances 30 each on their circumferences and preferably axially centrally. During the pressing in of the pins 31 into the bores 32 the protuberances 30 are plastically deformed, so that the pins 31 are held in the bores 32 by a press fit. In the embodiment shown here the body 2 has two bores 32, of which one bore 32 is arranged at the front end 29 of the implant 1 and the other bore 32 at the rear end 28 of the implant 1. The bores 32 are so constructed, that their axes 33 are parallel to the central axis 5 and lie in a plane extending through the central axis 5 and the longitudinal axis 14.

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English translation of the amended claims under Article 34 PCT of the International Patent Application No. PCT/CH03/00412 "Implant for the intervertebral space" in the name of Synthes AG Chur

Patent claims

1. An implant (1) for the intervertebral space comprising an essentially cuboid-shaped body (2) with
   A) a top contact surface (3) to be placed on the base plate of a body of the vertebra adjoining the implant (1) from above, a bottom contact surface (4) to be placed on the cover plate of a body of the vertebra adjoining the implant (1) below it;
   B) two lateral surfaces (18, 19), a front lateral and a rear lateral surface (16, 17) as well as a central axis (5) that intersects the two contact surfaces (3, 4), a longitudinal axis (14) that intersects the front and rear lateral surfaces (16, 17) and a transverse axis (15) that intersects the lateral surfaces (18, 19), and
   C) a central plane (36) situated between the contact surfaces (3, 4) and at right angles to the central axis (5) of the body (2), while
   D) the contact surfaces (3, 4) have at least partly macroscopic teeth (7) with central axes (34),

   characterised in that

   E) the central axes (34) of the teeth (7) are inclined relative to the central plane (36) in such a manner, that a rotation of the body (2) of 90° about the longitudinal axis (14) is facilitated in one direction and impeded in the other direction; and
   F) the distance between the two lateral surfaces (18, 19) is smaller than the distance between the two contact surfaces (3, 4).

2. An implant (1) according to claim 1, characterised in that viewed in the planes sectioning the body (2) perpendicularly to the longitudinal axis (14), the central axes (34) of the teeth (7) are inclined to the central plane (36).

3. An implant (1) according to claim 1 or 2, characterised in that also when viewed in the planes sectioning the body (2) perpendicularly to the transverse axis (15) the central axes (34) of the teeth (7) are inclined to the central plane (36).

4. An implant (1) according to any one of claims 1 to 3, characterised in that the teeth (7) are constructed as inclined pyramids or inclined tapers, inclined truncated pyramids or inclined truncated tapers.

5. An implant (1) according to any one of claims 1 to 4, characterised in that the central axes (34) of the teeth (7) are essentially parallel at least on one contact surface (3, 4).

6. An implant (1) according to any one of claims 1 to 5, characterised in that when viewed in sectional planes of the body (2), which are perpendicular to the longitudinal axis (14), the central axes (34) of the teeth (7) include an angle $+\varphi$ on the top contact surface and an angle $-\varphi$ with the central plane (36) on the bottom contact surface.

7. An implant (1) according to any one of claims 1 to 6, characterised in that the height of the teeth (7) is between 0.15 mm and 1.5 mm.

8. An implant (1) according to any one of claims 1 to 7, characterised in that in two sectional planes, which are at right angle to one another and are perpendicular to the central axis (5) of the body (2), the teeth (7) have a steep (8, 12) and a shallow (9, 13) flank each.

9. An implant (1) according to any one of claims 1 to 8, characterised in that the implant (1) is made from an X-ray permeable material.

10. An implant (1) according to any one of claims 1 to 9, characterised in that the surface of the implant is roughened.

11. An implant (1) according to claim 10, characterised in that the surface roughness is between 2 μm and 10 μm.

12. An implant (1) according to any one of claims 8 to 11, characterised in that when viewed in sectional planes which are perpendicular to the transversal axis 15), the shallow flanks (9) enclose with a straight line that is parallel to the central axis (5) of the body (2), an angle α and the steep flanks (8) enclose with the same straight line an angle ß.

13. An implant (1) according to any one of claims 8 to 12, characterised in that
a) when viewed in sectional planes which are perpendicular to the longitudinal axis (14), the shallow flanks (13) on the top contact surface (3) enclose with a straight line that is parallel to the central axis (5) of the body (2) an angle +γ and the steep flanks (12) enclose with the same straight line an angle +δ, and
b) when viewed in sectional planes which are perpendicular to the longitudinal axis (14), the shallow flanks (13) on the bottom contact surface (4) enclose with a straight line that is parallel to the central axis (5) of the body (2) an angle -γ and the steep flanks (12) enclose with the same straight line an angle -δ.

14. An implant (1) according to claim 13, characterised in that the angles α and γ of the shallow flanks (9, 13) are the same.

15. An implant (1) according to claim 13 or 14, characterised in that the angles ß and δ of the steep flanks (8, 12) are the same.

16. An implant (1) according to any one of claims 13 to 15, characterised in that the angles α and γ of the shallow flanks (9, 13) are between 30° and 80°.

17. An implant (1) according to any one of claims 13 to 16, characterised in that the angles ß and δ of the steep flanks (8, 12) are between 5° and 30°.

18. An implant (1) according to any one of claims 1 to 17, characterised in that the volume *V* of a tooth (7) is between 0.15 mm^3 and 1.2 mm^3.

19. An implant (1) according to any one of claims 8 to 18, characterised in that the steep flanks (8, 12) of the teeth (7) are situated in parallel planes.

20. An implant (1) according to any one of claims 1 to 19, characterised in that when viewed in a cross-sectional surface (11), which is perpendicular to the longitudinal axis (14), the body (2) has a rectangular construction with a unilateral rounding (23).

21. An implant (1) according to claim 20, characterised in that the radius of the rounding (23) is so dimensioned, that the contact surface to the bone is reduced by the rounding (23) by less than half, preferably by less than a third.

22. An implant (1) according to any one of claims 1 to 21, characterised in that when viewed in a cross-sectional surface (11), which is perpendicular to the longitudinal axis (14), the body (2) has a rectangular construction with two diagonally provided roundings (23).

23. An implant (1) according to claim 22, characterised in that the radii of the two roundings (23) are so dimensioned, that the second cross-sectional surface (11) of the body (2) is reduced by less than half, preferably by less than one quarter.

24. An implant (1) according to any one of claims 20 to 22, characterised in that the roundings (23) are elliptical.

25. An implant (1) according to any one of claims 20 to 23, characterised in that the roundings (23) have two different radii.

26. An implant (1) according to any one of claims 1 to 25, characterised in that the body (2) has a first and a second lateral surface (18, 19) which intersect the contact surfaces (3, 4) as well as the front lateral surface (16), and that diagonally between the first lateral surface (18) and the top contact surface (3) as well as between the second lateral surface (19) and the bottom contact surface (4) the body (2) has roundings (24).

27. An implant (1) according to any one of claims 1 to 26, characterised in that the body (2) has a front lateral surface (16) which intersects the contact surfaces (3, 4) and has second roundings (24) between this front lateral surface and the contact surfaces (3, 4).

28. An implant (1) according to any one of claims 1 to 29, characterised in that it has at least one X-ray marker (35).

29. An implant (1) according to claim 28, characterised in that it has a plurality of X-ray markers (35).

30. An implant (1) according to claim 28 or 29, characterised in that the body (2) has at least one bore (32) and the X-ray marker (35) comprises a pin (31) that can be pressed into the bore (32) and is made from an X-ray impermeable material.

31. An implant (1) according to claim 30, characterised in that at least one bore (32) has an axis (33), that is parallel to the central axis (5) and is situated in a plane extending through the central axis (5) and the longitudinal axis (14).

32. An implant (1) according to claim 30 or 31, characterised in that a pin (31) comprises at least one protuberance (30) protruding radially and arranged circumferentially and axially centrally.

33. An implant (1) according to any one of claims 30 to 32, characterised in that the pin (31) is made from a metal, preferably from steel, titanium, tantalum or gold.

34. An implant (1) according to any one of claims 1 to 33, characterised in that the entire contact surfaces (3, 4) are covered by teeth (7).

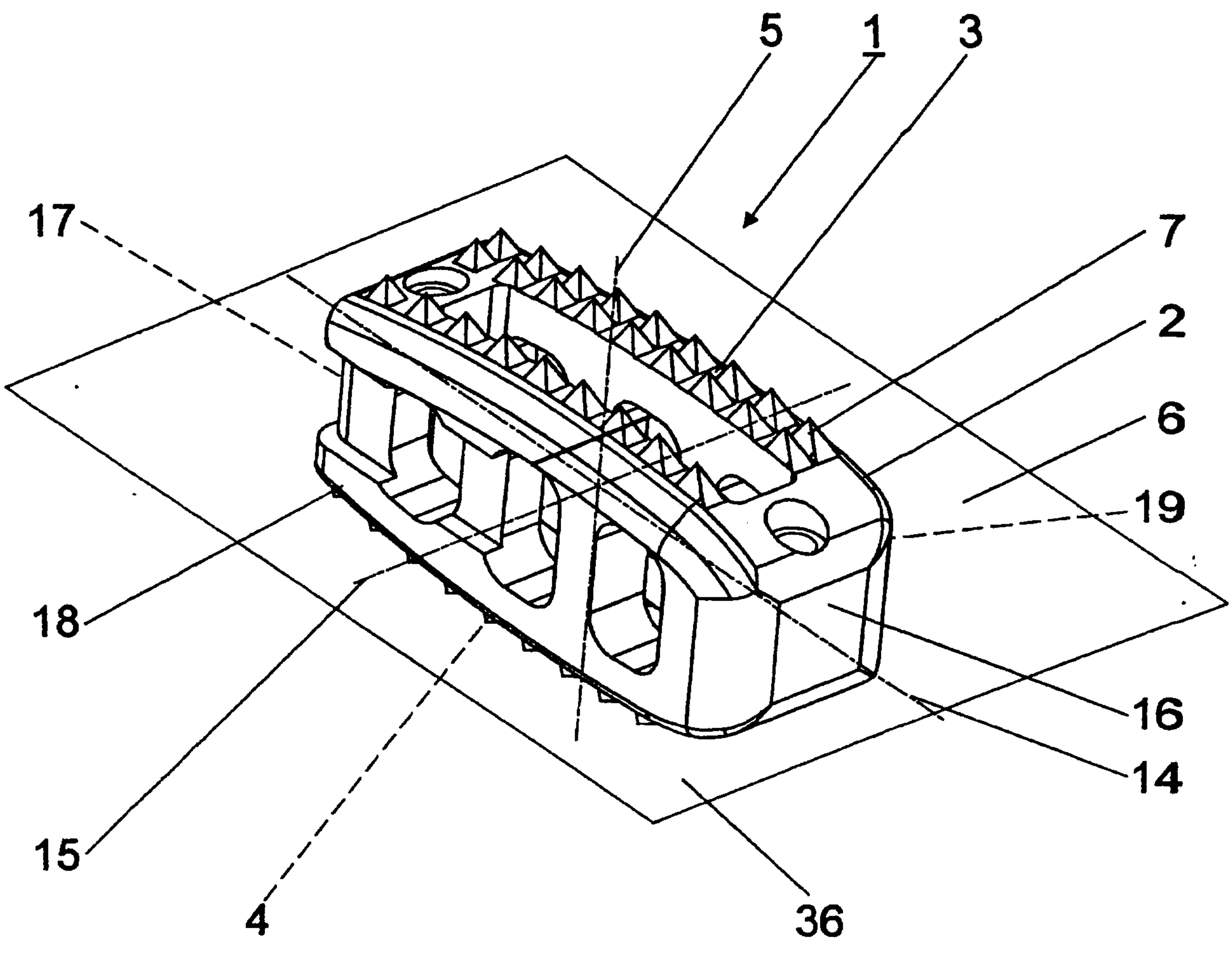


Fig. 1

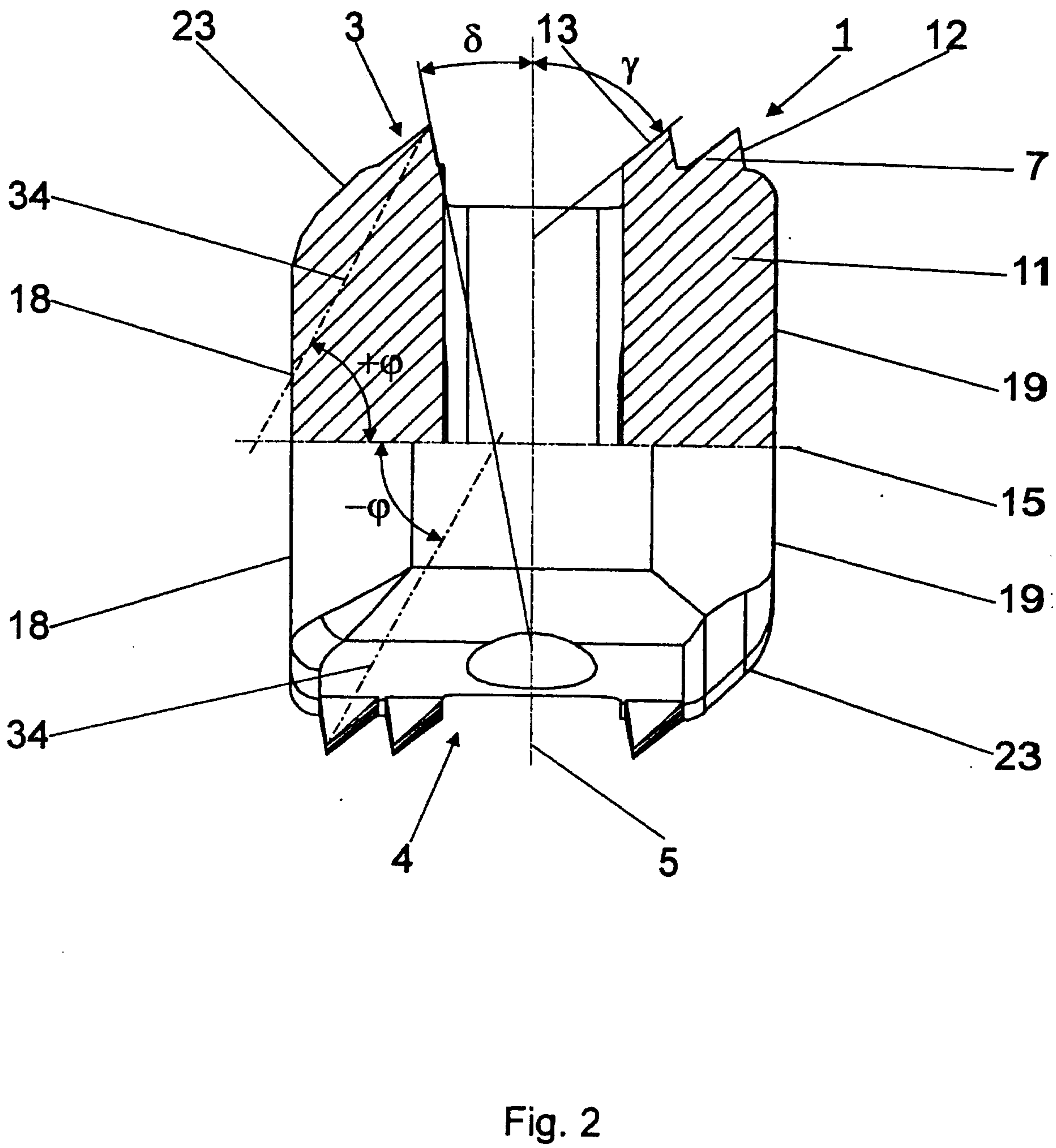


Fig. 2

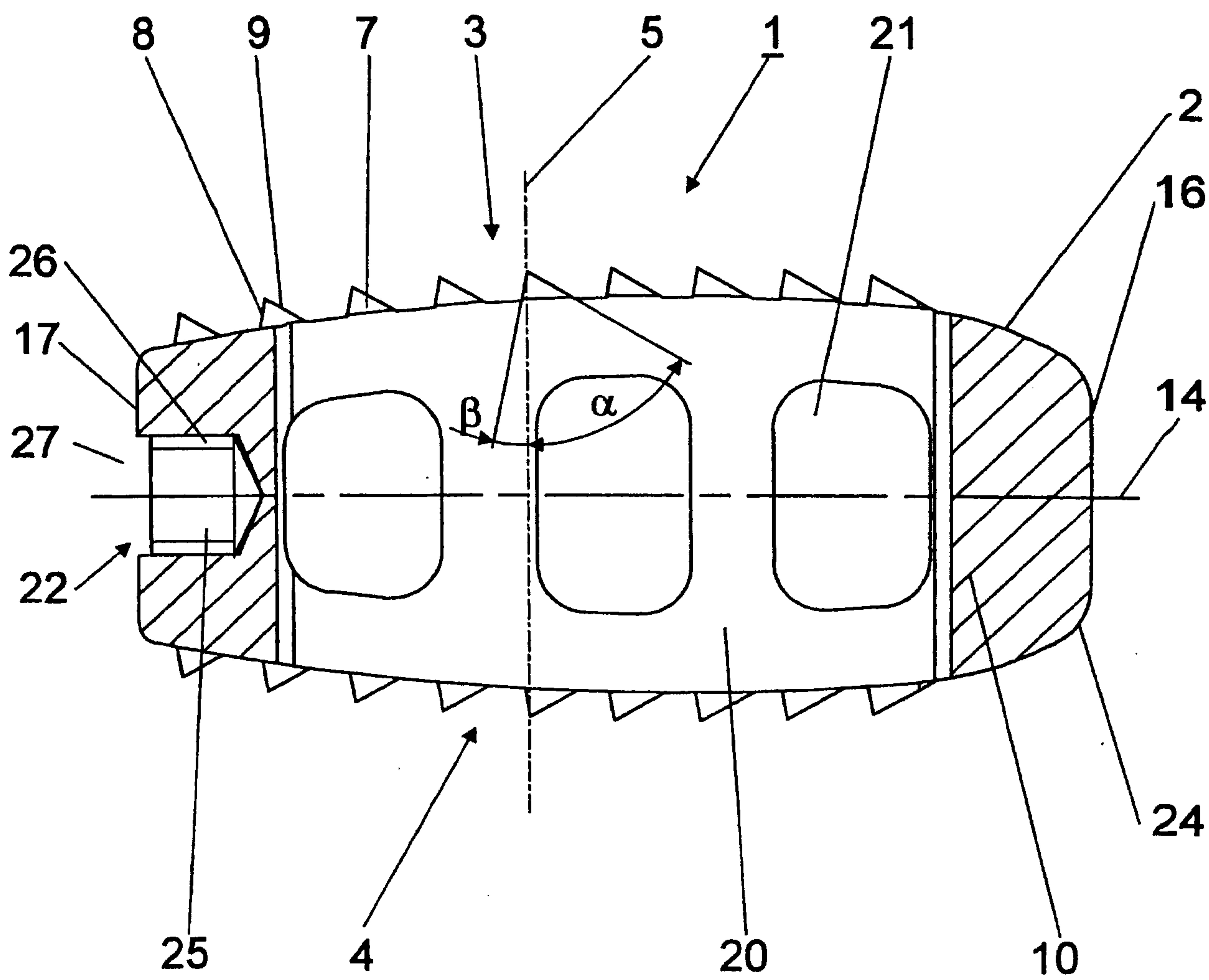


Fig. 3

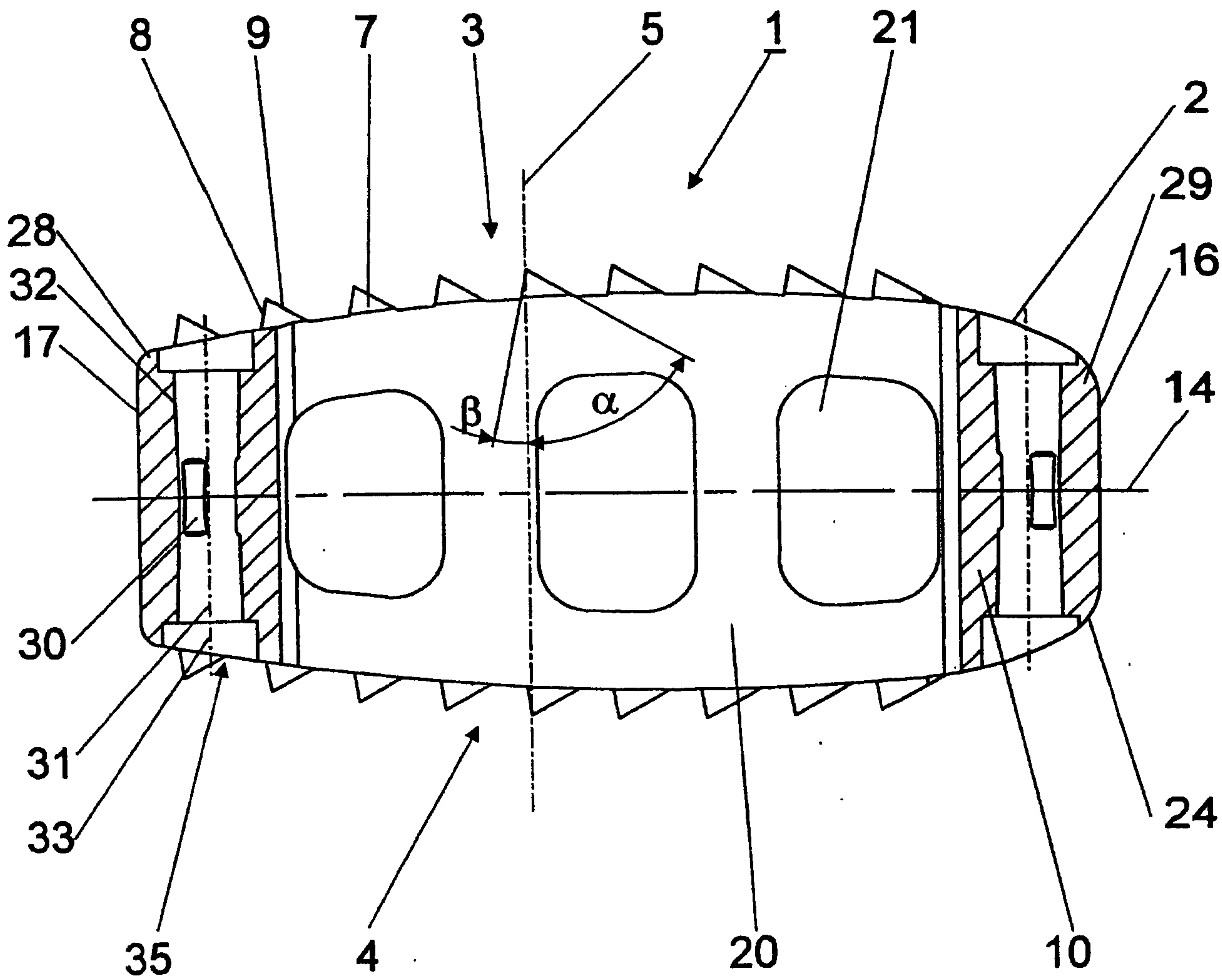


Fig. 4

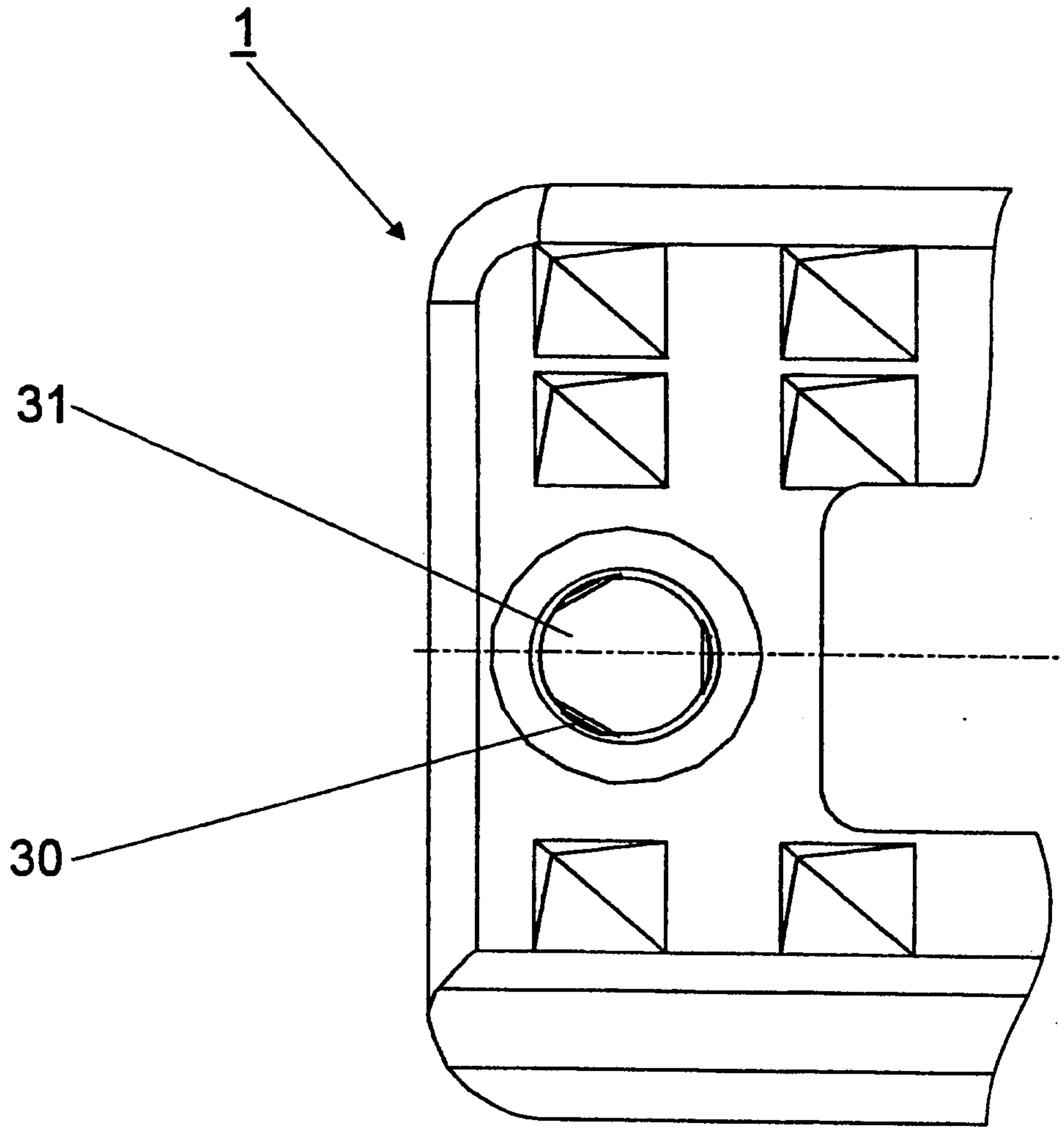
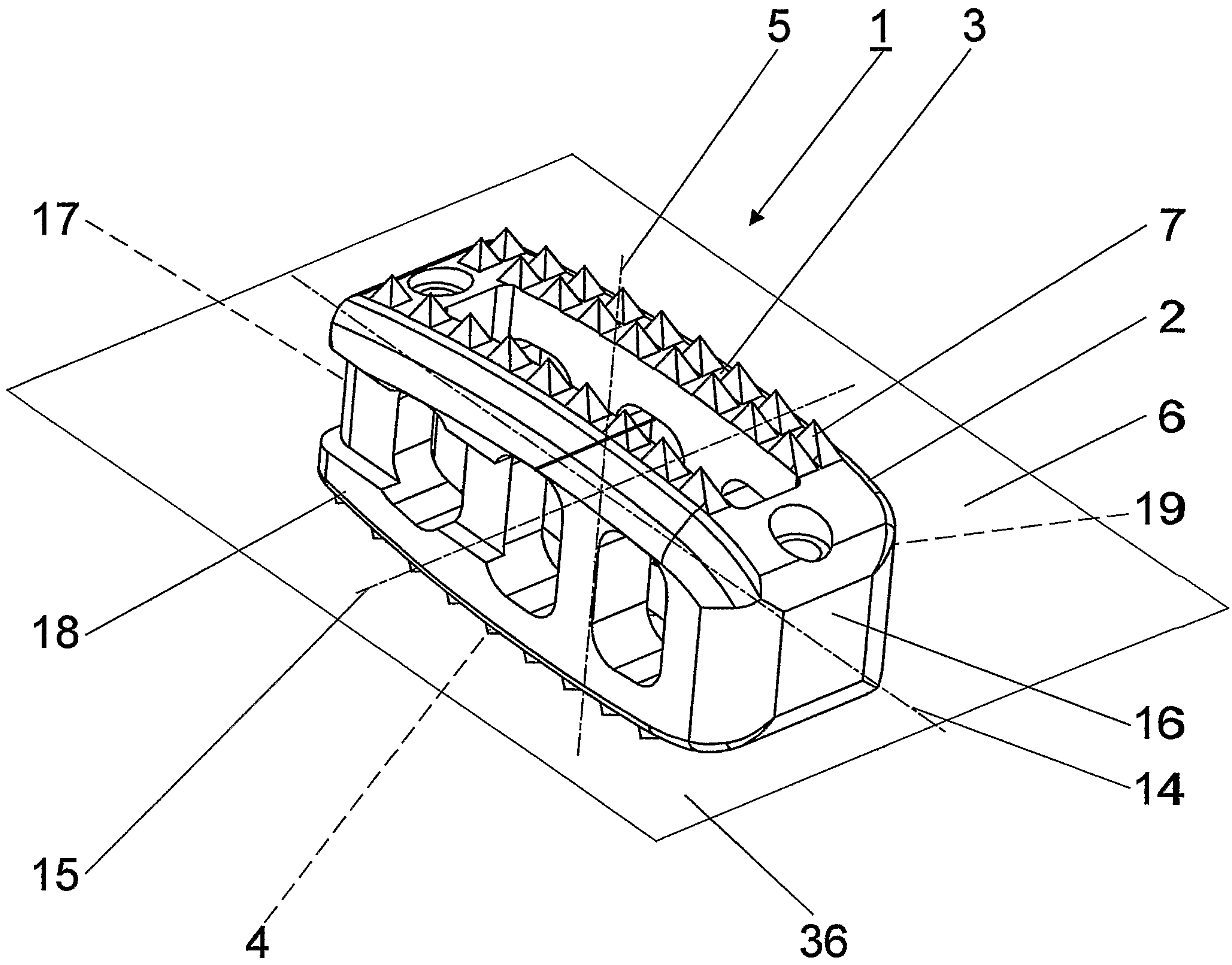


Fig. 5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