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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 August 2006 (10.08.2006)

PCT

(10) International Publication Number
WO 2006/082610 A2

(51) International Patent Classification:
A61C 8/00 (2006.01)

(21) International Application Number:
PCT/IT2006/000052

(22) International Filing Date: 31 January 2006 (31.01.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
FI2005A000020 4 February 2005 (04.02.2005) IT

(71) Applicants and
(72) Inventors: **CITO, Mario** [IT/IT]; Via Campagna, 45/a, I-50030 Scarperia (IT). **D'AMBROSIO, Gerardo** [IT/IT]; Via Cafaggio, 20, I-50030 Scarperia (IT). **VINCI, Salvatore** [IT/IT]; Viale Fratelli Kennedy, 13, I-50030 Borgo San Lorenzo (IT).

(74) Agents: **SOLDATINI, Andrea** et al.; Società Italiana Brevetti S.p.A., Corso dei Tintori, 25, I-50122 Firenze (IT).

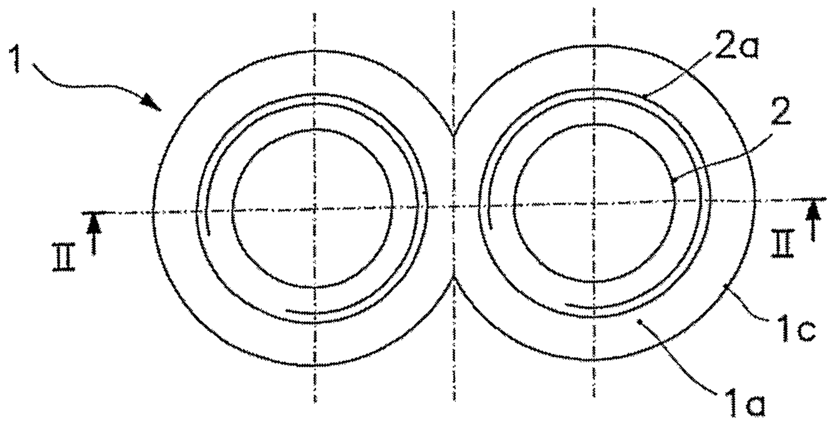
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC,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

(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, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTIPLE-ROOT ENDOSTEAL DENTAL IMPLANT



(57) Abstract: Endosteal dental implant for the reconstruction of tooth, comprising mechanical fixing means (3) suitable for being fixed into the maxilla/mandible (B) to support prosthesis, characterised in that it also comprises a intracortical collar (1) suitable for being arranged in chamber (A) formed in the surface of the bone (B), a least two through holes (2) formed in the collar (1), the fixing means (3) comprising at least two fixtures (3) suitable for engaging with respective holes (2) to b inserted within the bone (B) for locking the collar (1) in the chamber (A).

WO 2006/082610 A2

TITLE

MULTIPLE-ROOT ENDOSTEAL DENTAL IMPLANT

DESCRIPTION

Technical field of the Invention

The present invention relates to the field of implants, i.e. the field of dentistry that consists of replacing missing teeth with fixed dental prostheses. More specifically, the invention refers to a new endosteal dental implant, i.e. an implant intended to be integrated with the maxillary or mandibular bone to support a dental prosthetic appliance.

Background of the invention

Many implanting systems are known for recreating the structure of a lost tooth through the construction of a complex bio-mechanical system consisting of the bone, an endosteal implant that simulates the root of the tooth, an abutment intended for connection with the implant (to this purpose the same is provided with a suitable engagement seat), and finally the actual prosthesis, i.e. the tooth-shaped prosthetic appliance that is fixed to the implant-abutment assembly. Today, the implant-bone connection is considered from two points of view; that is to say, the process that leads to the stability of the implant consists of two steps: a primary stability step, wherein the implant seeks out support from the bone - to fix and support itself - in a purely mechanical way, and a secondary (biological) stability step, where the bone heals and remodels itself around the implant, integrating therewith.

The most commonly used implants are conical or cylindrical fixtures and the stress applied to them during mastication depends upon the position of the tooth that the implant replaces. The table below shows how these stresses vary substantially with the different types of tooth.

Central Incisors	Kg. 16
Lateral Incisors	Kg. 18
Canines	Kg. 30
First Premolars	Kg. 35
Second Premolars	Kg. 40
First Molars	Kg. 60
Second Molars	Kg. 62

It is thus clear that the fixtures must be of a suitable size to withstand the load applied. However, their cylindrical shape seriously restricts the possibility of using implants of a size suitable for withstanding the load, considering that the diameter and the length of the fixtures can not exceed the values compatible with the anatomical space available.

Considering in particular the case of the reconstruction of a molar tooth, a tooth defined as two- or three- rooted, a known system for avoiding this problem is to use two fixtures for supporting the prosthesis, these two fixtures being mutually connected externally to the gum. However, this technique has two fundamental drawbacks. Firstly, it exposes the zone between the fixtures to a serious risk of infection. Moreover, it does not reconstruct the root system of a molar, but rather "splits" a molar into two premolars, with negative consequences in terms of stability and distribution of the load, as well as of effectiveness of mastication.

Summary of the invention

The object of the present invention is to provide an implant capable of allowing greater primary stability in spite of a size that, when compared to the prior art, is much more compatible with the anatomical spaces available, without increasing in any way the risk of infection.

A particular object of the present invention is also to provide an implant of the aforementioned type, which carries out a better distribution of the mastication load compared to conventional implants.

These objects are achieved with the multiple-root endosteal dental implant according to the present invention the essential characteristics of which are defined in the first of the attached claims.

Brief description of the drawings

The characteristics and advantages of the endosteal dental implant according to the present invention will become apparent from the following description of embodiments thereof, given as non-limiting examples, with reference to the attached drawings in which:

- figure 1 shows a top plan view of a multiple-hole collar of the implant according to the invention;

- figure 2 is a cross section of the collar taken along lines II-II of figure 1;

- figure 3 is an axial section of a screw fixture for coupling with the collar of figures 1 and 2;

- figures 4a to 4c schematically show, in a perspective views, three subsequent steps of the process for inserting the implant of the previous figures;

- figure 5 is a top plan view of an abutment intended for connection with the implant of the previous figures;

- figure 6 is a cross section view of the abutment taken along lines V-V of figure 5;

- figure 7 shows the abutment in a perspective view, connected to the relative implant according to the invention;

- figure 8 is a perspective view of an implant-abutment assembly according to an alternative embodiment of the invention;

- figure 9 is a perspective view of a template assembly for use when implanting the implant according to the invention; and

- figure 10 shows two cutting tools to be used when implanting the implant according to the invention.

Description of the preferred embodiments

With reference to figures 1 and 2, the implant according to the invention comprises an intracortical collar 1 formed, in the depicted example, from a double-ring body with two parallel opposite flat faces 1a, 1b. The collar 1 is elongated according to a direction parallel to said faces, for a length that, as shall be seen later on, depends upon the size of the tooth that must be replaced.

A side surface 1c defined by two mutually intersecting cylindrical portions having generatrices perpendicular to the faces 1a, 1b, extends between these flat faces. The surface 1c joins flat face 1b with a round profile 1d. Two threaded through holes 2 extend between the two flat faces 1a, 1b. The holes 2 are formed in the collar 1 coaxially to respective cylindrical portions of the surface 1c. The holes 2 have, at the flat face 1a opposite the profile 1d, respective enlarged segments 2a.

With reference now also to figure 3, the holes 2 are intended for engagement with respective anchoring fixtures

3, one of which is shown in this figure. A fixture 3 consists of a substantially cylindrical member, externally threaded up to a head 5 in which, through a shaped circumferential notch 4, a projecting lip 6 is defined suitable for flush abutting arrangement inside the enlarged segment 2a of a hole 2 in the collar 1.

A longitudinal indentation 7 may be formed in the fixture 3, narrowing its cross section for an axial segment, at the opposite end to the head 5. The indentation 7, according to what is already known in implant technology, performs the function of decompression and drainage of the blood inside the bone socket. In a different embodiment, not shown, longitudinal grooves can also be formed in the fixture, e.g. three grooves angularly spaced of 120°, in order to assist the penetration of the fixture in the bone.

A cylindrical seat 8, centred with respect to the axis of the fixture 3, is formed axially in the same fixture. The seat 8 has a threaded inner segment 8a, and an outer segment 8b of larger diameter, which opens onto the head 5 with a step-like expansion 8c that further widens the diameter of the seat 8.

With reference now also to figures 4a to 4c, 9 and 10, the implant according to the invention is implanted in the following way. The maxillary or mandibular bone, indicated at B, is prepared by forming two parallel cylindrical bores C, each having a diameter substantially corresponding to that of a hole 2 of the collar 1, the two bores being spaced apart by an amount corresponding to the distance between the axis of the same holes 2 in the collar 1.

In order to assist this operation, after a first bore C has been formed, the second one may be formed with the support of a suitably sized template, taking the fist bore as a reference for guiding the drilling tool, so that the second bore is positioned and arranged according to a prefixed relationship with the first bore and the two bores are spaced apart with the due precision.

As shown in figure 9, a template assembly may comprise: the actual template, having the shape of a double-ring body 14 with two main holes 15a, 15b, similar to the collar 1; a reference pin 16 to be inserted via a first hole 15a in the bore C already formed; a rotation-locking small pin 17 to be introduced in a further small hole 18 formed in the body 14 between the main holes 15a, 15b; and a width-reducing member 19 for releasable engagement with the second hole 15b, so that drills of two different widths - a thin one for a first drilling step, a large one for a second, bore-enlarging step - can be precisely guided by the second hole 15b.

In the proximity of the bone surface, the two bores C are mutually communicated by excavating in the bone cortex a chamber A for the collar 1 to be fit into, the round profile 1d being arranged at the inside, and the flat face 1a resulting flush with the bone surface. The excavation of the chamber A can be carried out via suitable countersinking-milling tools like those shown in figure 10. In particular, a countersinking tool 20 is used for widening the top part of the bore C, with a head 21 comprising: a tip 21a for engagement with, and reference to, the bore already formed; an enlarged cutting portion 21b; and a further enlarged disk portion 21c for abutment and reference to the bone surface. A milling tool 22 is then used for completing the work of the tool 20 and profiling the chamber A. To this purpose, the tool 22 comprises a head 23 with a tip cutting portion 23a having a width corresponding to the transversal width of the chamber A, and an enlarged disk portion 23b for abutment and reference to the bone surface.

With the collar 1 accommodated in this way (figure 4a), the two fixtures 3 are inserted. The fixtures 3 screw firstly into the holes 2, and then grip directly to the bone tissue (figures 4b and 4c) until the lips 6 stop against the bottom of the enlarged segments 2a. The side surface of the bores C can possibly be previously threaded, according to conventional implanting techniques. In this way, the primary stability step is completed, creating a two-rooted structure similar to that of the tooth to be replaced.

The seats 8 of the fixtures 3 can at this point be used for connecting the prosthesis to the implant, by means of one or more abutments. Regarding this, although it is theoretically possible to use two conventional abutments, one for each seat 8, it is advantageous, in order to further improve the stability of the implant, to use a single double-ring abutment like the one shown in figures 5 to 7, to which reference will be made hereafter. The abutment, indicated at 9, is formed from a double-ring body, with two opposite and parallel flat faces 9a and 9b between which there develops a side surface 9c with two intersecting slightly conical portions, with axes perpendicular to the flat faces.

The flat face that, as a result of the cone shape of the side surface 9c, has a larger area is intended to be arranged in contact with the upper flat face 1a of the collar 1 and is indicated at 9b. The side surface 9c, near to the flat face 9b, has a peripheral projection 9d outlined accordingly to the outline of the double-ring collar 1. The projection 9d, if present, can act as a stop when the dental prosthesis is applied.

Between the two flat faces 9a and 9b two through holes 12 extend, coaxial to the axes of respective conical portions of the side surface 9c. The holes 12 have respective widened segments 12a nearby the upper flat face 9a and extend beyond the base face 9b, with portions of smaller diameter 12b within two tubular bits 10 that project from the base face 9b for a length substantially equal to that of the outer segment 8b of the seat 8 of a fixture 3. Each tubular bit 10 joins the base face 9b with a step 11, which extends annularly on the outside of the segment so as to be suitable for engagement with the expansion 8c of the seat 8 of a fixture 3.

As made clear from figure 7, the abutment 9 is thus arranged on the collar-fixture assembly previously implanted by inserting the tubular bits 10 in the seats 8 of the fixtures 3, and in particular in the relative outer segments 8b, until the base face 9b abuts on the upper face 1a of the collar 1. Then the abutment 9 is locked by inserting two screws 13 into the holes 12. The screws 13 engage with the threaded inner segments 8a of the holes 8 of the fixtures 3. The dental prosthesis, not shown, shall finally be connected to the abutment 9 with conventional methods.

From what has been described above it should be clear that, according to the invention, the primary stability of the implant is substantially improved. Indeed, the endosteal dental implant according to the present invention creates a root system substantially corresponding to the root system of the tooth to be replaced. Accordingly, it is possible to build implants with two or three roots, a result that cannot be obtained with current systems, increasing the firmness of the connection between the implant and the maxillary/mandibular bone.

The intracortical collar, housed along with the fixtures and connecting two or more of them within the maxillary/mandibular cortex, increases the cross-section of the implant only where useful, i.e. in the area that bears the greatest loads during mastication, remarkably improving the uniformity of the stress distribution and making these stresses more effectively withstandable. Since the load-bearing function is essentially carried out by the collar, the fixtures can have a smaller diameter and length than the fixtures used in the prior art. This means that the anatomical space available will be used in a more effective and less invasive way.

Since it is not necessary to carry out a connection between the fixtures over the gum, the risk of infection decreases. Moreover, the implant thus obtained does not "split" the original tooth down into two teeth of a lower category (for example a molar into two premolars). In spite of the advantageous possibility of using the template and the cutting tools above described, the implant according to the invention can be applied with instruments that already readily available to the dental surgeon.

The collar and the fixtures may be suitably designed so as to match up with one another (like in the depicted example, with a head 5 that precisely couples and engages with the enlarged segment 2a), and be marketed together in an implantation kit, possibly also with a template. However, suitably shaped collars according to the invention can also be supplied disjointedly, and therefore with holes 2 configured differently than those of the illustrated embodiment, so as to be usable with the various types of fixture already available in the art.

Clearly, also the outer shape of the collar can undergo multiple variations dictated by constructive or anatomical adaptation requirements. For example, figure 8 shows a different embodiment of the present invention, in which the outer profile of the collar, indicated at 101, and consequently of the abutment 109 is no longer in a double ring, but simply elliptical. This embodiment is particularly suitable for a collar and abutment equipped with three holes in which to house relative fixtures to reproduce the root system of a three-rooted tooth. More generally, not necessarily the collar will have two opposite parallel flat faces.

It is also important to consider how the fact that the axes of the holes of the collar are parallel, and therefore that said holes are perpendicular to the opposite and parallel flat faces (if present), does not represent an essential condition for the functionality of the implant. In some situations, in particular in case of three-rooted teeth, it may be preferable to have a certain angle between the axes, coplanar or skew, in order to optimally reproduce the configuration of the original root system.

Other variants and/or modifications can be brought to the multiple-root endosteal dental implant according to the present invention without for this reason departing from the scope of protection of the invention itself as defined by the appended claims.

CLAIMS

1. Endosteal dental implant for the reconstruction of a tooth, comprising mechanical fixing means to be driven and fixed into the maxillary or mandibular bone in order to support a dental prosthesis via an abutment (9), characterised in that it also comprises an intracortical collar (1) for arrangement in a chamber (A) formed in the surface of said bone, and at least two through holes (2) formed in said collar (1), said fixing means comprising at least two fixtures (3) to be engaged with respective of said holes (2) of said collar (1) and fixed in said bone in order to lock said collar (1) within said chamber (A).

2. The implant according to claim 1, wherein said holes (2) have axes parallel to each other.

3. The implant according to claim 1, wherein said holes (2) have axes skew to each other, or else coplanar but not parallel.

4. The implant according to any of the previous claims, wherein said holes (2) and said fixtures (3) mutually engage through via a screw-type connection.

5. The implant according to claim 2, wherein said collar (1) consists of a body with two parallel opposite flat faces (1a, 1b), elongated according to a direction parallel to said faces proportionally to the size of the tooth that must be reconstructed, said through holes (2) having axes perpendicular to said flat faces (1a, 1b).

6. The implant according to claim 5, wherein between said flat faces (1a, 1b) there develops a side surface (1c) having two mutually intersecting axially symmetrical portions, with respective axes perpendicular to said faces (1a, 1b) and coinciding with the axes of said holes (2).

7. The implant according to claim 5, wherein between said

flat faces (1a, 1b) there develops a side surface with a substantially elliptical outline.

8. The implant according to any of the claims 5 to 7, wherein said side surface (1c) has a round profile (1d) joining the same surface with one of said flat faces (1b) intended to come into contact with said bone.

9. The implant according to any of the previous claims, wherein said holes (2) of said collar (1) define respective axial stops (2a) for respective fixtures (3).

10. The implant according to claim 9, wherein said stops (2a) are defined by enlarged upper segments (2a) of said holes (2) suitable for engaging with respective lips (6) projecting peripherally outwards from the heads of the fixtures (3).

11. The implant according to any of the previous claims, wherein each of said fixtures (3) has an axially formed cylindrical seat (8), centred with respect to the axis of the fixture, said seat having a threaded inner segment (8a) for engagement with a screw connecting said fixture (3) to said abutment (9).

12. The implant according to claim 11, wherein said seat (8) has an outer segment (8b) of larger diameter, which opens onto the head (5) of the fixture (3) with a step-like expansion (8c) for engagement with a suitably shaped protruding bit (10) of said abutment (9).

13. The implant according to any of the previous claims, wherein said collar (1) is shaped for contact engagement with said abutment (9).

14. An assembly comprising a dental implant and an abutment for connection with said implant and for supporting a dental prosthesis, characterized in that said implant is an endosteal implant according to any of the

previous claims, and in that said abutment comprises a body (9) in which through holes (12) are formed in a number and arrangement corresponding to said holes (2) of said collar (1), said holes (12) being for the insertion of respective elements (13) connecting said abutment and said fixtures (3).

15. The assembly according to claim 14, wherein said body has two opposite and parallel flat faces (9a, 9b), elongated according to a direction parallel to the same faces, and a side surface (9c) developing between said faces (9a, 9b), shaped correspondingly to said side surface (1c) of said collar (1).

16. The assembly according to claim 14 or 15, wherein said abutment (9) comprises, in correspondence with respective holes (12), tubular protruding bits (10) for engagement with respective axial seats (8) formed in said fixtures.

17. A kit for assisting the implantation of an implant according to any of the claims from 1 to 13 comprising: a template (14) with two main holes (15a, 15b) arranged correspondingly to said holes (2) of said collar (1); a reference pin (16) to be inserted in a first main hole (15a); a rotation-locking small pin (17) to be introduced in a further small hole (18) formed in said body (14) between said main holes (15a, 15b); and a width-reducing member (19) for releasable engagement with a second main hole (15b), so that drills of two different widths can be precisely guided by said second hole (15b).

18. A kit according to claim 17, further comprising: a countersinking tool (20) with a head (21) comprising a tip (21a) for engagement with, and reference to, a fixture-housing bore (C) already formed in the bone, an enlarged

cutting portion (21b), and a further enlarged disk portion (21c) for abutment and reference to the bone surface; and a milling tool (22) for forming said chamber (A), comprising a head (23) with a tip cutting portion (23a) having a width corresponding to the transversal width of said chamber (A), and an enlarged disk portion (23b) for abutment and reference to the bone surface.

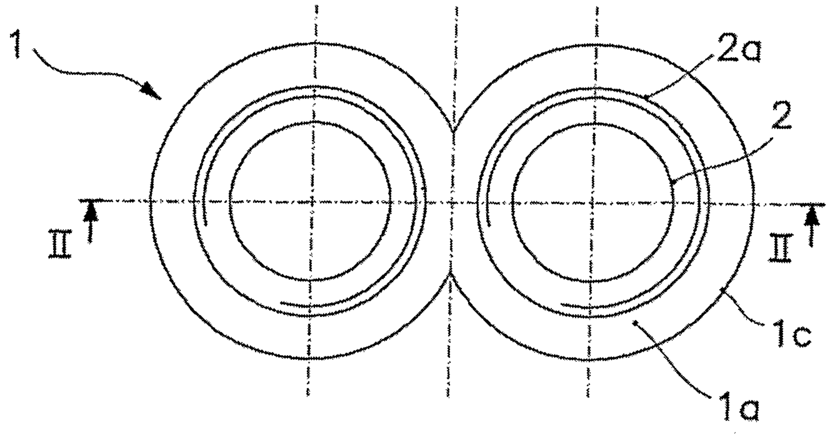


Fig.1

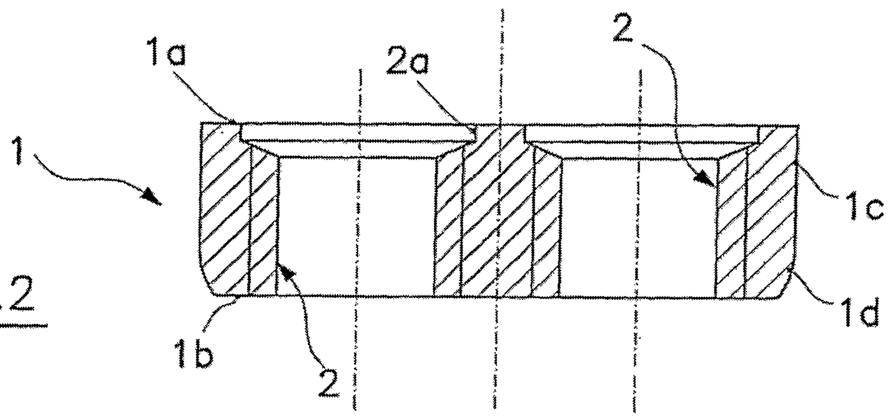


Fig.2

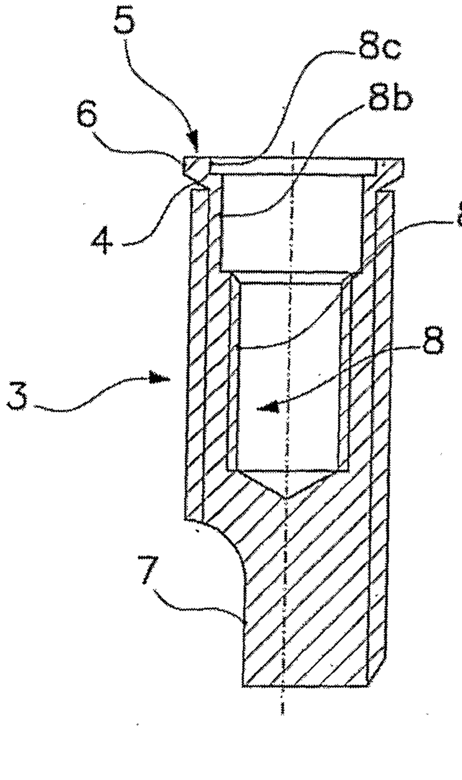


Fig.3

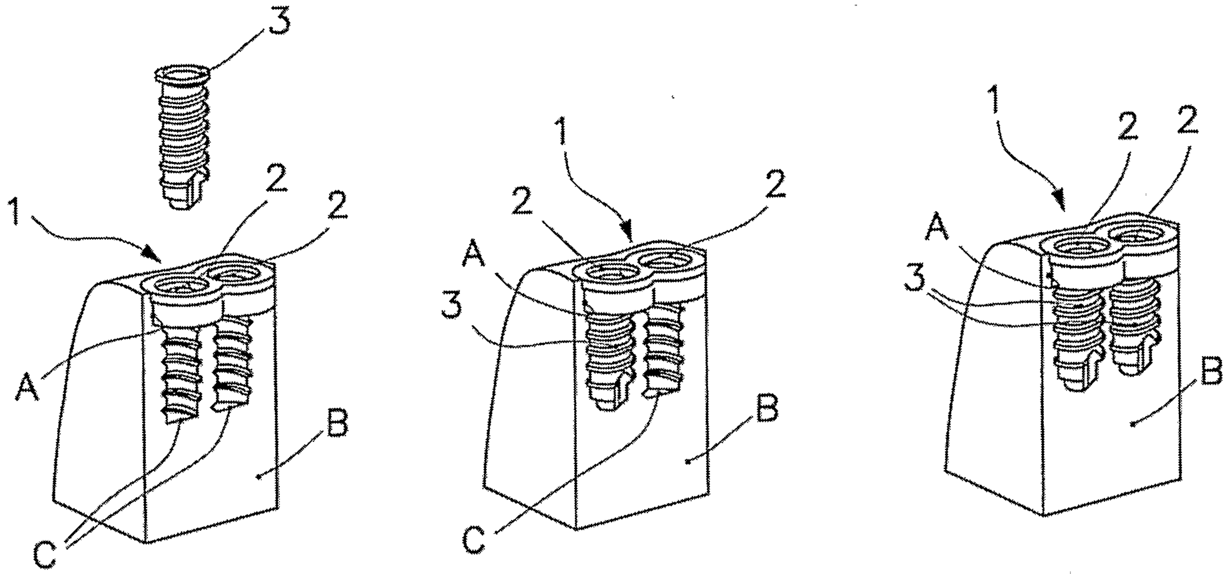


Fig.4a Fig.4b Fig.4c

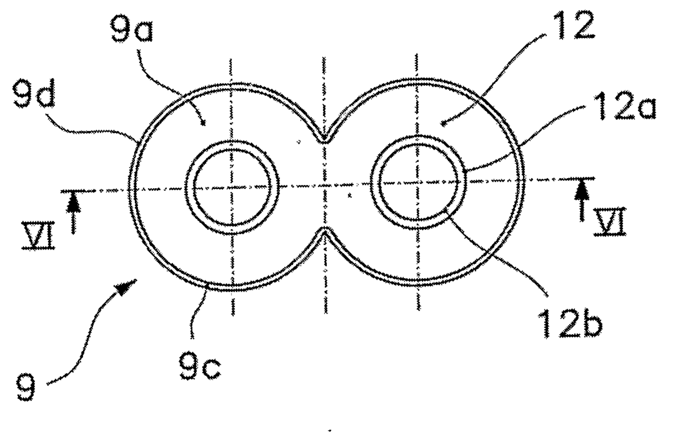


Fig.5

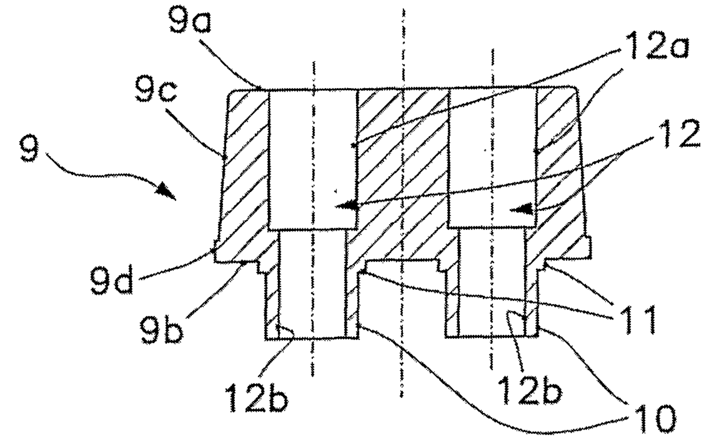


Fig.6

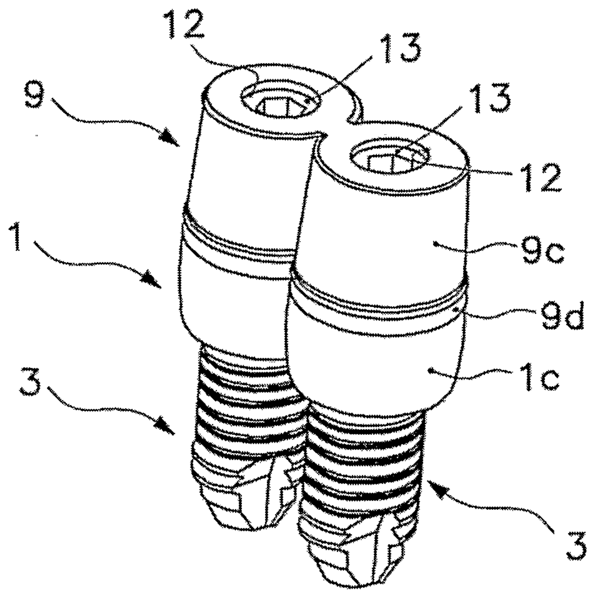


Fig.7

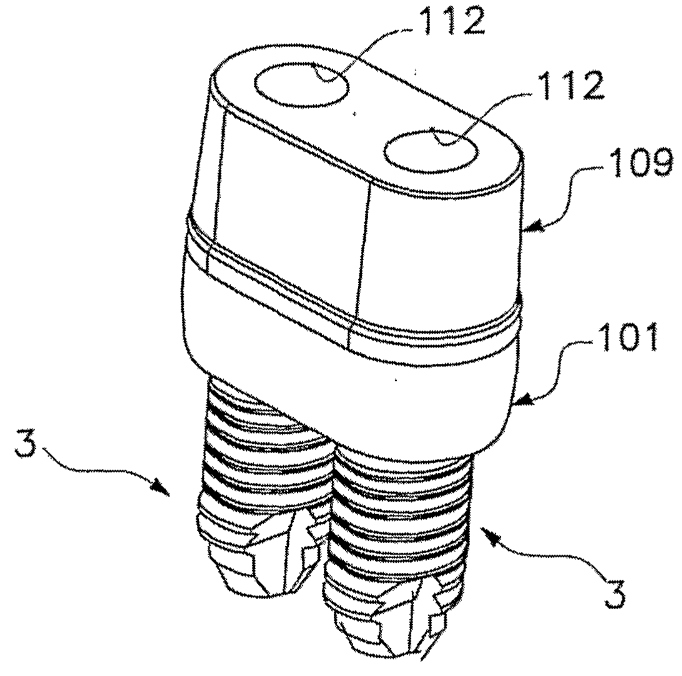


Fig.8

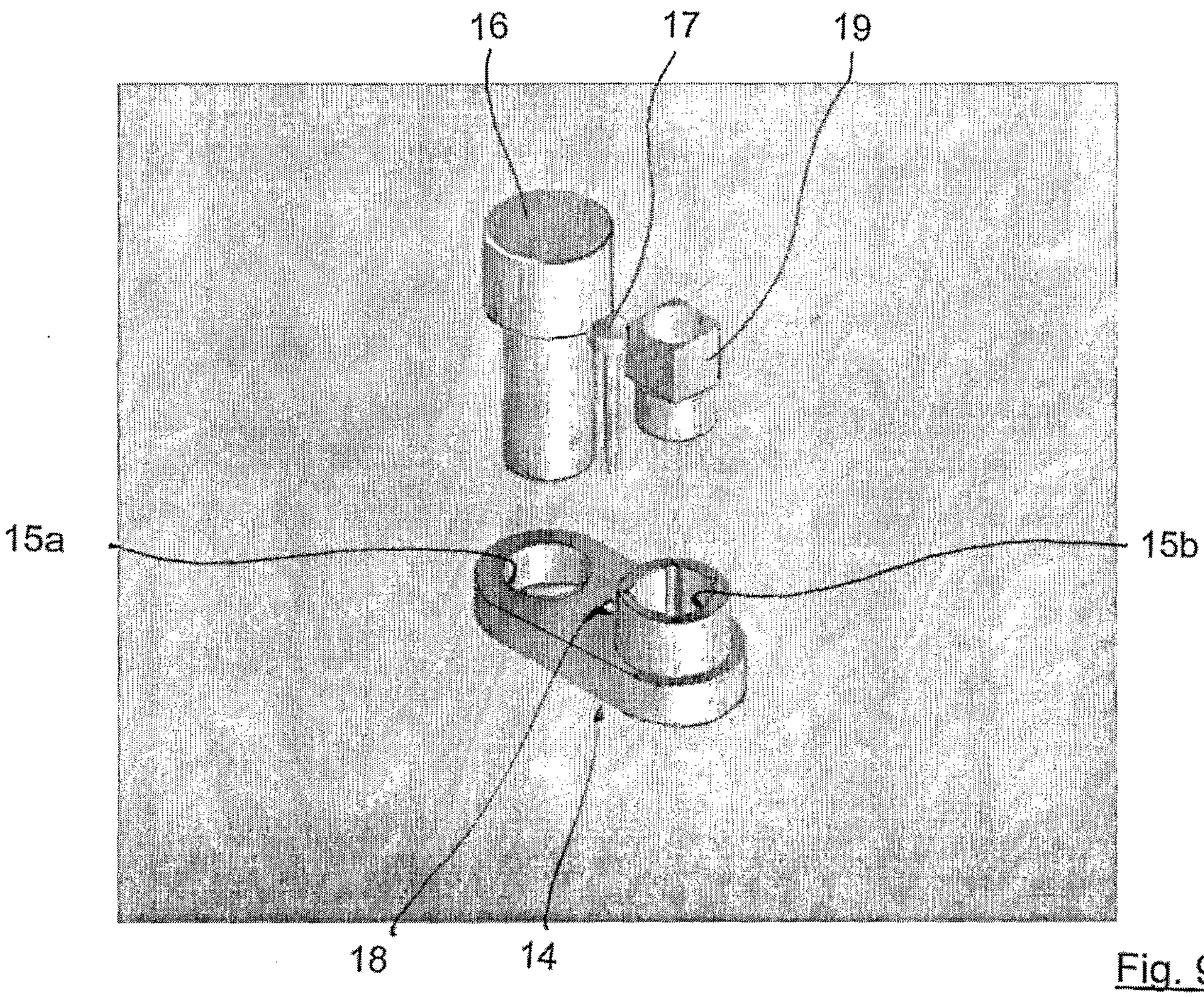


Fig. 9

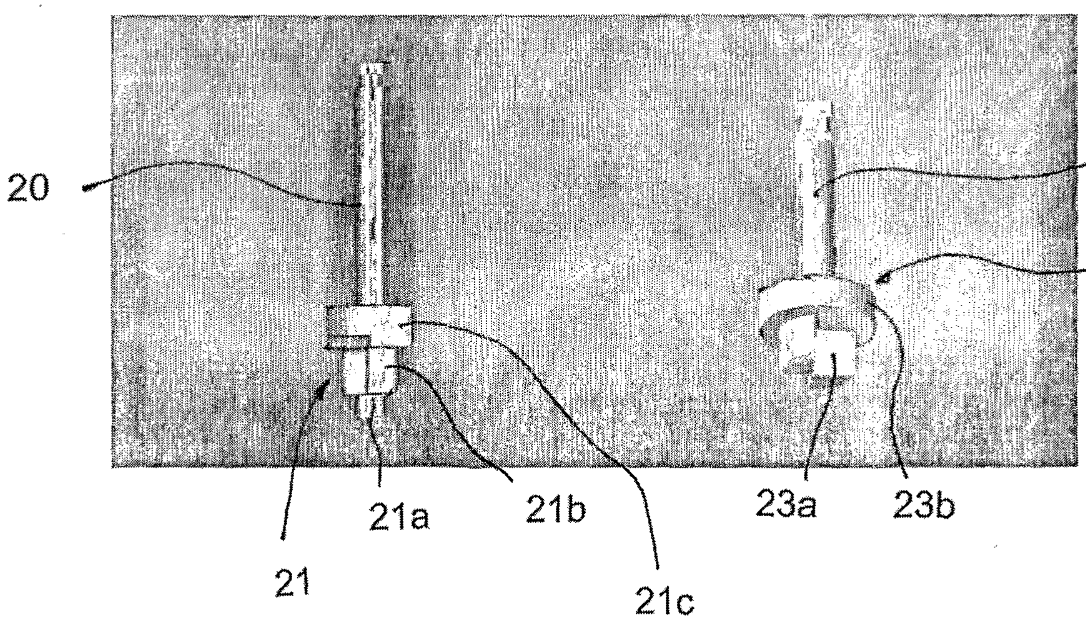


Fig. 10