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(54) Title : RESORPTIVE INTRAMEDULLARY IMPLANT BETWEEN TWO BONES OR TWO BONE FRAGMENTS

(54) Titre : IMPLANT INTRAMEDULLAIRE RESORBABLE ENTRE DEUX OS OU DEUX FRAGMENTS OSSEUX

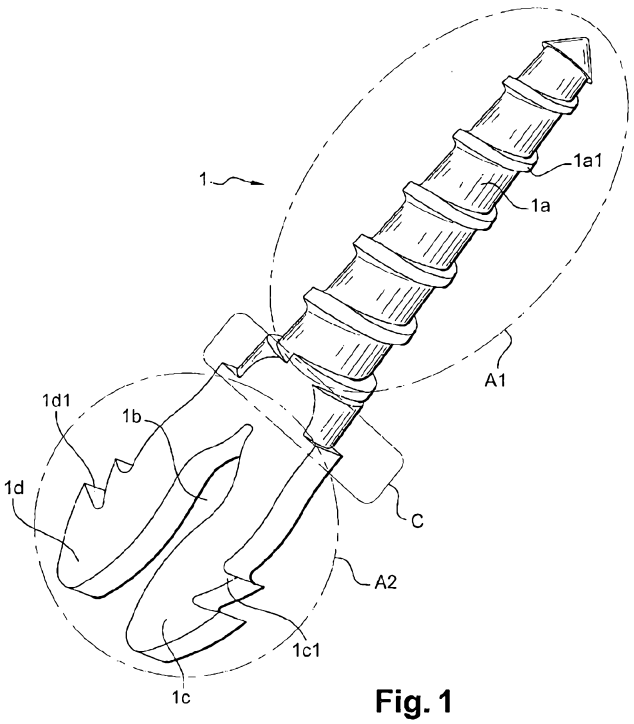

Fig. 1

(57) Abstract : The invention relates to a resorptive intramedullary implant between two bones or two bone fragments. The implant includes a single-piece body (1) having a generally elongate shape and having, at each end, areas for anchoring to the bone portions in question, characterised in that one of said areas (A1) has a cylindrical cross-section while the other area (A2) has a flat cross-section.

(57) Abrégé : Implant intramédullaire résorbable entre deux os ou deux fragments osseux L'implant est constitué par un corps monobloc (1) de forme générale allongée présentant, à chaque extrémité, des zones d'ancrage avec les parties d'os considérées, caractérisé en ce que l'une des zones (A1) est de section cylindrique, tandis que l'autre zone (A2) est de section méplate.

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RESORPTIVE INTRAMEDULLARY IMPLANT BETWEEN TWO BONES OR TWO BONE FRAGMENTS

FIELD

The invention relates to the technical field of orthopaedic implants, in particular for arthrodesis and osteosynthesis.

More particularly, the invention relates to an intramedullary implant for carrying out arthrodesis between two bone parts or osteosynthesis between two bone fragments, particularly in the case of the hand or foot.

DEFINITION

In the specification the term "comprising" shall be understood to have a broad meaning similar to the term "including" and will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps. This definition also applies to variations on the term "comprising" such as "comprise" and "comprises".

BACKGROUND

Various solutions have been proposed in order to provide the above noted functions.

For example, one solution is disclosed by the teaching of Patent Application FR 2,884,406, of which the present applicant is also the holder. This patent describes an intramedullary osteosynthesis device consisting of a body of elongate shape, the ends of which constitute anchoring regions engaging with the bone parts to be immobilized. The anchoring regions are profiled and made of a material selected to allow introduction into the bone parts, then carry out anchoring in said bone parts while avoiding any rotational movement, and resisting traction and maintaining a compression force.

Another solution is also disclosed by Patent Application FR 07,02003, also belonging to the applicant. This document describes an implant in the form of two anchoring regions connected by a central region, the overall shape of which is substantially circumscribed by a very elongate rectangle while having a substantial X-shape so as to constitute, in the anchoring regions, two tongues capable of being pressed apart by elastic effect or by shape memory effect.

On the basis of this design, various criteria have been established in order to make the implant easy to fit and effective so as to generate primary and secondary stability of the

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osteosynthesis or arthrodesis focus. The examples described in the Background above are not suitable in the case of an implant made of resorbable material. Further the reference to background art in this specification is not intended to, and should not be taken as, an acknowledgment, statement, suggestion or admission that the referenced prior art forms part of the common general knowledge in Australia or in any other country.

SUMMARY

According to a first aspect of the present invention, there is provided an intramedullary implant for carrying out arthrodesis between two bone parts or osteosynthesis between two bone fragments, the implant comprising of monobloc body of elongate overall shape having, at each end, regions for anchoring to the bone parts or bone fragments in question each having a longitudinal axis, wherein one of the regions has a circular cross section and is screw threaded while the other region has a flat cross section having at least a first tooth of a plurality of teeth spaced from a second tooth of the plurality of teeth in a direction along the longitudinal axis of the other region, at least the first tooth facing in a direction opposite a third tooth of the plurality of teeth and the second tooth facing in a direction opposite a fourth tooth of the plurality of teeth.

Embodiments of the invention may further improve the anchoring and stability of the implant and its adaptation to the morphology of the implantation site, when said implant is made of a resorbable material.

Advantageously, the implant may be made of a resorbable material whose mechanical properties are determined in order to last the required consolidation time, so that said implant is resorbable beyond 6 months. For example, the implant is composed of a polymer or copolymer of lactic acid (PLA, PGA, etc.).

In view of the specific mechanical properties of resorbable materials, and in order to achieve the relevant object of improving the anchoring and stability, the region with a circular cross section is screw-threaded and may have a conicity with its cross section decreasing in the direction of its free end.

In another embodiment, in order to allow sufficient deformation by elasticity, thus generating an expansion adapted to the geometry of the site, and the property of the material, the region with a flat cross section has, substantially in its middle part, an opening capable of allowing deformation of said region by elasticity. The opening delimits at least two anchoring tongues.

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It is therefore apparent that the combination of a cylindrical and screw-threaded anchoring region and an anchoring region with a flat cross section may be found to be particularly advantageous in view of the relevant object to be achieved.

In a further embodiment, in order to withstand the shear and bending stresses liable to be exerted at the bone focus, between the two anchoring regions, the body may have a central transition region capable of withstanding the shear and bending stresses exerted at the bone focus and capable of acting as a stop.

On the basis of this fundamental design of such an embodiment of the implant, the anchoring regions may be arranged in coaxial alignment or the anchoring regions may be angularly offset by between 1° and 30° approximately, and advantageously 10°. An angular offset may be located between the anchoring regions in order to correspond substantially to an arthrodesis line of the bones in question.

Further the anchoring regions may define a folding line that is located there between, and the folding line may correspond substantially to an arthrodesis line of the bones in question.

According to another aspect there is provided an intramedullary implant for carrying out arthrodesis between two bone parts or osteosynthesis between two bone fragments, the implant having:

a first threaded end for anchoring to a first bone part or to a first bone fragment;

a second end extending from the first end for anchoring to a second bone part corresponding to the first bone part or a second bone fragment corresponding to the first bone fragment and having a longitudinal axis and a plurality of outwardly projecting teeth, at least a first tooth of the plurality of teeth spaced from a second tooth of the plurality of teeth in a direction along the longitudinal axis of the second end, and at least the first tooth extending in a different direction than a third tooth of the plurality of teeth, the second end having an opening in a median portion thereof.

The intramedullary implant may include any one or more of the features of the first aspect of the invention defined above.

According to a further aspect there is provided an intramedullary implant for performing arthrodesis or osteosynthesis between first and second bone parts, the implant comprising:

a first threaded end for anchoring to the first bone part;

a second end extending from the first end for anchoring to the second bone part, the second end having a longitudinal axis, a body portion with a flat cross section, and a plurality of teeth projecting from the body portion, wherein at least a first tooth of the plurality of teeth is

spaced from a second tooth of the plurality of teeth in a direction along the longitudinal axis of the second end, the first and second teeth extending from the body portion in a same direction, and at least the first tooth extending from the body portion in a different direction than a direction a third tooth of the plurality of teeth extends from the body portion.

According to a further aspect there is provided an intramedullary implant for performing arthrodesis or osteosynthesis between first and second bone parts, the implant comprising:

a first threaded end for anchoring to the first bone part;

a second end extending from the first end for anchoring to the second bone part and having a plurality of outwardly projecting teeth, at least a first tooth of the plurality of teeth spaced from a second tooth of the plurality of teeth in a direction along the longitudinal axis of the second end, and at least the first tooth extending in a different direction than a third tooth of the plurality of teeth, the second end having an opening in a median portion thereof and opposing flat surfaces parallel to the longitudinal axis.

A flat surface of the first tooth may be coplanar with a flat surface of the second tooth.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments will be described, by way of example only, with reference to the appended drawings, in which:

Figure 1 is a perspective view of an embodiment of an implant;

Figure 2 is a front view of the implant before introduction into the bone part in question;

Figure 3 is a side view corresponding to Figure 2;

Figure 4 is a similar view to Figure 2 showing the positioning of the anchoring tongues of the flat section after introduction;

Figure 5 is a perspective view of another advantageous embodiment of the implant; and

Figures 6 and 7 shows the placement of the implant in two bone parts.

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DETAILED DESCRIPTION

The implant according to the present disclosure comprises a monobloc body (1) of elongate shape, having a so-called proximal first region (Ai) and a so-called distal second region (A2). The entire body of the implant is made of a resorbable material, the mechanical properties of which are determined so that the implant is resorbed over a timescale of more than about 6 months. In one exemplary embodiment, the implant is composed of a polymer or copolymer of lactic acid (PLA, PGA, etc.).

As will be indicated in the rest of the description, the regions (A1) and (A2) have arrangements for anchoring to the corresponding bone parts. Considering the specific characteristics of the resorbable material, and in order to achieve the relevant object of anchoring and stability, the region (A1) has a cylindrical cross section while the other region (A2) has a flat cross section.

The region (A1) consists of a cylindrical span (1a) having a conicity reduced in the direction of the free end. The span (1a) has a helicoid rib acting as a screw thread (1a1).

The region (A2) with a flat cross section has, substantially in its middle part, an opening (1b) capable of allowing deformation by elasticity of said region (A2). More particularly, the opening (1b) delimits at least two anchoring tongues (1c) and (1d), each having at least one outwardly projecting tooth (1c1), (1d1).

Advantageously, between the two anchoring regions (A1) and (A2), the body has a central transition region (C) capable of withstanding the shear and bending stresses liable to be exerted at the bone focus. By way of entirely nonlimiting indication, this middle region (C) may have a width of about 3.5 mm with a thickness of about 2 mm, for an implant length of between 15 and 25 mm approximately, with a diameter of 2 or 3 mm approximately, in the region (A1).

In the embodiment illustrated in Figure 1, the two regions (A1) and (A2) are arranged in coaxial alignment.

In order to achieve the object of adapting to the morphology of the implantation site, the anchoring regions (A1) and (A2) may be angularly offset by an angle α adapted to the geometry of the bone site. This angle α is between 1° and 30° approximately, and advantageously of the order of 10° in the case when the implant is used for an arthrodesis of the foot (Figure 5).

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In this embodiment, in which the two anchoring regions are angularly offset, the folding line is located in order to correspond substantially to an arthrodesis line of the bone parts in question.

Figures 6 and 7 will now be referred to, which schematically show the positioning of the implant according to the invention between two bone parts (01) and (02). After having produced suitable bone recesses by means of an instrument of the rasp type, the operator screws the threaded portion (1a) into the bone part in question (01) substantially as far as the middle region (C), which acts as a stop preventing excessive insertion of the implant into the bone in question (Figure 6). The operator then fits the second bone part (A2) onto the anchoring tongues (1d) and (1c) of the region (A2), which are clamped by elasticity (Figure 7).

The operating technique may thus be as follows:

- drilling two holes using a suitable conventional drill;
- preparing the recesses with a rasp for the flat side and a tap in order to prepare the internal screw thread on the cylindrical side;
- using a screwdriver with a gripping tip;
- screwing on the cylindrical side, in general P1, for the IPP arthrodesis of the foot;
- fitting the bone on the flat side onto the implant.

The advantages are readily apparent from the description, although in particular it should be emphasized and recalled that the combination of the two anchoring regions (A1) and (A2), respectively with a cylindrical cross section and a flat cross section, significantly improves the anchoring and stability of the implant which is adapted to the geometry of the bone focus and the properties of the material, namely resorbable material.

It will of course be realized that the above has been given only by way of illustrative example of the invention and that all such modifications and variations thereto, as would be apparent to persons skilled in the art, are deemed to fall within the broad scope and ambit of the invention as is herein set forth.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An intramedullary implant for carrying out arthrodesis between two bone parts or osteosynthesis between two bone fragments, the implant comprising a monobloc body of elongate overall shape having, at each end, regions for anchoring to the bone parts or bone fragments in question each having a longitudinal axis, wherein one of the regions has a circular cross section and is screw threaded while the other region has a flat cross section having at least a first tooth of a plurality of teeth spaced from a second tooth of the plurality of teeth in a direction along the longitudinal axis of the other region, at least the first tooth facing in a direction opposite a third tooth of the plurality of teeth and the second tooth facing in a direction opposite a fourth tooth of the plurality of teeth.

2. An implant according to claim 1, wherein the implant is formed of a substantially resorptive material.

3. An implant according to claim 1 or claim 2, wherein the region with a circular cross section has a conicity with its cross section decreasing in the direction of its free end.

4. An implant according to any one of the preceding claims, wherein the region with a flat cross section has, substantially at its middle part, an opening capable of allowing deformation of said region by elasticity.

5. An implant according to claim 4, wherein the opening delimits at least two anchoring tongues.

6. An implant according to any one of claims 1 to 5, wherein between the two anchoring regions, the body has a central transition region capable of withstanding the shear and bending stresses exerted at the bone focus and capable of acting as a stop.

7. An implant according to any one of claims 1 to 6, wherein the anchoring regions are arranged in coaxial alignment.

8. An implant according to any one of claims 1 to 6, wherein the anchoring regions are angularly offset.

9. An implant according to claim 8, wherein the anchoring regions are angularly offset between from approximately 1^{o} to 30^{o}.

10. An implant according to claim 8 or claim 9, wherein the anchoring regions are angularly offset by 10^{o}.

11. An implant according to any one of claims 8 to 10, wherein an angular offset between the anchoring regions is located in order to correspond substantially to an arthrodesis line of the bones in question.

12. An implant according to any one of claims 1 to 11, wherein the implant is made of a material which is resorbable and capable of being deformed by elasticity.

13. An intramedullary implant for performing arthrodesis or osteosynthesis between first and second bone parts, the implant comprising:

a first threaded end for anchoring to the first bone part;

a second end extending from the first end for anchoring to the second bone part, the second end having a longitudinal axis, a body portion with a flat cross section, and a plurality of teeth projecting from the body portion, wherein at least a first tooth of the plurality of teeth is spaced from a second tooth of the plurality of teeth in a direction along the longitudinal axis of the second end, the first and second teeth extending from the body portion in a same direction, and at least the first tooth extending from the body portion in a different direction than a direction a third tooth of the plurality of teeth extends from the body portion.

14. The intramedullary implant of claim 13, wherein the first threaded end tapers in a direction away from the second end.

15. The intramedullary implant of either of claims 13 or14, wherein the second end has an opening in a median portion therein, the opening allowing for elastic deformation of the second end.

16. The intramedullary implant of either of claims 13 or15, further comprising a central transition zone between the first and second ends, the central transition zone

defined at the second end by an abutment at an edge of the second end, the abutment being transverse to a longitudinal axis of the first end and adapted to prevent overinsertion of the implant into the second bone part.

17. The intramedullary implant of any of claims 13 to 16, wherein the implant is made of resorptive material.

18. The intramedullary implant of any of claims 13 to 17, wherein a flat surface of the first tooth is coplanar with a flat surface of the second tooth.

19. An intramedullary implant for performing arthrodesis or osteosynthesis between first and second bone parts, the implant comprising:

a first threaded end for anchoring to the first bone part;

a second end extending from the first end for anchoring to the second bone part and having a plurality of outwardly projecting teeth, at least a first tooth of the plurality of teeth spaced from a second tooth of the plurality of teeth in a direction along a longitudinal axis of the second end, and at least the first tooth extending in a different direction than a third tooth of the plurality of teeth, the second end having an opening in a median portion thereof and opposing flat surfaces parallel to the longitudinal axis.

20. The intramedullary implant of claim 19, further comprising a central transition zone between the first and second ends, the central transition zone defined at the second end by an abutment at an edge of the second end, the abutment being transverse to a longitudinal axis of the first end and adapted to prevent overinsertion of the implant into the second bone part.

21. The intramedullary implant of either of claims 19 and 20, wherein a flat surface of the first tooth is coplanar with a flat surface of the second tooth.

22. An intramedullary implant for carrying out arthrodesis between two bone parts or osteosynthesis between two bone fragments, substantially as hereinbefore described and with reference to any one of the accompanying drawings.

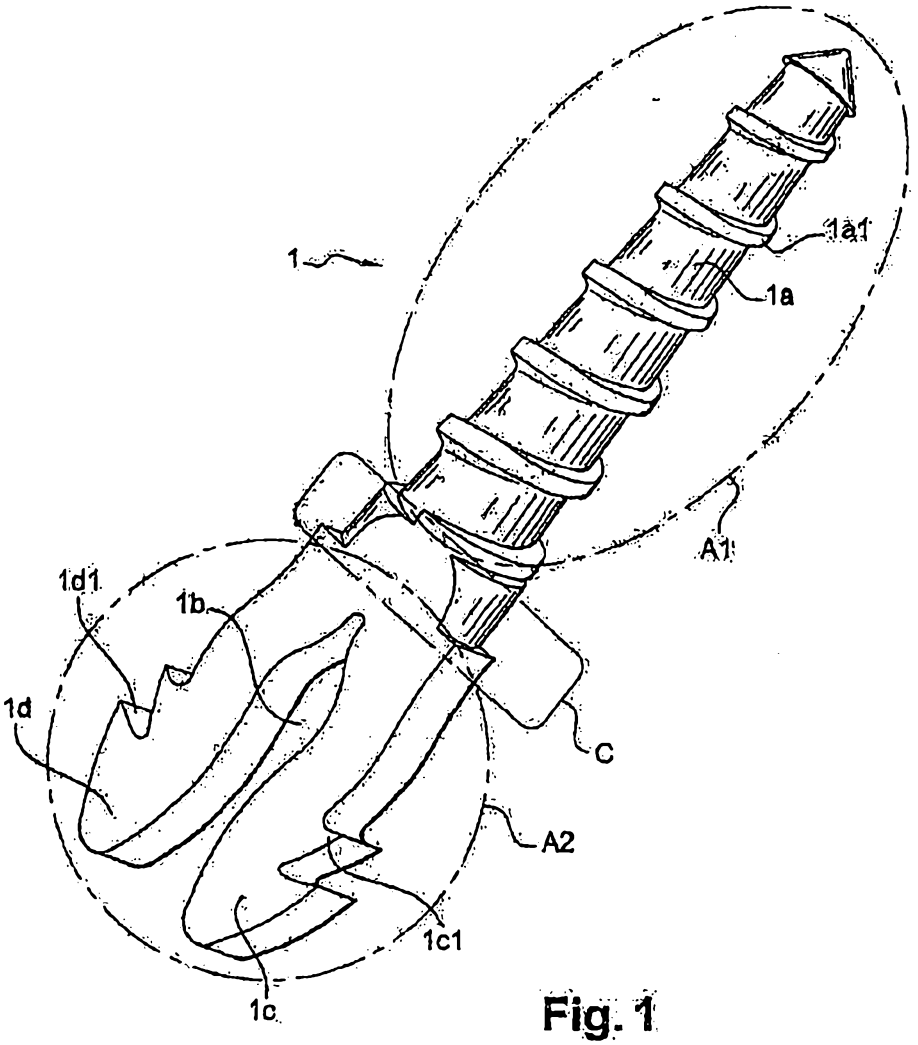

Fig. 1

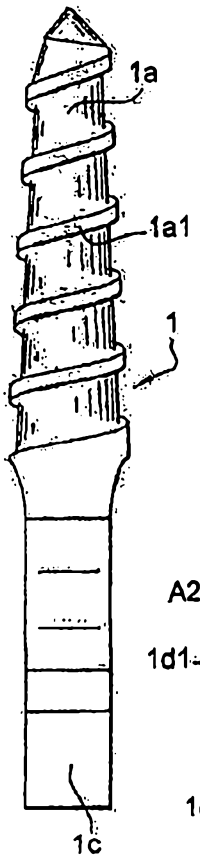

Fig. 3

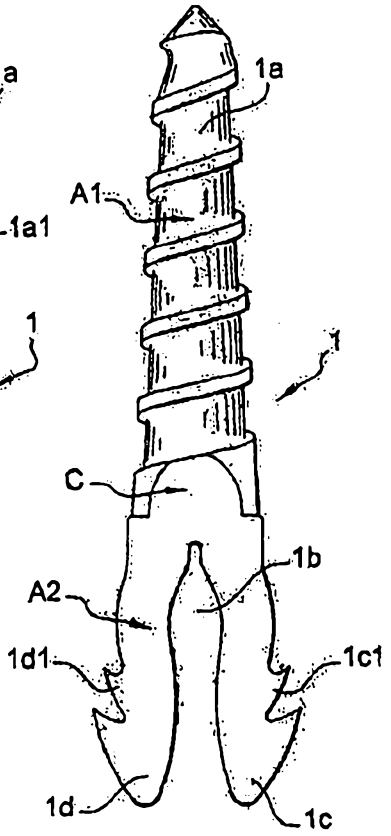

Fig. 2

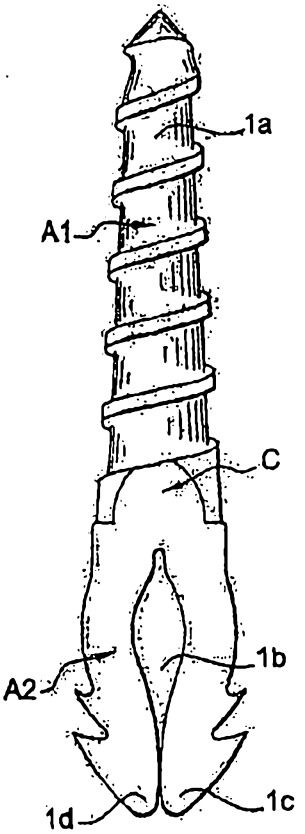

Fig. 4

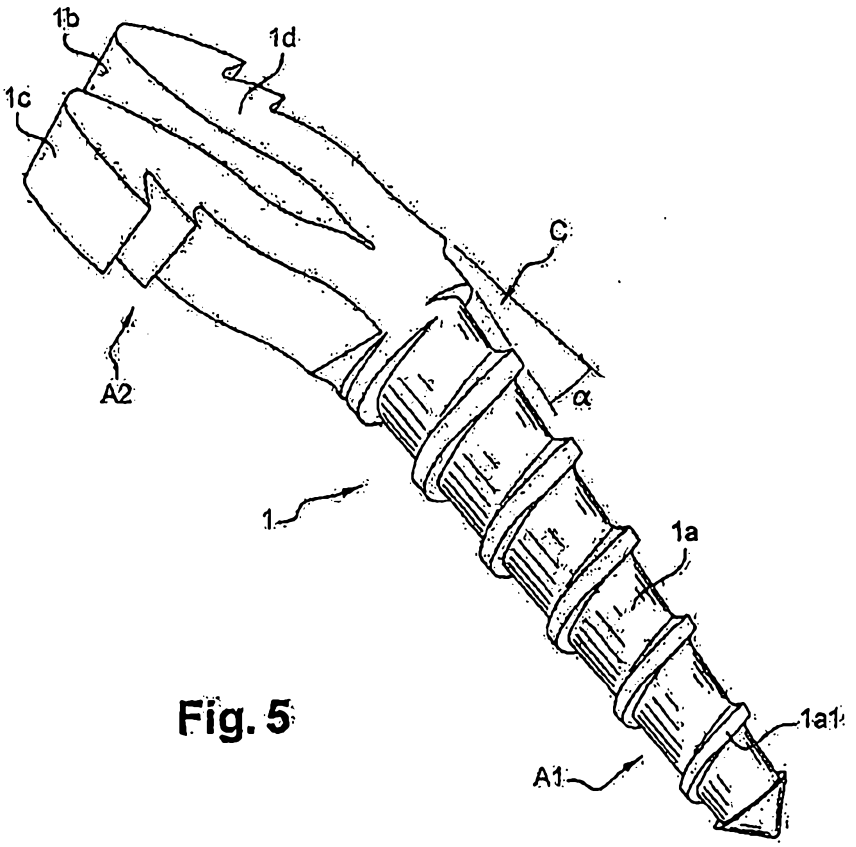

Fig. 5

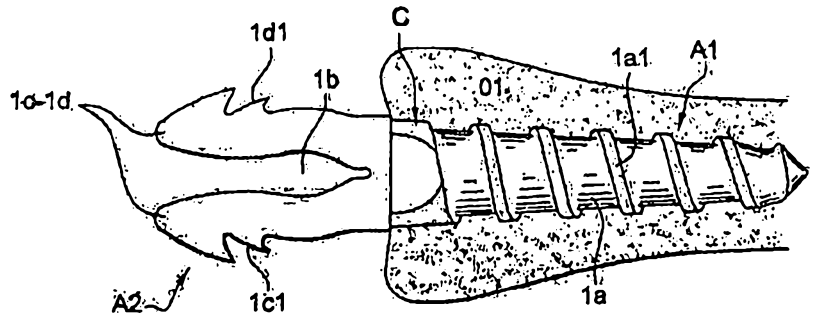

Fig. 6

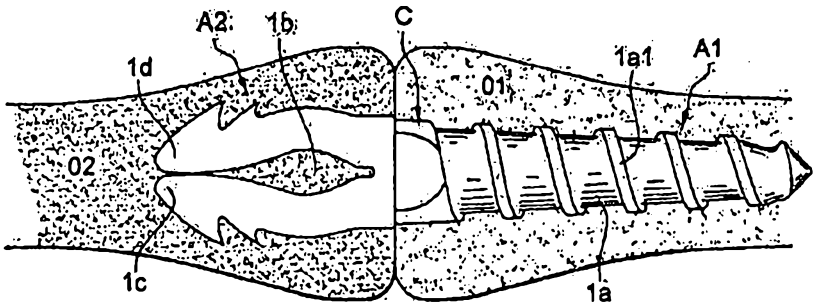

Fig. 7