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(54) Title: ABUTMENT FOR A DENTAL IMPLANT

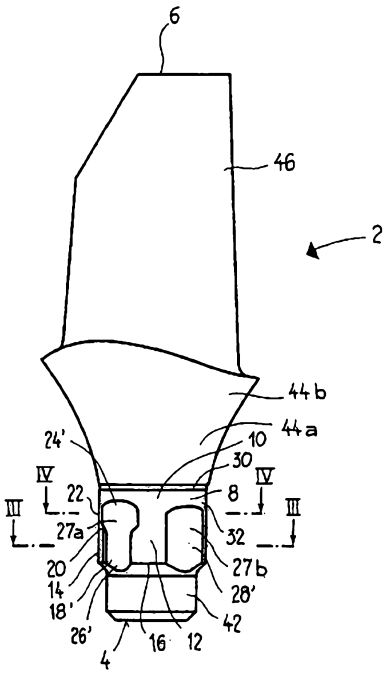

Fig.1

(57) Abstract: The present invention relates to an abutment for a dental implant (50), with an apical end (4) and with a coronal end (6) arranged opposite the apical end in the longitudinal direction. In the area of the apical end (4), the abutment has an insert portion (8) which is designed to be received by an opening of the dental implant and which has an anti-rotation segment (10) comprising at least one anti-rotation element (27). The anti-rotation element (27) comprises a groove (18', 18' ') which, from the edge of the anti-rotation segment (10) directed toward the apical end (4), extends in the coronal longitudinal direction along a groove portion (14) with a substantially constant groove width. The invention is characterized in that the groove (18', 18' ') is continuously widened in a transition portion (20) adjoining the groove portion (14), in order to merge into a bevel (24', 24' ') in a bevel portion (22) adjoining the transition portion (20).

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Abutment for a dental implant

The present invention relates to an abutment for a dental implant, a dental implant, and a dental implant system comprising the abutment and the dental implant.

Two-part or multi-part dental implant systems are well known in the field of dental implantology. Such systems generally comprise a dental implant which has an outer thread and which is designed to be anchored in the bone of the patient, and an abutment (also called a secondary part) which serves as a base for the prosthetic structure. The abutment is often fitted in a corresponding coronal opening of the dental implant, i.e. an opening directed toward the crown of the tooth in the implanted state.

A problem that often arises in multi-part dental implant systems of this kind concerns the correct positioning of the abutment in the dental implant. This problem has been considered in the following prior art documents, for example:

US-B-5,281,140 discloses a two-part abutment. The latter comprises a first part, which at its lower end is designed to be fitted in a complementary opening of the dental implant, and which at its upper end has a projection with a multiplicity of side faces, in order to be received in a complementary opening of a second part of the abutment.

However, mainly because of the relatively large number of individual parts, the solution described in said document has disadvantages as regards the sterility and stability of the connection between the abutment and the dental implant.

Proceeding from this, EP-A-1728486 proposed an abutment for use in a dental implant system that has means for guiding and locking the abutment in the dental implant. Said means comprise an area with anti-rotation means. These anti-rotation means comprise a surface which extends radially with respect to the axis of the abutment and which is designed to cooperate with a dental implant in such a way that the abutment is guided during insertion into the dental implant.

Moreover, CA-A-2596988 describes an abutment which, in its apical area, has a groove which forms an indexing element for defining the rotation position with respect to the dental implant.

The solution described in EP-A-1728486 and the solution described in CA-A-2596988 are both directed to a conventional dental implant system on the basis of metals, e.g. titanium. However, in a connection according to said documents, the material of the dental implant system is subjected to relatively high stress, such that, particularly in dental implant systems that comprise a ceramic material, for example zirconium oxide, the problem is that the dental implant system may be damaged. This is especially the case when the forces acting on the dental implant system act obliquely with respect to the axis thereof.

It is the object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages or to provide a useful alternative.

According to a first aspect of the invention there is disclosed herein an abutment for a dental implant, the abutment having an apical end and a coronal end arranged opposite the apical end in a longitudinal direction, the abutment further has, in the area of the apical end, an insert portion which is designed to be received by an opening of the dental implant and which has an anti-rotation segment comprising at least one anti-rotation element which is designed to cooperate with a corresponding mating anti-rotation element of the dental implant and comprising a groove which, from the edge of the anti-rotation segment directed toward the apical end, extends in the coronal longitudinal direction along a groove portion with a substantially constant groove width, wherein the groove is continuously widened in a transition portion coronally adjoining the groove portion, in order to merge into a flat surfaced bevel, in a bevel portion coronally adjoining the transition portion.

According to a second aspect of the invention there is disclosed herein a dental implant system comprising an abutment according to the first aspect and a dental implant with an opening for receiving the insert portion of the abutment, wherein the dental implant has at least one projection which protrudes into the interior of the opening and forms an anti-rotation mating element and which is designed to cooperate with a corresponding anti-rotation element of the abutment.

The abutment of an embodiment of the present invention has an apical end, i.e. an end directed toward the bone in the implanted state of the dental implant system, and a coronal end arranged opposite the apical end in the longitudinal direction, i.e. an end directed toward the crown of the tooth in the implanted state of the dental implant system. In the area of the apical

end, the abutment has an insert portion which is designed to be received by an opening of the dental implant. This insert portion has an anti-rotation segment comprising at least one anti-rotation element which is designed to cooperate with a corresponding mating anti-rotation element of the dental implant and thereby ensuring anti-rotation between abutment and dental implant.

The anti-rotation element comprises a groove which, from the edge of the anti-rotation segment directed toward the apical end, extends in the coronal longitudinal direction along a groove portion with a substantially constant groove width. Accordingly to an embodiment of the invention, the groove is continuously widened in a transition portion adjoining the groove portion, and it merges into a bevel in a bevel portion adjoining the transition portion. The groove generally has a constant cross section in the groove portion. Thus, in the preferred rectangular groove cross section, the groove, in addition to having a constant groove width, also has a constant groove depth.

In the context of embodiments of the present invention, a bevel is understood as meaning a flat surface as is obtained, for example, on milling a cylindrical body. Since the anti-rotation segment of the abutment according to a preferred embodiment of the invention generally has a circular cylindrical basic shape, the bevel describes, in cross section, a straight line connecting the arc-shaped portions of the adjacent circular cylindrical jacket portions. The plane of the bevel generally extends parallel to the longitudinal direction of the abutment or of the anti-rotation segment thereof.

The configuration according to embodiments of the invention now allows the abutment to be connected to the dental implant in a manner secure against rotation, such that the stresses acting on the dental implant system are distributed optimally, as a result of which the material stressing is kept low and a high degree of stability of the dental implant is achieved.

The groove of the preferred embodiments of the present invention has, in addition to the bottom face, two side faces. These form additional abutment faces of the anti-rotation element and ensure that anti-rotation is achieved with substantially less play than would be the case with a mere bevel.

Generally speaking, the anti-rotation mating element of the dental implant is a projection directed toward the interior of the opening of the dental implant. This projection is preferably in the form of a rail extending in the longitudinal or axial direction.

The groove width in the groove portion is preferably such that the side faces of the groove bear at least approximately directly on the respective side face of the projection.

In order to design the abutment as simply as possible and make it compatible with a large number of dental implants, at least the groove portion preferably has a cylindrical shape.

It is also preferable, for achieving the simplest possible design, that the bottom face of the groove and the bevel lie in the same plane. This permits a very simple and extremely stable anti-rotation.

It is also preferable that the continuous widening of the groove width in the transition portion is effected substantially symmetrically, as a result of which an optimal reduction of the material stressing is achieved.

It was found that, according to another preferred embodiment, the bevel of the abutment according to the invention is not formed as far as the edge of the anti-rotation segment directed toward the coronal end, which further ensures a high degree of stability of the connection between abutment and dental implant. Therefore, by virtue of its generally circular cylindrical basic shape, the anti-rotation segment in this embodiment also has a circular cylindrical shape in its edge area directed toward the coronal end.

The anti-rotations segment of the abutment according to an embodiment of the invention generally comprises more than one anti-rotation element, preferably two or four anti-rotation elements. It is particularly preferable that two grooves are arranged lying diametrically opposite each other, and between them, additional bevels lying diametrically opposite each other are arranged as additional anti-rotation elements. As is shown in connection with the figures, it was surprisingly found that, in a dental implant system comprising an abutment according to this preferred embodiment, the maximum material stressing is considerably less than in a dental implant system with an abutment not according to the invention. It was also found that the maximum stressing of the anti-rotation segment lies in the area between the anti-rotation elements in the abutment according to embodiments of the invention, whereas it lies within the

area of an anti-rotation element in the case of an abutment not according to the invention. This also contributes decisively to the increased stability of the dental implant system achieved according to preferred embodiments of the invention.

Generally speaking, the abutment is secured on the dental implant by means of a securing element. For this purpose, the abutment according to embodiments of the invention generally has a recess which extends from the coronal end to the apical end and which is designed in such a way that is can receive the securing element. The recess preferably has a support face which protrudes radially in the direction toward the interior and which is designed to cooperate with a corresponding mating support face of the securing element. The support face is preferably conically shaped, which, when a corresponding conical mating support face of the securing element is present, ensures that the least possible play exists between abutment and securing element. The cone angle of the conical support face is preferably in the range of 20 to 40°, preferably about 30°.

It has also been found that at least this conical support face preferably has a surface roughness Ra (according to EN ISO 4287) in the range of 0.1 to 0.15. in this range of surface roughness, sufficient coefficients of friction are ensured between the support faces of the parts that are to be connected, and the play between these parts can be kept relatively low, which results in a high degree of fatigue resistance.

In addition to the described abutment, an aspect of the present invention also relates to a dental implant which an opening for receiving the insert portion of the described abutment, the dental implant having at least one projection which protrudes into the interior of the opening, forms an anti-rotation mating element and is designed to cooperate with a corresponding anti-rotation element of the abutment. A preferred embodiment of the invention further relates to a dental implant system comprising the abutment and the dental implant.

Although embodiments of the present invention are suitable for a dental implant system comprising a ceramic material, the embodiments of the invention are of course also suitable for dental implant systems made of any other material suitable for dental implant systems, particularly a metal such as titanium, zirconium, gold, and any other material known by a person skilled in the art to be suitable.

Preferred embodiments of the present invention will now be described, by way of examples only, with reference to the accompanying drawings wherein:

Fig. 1 shows a side view of a straight abutment according to an embodiment of the invention;

Fig. 2 shows an enlarged detail from Fig. 1, focusing on the anti-rotation element according to the invention;

Fig. 3 shows the abutment according to Fig. 1, in cross section through the section plane III-III';

Fig. 4 shows the abutment according to Fig. 1, in cross section through the section plane IV-IV';

Fig. 5 shows another side view of the abutment according to Fig. 1, seen from a direction offset in the circumferential direction by

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ca. 135° about the axis in relation to Fig. 1;

Fig. 6 shows another side view of the abutment according to Fig. 1, seen from a direction offset in the circumferential direction by ca. 90° about the axis in relation to Fig. 5;

Fig. 7 shows a longitudinal section through the abutment according to Figures 1, 5 and 6, through the section plane VII-VII';

Fig. 8 shows a longitudinal section through the abutment according to Figures 1, 5 and 6, through the section plane VIII-VIII';

Fig. 9 shows a side view of an angled abutment according to the invention;

Fig. 10 shows a perspective view of a portion of an abutment according to the invention, which is connected to a symbolically indicated dental implant;

Fig. 11 shows a detail, from another perspective, of the anti-rotation segment of the abutment according to Fig. 10 connected to the dental implant;

Fig. 12 shows a perspective view of a portion of an abutment according to a comparison example, in which view the maximum local material stress in the shoulder portion under a defined force is indicated;

Fig. 13 shows a perspective view of a portion of an abutment according to the invention, which is connected to a symbolically indicated dental

implant, in which view the maximum local material stress in the shoulder portion under a defined force is indicated;

Fig. 14 shows a perspective view of a portion of an abutment according to the comparison example in Fig. 12, in which view the maximum local material stress in the apical insertion portion under a defined force is indicated;

Fig. 15 shows a perspective view of a portion of the abutment according to the invention in Fig. 13, in which view the maximum local material stress in the apical insertion portion under a defined force is indicated;

Fig. 16 shows a perspective view of the anti-rotation segment of the abutment according to the comparison example in Fig. 12, in which view the maximum local material stress under a defined force is indicated; and

Fig. 17 shows a perspective view of the anti-rotation segment of the abutment according to the invention in Fig. 13, in which view the maximum local material stress under a defined force is indicated.

As is clear in particular from Figures 1 and 5 to 8, the abutment 2 of the present invention has an apical end 4, i.e. an end directed toward the bone in the implanted state, and a coronal end 6 arranged opposite the apical end. In the area of the apical end 4, the abutment 2 has an insert portion 8 which is designed to be received in an opening of a dental implant. The insert portion 8 comprises an anti-rotation segment 10 which, in its edge area 12 directed toward the apical end, has a groove portion 14. In the embodiment shown

in the figures, the groove portion 14 has two diametrically opposite grooves 18', 18'' which extend in the longitudinal direction from the apical edge 16 of the anti-rotation segment 10 and are of substantially constant cross section, as can be seen from Fig. 3, for example. The groove portion 14 is adjoined in the coronal direction by a transition portion 20 in which the width of the groove 18', 18'' is continuously widened in order to merge into a bevel 24', 24'' lying in a beveled portion 22 adjoining the transition portion 20. In the embodiment shown, the bottom face 26', 26'' of the groove 18', 18'' and the bevel 24', 24'' lie in the same plane. In the embodiment shown, the widening of the width of the groove 18', 18'' in the transition portion 20 is effected symmetrically, specifically such that the groove 18', 18'' has a goblet-shaped profile. The groove forms, with the adjoining bevel, an anti-rotation element 27a.

Two additional bevels 28', 28'', likewise lying diametrically opposite each other, are arranged between the grooves 18', 18'' and extend in the longitudinal direction from the apical edge 16 of the anti-rotation segment and each form an additional anti-rotation element 27b. These additional bevels 28', 28'' extend slightly less far in the longitudinal direction than the bevels 24', 24'' adjoining the grooves. In the embodiment shown, neither the bevels 28', 28'' arranged between the grooves 18', 18'' nor the bevels 24', 24'' adjoining the grooves are formed as far as the edge 30 of the anti-rotation segment 10 directed toward the coronal end 6. As can be seen in particular from Figures 7 and 8, the transition from the bevels 24', 24'' or 28', 28'' into the edge area 32 directed toward the coronal end is arc-shaped in longitudinal section. Said coronal edge area 32 has a circular cylindrical shape.

In the embodiment shown, the ratio of the extent of the groove portion 14 in the longitudinal direction to the extent of the transition portion 20 in the longitudinal direction is ca. 2:1, and the ratio of the extent of the groove portion 14 in the longitudinal direction to the extent of the bevel portion 22 in the longitudinal direction is ca. 1:1. However, every other ratio suitable for the purposes of the present invention is also conceivable.

As can be seen in particular from Figures 7 and 8, the abutment 2 has a recess 34 which extends from the coronal end 6 to the apical end 4. This recess 34 comprises a first recess portion 36a directed toward the apical end 4 and a second recess portion 36b directed toward the coronal end 6. Between the first recess portion 36a and the second recess portion 36b, the recess 34 has a projection 38, which protrudes radially in the direction toward the interior and which forms a support face 40 designed to cooperate with a corresponding mating support face of the securing element. In the embodiment shown, the support face 40 lies in a plane extending at right angles to the longitudinal axis. However, it is also conceivable in particular for the support face to be shaped conically.

As is clear in particular from Figures 1 and 5 to 8, the anti-rotation segment 10 is adjoined in the apical direction by a circular cylindrical insertion portion 42, which has a smaller diameter than the anti-rotation segment 10 and whose edges are rounded. Arranged in the coronal direction toward the anti-rotation segment 10 there is a conically widening first shoulder portion 44a, which merges into a likewise conically widening second shoulder portion 44b whose cone angle is greater than that of the first shoulder portion 44a.

The embodiment shown in Fig. 9 differs from that in Figures 1 to 8 primarily in that the abutment portion 46 adjoining the second shoulder portion 44b in the coronal direction is oblique with respect to the longitudinal axis. Moreover, the different orientation of the abutment portion 46 according to Fig. 9 is accounted for by the bevels 24', 28' extending further in the coronal direction than according to Figures 1 to 8.

As can be seen in particular from Figures 10 and 11, the abutment 2, or the insert portion 8 thereof, is inserted into a complementary coronal opening 48 of the dental implant 50. In the embodiment shown, the dental implant 50 has four projections, of which two (52', 52'') are shown and which cooperate, as anti-rotation mating element 53, with the respective anti-rotation element 27a, 27b of the abutment 2. The surface 54 of the projections 52', 52'' bears at least approximately directly on the bevel 28'' or the groove bottom face 26' and the adjacent bevel 24' of the respective anti-rotation element 27b or 27a. On the anti-rotation element 27a comprising the groove 18', the side faces 56a, 56b of the groove 18' bear at least approximately directly on the respective side face 58a, 58b of the projection 52''.

Corresponding to the first shoulder portion 44a of the abutment part 2, the internal edge area 60 of the opening 48, on which edge area the shoulder portion bears, is likewise conical in shape.

The area of the coronal opening 48 comprising the projections 52', 52'' is adjoined in the apical direction by a substantially circular cylindrical opening portion 62, in which the circular cylindrical insertion portion 42 of the abutment 2 is received. In the apical direction from this circular cylindrical

opening portion 62 there is an inner thread portion 64, which is designed to cooperate with a corresponding outer thread of a securing element (not shown) for securing the abutment 2 on the dental implant 50, as can be seen in particular from Fig. 10.

The material stressing of the abutment, determined at a defined force acting at an angle of 30° with respect to the longitudinal axis, is shown in Figures 12 to 17. Here, according to Figures 13 and 15, for the abutment of the present invention, a maximum stress defined as 100% is established in the shoulder portion or in the insertion portion, which maximum stress is substantially below the stress of 124% in the corresponding portions in the comparison example according to Figures 12 and 14.

According to Fig. 17, compared to Fig. 16, the maximum material stress in the anti-rotation segment has a value of 37.9% and is much lower than the material stress in the comparison example (39.5%). Moreover, Fig. 17 shows that the maximum material stress is in the coronal edge area of the anti-rotation segment and not in the area of the anti-rotation element, as is the case in the comparison example shown in Fig. 16.

For reasons of clarity, a relatively high force of 500 N was assumed for the material stress shown in Figures 12 to 17, with a concrete value of 1618.2 MPa being obtained for the stress defined as 100%. Analogous differences in material stress between the abutments according to the invention and those not according to the invention are also obtained, albeit at substantially lower values, at a force of 240 N, which is customary for such tests.

CLAIMS

1. An abutment for a dental implant, the abutment having an apical end and a coronal end arranged opposite the apical end in a longitudinal direction, the abutment further has, in the area of the apical end, an insert portion which is designed to be received by an opening of the dental implant and which has an anti-rotation segment comprising at least one anti-rotation element which is designed to cooperate with a corresponding mating anti-rotation element of the dental implant and comprising a groove which, from the edge of the anti-rotation segment directed toward the apical end, extends in the coronal longitudinal direction along a groove portion with a substantially constant groove width, wherein the groove is continuously widened in a transition portion coronally adjoining the groove portion, in order to merge into a flat surfaced bevel, in a bevel portion coronally adjoining the transition portion.

2. The abutment according to claim 1, wherein the anti-rotation element is designed to cooperate with a corresponding projection directed toward the interior of the opening of the dental implant.

3. The abutment according to claim 2, wherein the groove width in the groove portion is such that the side faces of the groove bear at least approximately directly on the respective side face of the projection.

4. The abutment according to any one of the preceding claims, wherein at least the groove portion has a cylindrical shape.

5. The abutment according to any one of the preceding claims, wherein the bottom face of the groove and the bevel lie in the same plane.

6. The abutment according to any one of the preceding claims, wherein the bevel is not formed as far as the edge of the anti-rotation segment directed toward the coronal end.

7. The abutment according to claim 6, wherein the anti-rotation segment has a circular cylindrical shape in its edge area directed toward the coronal end.

8. The abutment according to any one of the preceding claims, wherein the continuous widening of the groove in the transition portion is effected substantially symmetrically.

9. The abutment according to any one of the preceding claims, wherein the anti-rotation segment comprises more than one anti-rotation element.

10. The abutment according to claim 9, wherein the anti-rotation segment comprises two or four anti-rotation elements.

11. The abutment according to claim 9 or claim 10 wherein two anti-rotation elements are arranged lying diametrically opposite each other and, between them, additional bevels lying diametrically opposite each other are arrange as additional anti-rotation elements.

12. The abutment according to any one of the preceding claims, wherein the abutment has a recess which extends from the coronal end to the apical end and which is designed in such a way that it can receive a securing element, and it has a conical support face which protrudes radially into the interior of the recess and which is designed to cooperate with a corresponding mating support face of the securing element.

13. The abutment according to claim 12, wherein the cone angle of the conical support face is in the range of 20 to 40°.

14. The abutment according to claim 13, wherein the cone angle of the conical support face is about 30°.

15. A dental implant system comprising an abutment as claimed in one of claims 1 to 14 and a dental implant with an opening for receiving the insert portion of the abutment, wherein the dental implant has at least one projection which protrudes into the interior of the opening and forms an anti-rotation mating element and which is designed to cooperate with a corresponding anti-rotation element of the abutment.

16. An abutment for a dental implant, the abutment being substantially as hereinbefore described with reference to the accompanying drawings.

17. A dental implant system substantially as hereinbefore described with reference to the accompanying drawings.

Dated 30 November 2012

Straumann Holding AG

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON

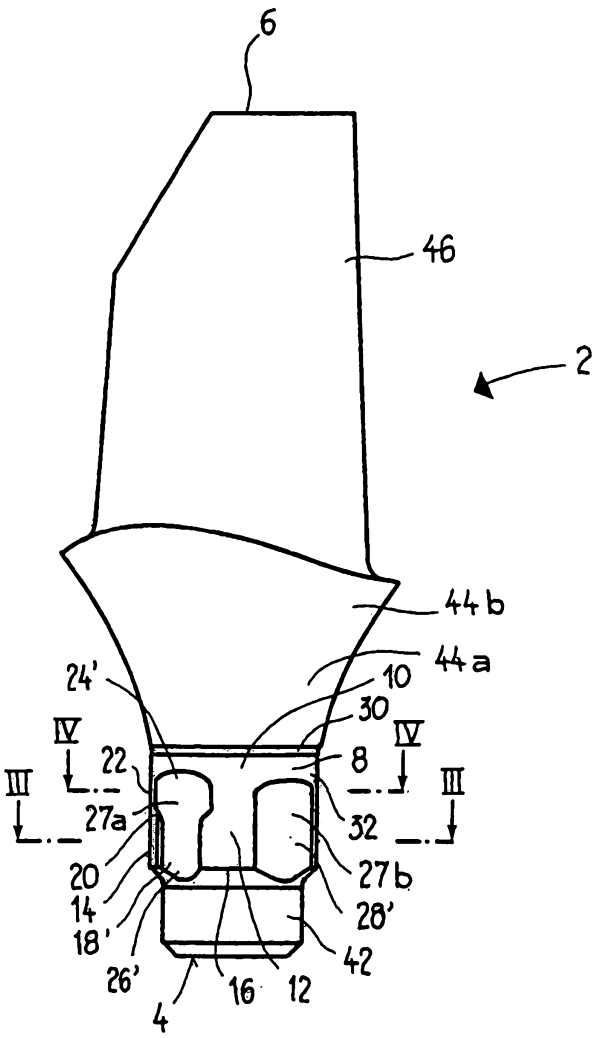
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Fig.1

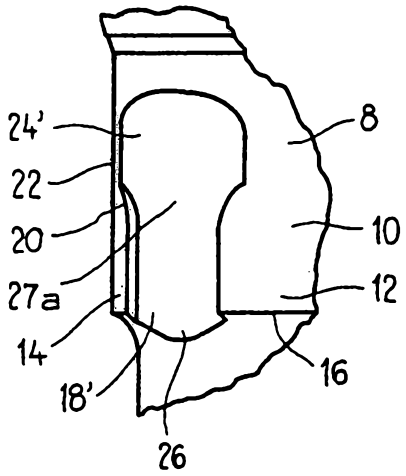
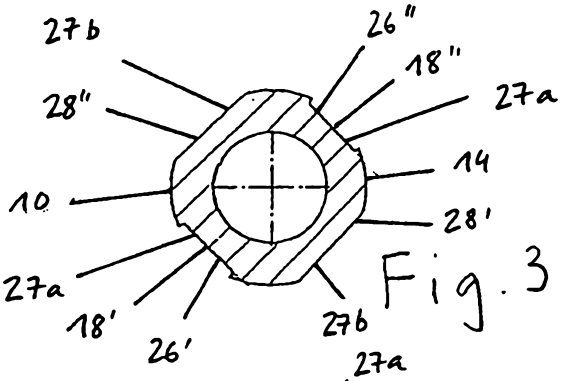


Fig.2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26'
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Fig. 3

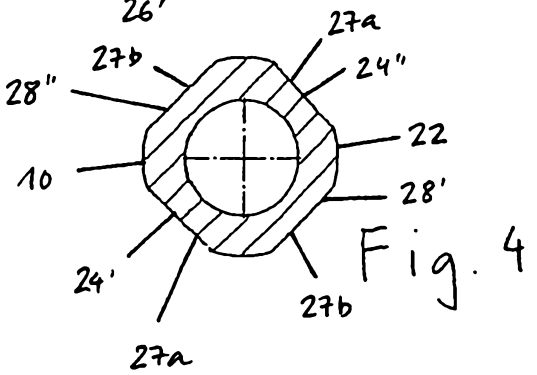
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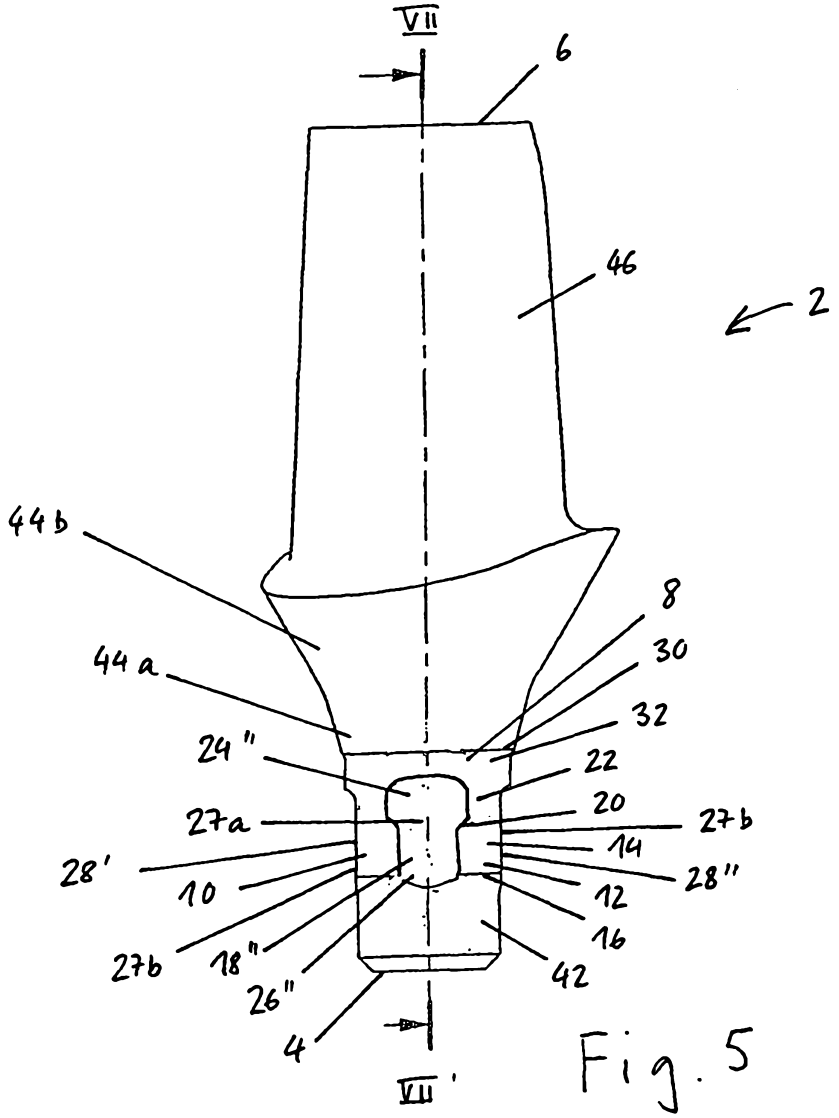
Fig. 4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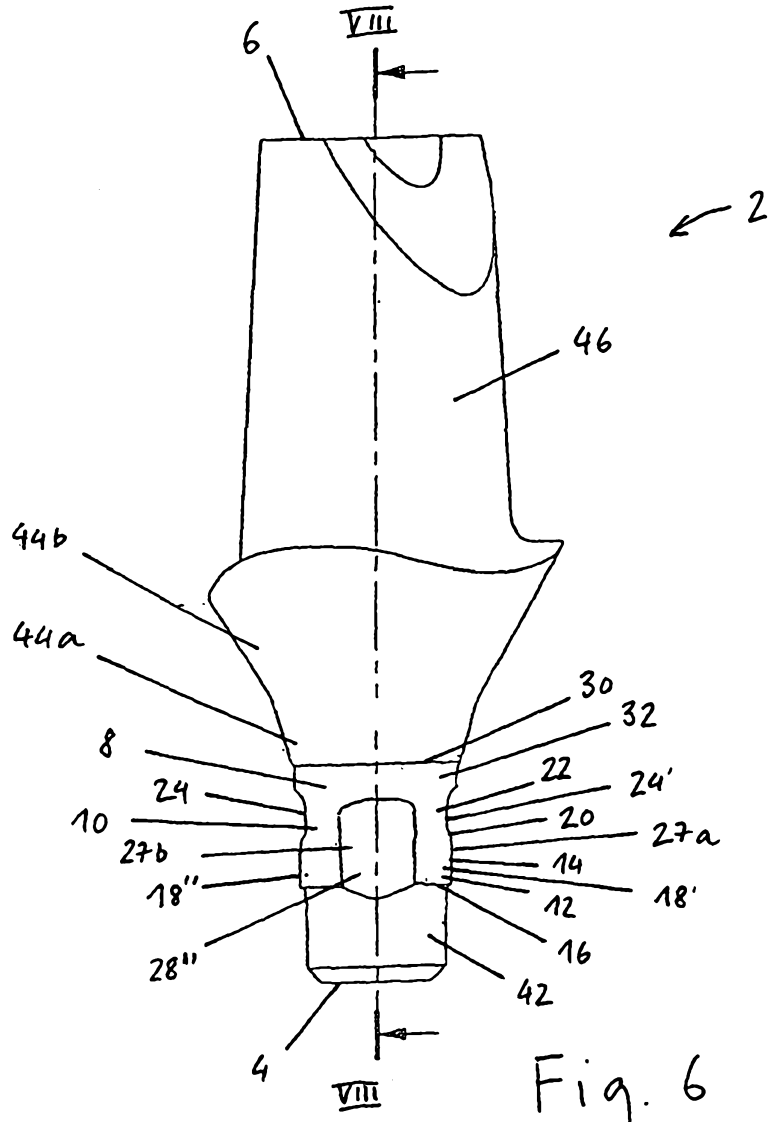
VII'

Fig. 5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16
28''
42
4
VIII

Fig. 6

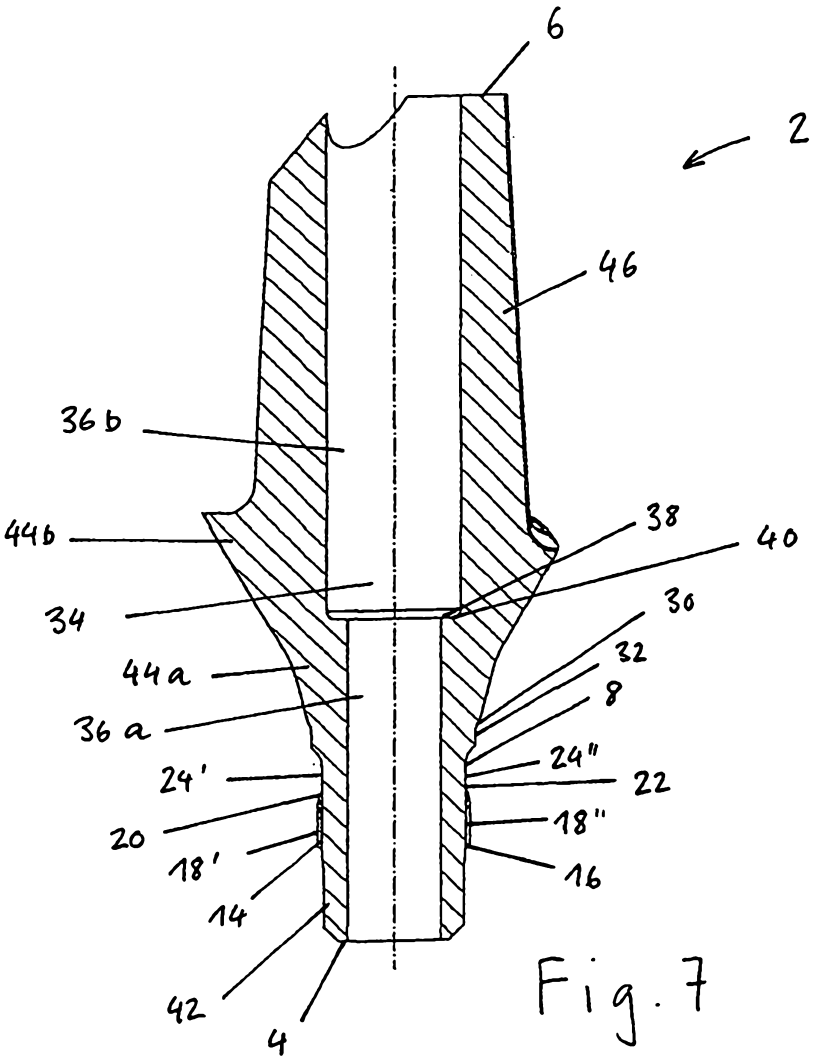

Fig. 7

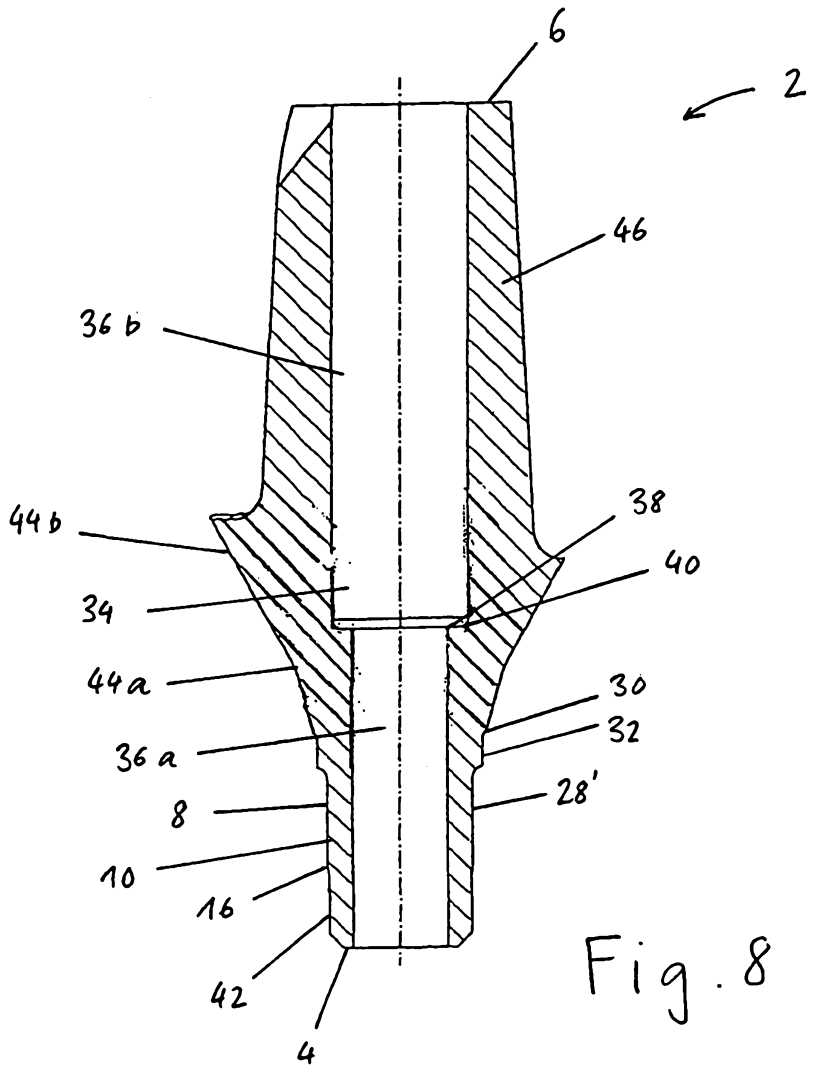

Fig. 8

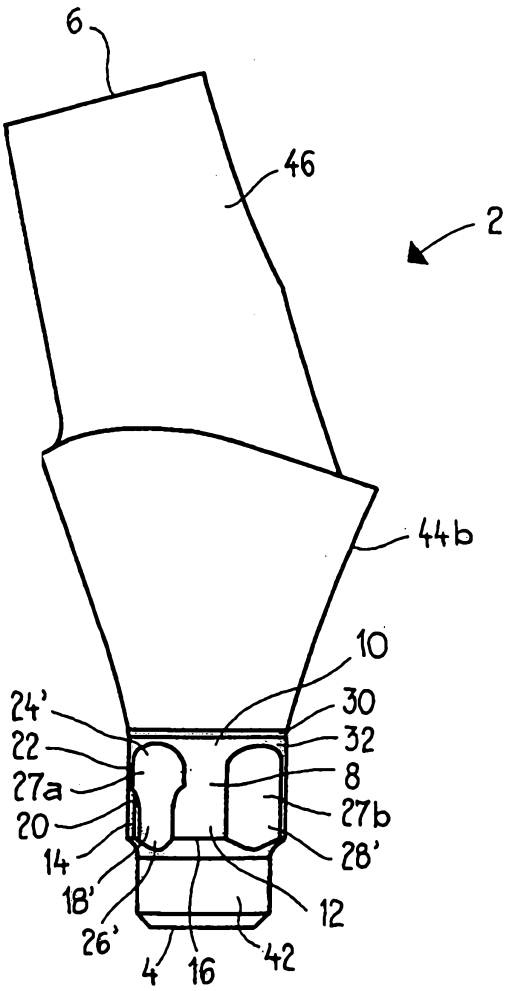

Fig.9

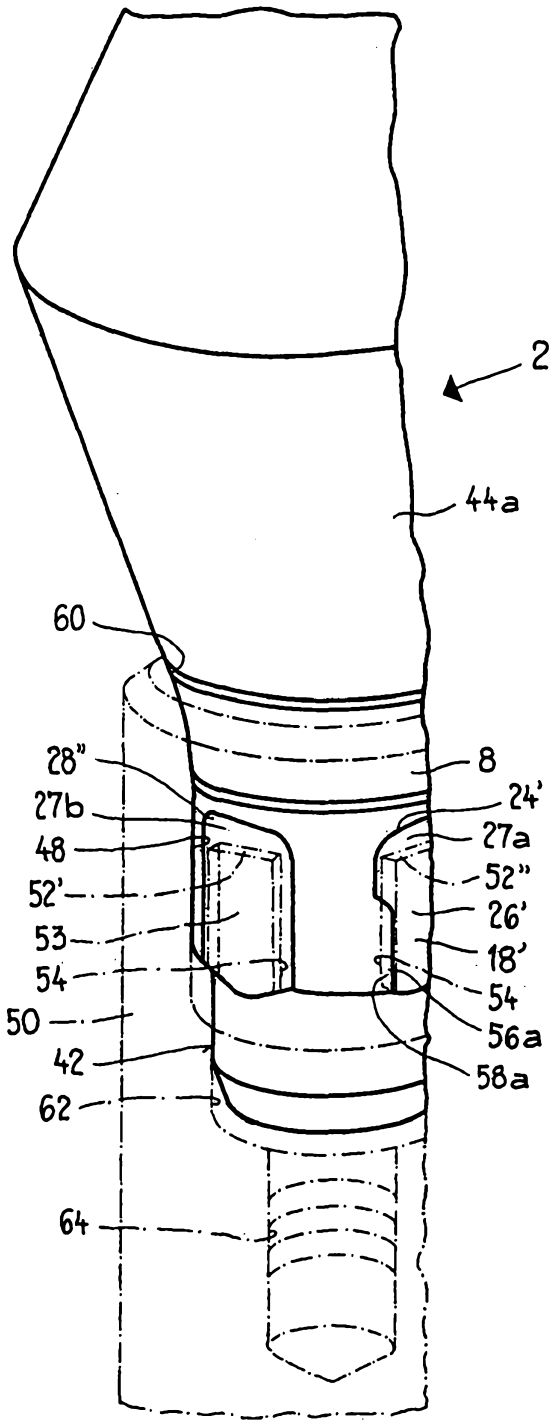

Fig.10

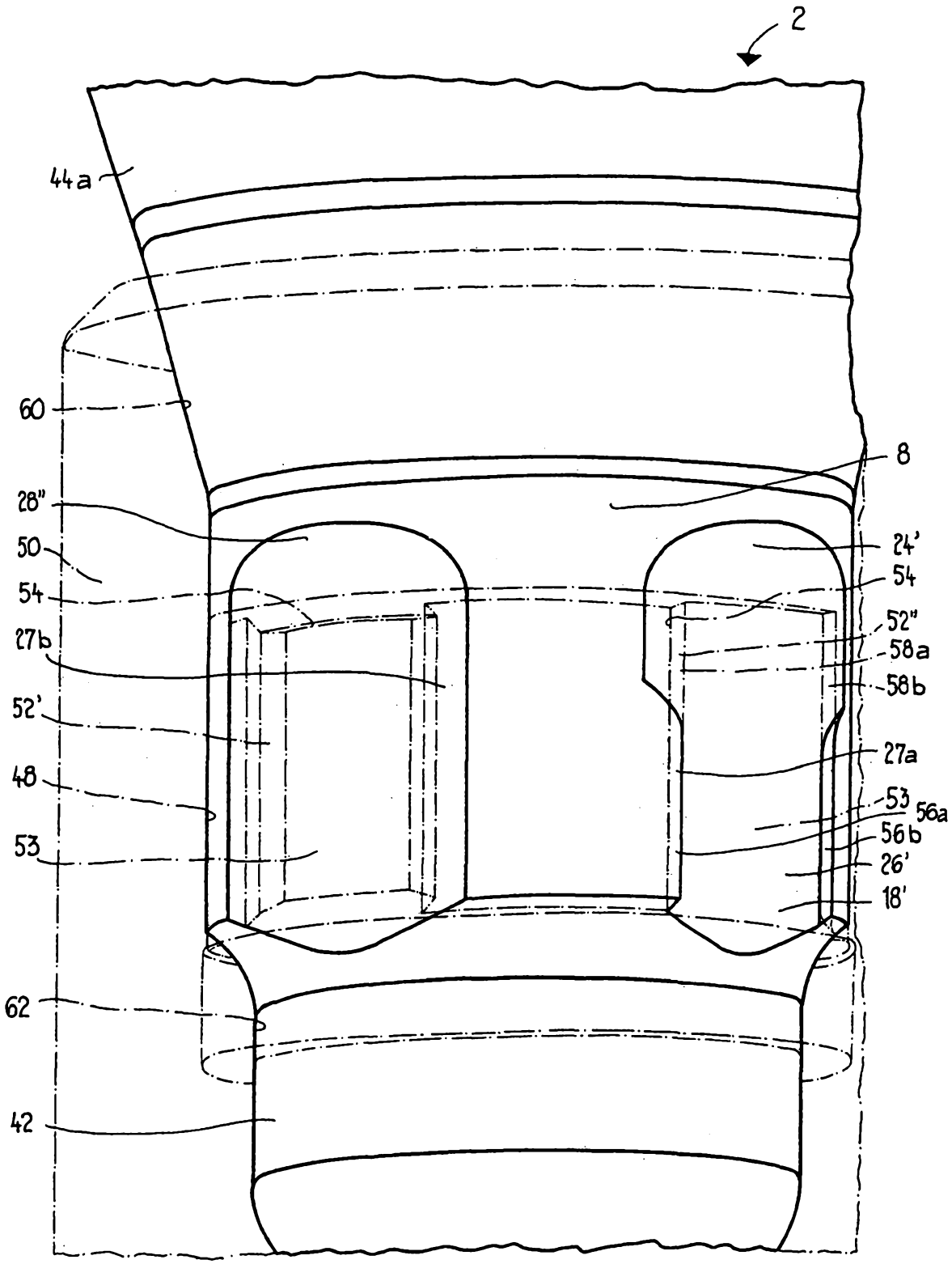
2
44a
60
28"
50
54
27b
52'
48
53
62
42
8
24'
54
52"
58a
58b
27a
53
56a
56b
26'
18'

Fig.11

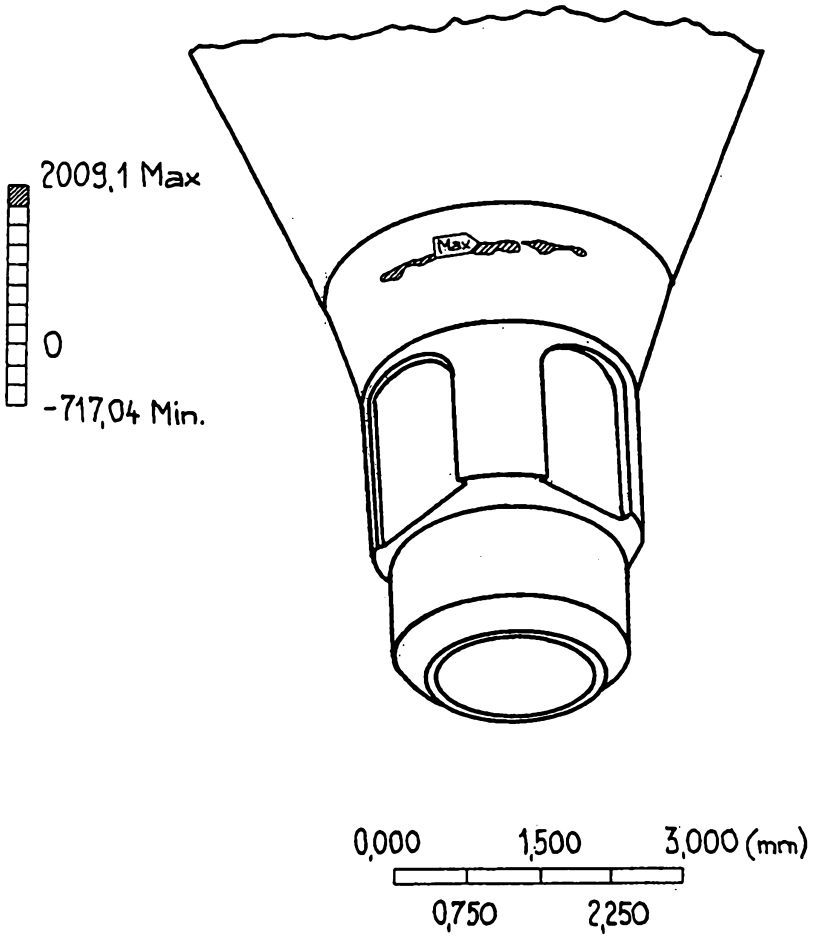

Fig.12

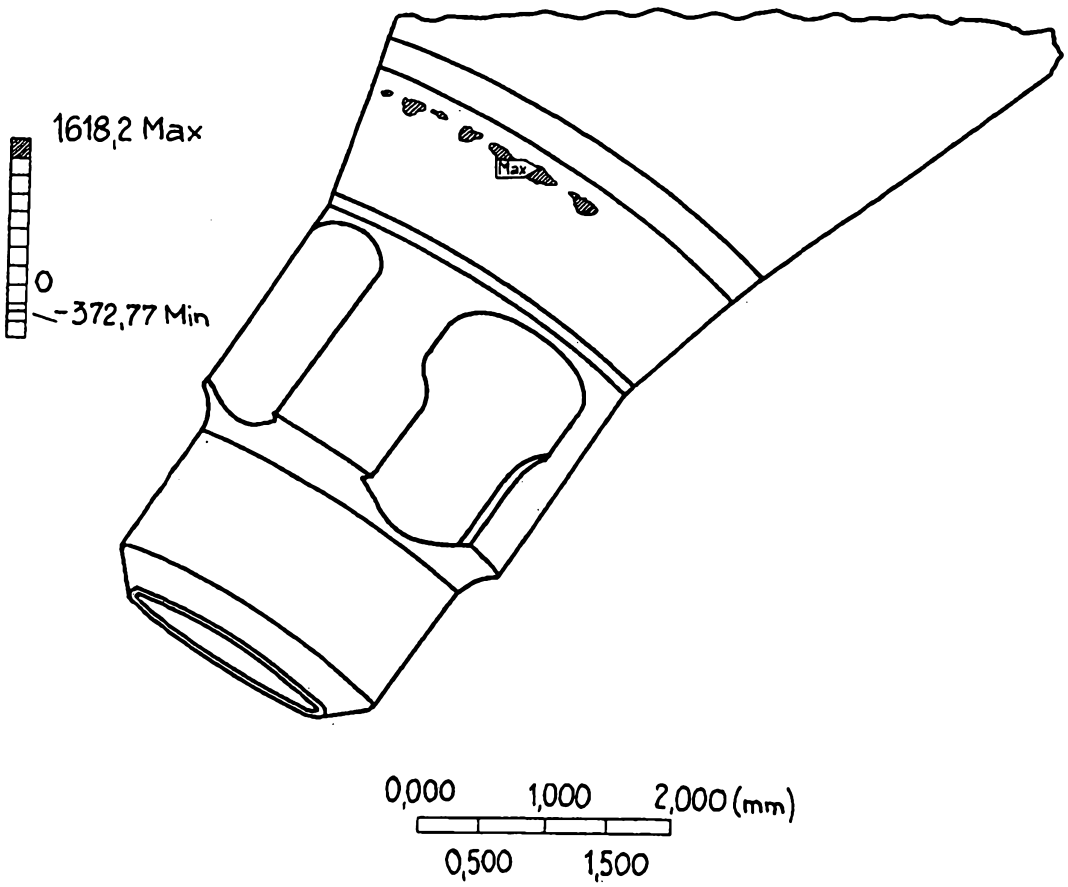

Fig.13

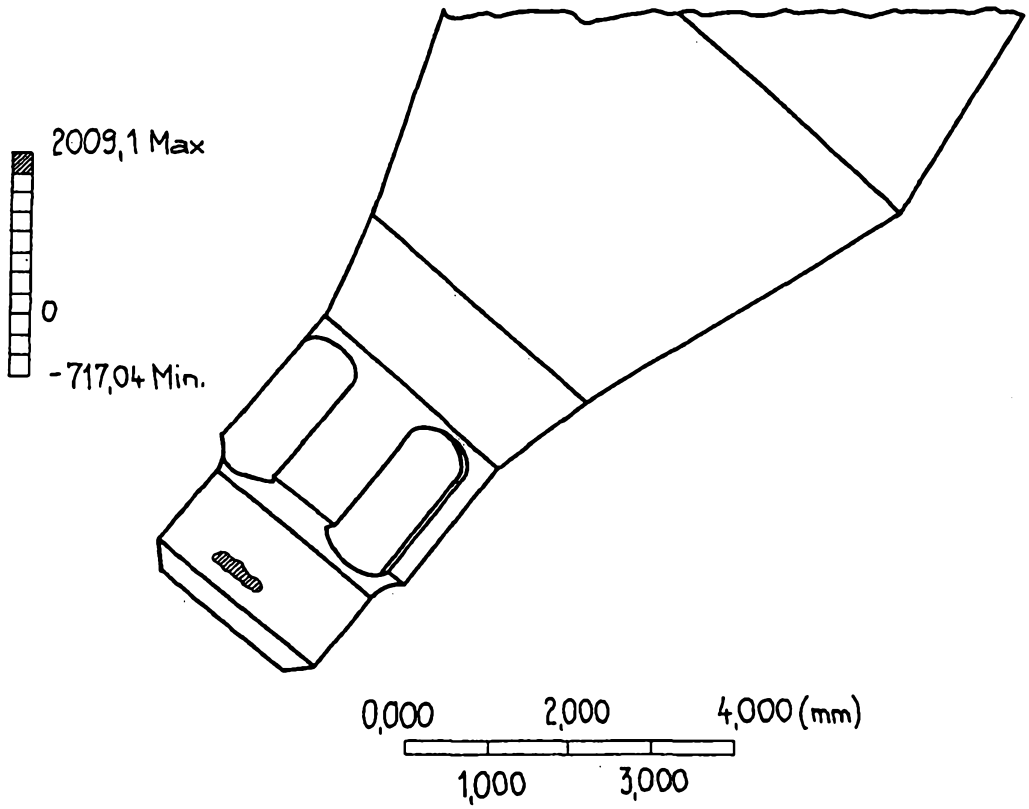

Fig. 14

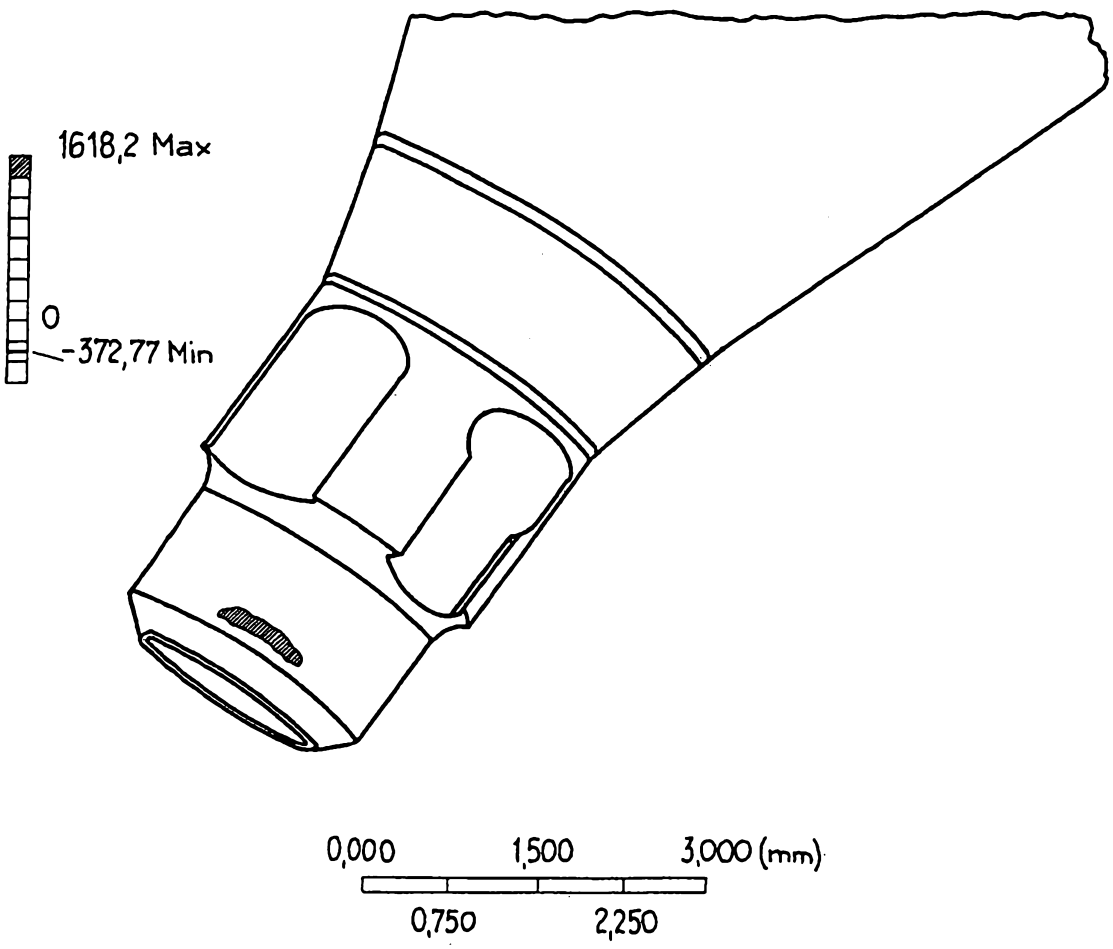

Fig.15

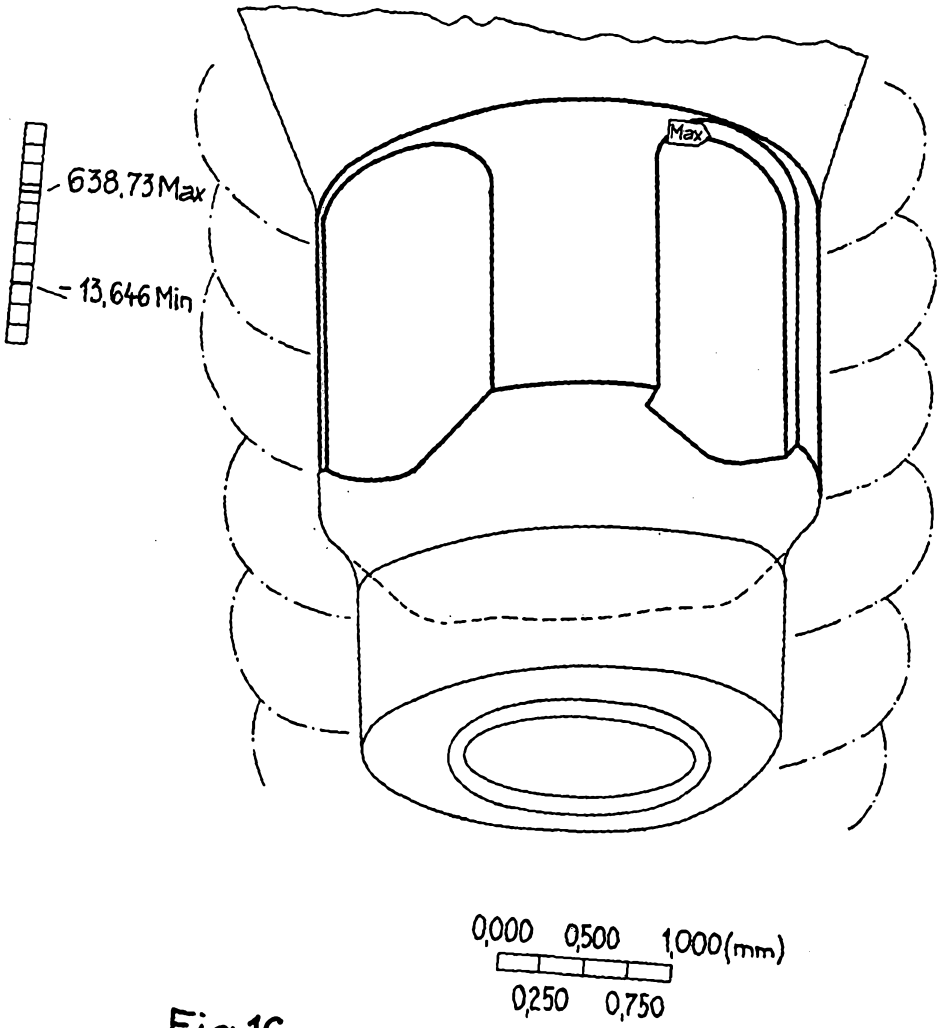

Fig.16

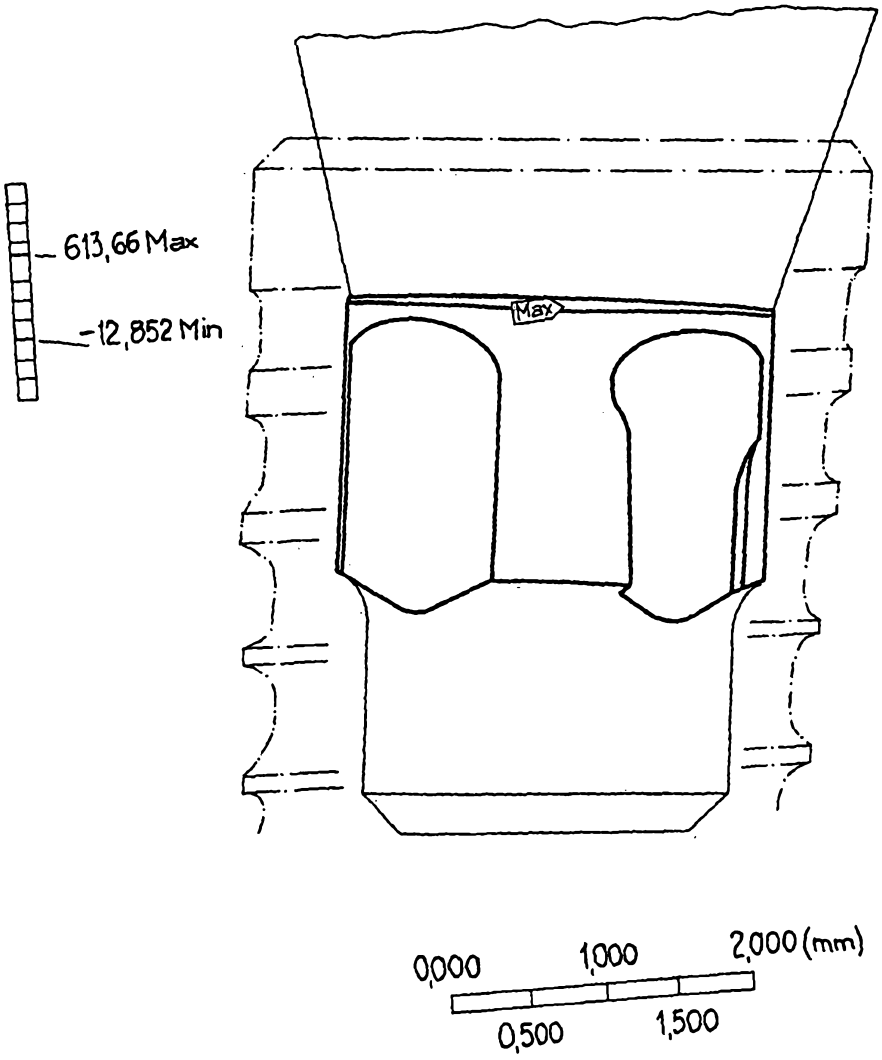

Fig.17