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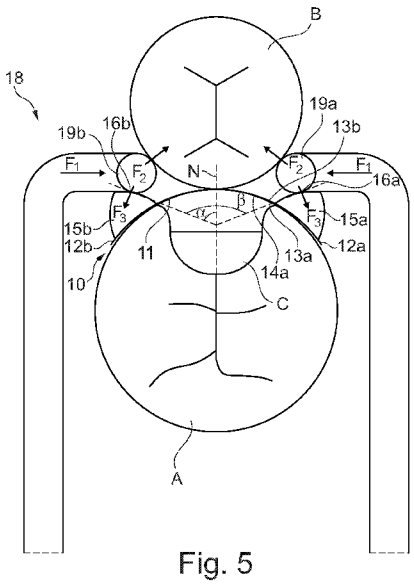


Fig. 5

(57) Abstract: The invention relates to a dental matrix section (10) intended for providing a wall at a laterally open part of a tooth cavity (C) at filling therapy. It has a base portion (11) of a band like shape extending from a first lateral end (12a) to a second lateral end (12b). The base portion (11) has an inside (13a) intended to face the tooth cavity (C) to be filled and an outside (13b) opposite to the inside. According to the invention, the outside (13b) of the base portion (11) is provided with at least one abutment surface (16a, 16b) adjacent at least one of the first (12a) and second (12b) lateral ends. The abutment surface forms an angle (α) directed towards the outside of the base portion (11) of less than 90 degrees with a line (N) perpendicular to the base portion at the middle thereof, which abutment surface is adapted to be acted on by a separation ring (18), wherein each abutment surface (16a, 16b) is located on a projection (15a, 15b) projecting from the outside (13b) of the base portion (11). The invention also relates to a dental system with a matrix section according to an embodiment of the invention and a separation ring designed to match the matrix section.

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# A DENTAL MATRIX SECTION

## FIELD OF INVENTION

The present invention relates to a dental matrix section intended for providing a wall at a laterally open part of a tooth cavity at filling therapy, and includes a base portion of a band like shape extending from a first lateral end to a second lateral end, which base portion has an inside intended to face the tooth cavity to be filled, an outside opposite to the inside, an upper edge intended to be located adjacent the upper end of the tooth which is to be filled and a lower edge intended to be located adjacent the root part of the tooth, which base portion is straight or arc shaped in the direction from the first lateral end to the second lateral end and in the latter case being convex at the outside.

The invention also relates to a dental system including a matrix section and a separation ring.

## BACKGROUND OF INVENTION

Within dental filling therapy there exists a plurality of various matrix systems to create a wall where a tooth cavity that is open towards the side of the tooth. The matrix thereby forms a limitation of the cavity such that it can be filled with filling material. The open cavity may be a consequence of caries, of a fracture or due to removal of tooth material by the dentist in order to reach lower located caries. Traditionally a thin metal band is applied around the tooth and thereafter tightened by some kind of matrix holder. This normally provides a good fitting around the tooth and its cervical parts, where it is particularly important to have a sealing contact in order to avoid that filling material leaks out below the lower edge of the band. Such leakage results in a surplus of material which complicates cleaning between the teeth and might be a source for bacteria growth which may lead to secondary caries.

Such matrix bands applied around the complete tooth have more and more been replaced by matrix sections extending only along a part of the tooth, namely the part of the tooth where the cavity lacks wall of tooth material. Such a matrix section is used in combination with a separation ring applied to fixate the

matrix section and simultaneously provide a separation force separating the tooth to be filled from the neighbouring tooth to provide space for the matrix section between the two teeth. Additionally one or two wedges may be inserted between the matrix section and the neighbouring tooth to increase the separating force and to press the matrix section against the tooth to be filled in order to reduce the leakage risk. If the separation force is not sufficiently strong there might be a void space between the filling material and the neighbouring tooth after removal of the matrix section. This space results in that food may get stuck between the teeth, and entails the risk for secondary caries. It further results in inconvenience when fibres from meat or vegetables become wedged between the tooth.

There is a problem with existing matrix sections held by separations rings in that a force is created in an unfavourable direction when the separation ring is applied to the matrix section. The pressure heads of the separation ring act adjacent each lateral end of the matrix section. Due to the prevailing geometry and due to the force acting on the pressure heads from the neighbouring tooth the force tends to squeeze the matrix section in the lateral direction whereby the matrix section tends to bulge out from the tooth to be treated. This might result in leakage of filling material below the lower edge of the matrix section, i. e. at the cervical part of the tooth. This problem is not at hand with the traditional matrix bands tensioned around the complete tooth where the force applied to the matrix band is a tensioning force.

Furthermore it sometimes will occur forces tending to lift the matrix section from its proper position such that the application of the matrix section has to be repeated. There is also a risk for deformation of the matrix section due to the squeezing force.

The bulging of the matrix section results in surplus filling material not only from leakage below the matrix section but also since the created bulge becomes filled with surplus filling material. To remove the surplus filling material is somewhat complicated, in particular with modern light curing filling material, and requires certain skill from the dentist.

Representative examples of matrix sections of the kind to which the present invention relates are disclosed e. g. in US 6712608 and in https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwii34bcpJ7iAhXAAxAIHUuYAwMQtwIwAXoECAkQAQ&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DGB7Wy4OSaNk&usg=AOvVaw1luGQFb0itwvjGvQm5w9k3

SUMMARY OF INVENTION

The object of the present invention is to overcome the problems related to conventional matrix sections as described above, and in particular to solve the problem of leakage of filling material below the lower edge of the matrix section and the problem of excess filling material between the teeth.

This object is achieved in that a dental matrix section of the kind specified in the preamble of claim 1 includes the specific features specified in the characterizing portion of the claim. The matrix section thus is such that the outside of the base portion is provided with at least one abutment surface, adjacent at least one of the first and second lateral ends, forming an angle directed towards the outside of the base portion of less than 90 degrees with a line perpendicular to the base portion at the middle thereof, which at least one abutment surface is adapted to be acted on by a separation ring, wherein each abutment surface is located on a projection projecting from the outside of the base portion.

By such orientation of the surface(s) on which the separation ring exert a pressure force, the geometry results in a tensional force in the base portion of the matrix section, i.e. a force in the direction of separating the two ends from each other. The lower edge of the band thereby is forced to tightening seal against the root region of the tooth. Thereby the risk for leakage of filling material of the kind occurring in conventional matrix section where the bulging out of the band opens for leakage is prevented. And the problem of excess material between the teeth is eliminated. By providing each abutment surface is located on a projection projecting from the outside of the base portion, a

particularly simple way of establishing the oblique abutment surfaces, providing an easy and cost effective manufacturing.

The term “adjacent” is to be understood as the portion of the band extending from the very end to a distance therefrom representing about 30 % of the total band length.

According to a preferred embodiment, at least one such abutment surface is provided adjacent each of said lateral ends and wherein the abutment surfaces form an angle of less than 180 degrees to each other on the side of the outward direction, preferably less than 160, degrees, most preferably less than 130 degrees.

By providing such an angled abutment surface adjacent both of the ends the tensioning of the band will be more effective and secure. Thereby the elimination of the leakage risk is still better assured. Although it is sufficient that the angle is slightly less than 180 degrees in order to obtain a tensional force, it is easier to obtain the tensioning force the smaller the angle is.

According to a further preferred embodiment, the at least one abutment surface is located solely adjacent one of said ends.

Thereby it will be easier to design the other end of the base portion for other purposes that might be appropriate, however on the cost of less distinct tension force. This may be compensated by a decrease of the angle such hat the angle of the abutment surface with the perpendicular line is still more acute, such as 60-80 degrees. With this one-side arrangement it will be advantageous to arrange for a non-pulling stop or a fixation of the other end at the tooth to be treated or at the related pressure head of the separation ring.

According to a further preferred embodiment, a plurality of such abutment surfaces are provided adjacent at least one of said lateral ends.

This provides a greater flexibility when manipulating the separation ring onto the matrix section.

According to a further preferred embodiment, the plurality of abutment surfaces includes abutment surfaces distributed in the lateral direction and/or abutment surfaces distributed in the vertical direction.

Two or more abutment surfaces laterally distributed adjacent one or both ends provides a freedom to optimize the location of the attack points of the forces separating the band. Two or more abutment surfaces vertically distributed also contributes to optimize the location of the attack points. The plurality of abutment surfaces also allows an adaption to different types and sizes separation rings.

By vertical direction is to be understood the direction from the upper edge of the base portion to the lower edge of the base portion or in other words from the top of the tooth to the root when mounted.

According to a further preferred embodiment, each projection is a ridge extending mainly in a vertical direction or is a segment of a sphere.

Such configurations of the projections also contribute to a simple and precise manufacture of the matrix section. The projections may be of the same material as the base portion or be of other material. They may be attached to the base portion or stamped from it.

The term “mainly vertical” is to be understood that the vertical component of the direction of the ridge is larger than its horizontal component. Normally it is much larger or the sole component. The term “segment of a sphere” is not to be understood in its strict mathematical sense, but is to be understood as including other kind of arc shapes as the generator.

According to a further preferred embodiment, at least one ridge is provided adjacent each lateral end, whereby each ridge extends in a direction forming an angle with the vertical direction such that the direction of the ridge adjacent the first lateral end converges with the direction of the ridge adjacent the second lateral end.

The ridges may converge in the upward direction or in the downward direction. This embodiment increases the flexibility. It provides an adaption to various sizes of the separation ring. Further it allows the dentist to apply the separation ring where it has the best effect with regards to the best sealing effect from the tension force.

According to a further preferred embodiment, at least one abutment surface is convex in a plane perpendicular to the base portion, which plane extends in the lateral direction.

The convex shape means that the acute angle varies between a minimum and a maximum, which further contributes to obtain a precise and effective action of the pressure heads of the separation ring onto the abutment surfaces. Preferably all abutment surfaces are convex.

According to a further preferred embodiment, at least one abutment surface is provided with a recess for receiving a pressure head of a separation ring.

With such a recess, the separation ring may be more effective and precise applied to the matrix section which further contributes to an effective sealing. The risk for mistake by the dentist is also reduced. Preferably all abutment surfaces are provided with a respective recess. It is to be understood that the abutment surface is defined by the surface from which the recess is established. The walls of the recess as such may have directions that deviate from the direction specified for the abutment surface.

The invention also relates to a dental system including a dental matrix and a separation ring, whereby the dental matrix is according to the present invention and the separation ring is provided with at least one pressure head, which pressure head has a portion with a shape that is complementary to the shape of the abutment surface of the matrix section.

The invented system has advantages similar to those described above. In addition this matching of the matrix section and the separation ring provides a more secure and distinct application of the matrix section since the direction of the forces from the separation ring is better controlled and optimized.

By providing a special separation ring that is particularly designed to fit in the recesses, the advantages of that embodiment are further accentuated.

According to a preferred embodiment of the dental system, the portion of the pressure head includes a recess, which recess is complementary to at least a part of said abutment surface.

This embodiment is particularly suitable for some of the preferred embodiments of the invented matrix section-

According to a further preferred embodiment, the dental matrix is of the kind having a recess in the abutment surface, and the portion of the pressure head has a projection that fits into the recess.

By an adequate design of the projection it will be possible to also apply a downwardly directed force to the matrix section which enhances its ability to seal tightly and maintain its correct position.

The above preferred embodiments of the invention are set out in the dependent claims. Further preferred embodiments may be constituted by any possible combination of features in the described preferred embodiments and by any possible combination of these features with features mentioned in the description of examples below.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates an end view from above of a matrix section according to prior art together with a separation ring at the moment when the separation ring is to be applied.

Fig. 2 in a similar view illustrates the matrix section of fig. 1 when the separation ring is applied.

Fig. 3 in a side view from above illustrates a matrix section according to a first example of the invention.

Fig. 4 in a horizontal side view illustrates the matrix section of fig. 3

Fig. 5 in a side view from above illustrates the matrix section of fig. 3 with a separation ring when applied.

Fig. 6 in a view similar to that of fig. 4 illustrates a second example of a matrix section according to the invention.

Fig. 7 in a view similar to that of fig. 4 illustrates a third example of a matrix section according to the invention.

Fig. 8 in a view similar to that of fig. 4 illustrates a fourth example according to the invention.

Fig. 9 in a view similar to that of fig. 4 illustrates a fifth example of a matrix section according to the invention.

Fig. 10 in a view similar to that of fig. 4 illustrates a sixth example of a matrix section according to the invention.

Fig. 11 in a view similar to that of fig. 4 illustrates a seventh example of a matrix section according to the invention.

Fig. 12 in a view similar to that of fig. 4 illustrates an eighth example of a matrix section according to the invention.

Fig. 13 in a side view from above illustrates the matrix section of fig. 12.

Fig. 14 in a view similar to that of fig. 4 illustrates a ninth example of a matrix section according to the invention.

Fig. 15 illustrates a separation ring according to an example of the present invention.

Fig. 16 illustrates a separation ring according to a second example of the present invention.

Fig. 17 illustrates a separation ring according to a sixth example of the present invention.

DESCRIPTION OF EXAMPLES

In fig. 1 a conventional matrix section 104 is depicted located between the tooth 101 to be treated and the neighbouring tooth 102. The matrix section forms 104 a wall along the external side of the cavity 103 into which filling material is to be filled. A separation ring 105 is shown in a position just before it is to be activated and has a pressure head 106, 107 at each end inserted between the matrix section 104 and the neighbouring tooth 102. The separation ring 105 has an inherent spring function acting in a direction that tends to bring the pressure heads 106, 107 towards each other as indicated by the arrows. The purpose of the separation ring 105 is to tighten the matrix section and to separate the neighbouring tooth 102 from the tooth 101 to be treated.

Fig. 2 illustrates the position when the separation ring 105 has been properly brought in place. Each pressure head 106, 107 exerts a separating force between the teeth 101, 102 such that the small gap between them becomes somewhat widened. Due to the convex shape of the matrix section 104 each pressure head 106, 107 exerts a force on the matrix section towards each

other. The result from these forces is that the matrix section 104 is compressed and tends to bulge out such that a clearance 108 is created between the matrix section and the cavity 103 that is to be filled. As mentioned in the introduction of the description, this clearance may create problems. One problem is that excess filling material is filled also in the clearance and that filling material may leak out below the lower edge of the matrix section 104.

Fig. 3 and 4 illustrate a matrix section according to an example of the present invention. The matrix section is formed by a slightly curved base portion 11 such as a band. The base portion 11 has two lateral ends 12a, 12b, an inside 13a for facing the cavity to be treated, an outside 13b, an upper edge 14a and a lower edge 14b. On the outside 13b of the base portion 11 there is a ridge a short distance from the respective lateral end 12a, 12b. The ridges form a respective projection 15a, 15b, having a convex shape on the parts facing each other. As will be described below these parts are arranged for the pressure heads of a separation ring to abut on a respective abutment surface 16a, 16b when the separation ring is applied.

Fig. 5 illustrates the function of the matrix section of fig. 3 and 4 and its cooperation with the separation ring when a tooth is to be treated. The figure illustrates the position when the separation ring has been brought into place. The spring force $F_1$ of the separation ring 18 acts in the direction pressing the left pressure head 19b into the wedge shaped space between the neighbouring tooth B and the abutment surface 16b. Thereby the pressure head 19a exerts a normal force $F_2$ against the neighbouring tooth B and a normal force $F_3$ on the abutment surface 16b of the matrix section 10 such that the teeth 101, 102 are slightly separated from each other.

The force $F_3$ on the abutment surface also results in a pulling action on the matrix section 10. The action of the pressure head 19a on the right hand is the same. The result will be that the matrix section 10 is tensioned, and in stead of bulging out will tightly follow the profile of the tooth A that is to be treated. Since no bulge is formed there will be no excess filling material between the teeth and the risk for leakage below the matrix section is eliminated.

In the figure a normal N perpendicular to the dental matrix 10 at the middle thereof is indicated. A tangent from the left abutment surface 16b forms an angle α with the normal N. This angle is to be less than 90 degrees, and is in the figure about 60 degrees. A tangent to the right abutment surface forms a corresponding angle. The angle β between the two tangents thus is about 120 degrees.

Fig. 6 illustrates an example of the matrix section 20 where the two projections 25a, 25b and their abutment surfaces 26a, 26b converge in the downward direction. In the example 30 in fig. 7 the projections 35a, 35b with their abutment surfaces 36a, 36b converge in the upward direction.

Fig 8 illustrates an example 40 where the abutment surfaces 46a, 46b on the projections 45a, 45b are concavely shaped.

Fig. 9 illustrates an example where there are two short projections 55a, 55b with a respective abutment surface 56a, 56b on the left side of the matrix section 50, which projections are arranged above each other. The right side has a corresponding design. In the illustrated example the distance between the upper projections 55a, 55c is equal to the distance between the lower projections 55b, 55d. Alternatively the distance may be different from each other.

Fig 10 illustrates an example 60 where there are two projections 65a, 65b arranged laterally side by side at the left end and two correspondingly arranged projections 65c, 65d at the right side.

Fig. 11 illustrates an example where a band forming the base portion of the matrix section 70 is folded into a loop at each end thereof. The ends of the band are attached to the outside of the band. Thereby a projection 75a, 75b with a respective abutment surface 76a, 76b is formed at each end.

Fig. 12 and 13 illustrate an example 80, where each projection 85a, 85b, with their respective abutment surfaces 86a, 86b is hemispherical. The profile of the projections can have other arc shapes than circular.

Fig. 14 illustrates an example 90 where a recess 97a, 97b is formed on each abutment surface 96a, 96b of the projections 95a, 95b. The shape of the

recessions 97a, 97b is adapted to receive a portion of a pressure head of a separation ring.

Fig. 15 illustrates a separation ring 98 particularly designed for cooperation with a matrix section of the kind illustrated in fig. 14. The pressure head 99 of the separation ring 98 has a projection 991 with a profile corresponding to the recess 97a of the matrix section 90 in fig. 14. The other, not shown, pressure head of the separation ring 98 has a corresponding projection. As can be seen by the force arrows in the figure, the pressure ring according to this example may exert a vertical force in addition to the horizontal one.

Fig. 16 illustrates a separation ring particularly designed for cooperation with a matrix section of the kind illustrated in fig. 12. The pressure head 199 of the separation ring 198 has a recess 1991 with a profile corresponding to the shape of the projection 86a of the matrix section 80 in fig. 12 and 13.

Fig. 17 illustrates a further example of a separation ring 298 with a pressure head 299 provided with a wedge shaped projection 2991 fitting into a wedge shaped recess 297a in the abutment surface of a matrix section that is principally similar to that of fig 14 and 15 but differs from that by the shape of the recess. Also in this example it is indicated by arrows that a vertical as well as a horizontal force may be established.

The matrix section according to the invention preferably is manufactured by metal and/or polymer. The base portion may be of metal with projections of polymer attached thereto by any convenient joint, or vice versa. Alternatively the complete matrix section may be made in one piece either by metal or polymer. Is it to be understood that the various examples illustrated and described may be combined different ways.

CLAIMS

1. A dental matrix section (10) intended for providing a wall at a laterally open part of a tooth cavity (C) at filling therapy and including a base portion (11) of a band like shape extending from a first lateral end (12a) to a second lateral end (12b), which base portion (11) has an inside (13a) intended to face the tooth cavity (C) to be filled, an outside (13b) opposite to the inside, an upper edge (14a) intended to be located adjacent the upper end of the tooth (A) which is to be filled and a lower edge (14b) intended to be located adjacent the root part of the tooth (A), which base portion (11) is straight or arc shaped in the direction from the first lateral end (12a) to the second lateral end (12b) and in the latter case being convex at the outside (13b), **characterized in that** the outside (13b) of the base portion (11) is provided with at least one abutment surface (16a, 16b) adjacent at least one of the first (12a) and second (12b) lateral ends, which at least one abutment surface (16a, 16b) forms an angle (α) directed towards the outside of the base portion (11) of less than 90 degrees with a line (N) perpendicular to the base portion at the middle thereof, and which at least one abutment surface (16a, 16b) is adapted to be acted on by a separation ring (18), wherein each abutment surface (16a, 16b) is located on a projection (15a, 15b) projecting from the outside (13b) of the base portion (11).

2. A dental matrix section according to claim 1, wherein at least one such abutment surface (16a, 16b) is provided adjacent each of said lateral ends (12a, 12b) and wherein the abutment surfaces (16a, 16b) form an angle (β) of less than 180 degrees to each other on the side of the outward direction, preferably less than 160, degrees, most preferably less than 130 degrees.

3. A dental matrix according to any one of claim 1- 2, wherein a plurality of such abutment surfaces (56a-d, 66a-d) are provided adjacent at least one of said lateral ends (52a, 52b, 62a, 62b).

4. A dental matrix according to claim 3, wherein said plurality of abutment surfaces (56a-d, 66a-d) includes abutment surfaces (66a-d) distributed in the lateral direction and/or abutment surfaces (65a-d) distributed in the vertical direction.

5. A dental matrix according to any one of claims 1-4, wherein each projection (15a, 15b) is a ridge extending mainly in a vertical direction or is a segment of a sphere (85a,85b).

6. A dental matrix according to any one of claims 1-4, wherein at least one ridge is provided adjacent each said lateral end (22a, 22b, 32a, 32b), whereby each ridge extends in a direction forming an angle (φ, ε) with the vertical direction such that the direction of the ridge adjacent the first lateral end (22a, 32a) converges with the direction of the ridge adjacent the second lateral end (22b, 32b) .

7. A dental matrix section according to any one of claims 1-6, wherein at least one abutment surface (16a, 16b) is convex in a plane perpendicular to the base portion (11) which plane extends in the lateral direction.

8. A dental matrix according to any one of claims 1-7, wherein at least abutment surface (96a, 96b) is provided with a recess (97a, 97b) for receiving a pressure head of a separation ring.

9. A dental system including a dental matrix section (90) and a separation ring (98), **characterized in that** the dental matrix section (90) is according to any one of claims 1 - 8 and the separation ring (98) is provided with at least one pressure head (99), which pressure head (99) has a portion (991) with a shape that is complementary to the shape of said abutment surface.

10. A dental system according to claim 9, wherein said portion includes a recess, which recess is complementary to at least a part of said abutment surface.

11. A dental system according to claim 9, wherein the dental matrix is according to claim 8, wherein said portion of the pressure head has a projection that fits into said recess.

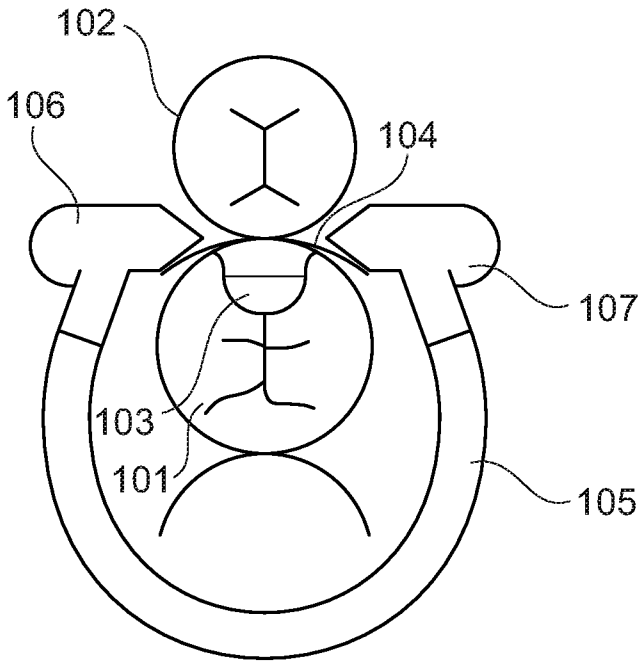



Fig. 1
PRIOR ART

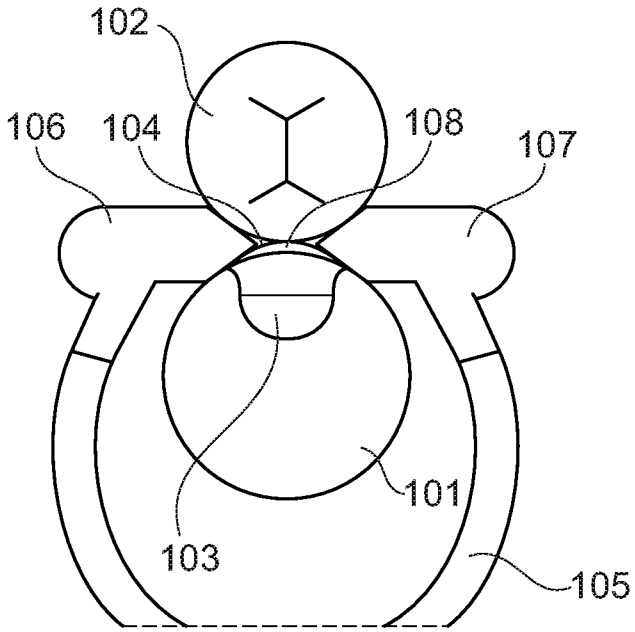



Fig. 2
PRIOR ART

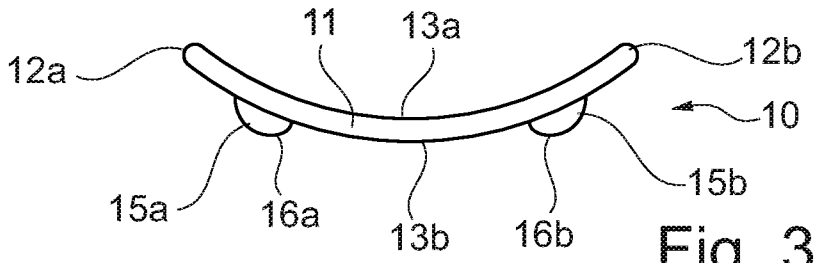



Fig. 3

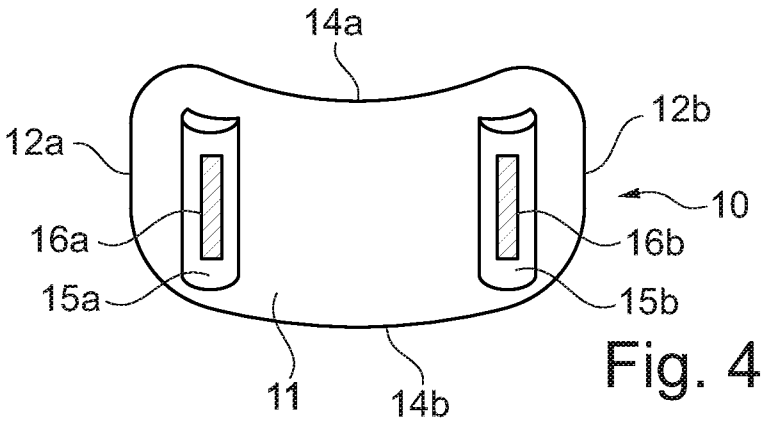



Fig. 4

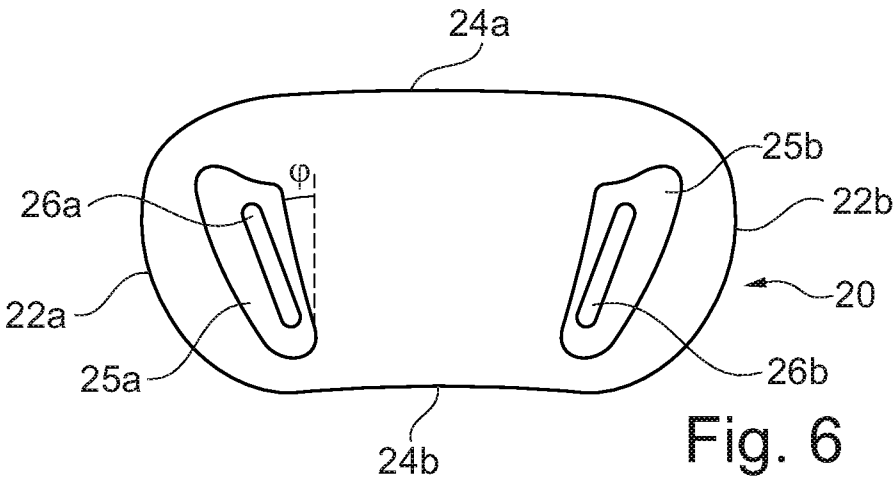



Fig. 6

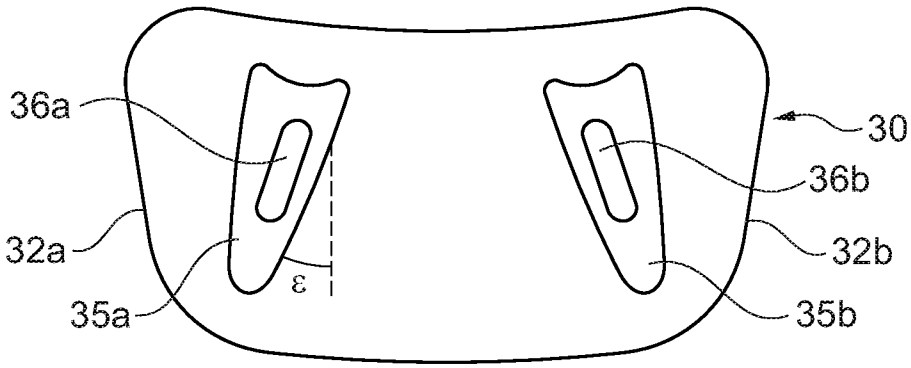
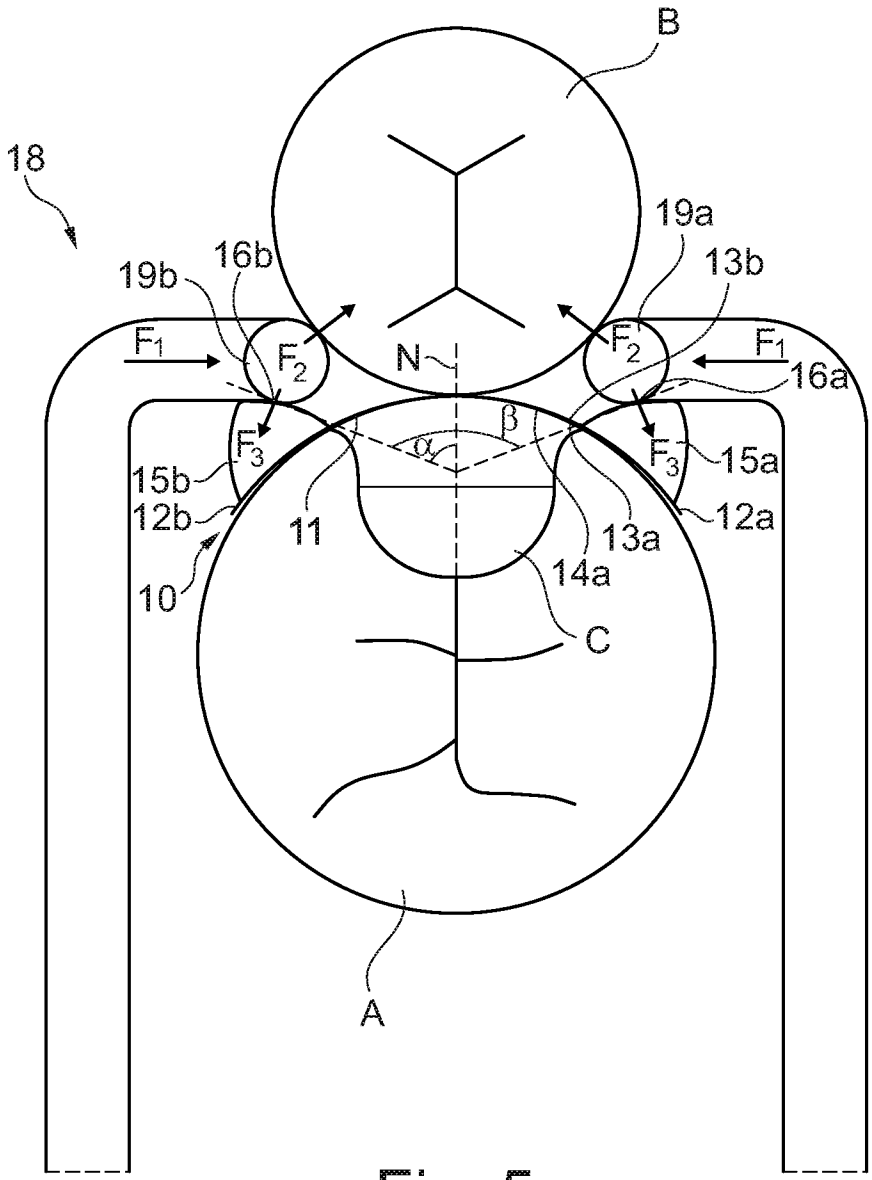



Fig. 7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F2
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15a
15b
12b
11
13a
12a
10
14a
C
A

Fig. 5

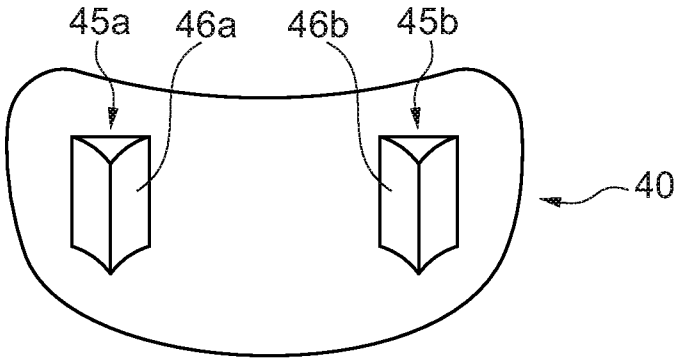


Fig. 8

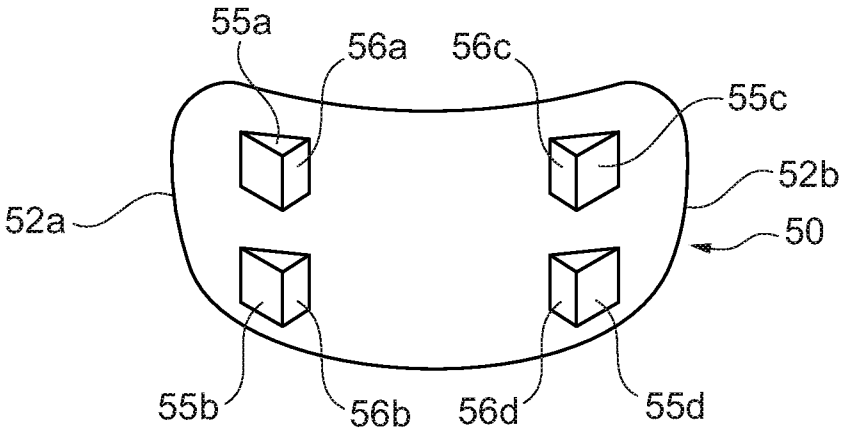


Fig. 9

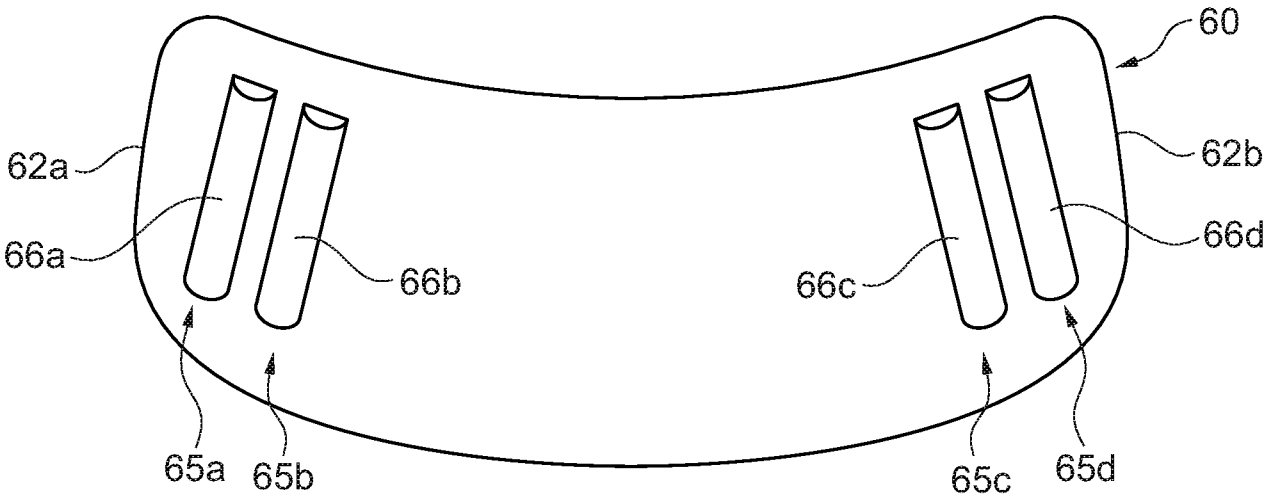


Fig. 10

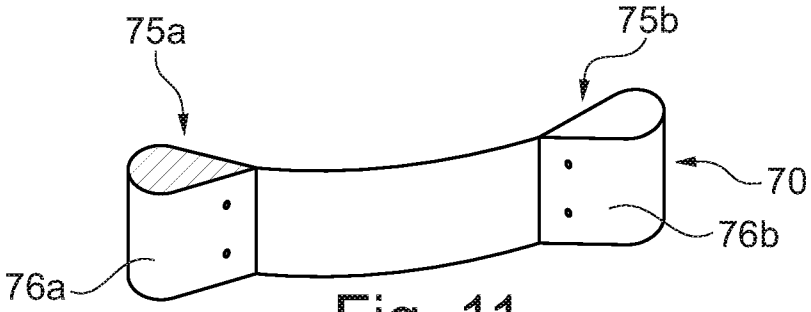


Fig. 11

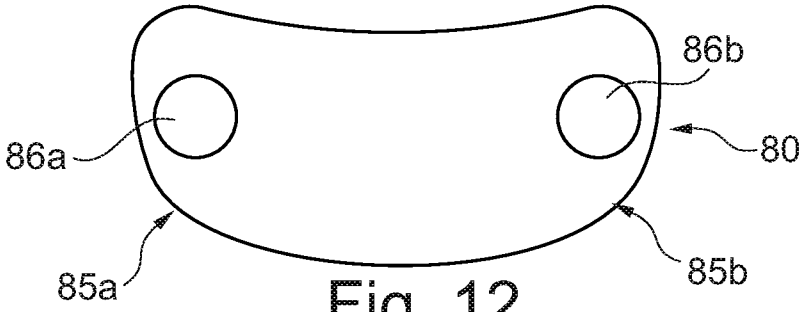


Fig. 12

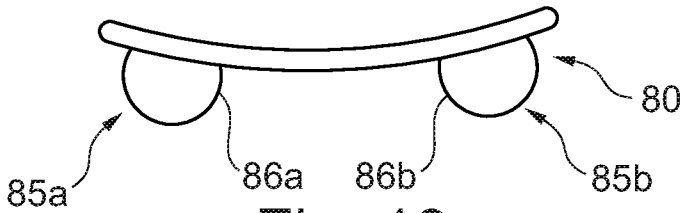


Fig. 13

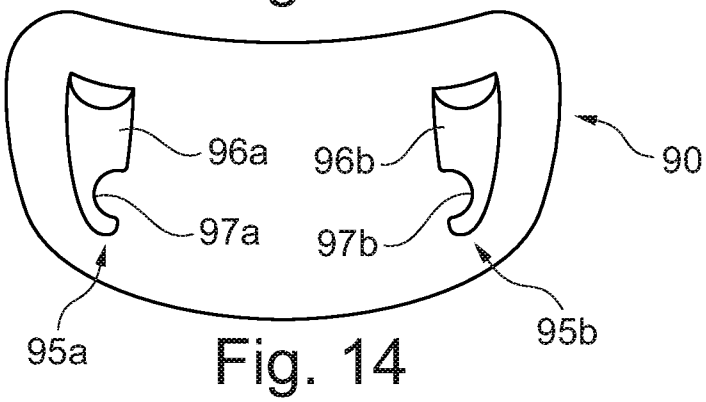


Fig. 14

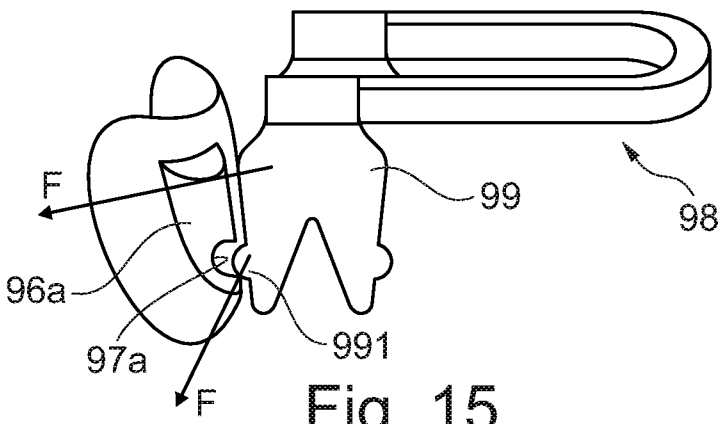


Fig. 15

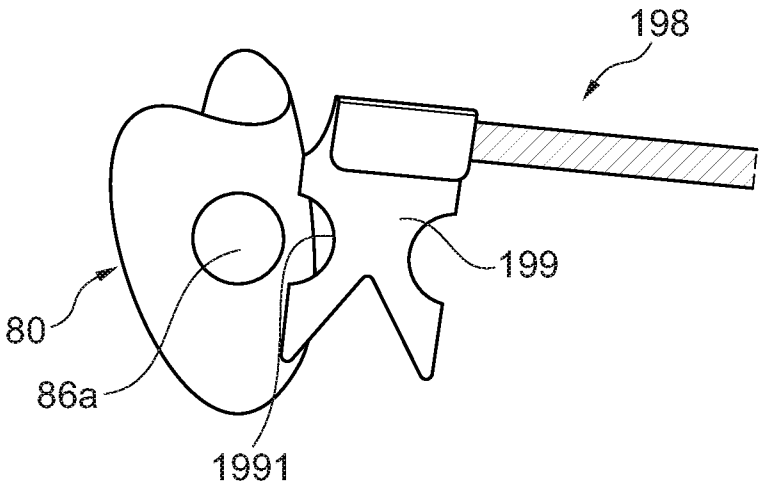


Fig. 16

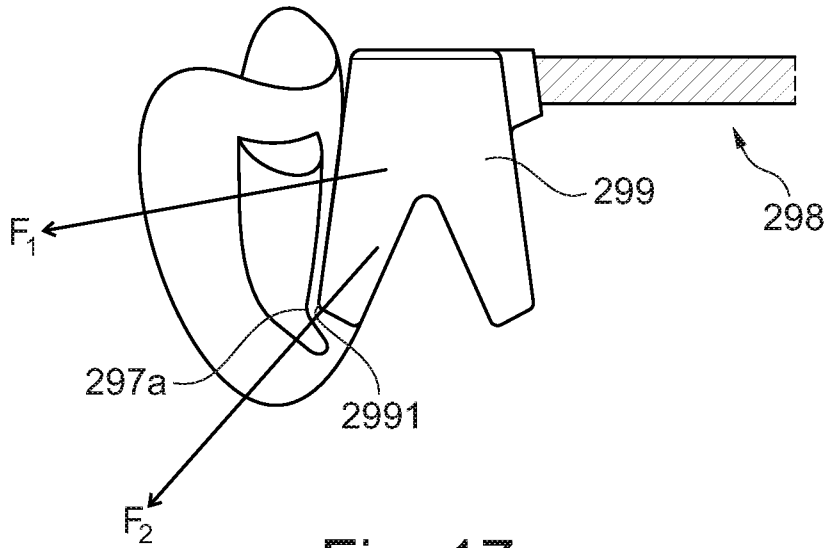


Fig. 17

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050654

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 20020155410 A1 (BILLS DAN J), 24 October 2002 (2002-10-24); abstract; all figures<br>-- | 1-11 |
| A | US 6206697 B1 (HUGO BURKHARD), 27 March 2001 (2001-03-27); abstract; all figures<br>-- | 1-11 |
| A | US 9358080 B2 (CLARK DAVID J), 7 June 2016 (2016-06-07); abstract; all figures<br>-- | 1-11 |
| D, A | US 6712608 B2 (BILLS DAN J), 30 March 2004 (2004-03-30); abstract; all figures<br>--<br>-------- | 1-11 |

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 24-08-2020 | 26-08-2020 |


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International application No.
PCT/SE2020/050654

**Continuation of:** second sheet

**International Patent Classification (IPC)**

***A61C 5/85*** (2017.01)

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| US | 6206697 | B1 | 27/03/2001 | DE | 59710733 | D1 | 16/10/2003 |
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| US | 9358080 | B2 | 07/06/2016 | US | 20130252199 | A1 | 26/09/2013 |
| US | 6712608 | B2 | 30/03/2004 | AU | 2002257155 | A1 | 05/11/2002 |
| | | | | US | 20020172920 | A1 | 21/11/2002 |
| | | | | WO | 02085234 | A3 | 06/11/2003 |