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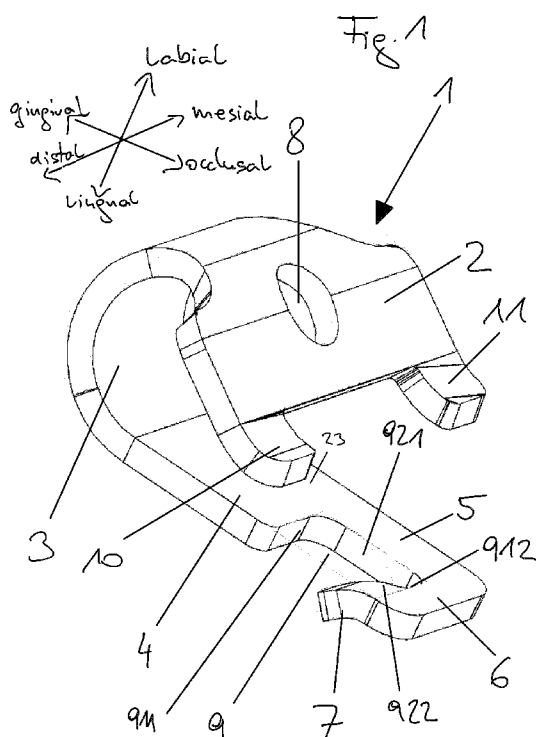
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(54) Title: ORTHODONTIC SELF-LIGATING BRACKET



(57) Abstract: A ligating clip (1) for a self-ligating orthodontic bracket (12), comprising: - a labial arm (2) having a free end and a further end - a lingual arm (4) having a free end and a further end - a connecting arm (3) connected to the further ends of the labial arm (2) and the lingual arm (4) the labial arm (2), the connecting arm (3) and the lingual arm (4) each having a distal side and a mesial side, the labial arm (2) and the lingual arm (4) extending generally in a gingival-occlusal direction and the connecting arm (3) extending generally in a lingual-labial direction - a locking element in form of a hook (7) arranged at the free end of the lingual arm (4), the hook (7) protruding in a lingual-labial direction, wherein at least one cutout (9) is arranged at the free end of the lingual arm (4), the at least one cutout (9) being open at either the distal or the mesial side of the lingual arm (4).

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## Orthodontic self-ligating bracket

The present invention relates to a ligating clip for a self-ligating orthodontic bracket, with the features of the preamble of claim 1 and a self-ligating orthodontic bracket having at least one such ligating clip and an orthodontic bracket with the features of the preamble of claim 12.

A ligating clip with the features of the preamble of claim 1 and a self-ligating orthodontic bracket having such a clip is shown in EP 3 419 553 B1.

The ligating clip, made of superelastic material, is approximately U-shaped with a labial arm, a lingual arm and a connecting arm connecting the labial arm and the lingual arm and has three fingers (which, in the present disclosure, are also called protrusions or protruding elements) on a free end of its labial arm.

A locking element in form of a hook is provided at a free end of the lingual arm, the hook protruding in a lingual-labial direction. The hook is manufactured by stamping with bending down or up the free end of the lingual arm such that the hook has three cut sides (two of them running in a gingival-occlusal direction and one of them running in a mesial-distal direction) and is connected to the material of the lingual arm by a single side (running in a mesial-distal direction). Due to the stamping, the hook extends generally in a lingual-labial direction. The hole produced as a consequence of the stamping is completely surrounded by material of the lingual arm (in other words, it is not open at any side of the lingual arm). In a view along the lingual-labial direction, the hook is only minimally distanced from the three sides.

In an inserted state in which the ligating clip is inserted in a self-ligating bracket, the lingual arm runs through an occlusal-lingual channel which has two sections of different clearance and separated from each other by a step. The section at the occlusal side has a higher clearance and allows the hook to slide freely and the other section has a lower clearance to stop the hook in a position in which the archwire slot is open such that an archwire can be inserted into or removed from the archwire slot. In this way, a loss of the

clip in the open position can be avoided. In the closed position the clip is locked by its elastic force only, not by a dedicated locking element.

During use the archwire will apply varying forces on the ligating clip.

5

A different concept of a ligating clip in which cutouts are used to provide locking elements in a closed position of the clip is shown in US 9,345,558 B2 and US 10,555,793 B2.

10 Self-ligating orthodontic brackets were developed to eliminate the need to secure the arch wire to the bracket with external ligation, usually either elastic or metal- wire ties. These brackets have a slot to receive the arch wire, and a clip is then snapped into place over the slot to keep the arch wire attached.

15 U.S. Patent 3,772,787 to Hanson discloses an early design of a passive self-ligating bracket based on a flexible clip. The disclosed orthodontic bracket comprises a body slotted for the reception of an arch wire and a U-shaped clip for retaining the arch wire in the slot. The clip is designed of flat metal conforming to the shape of the body and is movable between two positions in which the labial opening is respectively open and  
20 closed. A big drawback of this original design is there is nothing to secure the free end of the clip's labial side and therefore the arch wire can easily be displaced from the arch wire slot.

U.S. Patent 4,492,573 to Hanson improved upon the original design with an active self-  
25 ligating bracket by 1) adding a mesial-distal retainer slot to the gingival side of the arch wire slot, 2) bending the free end of the retainer member's labial side so that it can be inserted into the retainer slot of the arch wire slot and 3) forming a saddle ridge at the labial side of the body. The first two modifications help to hold the free end of the clip's labial side at a closed position and prevent the clip from moving beyond its elastic limit  
30 when subjected to a force in the labial direction. The third secures the clip's labial side at the open position. However, there is still insufficient restraint on the free end of the clip's labial side when it is subjected to a force in the mesial-distal direction.

U.S. Patent 5,586,882 to Hanson documented the use of a Ni-Ti based shape-memory alloy as the clip material. The disclosed self-ligating orthodontic bracket comprises a U-shape spring clip with converging arms, movable on the bracket body between slot open and closed positions; in the latter position the spring retains an arch wire in the slot and urges the bracket and wire to their optimum relative positions. The clip is of a superelastic shape recovery metal alloy, preferably of thickness from 0.20 mm (0.008 in) to 0.25 mm (0.010 in), with rounded edges.

10 The original design by Hanson did not have a restraint to prevent the clip moving in the mesial-distal direction. U.S. Patent 5,906,486 to Hanson added a cut-out in the gingival side of the arch wire slot wall to retain the clip and prevent it from moving in the mesial-distal direction. The free end part of the labial arm portion extends into the recess to protect the spring member against excessive movement in the labial direction. Brackets  
15 based on the design concepts disclosed in the above patents have been marketed by Speed System and still available today. Only metal brackets have been produced and no aesthetic version is available by Speed System.

A hybrid between a conventional twin bracket and a flexible clip active self-ligating  
20 bracket, known as the In-Ovation bracket, was developed by Voudouris in 1997 and is described in US Patent No. 5,857,850. An improved design has been available since 2002, marketed as In-Ovation R (See US Patent No. 6,368,105 and US 6,776,613). An important feature of the design is a slot blocker to prevent the clip's movement in the mesial-distal direction. An aesthetic version of this system (In-Ovation C) was introduced  
25 in 2007 in the form of a ceramic bracket, in which the metal clip has been plated with Rh so that it is matte in appearance and thus does not reflect light as much as a polished surface would. The clip is made of a Co-Cr-Mo alloy and tends to lose its modulus after use during treatment. However, the coating tends to wear off in the early stage of treatment and lose its aesthetics.

30 US Patent Application No. 9,770,310 to Hirsch discloses a bracket that has a wall portion extending upward along one side of the arch wire slot. This wall portion has three

indentations in a line parallel to the mesiodistal direction. There is a channel running entirely through the bracket element underneath the arch wire slot and in a gingival-occlusal direction of the bracket. The clip is substantially U-shaped and has a first end with three parallel protrusions (which, in this disclosure, are also called fingers) shaped to fit within the three indentations of the wall portion, and a second end having a locking element. The clip is securable to the bracket by placing the second end through the channel and engaging the locking element onto the bracket element and placing the protrusions into the indentations of the bracket element. The protrusions are held in the indentations by friction due to the downward spring force of the clip on the floor of the indentation. The clip is releasable by sliding the protrusions out of the indentations to expose the arch wire slot. While this device is suitable for most purposes, it would be desirable to improve upon this construction and provide a clip that has an even more secure fit to the bracket, to avoid any inadvertent release during use.

It is an object of the invention to develop a ligating clip and a self-ligating orthodontic bracket that are easy to fabricate, easy to assemble and securely fastened. It is another object of the invention to develop a self-ligating orthodontic bracket that is easy to use, even more securely fastened and aesthetically pleasing.

This object is accomplished by a clip for a self-ligating orthodontic bracket having the features of claim 1 and a self-ligating orthodontic bracket having at least one such ligating clip and/or an orthodontic bracket having the features of claim 12. Preferred embodiments of the invention are defined in the dependent claims.

Embodiments of the invention refer to an orthodontic bracket comprising a base configured for attachment to a tooth surface, a bracket element with an arch wire slot attached to one side of the base, and a clip for securing the arch wire in the slot. The arch wire slot is formed in the labial side of the bracket element and runs along a mesiodistal direction of the bracket element.

In some embodiments, the bracket element has a wall portion extending upward along one side of the arch wire slot. This wall portion has three indentations in a line parallel to

the mesiodistal direction. These indentations are bounded on the interior side by two side walls that separate the three indentations. Each of the side walls has a free end on which outwardly extending flanges are formed. Each flange extends toward the respective indentation parallel to the mesiodistal direction and forms a stop surface for the clip elements. There is a channel running entirely through the bracket element underneath the arch wire slot and in a gingival-occlusal direction of the bracket.

In some embodiments, the clip is substantially U-shaped and has a first end with two protruding elements shaped to fit within the outer indentations of the wall portion, and a central element comprising two diverging fingers, that fits within the central indentation. The outer protruding elements have ends that extend inwardly toward the central elements and which are held in place behind the flanges on the side walls. The fingers diverge outwardly and are also held in place behind the flanges on the side walls.

In some embodiments, a second end of the U-shaped clip has a locking element that engages the underside of the bracket. This second end is curved in the shape of a J, with the short end of the J being bent downward to engage a stop surface in the channel. The clip is securable to the bracket by placing the second end through the channel until the downwardly bent section passes the stop surface, and placing the three protruding clip elements into the indentations of the bracket. The outer protrusions are held in the indentations by friction due to the downward spring force of the clip on the floor of the indentations, as well as by the flanges acting as a stop surface against the protrusions of the outer elements, which engage a rear surface of the flanges as rearward pressure is applied to the clip to remove it from the bracket. The fingers of the central element engage the flanges that extend toward the central indentation, to further lock the clip into the bracket.

In some embodiments, the clip is releasable by sliding the protrusions and central element out of the indentations to expose the arch wire slot. This sliding motion can require additional force, to allow the fingers and the protrusions to bend enough to clear the flanges.

The combination of the two protrusions, central element and three indentations with the locking flanges secures the clip firmly when it is subjected to force in the mesial-distal direction as well as the gingival-occlusal direction, and provides an even distribution of forces on the arch wire during the active ligation stage.

5  
In the present disclosure a coordinate system is used which is attached to a labial tooth surface on the mandible. This is not to be understood in a limiting way. The invention can be practiced irrespective of the position of the tooth and irrespective of the tooth surface. By way of example, a ligating clip and a self-ligating orthodontic bracket according to the  
10 invention could also be used with a labial or lingual surface of a tooth of the maxilla.

A ligating clip and a self-ligating orthodontic bracket according to the invention will have the following pairs of direction:

- lingual-labial
- 15 - mesial-distal
- gingival-occlusal

In the present disclosure the term “connected to” is not to be construed as implying that the objects connected to each other would have to be separate physical parts. By way of  
20 example, with respect to the ligating clip, although it is stated that the labial arm and the lingual arm are connected to the connecting arm it is possible – even preferred – that the ligating clip is made of a single physical part.

The ligating clip is made of superelastic material and is approximately U-shaped with a  
25 labial arm, a lingual arm and a connecting arm connecting the labial arm and the lingual arm and has one, two or three fingers on a free end of its labial arm.

A locking element in form of a hook is provided at a free end of the lingual arm, the hook protruding in a lingual-labial direction. In an inserted state in which the ligating clip is  
30 inserted in a self-ligating bracket, the lingual arm runs through an occlusal-gingival channel which has two sections of different clearance and which are separated from each other by a step. The section at the occlusal side has a higher clearance and allows the

hook to slide freely and the other section has a lower clearance to stop the hook in a position in which the archwire slot is open such that an archwire can be inserted into or removed from the archwire slot. In this way, a loss of the clip in the open position can be avoided. In the closed position the clip is locked by its elastic force only, not by a dedicated locking element, namely, the fingers are held in the cavities of the occlusal wall of the bracket by friction due to the downward spring force of the clip on the floor of the cavities. Of course, during insertion of the clip, in the gingival section the hook is pressed into the plane of the lingual arm which is possible due to the elasticity of the hook. Once the section having higher clearance is reached, the hook is released back into its state protruding from the plane of the lingual arm.

Due to the cutout the clip is better suited to endure the forces acted upon by the archwire because the cutout increases the elasticity of the clip resulting in a securely fastened clip. Due to the increased elasticity assembly of the clip and the bracket is easier because a hook having a smaller width can be used. The cutout and the hook can easily be produced by stamping with bending down or up.

In some embodiments of the clip the at least one cutout has at least one mesial-distal border and at least one gingival-occlusal border.

In some embodiments of the clip the hook, in a view along the lingual-labial direction, has a length and is distanced from at least one mesial-distal border and from at least one gingival-occlusal border by at least half of its length.

In some embodiments of the clip the at least one cutout, in a view along the lingual-labial direction, is generally L-shaped. With respect to these embodiments it can be provided that a shape of the lingual arm due to the cutout is given by a gingival section, a protrusion connected to the gingival section, the protrusion running in the gingival-occlusal direction and having a smaller width along the mesial-distal direction than the gingival section, and, preferably, a transversal part running in the mesial-distal direction, the transversal part being connected on one end to the protrusion and on a further end to the hook.

In some embodiments of the clip the labial arm is provided with a mesial finger and a distal finger, only. Alternatively, a single finger or an additional (mesial) finger could be provided.

- 5 In some embodiments, the clip can be slid open and closed with the aid of an aperture for a tool.

In some embodiments, the clip is provided with only one cutout such that, in a view along the lingual-labial direction, the clip is of asymmetric design due to the presence of the  
10 cutout.

Preferably, the clip is made of superelastic material, e.g., a Ni-Ti alloy.

In some embodiments, the hook protrudes from a lingual surface of the lingual arm.  
15 Alternatively, it could be provided that the hook protrudes from a labial surface of the lingual arm (of course, the position of the step in the occlusal-gingival channel has to be adapted accordingly).

Preferably, the clip can be provided with a coating minimizing the amount of Ni leaching  
20 from the clip (in case a Ni-Ti alloy is used) and/or improving the aesthetics of the clip.

In some embodiments of the bracket it is provided with an occlusal-gingival channel which has two sections of different clearance and which are separated from each other by a step such that, in a position in which the archwire slot is open, the hook acts together with  
25 step to prevent a separation of the clip from the bracket.

Preferably, the bracket is made of ceramics, metals, or polymeric materials.

Optional tie-wings of the bracket can be used to apply bands  
30

With the exception of the provision of a cutout as described in this document, the clip and the bracket can have the features described in EP 3 419 553 B1.

In one embodiment, the clip is made of a Ni-Ti alloy. This alloy exhibits superelasticity, which keeps the elastic modulus of the clip substantially unchanged even with extended use. The clip can also be coated with a coating such Au/Rh, Pt/Rh and Pd/Rh, with Rh  
5 being an outermost layer. This coating minimizes the amount of Ni that leaches from the clip, and improves the aesthetics of the bracket when used in conjunction with a ceramic bracket body.

In a preferred embodiment, the arch wire slot is chamfered on its edges to minimize  
10 friction when inserting and removing the arch wire from the slot.

Preferably the base is manufactured by embossing protrusions into the base, by stamping the base immediately after molding. This forms undercuts around the protrusions, which enhances the adhesion of the base to the tooth surface.

15

In the drawings, the figures show:

- Fig. 1 a ligating clip in isometric view
- Fig. 2a-c the clip of Fig. 1 in a view along a lingual-labial direction, a gingival-occlusal direction and a mesial-distal direction, respectively
- 20 Fig. 3a,b a self-ligating bracket having a clip according to Fig. 1 and 2 in two different isometric views
- Fig. 4a,b the bracket of Fig. 3 in a view along a gingival-occlusal direction with and without inserted clip, respectively
- Fig. 5 the bracket of Fig. 4b in an isometric view
- 25 Fig. 6 a cut view of the bracket of Fig. 4a
- Fig. 7 an alternative embodiment of a ligating clip in a view along a lingual-labial direction
- Fig. 8 a top view of a bracket according to another embodiment of the invention
- Fig. 9 a side view of the bracket of Fig. 8
- 30 Fig. 10 a top view of the clip for use with the bracket of Fig. 8
- Fig. 11 a perspective view of the clip shown in Fig. 10
- Fig. 12 a cross-sectional view along line V-V of Fig. 11

Fig. 13 a cross-sectional view along line VI-VI of Fig. 8 and

Fig. 14 a bottom view of the bracket of Fig. 8

Fig. 1 and 2 show a first embodiment of a ligating clip 1 for a self-ligating orthodontic bracket 12 shown in Fig. 3 to 6, the clip 1 comprising:

- a labial arm 2 having a free end and a further end
- a lingual arm 4 having a free end and a further end
- a connecting arm 3 connected to the further ends of the labial arm 2 and the lingual arm 4

the labial arm 2, the connecting arm 3 and the lingual arm 4 each having a distal side and a mesial side, the labial arm 2 and the lingual arm 4 extending generally in a gingival-occlusal direction and the connecting arm 3 extending generally in a lingual-labial direction

- a locking element in form of a hook 7 arranged at the free end of the lingual arm 4, the hook 7 protruding in a lingual-labial direction
- at least one cutout 9 arranged at the free end of the lingual arm 4, the at least one cutout 9 being open at either the distal or the mesial side of the lingual arm 4

It can be seen, that the at least one cutout 9 has two mesial-distal borders 911, 912 and two gingival-occlusal borders 921, 922.

The hook 7, in a view along the lingual-labial direction, has a length L and is distanced from the mesial-distal borders 911, 912 and from the gingival-occlusal borders 921, 922 by at least half of its length L.

The at least one cutout 9, in a view along the lingual-labial direction, is generally L-shaped and a shape of the lingual arm 4 due to the cutout 9 is given by a gingival section 23, a protrusion 5 connected to the gingival section 23, the protrusion 5 running in the gingival-occlusal direction and having a smaller width along the mesial-distal direction than the gingival section 23, and a transversal part 6 running in the mesial-distal direction, the transversal part 6 being connected on one end to the protrusion 5 and on a further end to the hook 7.

In the embodiment of Fig. 1 to 6 the clip 1 is provided with only one cutout 9 such that, in a view along the lingual-labial direction, the clip 1 is of asymmetric design due to the presence of the cutout 9.

5 In the alternative embodiment of a clip 1 shown in Fig. 7, two cutouts 9 are provided wherein each cutout 9 and hook 7 is designed as shown in the embodiment of Fig. 1 and 2. The clip 1 of this embodiment is of a symmetric design.

10 The bracket 12 is provided with an occlusal-gingival channel 21 which has two sections of different clearance and which are separated from each other by a step 211 (cf. Fig. 4b) such that, in a position in which the archwire slot 22 is open, the hook 7 acts together with step 211 to prevent a separation of the clip 1 from the bracket 12.

15 A base 15 of the bracket 12 can be bonded to a tooth enamel by applying adhesives between the base 15 and the enamel as is well known in the art.

The bracket 12 has an archwire slot 22 to accept an archwire (not shown).

20 An occlusal wall of the bracket 12 is provided with a mesial cavity 13 and a distal cavity 14 to cooperate with the fingers 10, 11. Another (medial) cavity 18 is not used in this embodiment but could be used together with a clip 1 having three fingers. Alternatively, it could be provided that the medial cavity 18 is not present.

25 The clip 1 can be slid open and closed with the aid of an aperture 8 for a tool.

Preferably, the clip 1 is made of superelastic material, e.g, a Ni-Ti alloy.

30 Preferably, the clip 1 can be provided with a coating minimizing the amount of Ni leaching from the clip (in case a Ni-Ti alloy is used) and/or improving the aesthetics of the clip 1.

Preferably, the bracket 12 is made of ceramics, metals, or polymeric materials.

Optional tie-wings 16, 17, 19, 20 can be used to apply bands.

Fig. 8 and 9 show a self-ligating orthodontic bracket 310 comprising a base 311 and a  
5 bracket element 312, as well as a U- shaped ligating clip 320, shown in detail in Figs. 10  
and 11. Bracket element 312 has a mesial-distal slot 313 to accept an arch wire. Three  
cavities 314, 315, 316 are made at the gingival wall 317 of slot 313 (see Fig. 12). Clip 320  
has a first end with two protrusions 321, 322, and a central element comprising central  
10 fingers 323, 324, which engage indentations 314, 315, 316 when the clip 320 is in the  
closed position. These protrusions and fingers in combination with the indentations  
secures the clip firmly when it is subjected to force in the mesial-distal direction, providing  
an even distribution of forces on the arch wire during the active ligation stage.

The clip 320 is made of a superelastic material. The bracket element and base can be  
15 made of ceramics, metals, or polymeric materials.

Lingual side 325 of clip 320 is inserted into a gingival-occlusal channel 319 of bracket  
element 312, as shown in Fig. 13, and the labial side 326 is used for locking and unlocking  
the arch wire slot 313. The two sides are connected by a bend 327 at the occlusal side.  
20 The lingual side 325 and the bend 327 are narrower than the width of the channel 319,  
so that the clip 320 can be easily inserted.

At the labial side 326, the clip 320 expands to cover the full length of the arch wire slot  
towards its gingival end. As shown in Figs. 10 and 11, two cut-outs 331, 332 are made at  
25 free gingival end of the clip to form the two parallel protrusions 321, 322, and central  
fingers 323, 324. Central fingers 323, 324 are angled outwardly toward a respective  
adjacent protrusion, so that the ends of each finger 323, 324 and protrusion 321, 322 abut  
the adjacent side wall 318a, 318b, 318c, 318d of the bracket. The sides walls 318a-318d  
each have distal ends with flanges 317a-317d that protrude parallel to the mesial-distal  
30 direction, and act as stop surfaces for protrusions 321, 322 and central fingers 323, 324  
when they are inserted into the indentations 314, 315, 316 and are locked in place behind  
flanges 317a-317d, as shown in Fig. 12. The protrusions 321, 322 and fingers 323, 324

are angled so that they extend substantially parallel to the lingual side 325 of the clip 320, and exert a downward pressure on the surface of the bracket with the indentations, to add extra resistance to movement when in the locked position.

- 5 Clip 320 can be slid open and closed with the aid of an aperture 335 disposed behind protrusions 321, 322 and fingers 323, 324. A user can slide clip 320 open and closed by inserting a tool through aperture 335 and moving the tool back and forth.

10 Due to the interaction of the ends of protrusions 321, 322 and fingers 323, 324 with the flanges 317a-317d, the user must exert sufficient force to bend the protrusions and fingers so that they clear flanges 317a-317d to release clip 320 from bracket element 312.

15 As shown in Figs. 10-12, the lingual side 325 of the clip is in the shape of a J, having a hooked end with a tip 328. Tip 328 is bent in the lingual direction to serve as a locking tab so that clip 320 will not separate from the bracket element 312 after being inserted into the channel 319. Channel 319, as shown in Fig. 13, has two stepped sections: the section 333 at the gingival side has a higher clearance to allow the tip 328 to slide freely and the other section 334 with a lower clearance, forming a stop surface, to stop the tip 328. The location of the stepped divide between the two sections is determined so as to minimize the length of the lingual side portion of the clip and not extend far beyond the bracket base boundary.

20

The base 311 is bonded to the tooth enamel by applying adhesives between the base and enamel. A structured bottom surface of the base 311 can be formed such as shown in Fig. 12. No adhesion promoter is applied on the surface of the base 311 to enhance bonding chemically, and the bonding to the base is completely mechanical by anchoring solidified adhesives at undercuts on the base, formed either by embossed protrusions or particles glued to the base. As shown in Fig. 12, protrusions 340 are embossed over the surface of the base 311. Undercuts can be formed by stamping the protrusions 340 right after the molding process, simplifying the manufacture process and lowering its cost.

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- In a preferred embodiment, the clip 320 is made of Ni-Ti alloy. Due to the superelastic property of the alloy, the elastic modulus of the clip remains unchanged even after extended use in oral cavity. This is a big advantage compared with other spring materials such as Co-Cr-Mo alloys. In addition, the clip can be coated with dual layers of Au/Rh, Pt/Rh or Pd/Rh, all with Rh in the outermost layer. Preferably, the thickness of the Rh is between 0.5  $\mu\text{m}$  and 3  $\mu\text{m}$  to maintain the integrity of the coating during long exposure in oral cavity. This coating can minimize Ni from leaching and improve the esthetics when used along with a ceramic bracket body.
- 10 In another preferred embodiment, the bracket body is manufactured by injection molding. The molded green bodies are converted to transparent ceramics through binder burnout, sintering and/or hot isostatic pressing. The materials can be high-purity alumina, zirconia or other compounds that can be densified to full density and high translucency, such as sialon or spinel. Preferably, the body is polished chemically to produce a fine surface
- 15 finish. The smoothly polished surface, combined with a chamfer 336 at the edge of the arch wire slot (Fig. 9), make friction of arch wire over the slot extremely small. The frictional force can be comparable to or even smaller than that over a polished metallic bracket.
- 20 In a further embodiment, the bracket body can be manufactured by 3D printing, in particular using a DLP (digital light processing) or SLA (stereolithography) printer.

## List of reference signs:

- 1 ligating clip for a self-ligating orthodontic bracket
- 2 labial arm of clip
- 3 connecting arm of clip
- 5 4 lingual arm of clip
- 5 protrusion of lingual arm of clip
- 6 transversal part of lingual arm of clip
- 7 hook
- 8 aperture for tool
- 10 9 cutout
  - 911 first mesial-distal border of cutout
  - 912 second mesial-distal border of cutout
  - 921 first gingival-occlusal border of cutout
  - 922 second gingival-occlusal border of cutout
- 15 10 distal finger of clip
- 11 mesial finger of clip
- 12 self-ligating orthodontic bracket
- 13 mesial cavity in occlusal wall of bracket
- 14 distal cavity in occlusal wall of bracket
- 20 15 base of bracket
- 16 first gingival tie-wing
- 17 second gingival tie-wing
- 18 medial cavity in occlusal wall of bracket
- 19 first occlusal tie-wing
- 25 20 second occlusal tie-wing
- 21 occlusal-gingival channel
  - 211 step in occlusal-gingival channel
- 22 archwire slot
- 23 gingival section of lingual arm
- 30 310 orthodontic bracket
  - 311 base
  - 312 bracket element

- 313 mesial-distal slot
- 314 cavity
- 315 cavity
- 316 cavity
- 5 317 gingival wall
  - 317a flange
  - 317b flange
  - 317c flange
  - 317d flange
- 10 318a adjacent side wall of the bracket
- 318b adjacent side wall of the bracket
- 318c adjacent side wall of the bracket
- 318d adjacent side wall of the bracket
- 319 channel
- 15 320 clip
- 321 protrusion
- 322 produsion
- 323 finger
- 324 finger
- 20 325 lingual side
- 327 bend
- 328 tip
- 331 cutout
- 332 cutout
- 25 333 section
- 334 section
- 335 aperture
- 336 chamfer
- 340 protrusion
- 30 L length of hook in a view along the lingual-labial direction

## Claims:

1. A ligating clip (1) for a self-ligating orthodontic bracket (12), comprising:
- 5       - a labial arm (2) having a free end and a further end
- a lingual arm (4) having a free end and a further end
- a connecting arm (3) connected to the further ends of the labial arm (2) and the  
       lingual arm (4)
- the labial arm (2), the connecting arm (3) and the lingual arm (4) each having a distal  
10       side and a mesial side, the labial arm (2) and the lingual arm (4) extending generally  
       in a gingival-occlusal direction and the connecting arm (3) extending generally in a  
       lingual-labial direction
- a locking element in form of a hook (7) arranged at the free end of the lingual  
       arm (4), the hook (7) protruding in a lingual-labial direction
- 15       characterized in that
- at least one cutout (9) is arranged at the free end of the lingual arm (4), the at least  
       one cutout (9) being open at either the distal or the mesial side of the lingual arm  
       (4).
- 20   2. The clip of claim 1, wherein the at least one cutout (9) has at least one mesial-distal  
       border (911, 912) and at least one gingival-occlusal border (921, 922).
3. The clip of one of the preceding claims, wherein the hook (7), in a view along the  
       lingual-labial direction, has a length (L) and is distanced from at least one mesial-  
25       distal border (911, 912) and from at least one gingival-occlusal border (921, 922) by  
       at least half of its length (L).
4. The clip of one of the preceding claims, wherein the at least one cutout (9), in a view  
       along the lingual-labial direction, is generally L-shaped.
- 30   5. The clip of the preceding claim, wherein a shape of the lingual arm (4) due to the  
       cutout (9) is given by a gingival section (23), a protrusion (5) connected to the

- gingival section (23), the protrusion (5) running in the gingival-occlusal direction and having a smaller width along the mesial-distal direction than the gingival section (23), and, preferably, a transversal part (6) running in the mesial-distal direction, the transversal part (6) being connected on one end to the protrusion (5) and on a further end to the hook (7).
- 5
6. The clip of one of the preceding claims, wherein the labial arm (2) is provided, preferably only, with a mesial finger (11) and a distal finger (10).
- 10 7. The clip of one of the preceding claims, wherein the hook (7) protrudes from a lingual surface of the lingual arm (4).
8. The clip of one of the preceding claims, wherein the clip (1) is provided with only one cutout (9) such that, in a view along the lingual-labial direction, the clip (1) is of asymmetric design due to the presence of the cutout (9).
- 15
9. The clip of one of the preceding claims, wherein the clip (1) has, at its labial arm (2) only a mesial finger (11) and a distal finger (10) between which there is arranged a wall running in the mesial-distal direction which is free of protrusions or fingers and which – preferably is running straight – and which together with the fingers (11, 10) which run in a gingival-occlusal direction borders an indentation arranged on the end of the labial arm (2).
- 20
10. The clip of one of claims 1 to 8, wherein the clip (310) has, at its labial arm (2) a mesial finger (321) and a distal finger (322) and two central fingers (323, 324) wherein the two central fingers (323, 324) are arranged adjacent to each other.
- 25
11. A self-ligating orthodontic bracket (12) comprising a clip (1) according to at least one of the preceding claims.
- 30
12. The bracket of the preceding claim, wherein the bracket (12) is provided with an occlusal-lingual channel (21) which has two sections of different clearance and which are separated from each other by a step (211) such that, in a position in which

the archwire slot (22) is open, the hook (7) acts together with step (211) to prevent a separation of the clip (1) from the bracket (12).

13. An orthodontic bracket, in particular according to one of claims 11 or 12, comprising
- a base configured for attachment to a tooth surface;
  - a bracket element attached to one side of the base, the bracket element comprising

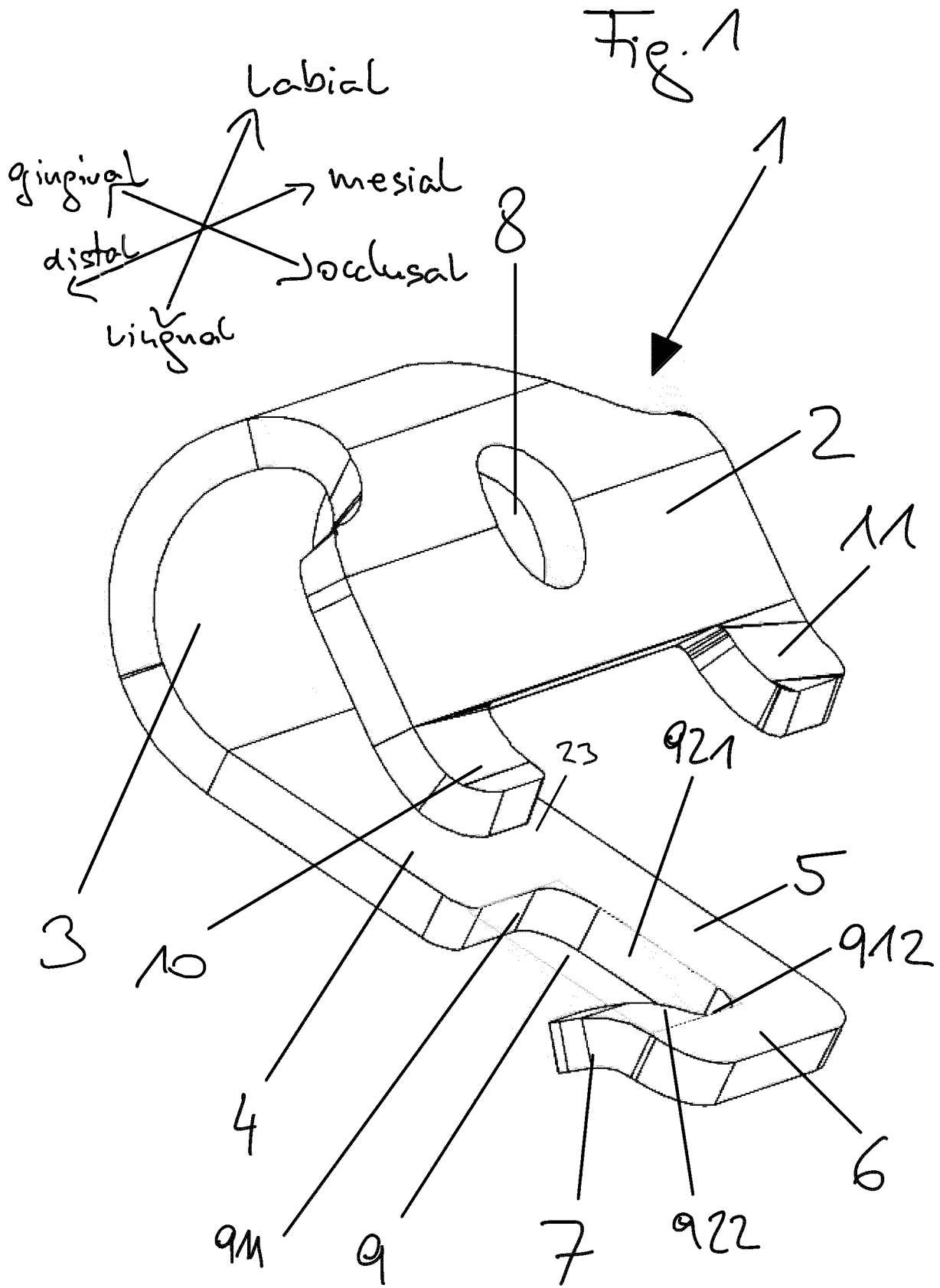
- an arch wire slot formed in a labial side of the bracket element and running along a mesiodistal direction of the bracket element, said arch wire slot being configured for supporting an arch wire therein;
- a wall portion of the bracket element extending upward along one side of the arch wire slot, the wall portion having three indentations in a line parallel to the mesiodistal direction, forming outer indentations and a central indentation, the wall portion having two side walls separating the indentations from one another, each of the side walls having free ends configured with flanges that extend into the central and outer indentations parallel to a mesiodistal direction; and
- a channel running entirely through the bracket element underneath the arch wire slot and in a gingival-occlusal direction of the bracket;

characterized in a substantially U-shaped clip having a first end with two protrusions shaped to fit within the two outer indentations of the wall portion, and two central fingers shaped to fit within the central indentation of the wall portion, and a second end in the shape of a J and having a locking element at a tip thereof; wherein the clip is securable to the bracket by placing the second end through the channel and engaging the locking element and placing the protrusions and central fingers into the indentations of the bracket element, wherein the protrusions and central fingers are held in the indentations by the flanges, and wherein the clip is releasable by sliding the protrusions out of the indentations with a force sufficient to cause the protrusions and central fingers to clear the flanges to expose the arch wire slot.

14. The bracket according to claim 13, wherein the locking element is formed by a bend in the tip in a lingual direction of the bracket, wherein the channel is formed

from two stepped sections, and wherein the locking element on the clip engages a wall of one of the sections to maintain the clip in the channel.

- 5 15. The bracket according to one of claim 12 or 14, wherein the fingers are constructed so as to diverge outward toward the adjacent side walls and engage a rear surface of the flanges on the adjacent side walls when the clip is in a locked position.
- 10 16. The bracket according to one of claims 12 to 15, wherein protrusions have ends that bend inward toward the adjacent side walls and engage a rear surface of the flanges on the adjacent side walls when the clip is in a locked position.
17. The bracket according to one of claims 1 to 16, wherein the clip is made of a Ni-Ti alloy.
- 15 18. The bracket according to one of claims 1 to 17, wherein the clip is coated with a material selection from the group consisting of Au/Rh, Pt/Rh and Pd/Rh, with Rh being an outermost layer.
- 20 19. The bracket according to one of claims 1 to 18, wherein the bracket element and base are formed of ceramic.
20. The bracket according to one of claims 1 to 19, further comprising an aperture in the clip for receiving a tool to slide the clip between an open and a closed position.





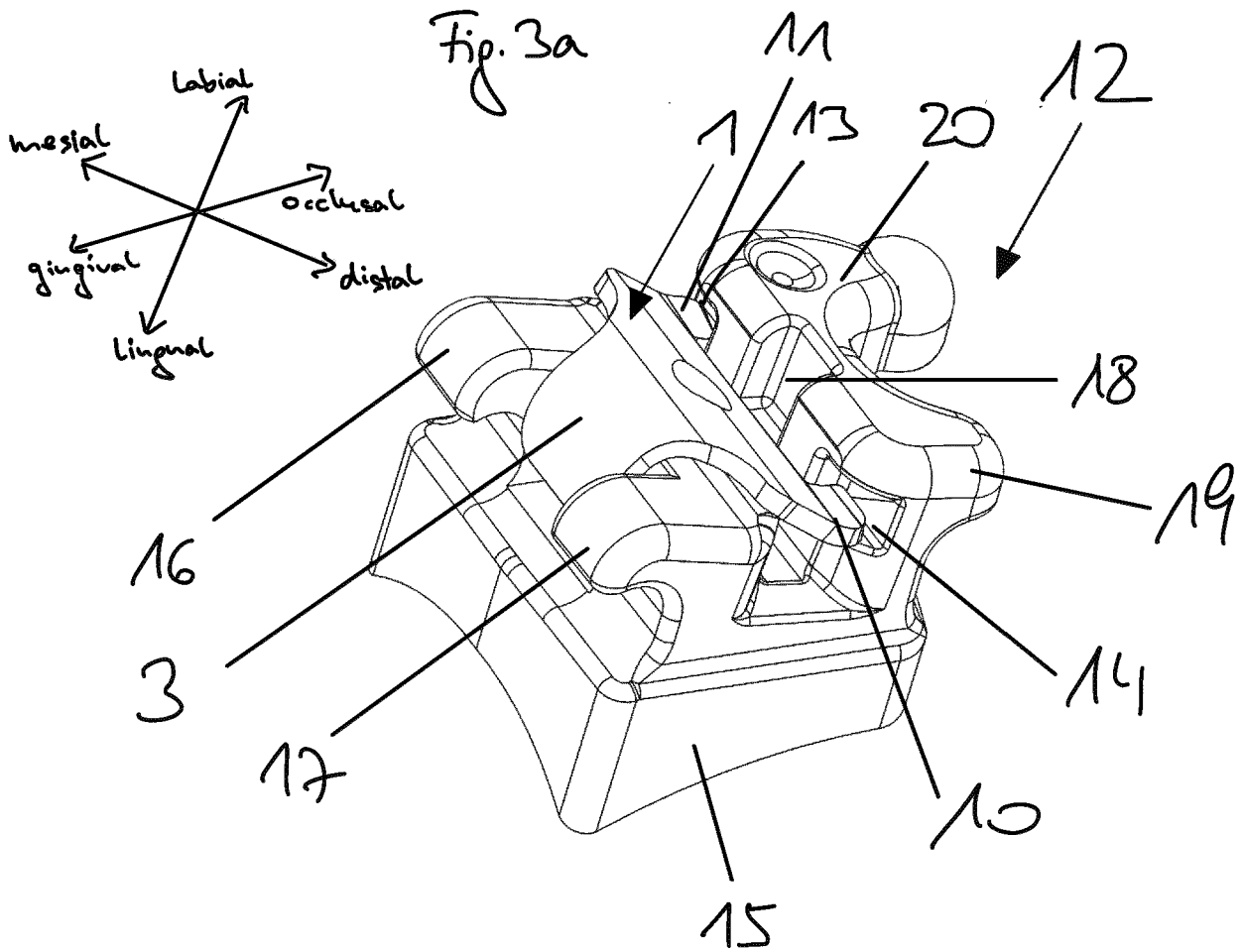


Fig. 3b

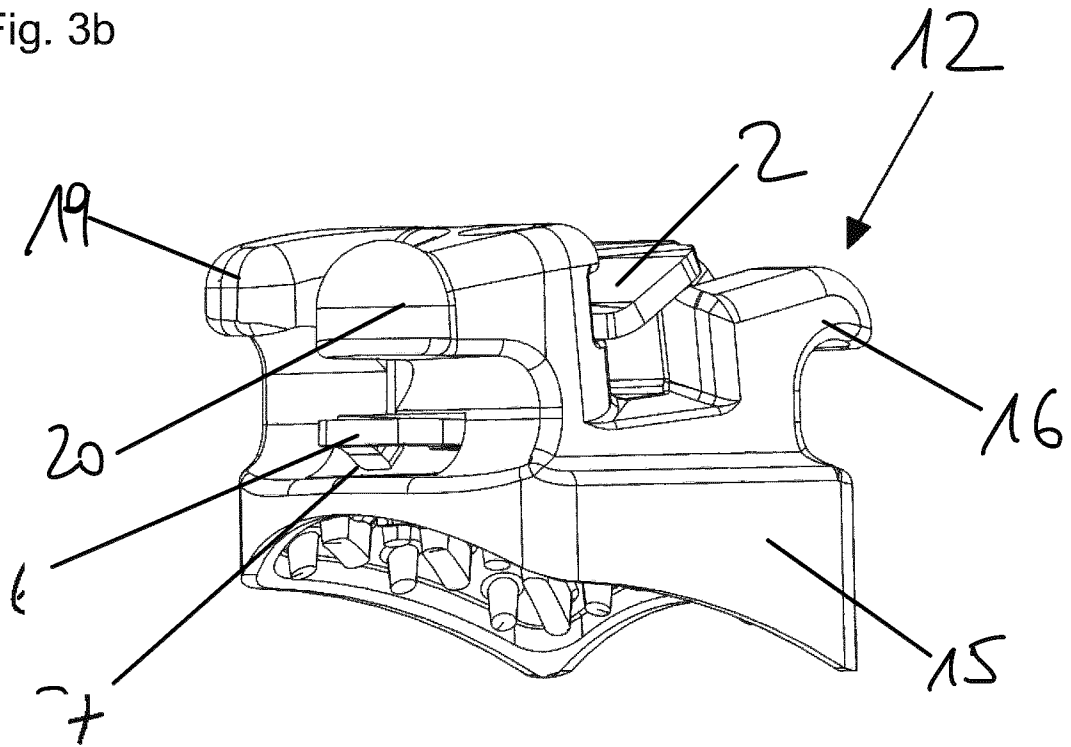


Fig. 4a

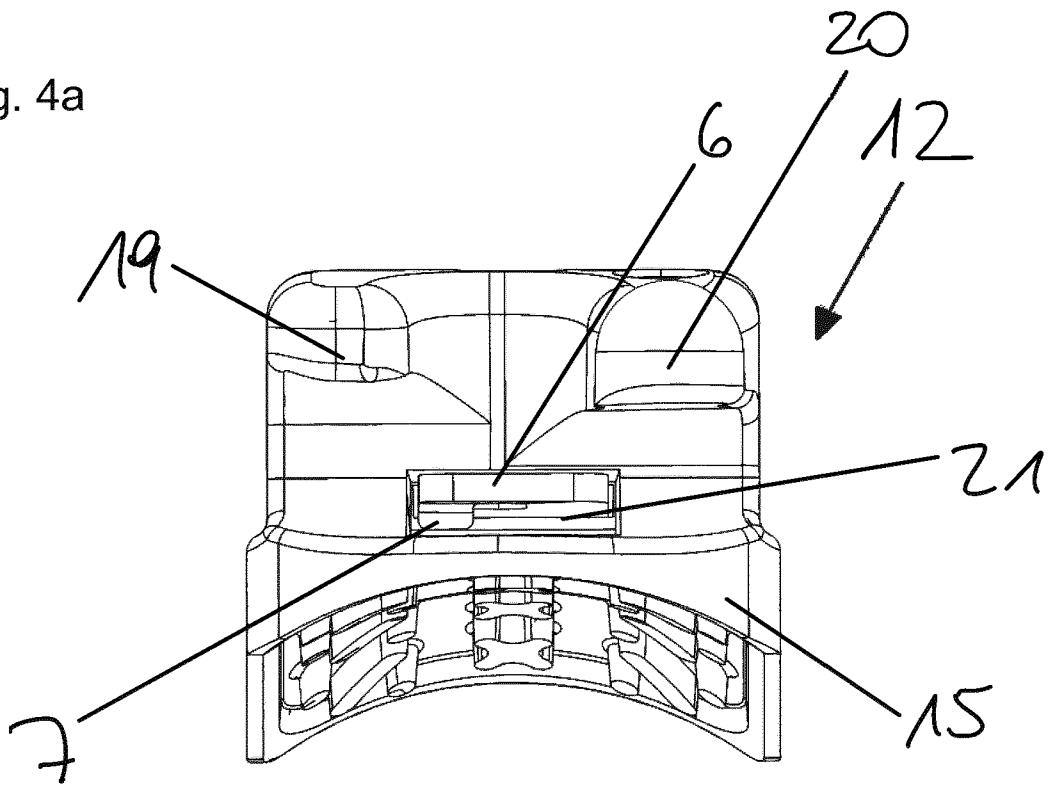


Fig. 4b

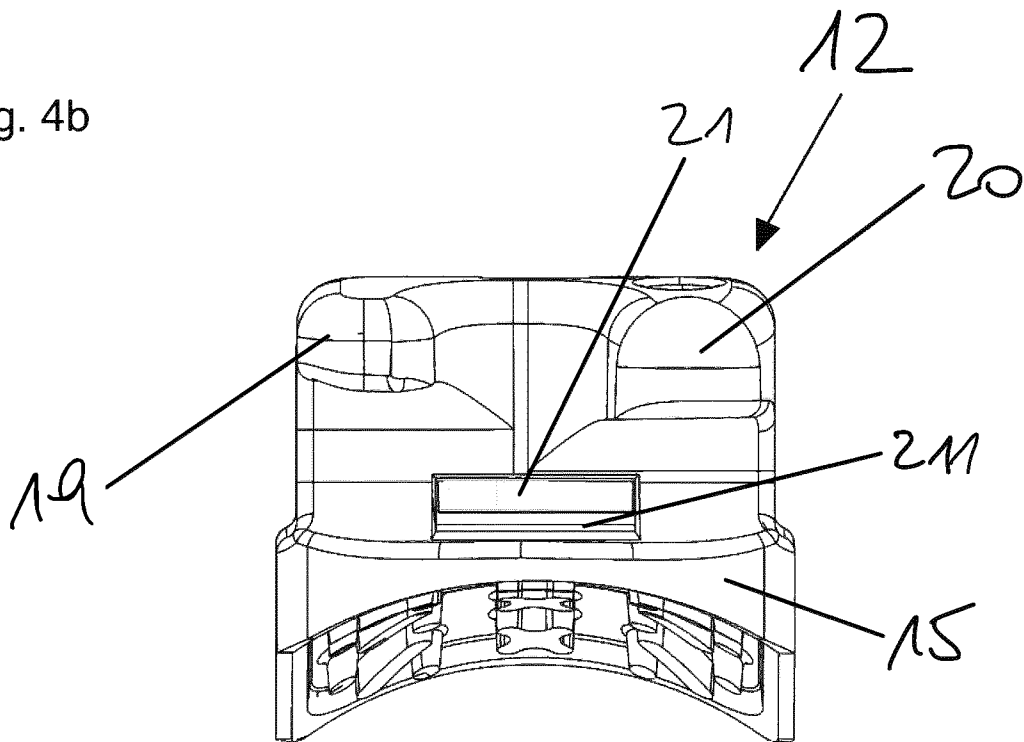


Fig. 5

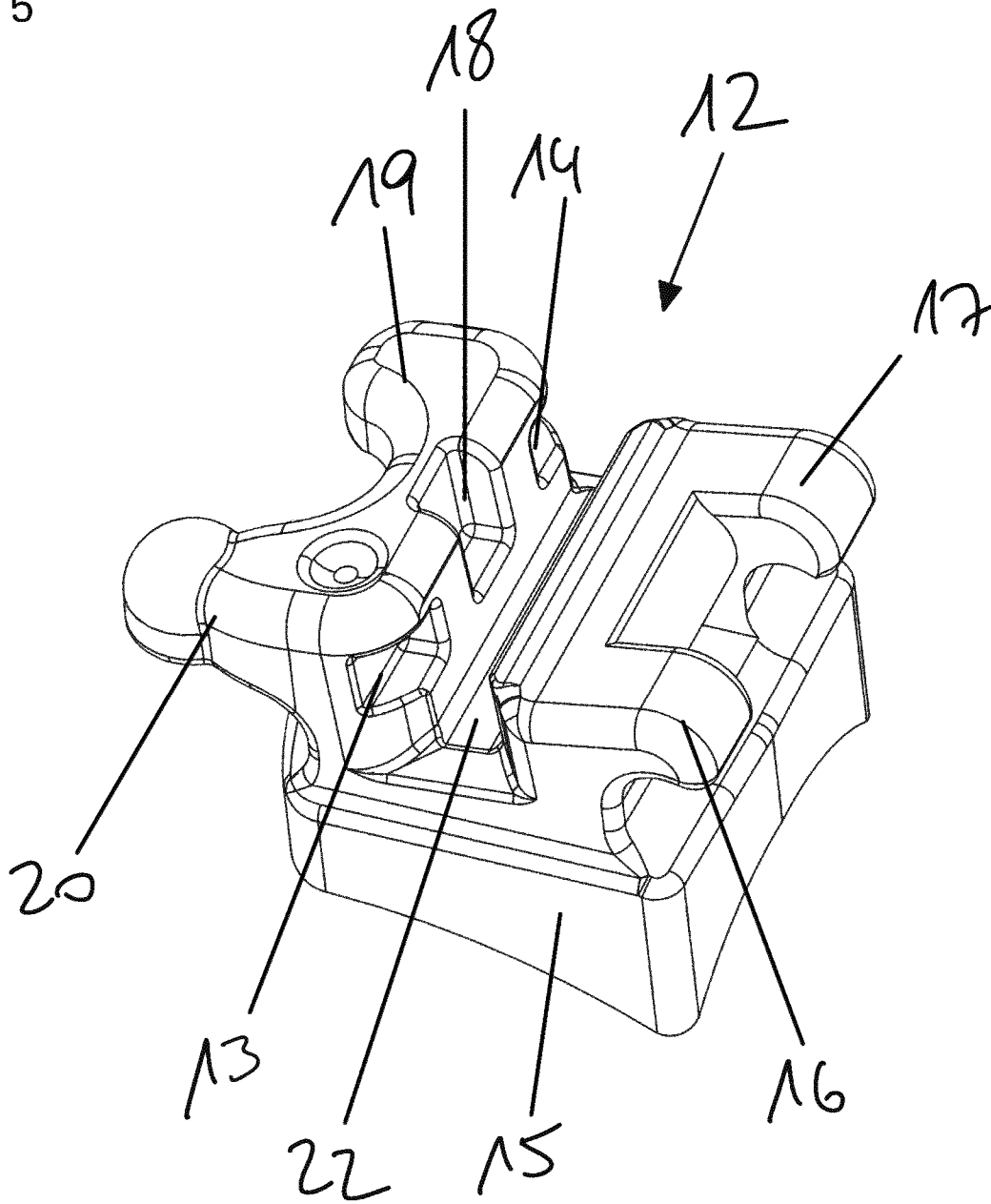


Fig. 6

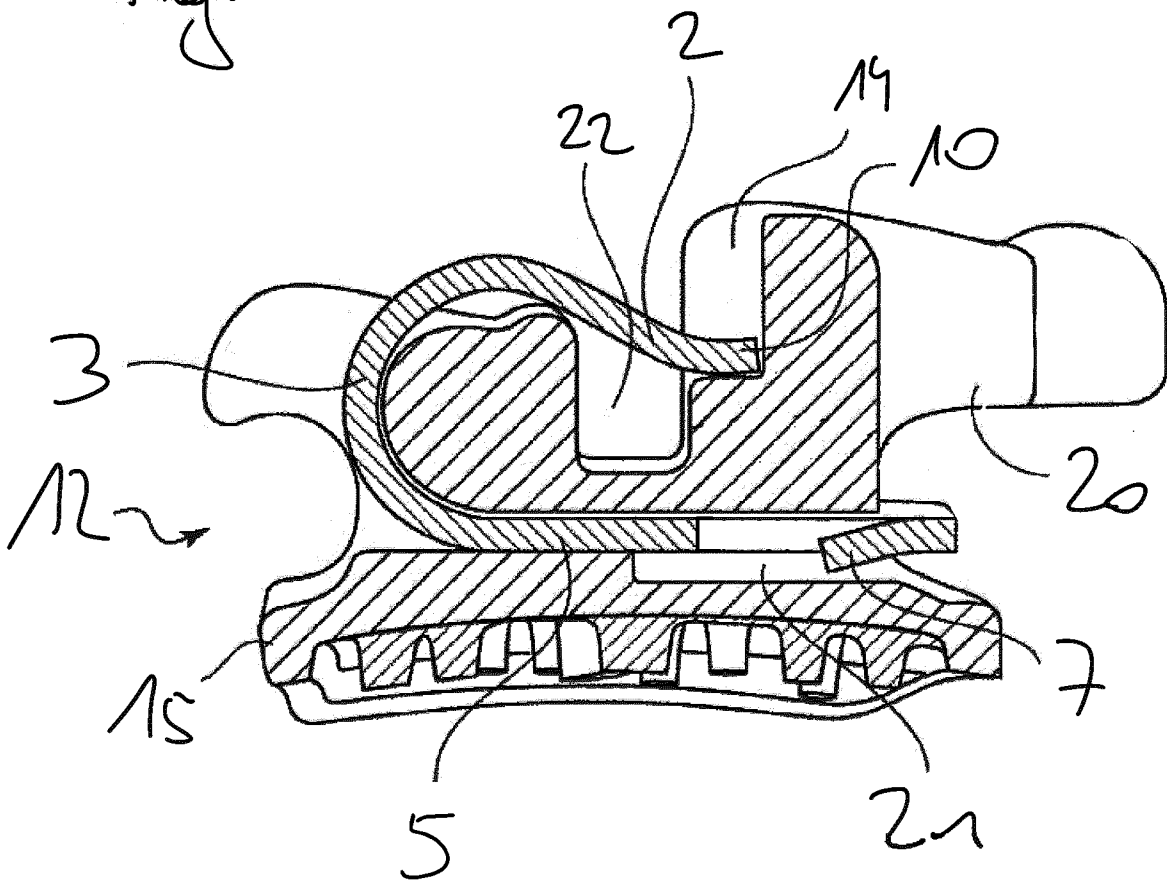
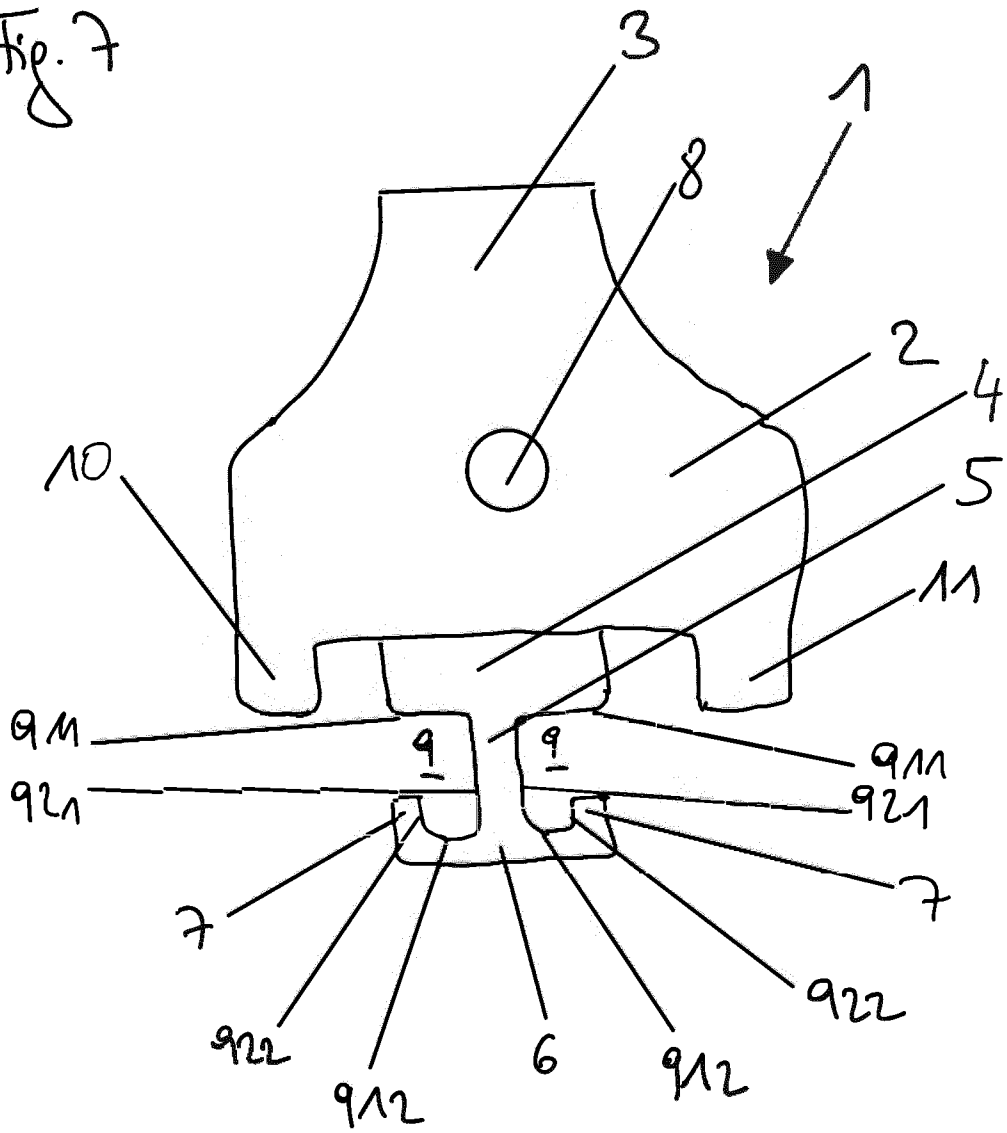


Fig. 7



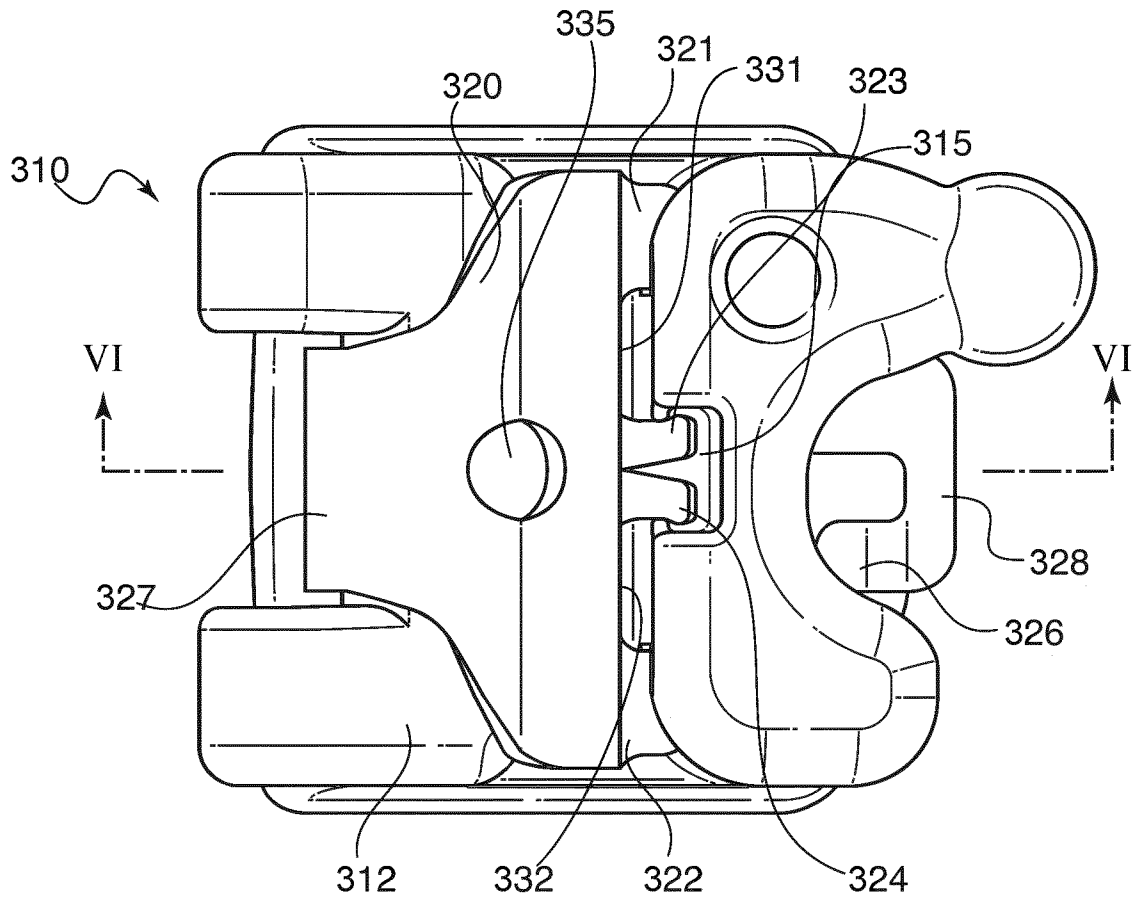


FIG. 8

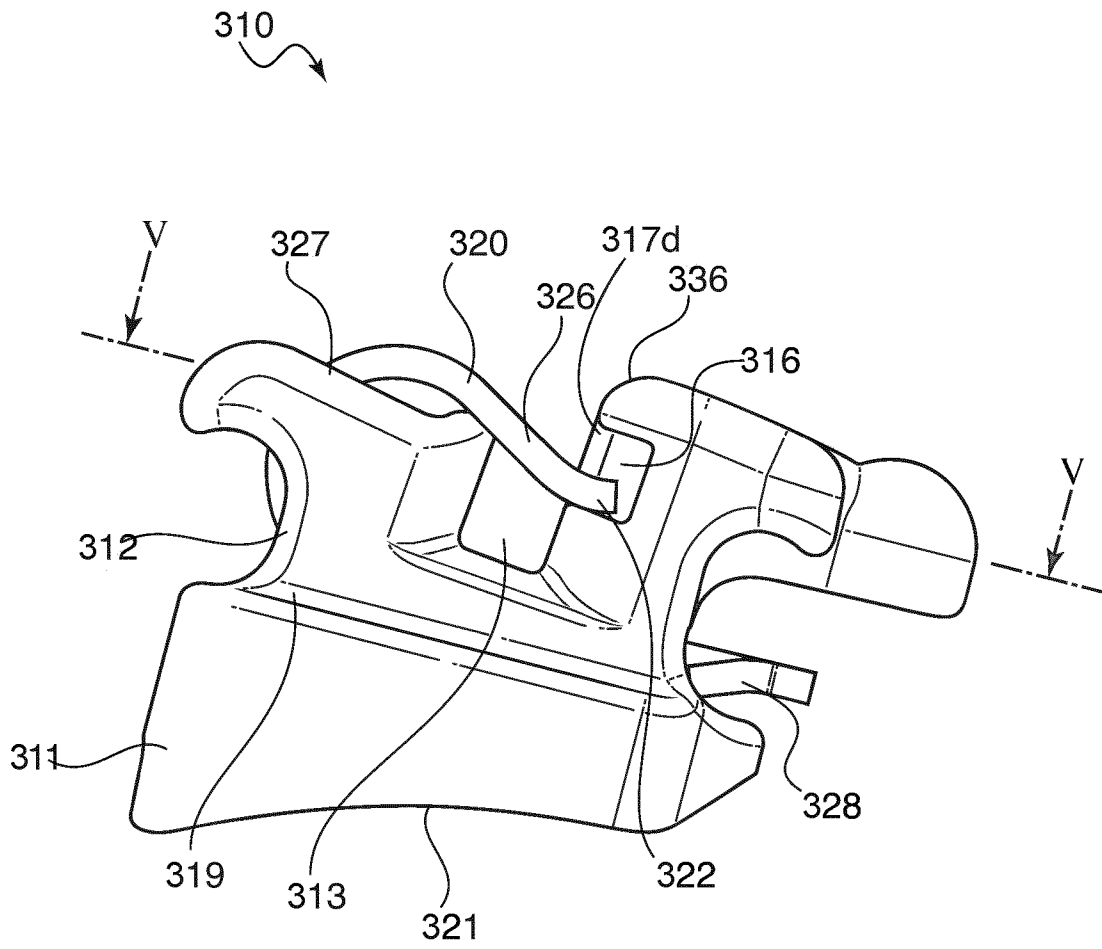


FIG. 9

FIG. 10

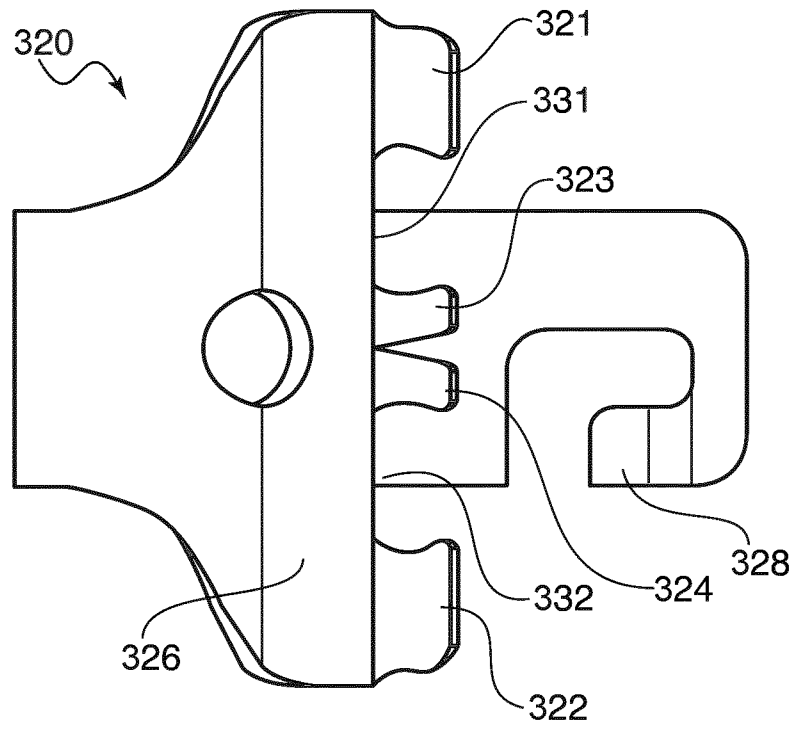
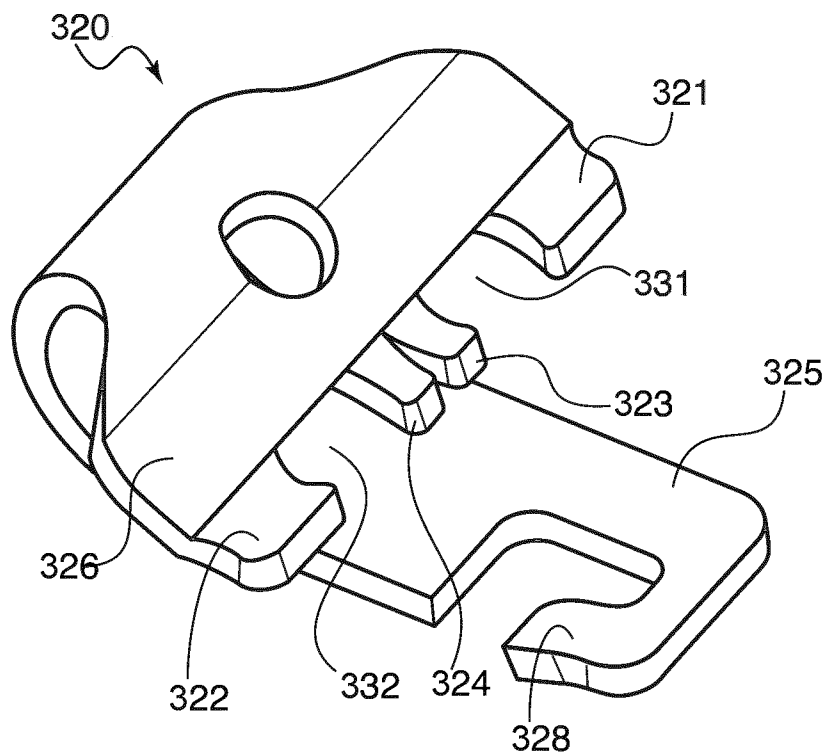


FIG. 11



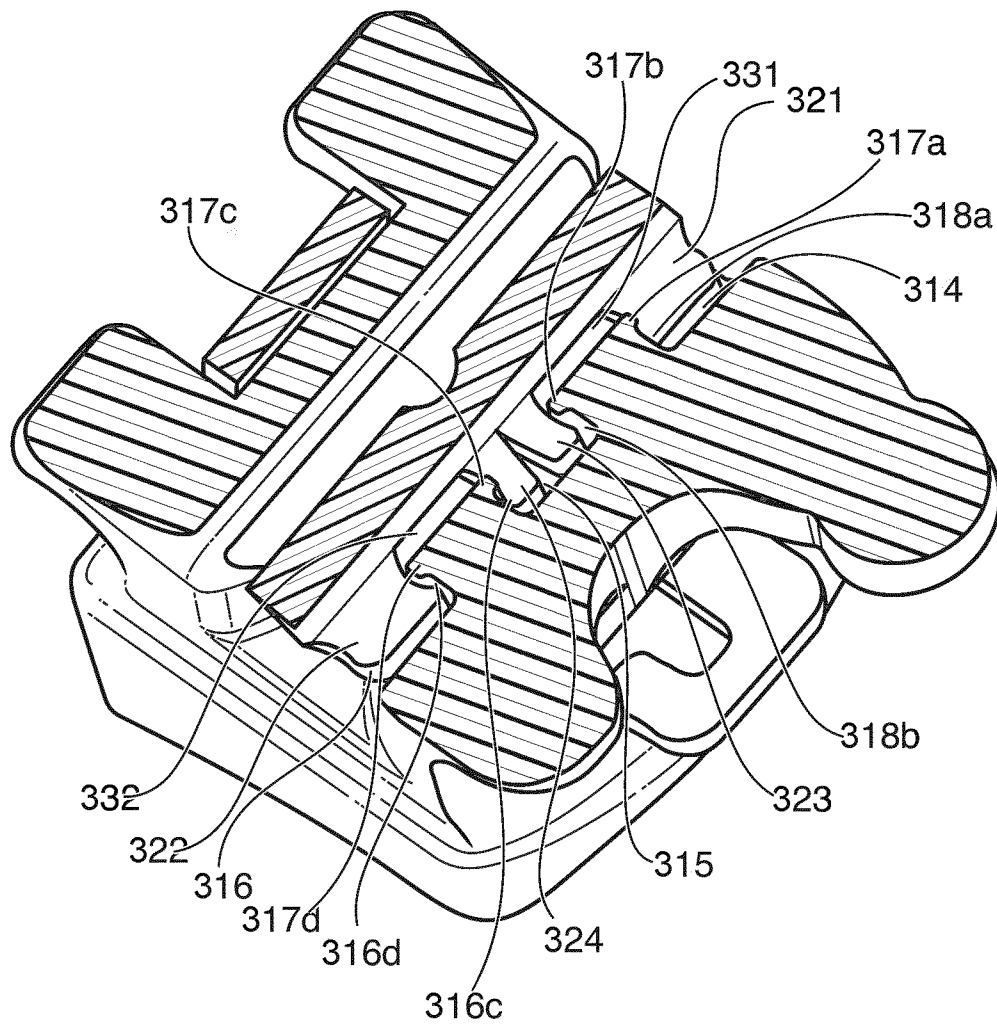


FIG. 12

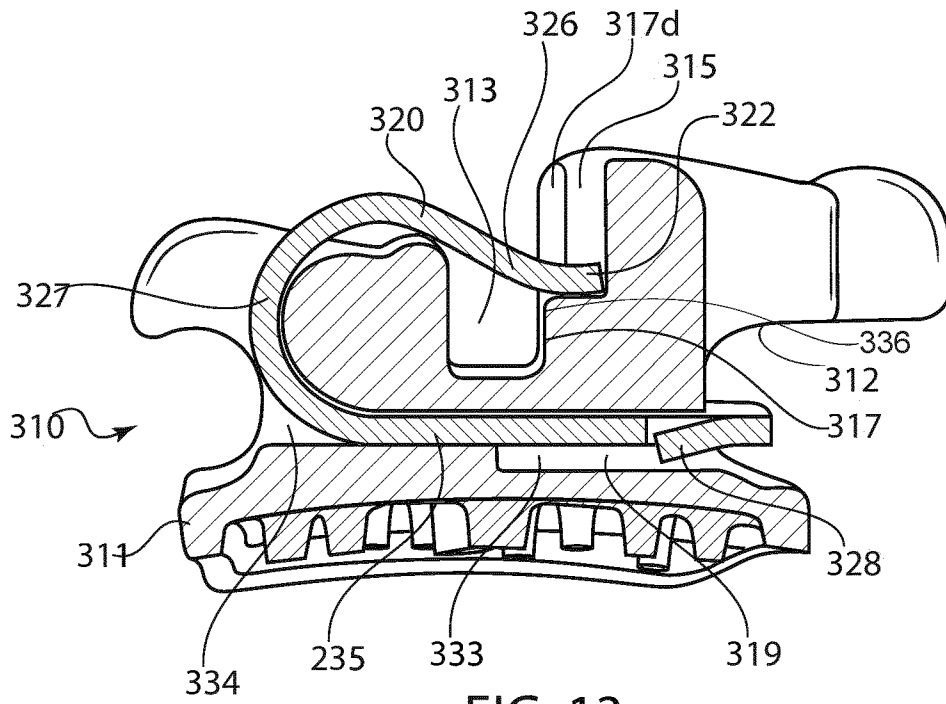


FIG. 13

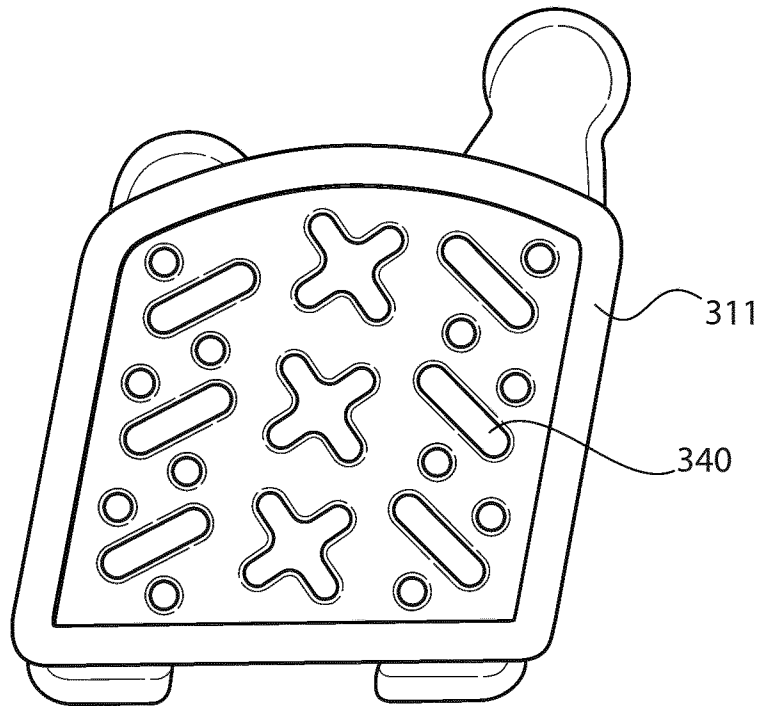


FIG. 14

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/EP2021/054521

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. A61C7/30      A61C7/28      A61C7/12      A61C7/14  
 ADD.

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)  
 A61C

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

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3 419 553 B1 (PBD PATENT&BUSINESS DEV AG [CH]) 20 November 2019 (2019-11-20) cited in the application the whole document -----	1-20

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

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>
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Date of the actual completion of the international search  1 June 2021	Date of mailing of the international search report  14/06/2021
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2021/054521

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 3419553	B1	20-11-2019	EP 3419553 A1	02-01-2019
			US 2017245963 A1	31-08-2017
			WO 2017144629 A1	31-08-2017
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