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(54) Benevnelse **SURGICAL INSTRUMENT**

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Description

The present invention relates to a surgical instrument for use in dental surgery.

Surgically active dentists, oral surgeons, and jaw surgeons are frequently faced with the challenge that bone has been lost in the oral cavity due to bone atrophy, due to accidents, due to periodontitis, or due to tooth extraction.

When dental implants are planned to insert new teeth, it is thus important that these bone deficits are built up before or simultaneously with the implant setting, so that the dental implants again have a new foundation and a stable support in the bone.

Autologous, patient-intrinsic bone is still considered to be the gold standard in bone-construction interventions. This is because of the properties of the bone, since autologous bone unifies osteogenic, osteoinductive, and also osteoconductive properties with one another. This means the bone has the power of forming intrinsic bone tissue, forming tissues, and moreover acts as a guide structure for newly formed bone. In contrast to autologous bone, bone replacement material has no biological power and only acts osteoconductively i.e., it also acts as a guide rail.

Various methods are previously known when working with autologous bone. In the event of larger bone deficits, in principle toothless bone areas are advisable as the second intraoral removal point, alternatively the maxillary tuberosity, the anterior nasal spine, the gums, the region of the maxillary sinus wall in the maxilla or the mandible, since this is more of a cortical nature and the bone quality is considered very good and stable. There are various bone removal points in the mandible, thus, for example again toothless areas, the chin or the retromolar region.

The bone removal can be performed in this case using various instruments. The concept of the bone removal is usually similar here. Three to four intended breakpoints are provided either using a so-called Lindemann bone cutter or using a piezoelectric surgery device or using a small saw and the block is then broken out using a chisel or another instrument. It is disadvantageous in this case that during

a bone removal, more or less application of force to the jaw is necessary. Therefore, the physician sometimes is reluctant to perform this intervention, also for the reason that this hammering or breaking out of the bone block from the respective region is also unpleasant for the patient.

Dentists are familiar with rotating instruments and drills because of their profession. The so-called trephine drill has thus also become established, which is plugged onto a handpiece and has a head which is formed as a hollow cylinder. Teeth for the cutting processing of the bone are formed on the distal edge of the head. Trephine drills are used, for example, for implant bed preparation and have a diameter of approximately 3 mm to 4 mm. Extremely small and narrow drilled cylinders are removed with the aid of these drills, which only have limited suitability for bone construction.

In the above-mentioned devices, approximately three to four cuts or intended breakpoints have to be applied for the bone removal in order to obtain the required piece of bone. This causes significant stress to the patient and requires great manual skill by the operator. In particular, it is to be ensured in this case that the surrounding soft tissue, for example cheek or lip, is not injured by the surgical tool.

Further designs of trephine drills are described in the documents WO 2008/088105 A1, WO 2011/026164 A1, and EP 0 083 558 A1. The document US 2008/0249553 A1 relates to a device for removing a myoma on a uterus.

The invention is therefore based on the object of designing and refining a surgical instrument in such a way that a reliable bone removal which is gentle for the patient is possible using constructively simple means.

The preceding object is achieved according to the invention by the features of Claim 1. Accordingly, a surgical instrument is specified for use in dental surgery, having a processing device and a protection device wherein the processing device has a shaft having a connection region and a hollow-cylindrical head, wherein at a distal edge of the head an active region for cutting or grinding processing of bones

is constructed, wherein the protection device surrounds the head at least in regions, wherein the protection device around the head in such a manner that only a circular arc of the distal edge acts as an active region and wherein the protection device is rotatably coupled to a bearing element of the processing device, which bearing element extends inside the head at least in regions.

It has been recognized according to the invention that the underlying object can be achieved by the combination of a processing device, in particular a trephine drill, and a protection device in a surprisingly simple manner. For this purpose, the processing device has a shaft having a connection region and a hollow-cylindrical head. The connection region can be used for the connection to a surgical handheld device, for example a routine angled piece or handpiece, as is used by dentists or dental surgeons. Furthermore, the distal edge of the head is formed as an active region, in particular for the cutting processing of bones. For example, the distal edge can have cutting teeth or saw teeth and/or a diamond coating.

It has furthermore been recognized according to the invention that the protection device can be rotatably coupled in a particularly safe and simple manner to the head or the processing device in that the processing device has a bearing element which extends inside the head at least in regions. It is thus possible that bone is processed at the removal point using the distal edge of the processing device rotated by a medical handheld device, while the protection device remains essentially stationary, namely due to the rotatable connection between protection device and processing device. The surrounding tissue is thus protected in an ideal manner from injuries.

It is specifically conceivable here that the bearing element extends in the axial direction, in particular from the base of the head, at least as far as the distal edge of the head. The protection device can be coupled to the free end of the bearing element. The bearing element does not necessarily have to extend up to the distal edge in the axial direction if the protection device projects correspondingly far into the head in order to be rotatably coupled to the bearing element. In a further advantageous manner, the bearing element extends in the axial direction over the distal edge of the head, so that the connection between protection device and

processing device is implemented outside the head. Specifically, it is conceivable here that the bearing element is constructed in a journal-like manner and engages in a corresponding region of the protection device.

In a manner according to the invention, the protection device surrounds the head in such a way that only a circular arc of the distal edge is used as an active region. Contrary to a prejudice of the technical world, it has been recognized here that a processing device having a head formed as a hollow cylinder, which has an active region for cutting processing of bone, is not only suitable for removing small drilled cylinders. Rather, a correspondingly designed processing device may also be used to “peel out” the required bone piece or bone segment from the bone. Due to the special arrangement and design of the protection device, only a circular arc of the distal edge of the head can be brought into contact with the bone and is thus used as the effective active region. Due to this design measure, it is possible for the operator to “peel off” an approximately crescent-shaped bone piece from the bone, which is usable for the bone construction. In contrast to the instruments or tools known from the prior art, three to four cuts or intended breakpoints do not have to be applied. Rather, only one single intended breakpoint – for example apical – results, hammering out the bone is not necessary. The resulting block can then be detached or luxated without great application of force, which is much more gentle and pleasant to the patient in comparison to the known devices and techniques. The protection device advantageously surrounds the head in such a way that a circular segment formed by the circular arc has a segment height of 2.0 mm to 3.5 mm, preferably of 2.2 mm to 2.5 mm.

In particular, it is conceivable that the head has an internal diameter of 5 mm to 10 mm, preferably of 6 mm to 8 mm, and/or a wall thickness of 0.2 mm to 0.6 mm, preferably of 0.4 mm. Alternatively or additionally, the head can have a depth of 6 mm to 17 mm, in particular of 9 mm to 14 mm, and/or the bearing element can have a length of 10 to 19 mm, in particular of 12 to 17 mm. Particularly advantageously, the bearing element can extend 2 to 4 mm, in particular 3 mm, beyond the distal edge of the head viewed in the axial direction.

To use the distal end of the protection device to displace the surrounding tissue at the removal point, the protection device can preferably be constructed to be completely, or at least substantially, closed at the distal end thereof. A particular combinatorial effect is achieved here with the design of the bearing element, which specifically stabilizes the protection device when the external tissue exerts a pressure, in particular in the axial direction, on the distal end of the protection device.

To establish a secure connection between the protection device and the processing device, the protection device can be rotatably coupled at the proximal end thereof to the shaft. Specifically, it is conceivable here that the protection device surrounds the shaft in the circumferential direction.

The protection device can advantageously be rotatably coupled to the bearing element and/or the shaft by means of a plain bearing and/or a ball bearing and/or a roller bearing. A plain bearing is advantageous here in particular, since it is distinguished by an extremely simple and thus inexpensive construction. The plain bearing does not have to be formed in this case as a separate element, rather the corresponding region of the protection device or the processing device can represent the plain bearing.

To prevent the processed tissue from being damaged due to overheating, at least one fluid opening, for example having a diameter of approximately 0.5 mm to 0.9 mm, preferably 0.7 mm, can be constructed on the bearing element, which is connected to a fluid channel, for example having a diameter of approximately 0.6 mm to 1.0 mm, preferably 0.8 mm. The fluid channel can extend from the connection region through the shaft and the bearing element to the at least one fluid opening. A coolant liquid can thus be introduced, for example from the surgical handpiece, to which the surgical instrument is connected via the connection region. Since the bearing element is arranged inside the hollow-cylindrical head, coolant liquid can be applied ideally to the hollow-cylindrical head and in particular the distal edge.

In a further advantageous manner, the protection device can be produced from plastics material or metal. Plastics material has the advantage that the protection device is producible particularly easily and thus inexpensively. Furthermore, a plain bearing for connecting the protection device to the bearing element and/or the shaft can be produced in a particularly simple manner if the protection device is manufactured from plastics material. The implementation of the protection device from metal offers the advantage that the protection device can be prepared again – for example in an autoclave – so that multiple uses are possible.

To enable a good view of the removal point for the operator, the protection device can ideally be constructed in a transparent manner – for example from a transparent plastics material. Alternatively or additionally, a depth marking can be constructed on the outer wall of the head, so that the operator can infer in a simple manner how deep the head is introduced into the bone to be processed. For example, a strip, in particular a black strip, can preferably be constructed as a laser marking on the outer wall at regular intervals for this purpose. The depth marking can be constructed in particular in steps of 1 mm to 3 mm, preferably 2 mm.

In a particularly refined manner, at least one opening can be constructed in the side wall of the head, through which the operator can push the removed bone piece – for example using tweezers – out of the head. The opening can be constructed to be oval, for example, wherein the longest axis can be in particular 3 mm to 5 mm, preferably 4 mm.

In a further advantageous manner, a safety element can be constructed on the shaft from a material, in particular from a plastics material, the shape and/or color of which changes upon a preparation of the instrument, for example upon autoclaving. The safety element can particularly advantageously be arranged in or on the connection region and can change upon a preparation of the instrument in such a way that the instrument can no longer be coupled to a medical handheld device.

There are now various possibilities for advantageously designing and refining the teaching of the present invention. In this regard, reference is made, on the one hand,

to the claims dependent on Claim 1 and, on the other hand, to the following explanation of a preferred exemplary embodiment of the invention on the basis of the drawing. In conjunction with the explanation of the preferred exemplary embodiment of the invention on the basis of the drawing, generally preferred designs and refinements of the teaching are also explained. In the figures

Figure 1 shows a schematic perspective illustration of an exemplary embodiment of a surgical instrument according to the invention,

Figure 2 shows a schematic side view of the surgical instrument according to the invention from Figure 1,

Figure 3 shows a further schematic perspective view of the surgical instrument according to the invention from Figure 1,

Figure 4 shows a schematic sectional view of the surgical instrument according to the invention from Figure 1,

Figure 5 shows a further schematic sectional view of the surgical instrument according to the invention from Figure 1,

Figure 6 shows a schematic view in partial section of the surgical instrument according to the invention from Figure 1,

Figure 7 shows a further schematic view in partial section of the surgical instrument according to the invention from Figure 1,

Figure 8 shows a further schematic view in partial section of the surgical instrument according to the invention from Figure 1,

Figure 9 shows a schematic perspective exploded view of the surgical instrument according to the invention from Figure 1, and

Figure 10 shows a further schematic perspective exploded view of the surgical instrument according to the invention from Figure 1.

Figures 1 to 10 show various views of an exemplary embodiment of a surgical instrument according to the invention. The surgical instrument comprises a processing device 1, which is constructed in the exemplary embodiment shown here as a hollow drill or trephine drill. The processing device 1 comprises a shaft 2, which has a connection region 3 for coupling to a surgical handheld device (not shown), for example an angled piece or handpiece of a dentist or dental surgeon. The processing device 1 can be set into rotation via the handheld device.

A hollow-cylindrical head 4 is arranged on the shaft 2. The head 4 has a distal edge 5, which is used as an active region 6 for processing or detaching the bone. For example, a diamond coating and/or saw teeth or cutting teeth can be constructed on the distal edge 5.

A bearing element 7, which is constructed as a bearing journal, extends inside the head 4. In the exemplary embodiment shown here, the bearing element 7 extends from the base 9 of the head 4 in the axial direction through the entire head 4 over the distal edge 5. Specifically, the bearing element 7 is constructed as an extension of the shaft 2.

Furthermore, a protection device 8 is rotatably coupled to the processing device 1. The base 10 of the protection device surrounds the shaft 2 and is rotatably coupled to both the shaft 4 and also the base 9 of the head 4, and specifically the bearing element 7 can be arranged in a recess of the distal end 11. Furthermore, the distal end 11 of the protection device 8 is constructed to be closed and the protection device 8 is rotatably coupled via the distal end 11 to the bearing element 7. It is to be noted at this point that the coupling between protection device 8 and processing device 1 can also be produced via a separate bearing. It is solely essential that the bone can be processed or detached using the rotating head 4 of the processing device 1 while the protection device 8 essentially does not rotate and protects the surrounding tissue.

In particular, it is clear from Figure 1 that the protection device 8 encloses the processing device 1 in such a way that only a circular arc of the distal edge 5 is used as the active region 6 or can be brought into contact with the bone to be processed. Penetration excessively deep into the bone is prevented by this measure, and surrounding tissue is also protected. Furthermore, it is made possible for the operator to peel out an approximately crescent-shaped bone piece from the jaw. Due to the coupling of the distal end 11 of the protection device 8 to the bearing element 7, the distal end 11 can be used as a displacer element, using which the surrounding tissue can be pushed away during the intervention. In particular, it can

be seen clearly in Figure 5 that a bevel 17 is formed at the distal end 11. The removal of the bone segment from the head 4 is simplified by the bevel 17. In order that the distal end 11 is formed solidly enough in the region of the bevel 17, the diameter of the bearing element 7 decreases at its end. Furthermore, it is to be noted that the corner region 18 of the distal end 11 can be formed rounded to prevent jamming of the protection device 8.

To remove the circular-segment-shaped bone piece from the head 4, openings 12 are formed in the side wall 13 of the head 4. The operator can thus push the detached bone piece through the opening 12 – for example using tweezers or a similar tool – out of the head 4. It is clear from Figure 5 that the opening 12' extends up to the base 9 of the head, so that the removed bone segment can be pushed in a particularly simple manner using a separate instrument out of the head 4. To simplify this once again, the edge 19 of the cylinder element 16 essentially terminates in the axial direction with the base 9 of the head 4.

To cool the engagement point, a fluid channel 14 is constructed which extends from the connection region 3 through the shaft 4 and the bearing element 7. In particular, it can be seen clearly from Figure 5 that two fluid openings 15 are constructed in the bearing element 7, which are connected to the fluid channel 14, so that coolant liquid can be conveyed from the surgical handpiece via the connection region 3 and the fluid channel 14 to the fluid openings 15. The coolant liquid is sprayed from the fluid openings 15 on the head 4 and/or the removal point behind it.

As can be seen in particular from Figures 9 and 10, the protection device 8 is constructed in two parts in the exemplary embodiment illustrated here, and specifically has a base 10 and a cylinder element 16. The base 10 and the cylinder element 16 can be connected to one another in a formfitting and/or friction-locked or materially-bonded manner, for example, screwed, clamped, adhesively bonded, ultrasonically welded, etc. The base 10 of the protection device 8 can advantageously rest flatly on the base 9 of the head 4 at least in regions.

Reference is made to the general part of the description and to the appended claims with respect to further advantageous designs of the device according to the invention to avoid repetitions.

Finally, it is to be expressly noted that the above-described exemplary embodiments of the device according to the invention serve only to explain the claimed teaching, but do not restrict it to the exemplary embodiments.

List of reference numerals

1	processing device
2	shaft
3	connection region
4	head
5	distal edge (head)
6	active region
7	bearing element
8	protection device
9	base (head)
10	base (protection device)
11	distal end (protection device)
12, 12'	opening (head)
13	side wall
14	fluid channel
15	fluid opening
16	cylinder element
17	bevel
18	corner region
19	edge

Patentkrav

1. Kirurgisk instrument for bruk i tannkirurgien, med en behandlingsinnretning (1) og en beskyttelsesinnretning (8) hvor behandlingsinnretningen (1) har en skaft (2) som har et forbindelsesområde (3) og et hulsylindriskformet hode (4), hvor ved en distal kant (5) av hodet (4) et virkningsområde (6) for sponskjærende eller slipende behandling av ben, er utformet, hvor beskyttelsesinnretningen (8) omgir hodet (4) i det minste i områder, hvor beskyttelsesinnretningen (8) omgir hodet (4) på en slik måte, at bare en sirkelbue av den distale kanten (5) fungerer som et virkningsområde (6) og hvor beskyttelsesinnretningen (8) er roterbart koblet til en lagerelement (7) av behandlingsinnretningen (1), hvor lagerelement (7) strekker seg i det minste i områder innenfor hodet (4).

2. Kirurgisk instrument ifølge krav 1, **karakterisert ved at** lagerelementet (7) strekker seg i en aksiell retning, spesielt fra bunnen (9) av hodet (4), i det minste til den distale kanten (5) av hodet (4).

3. Kirurgisk instrument ifølge krav 1 eller krav 2, **karakterisert ved at** lagerelementet (7) strekker seg i en aksial retning over den distale kanten (5) av hodet (4).

4. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 3, **karakterisert ved at** lagerelementet (7) er utformet på en tappformete måte.

5. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 4, **karakterisert ved at** beskyttelsesinnretningen (8) ved den distale enden (11) er koblet til lagerelementet (7).

6. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 5, **karakterisert ved at** beskyttelsesinnretningen (8) ved den distale enden (11) er utformet for å være lukket.

7. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 6, **karakterisert ved at** beskyttelsesinnretningen (8) ved den proksimale enden er roterbart koblet til skaftet (2).

8. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 7, **karakterisert ved at** beskyttelsesinnretningen (8) ved hjelp av et glidelager (17) og/eller et kulelager og/eller et rullelager er roterbart koblet til lagerelementet (7) og/eller skaftet (2).

9. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 8, **karakterisert ved at** ved lagerelementet (7) i det minste en fluidåpning (15) er utformet, som står i

forbindelse med en fluidkanal (14), hvor fluidkanalen (14) strekker seg fra forbindelsesområdet (3) gjennom skaftet (2) og lagerelementet (7).

10. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 9, **karakterisert ved at** beskyttelsesinnretningen (8) er produsert av plastmateriale eller metall.

11. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 10, **karakterisert ved at** beskyttelsesinnretningen (8) er utformet på en transparent måte.

12. Kirurgisk instrument ifølge et hvilket som helst av kravene 1 til 11, **karakterisert ved at** i sideveggen (13) av hodet (4) i det minste én åpning (12) er utformet.

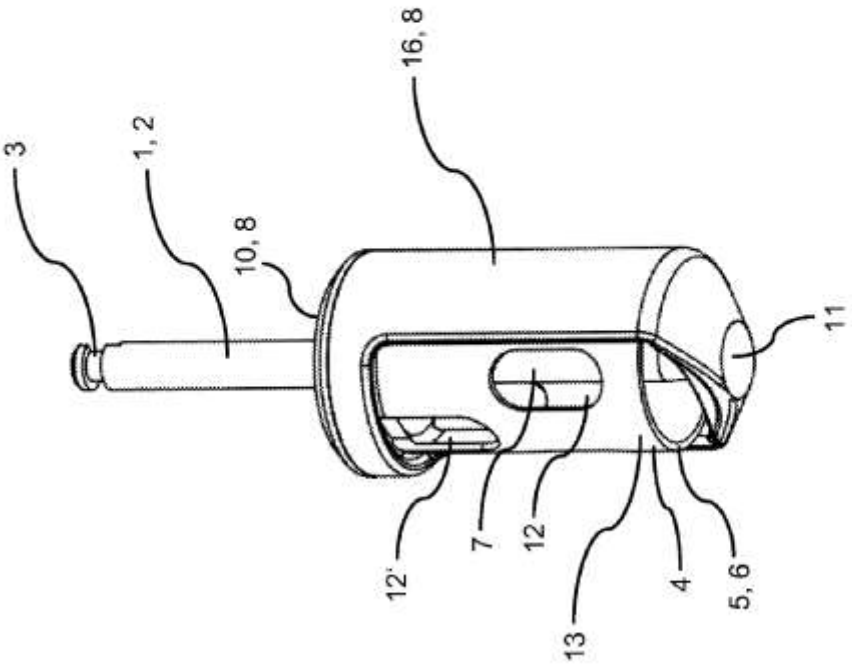

Fig. 1

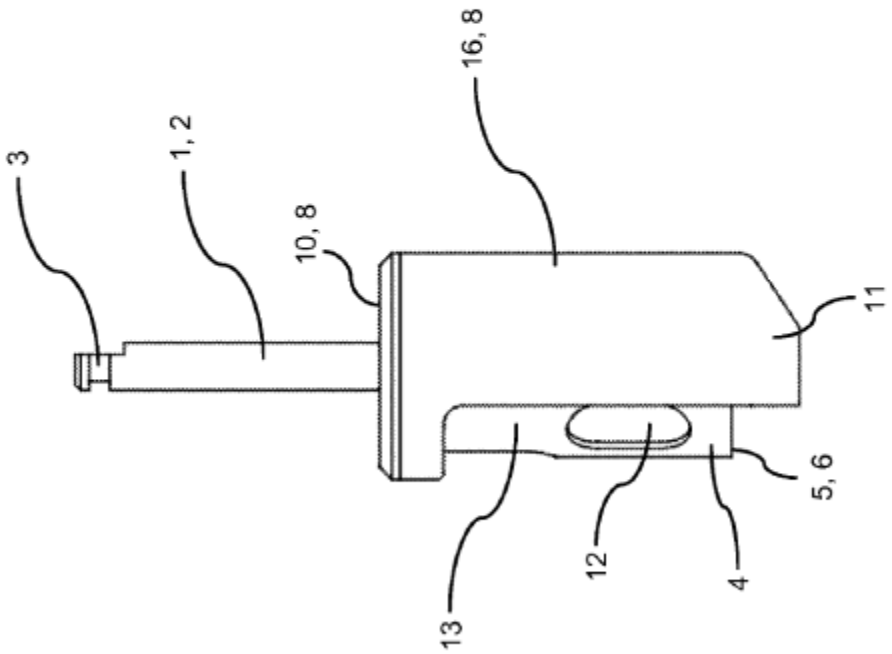

Fig. 2

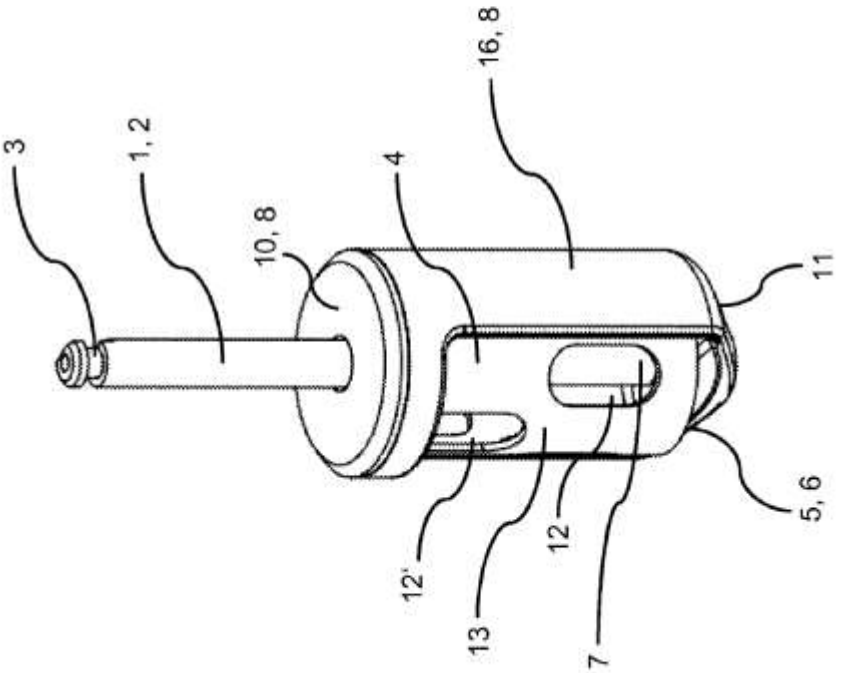

Fig. 3

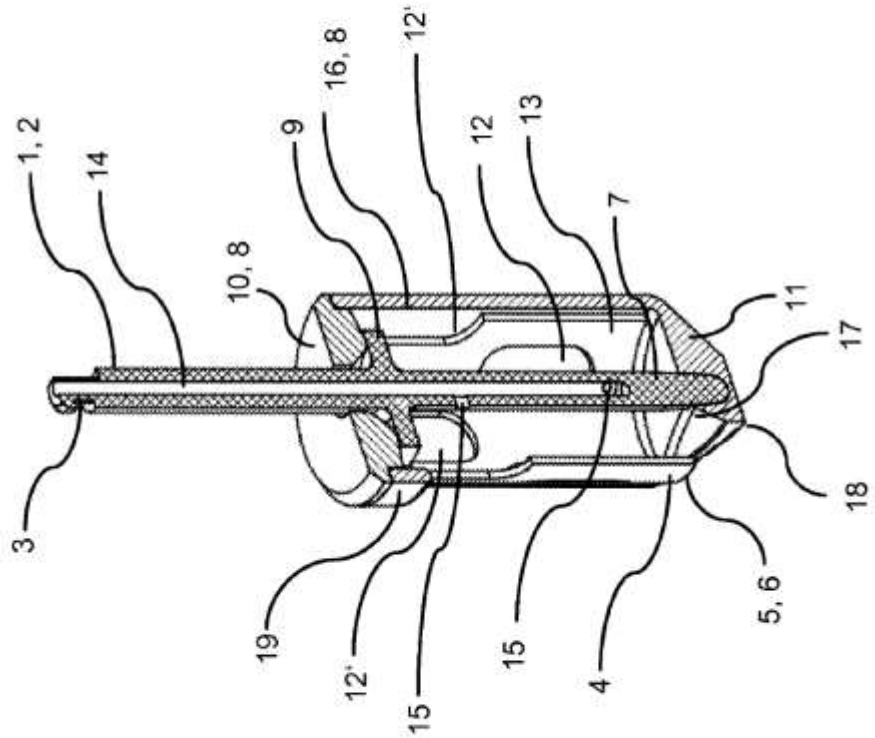

Fig. 4

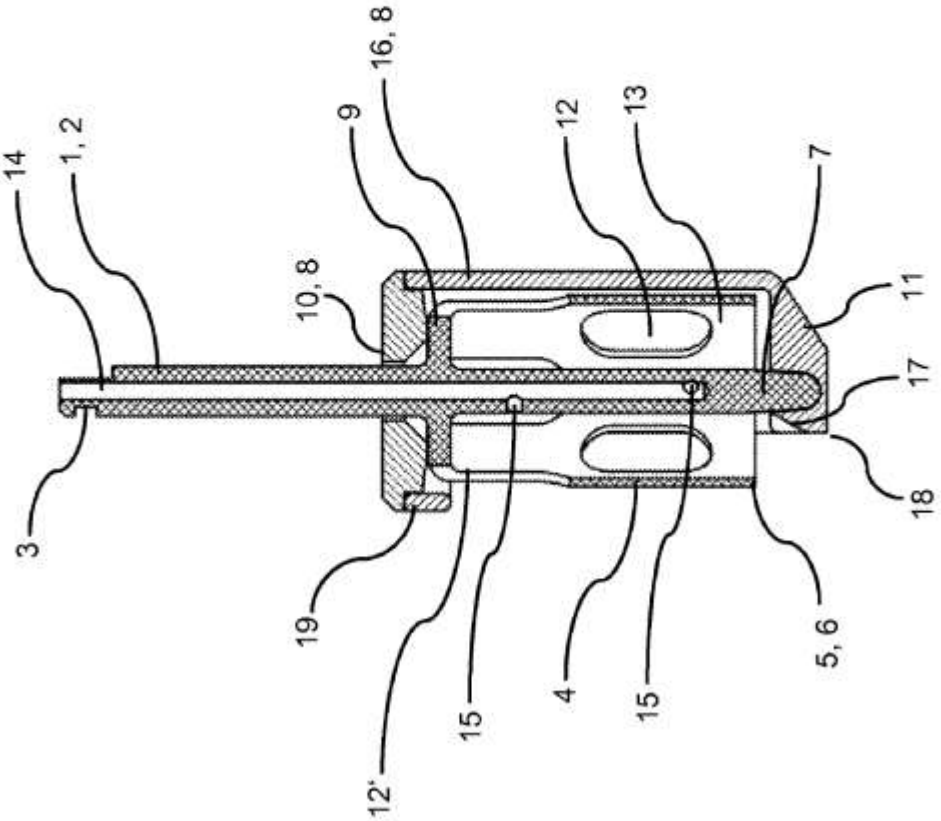

Fig. 5

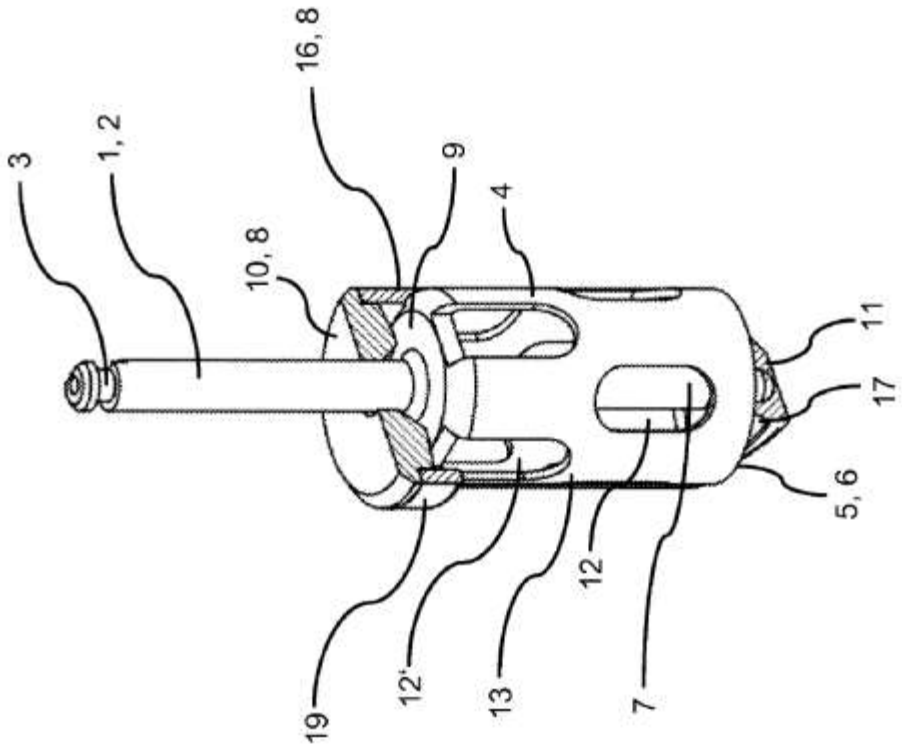

Fig. 6

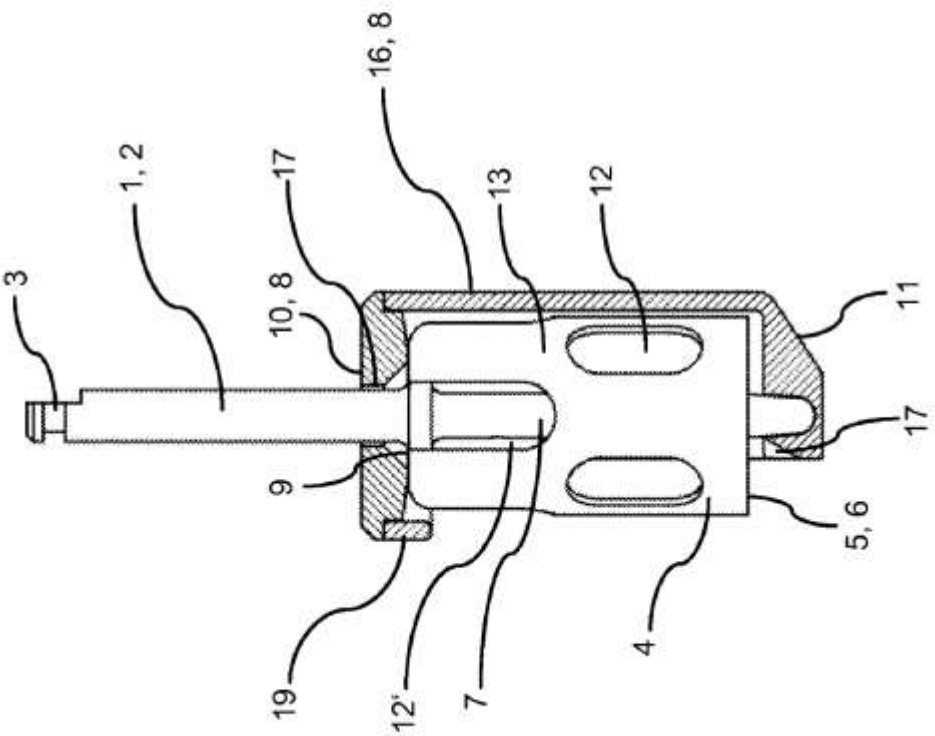

Fig. 7

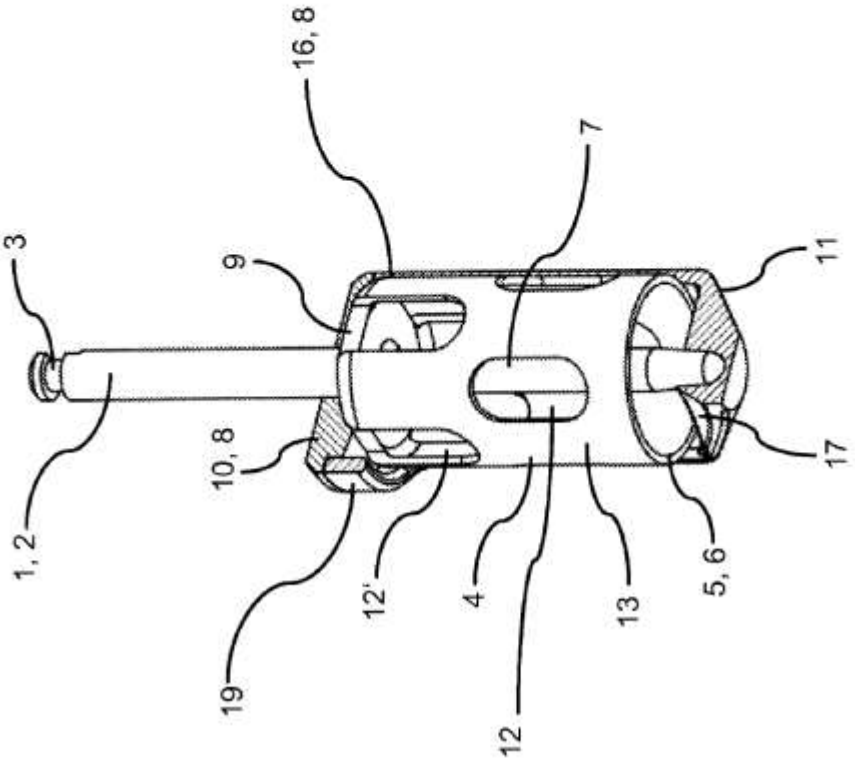

Fig. 8

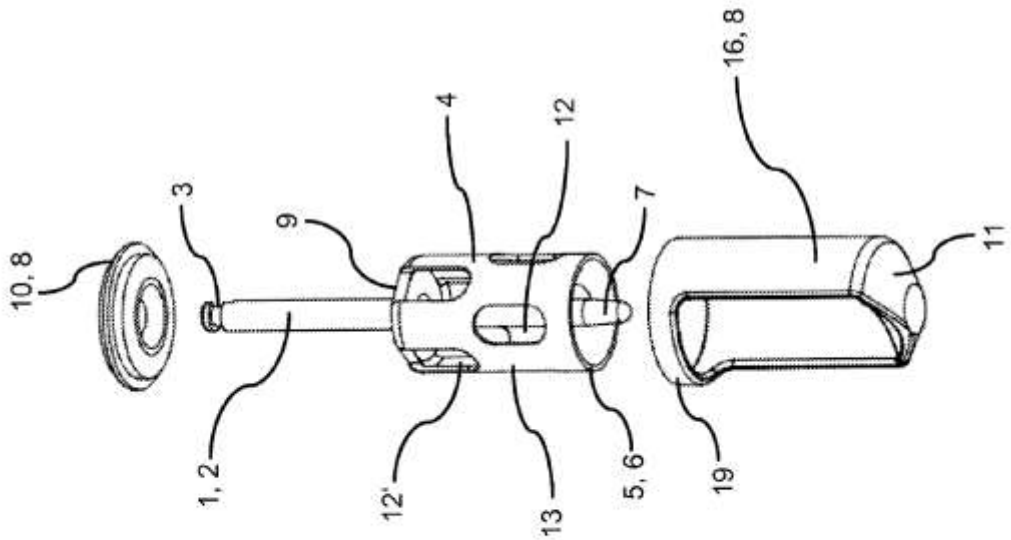

Fig. 9

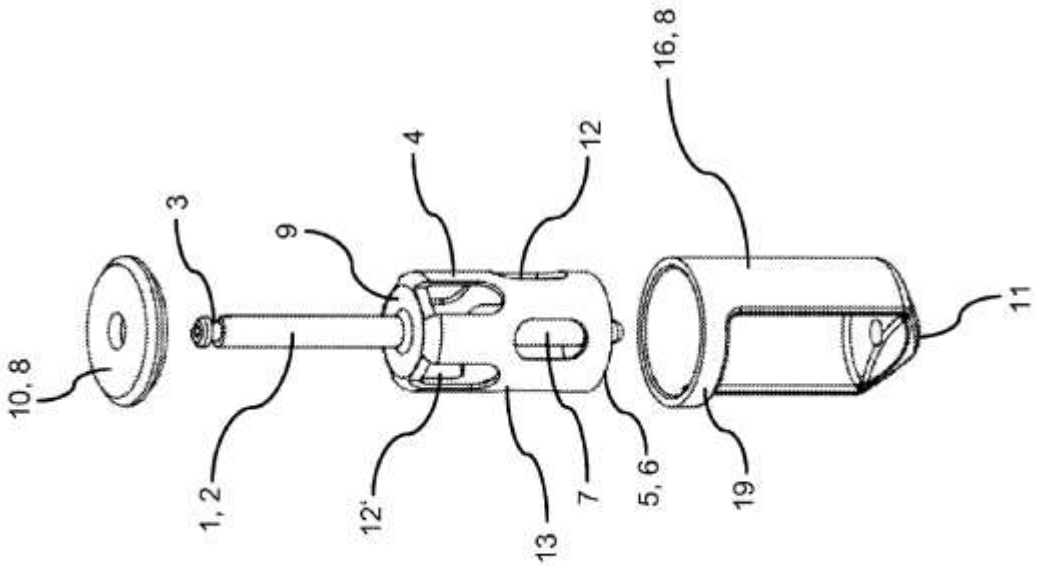

Fig. 10