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Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.



Apparatus for cutting and aspirating tissue

Description

The invention relates to a device for cutting and drawing tissue from the human or animal body, in particular for use in vitrectomy, for retina peeling according to the definition of the subject-matter according to claim 1. The device comprises an outer tube and an inner tube which can be displaced in the outer tube in an alternating, concentric manner with little play, wherein the outer tube is closed at the free end and close to the free end has a lateral opening with at least one inner cutting edge. The inner tube is open at the free end and has at that location an outer cutting edge. The cutting edges cooperate in a cutting manner when the inner tube is displaced.

In principle, a surgical cutting instrument for removing tissue is involved here. With the instrument, the tissue can be cut - on or in the body - and can be drawn from the body or out of the body. More specifically, this may be a quite specific cutting instrument, by means of which in the context of vitrectomy the vitreous body in the eye is destroyed or broken up and removed from the eye. It is also possible using this instrument to remove blood, blood clots and connective-tissue-like changes and regions of the retina in the context of a retina peeling.

With regard to the prior art, reference may be made purely by way of example to US 5,630,827 from which a cutting instrument which is suitable for vitreous body operations is known. At the proximal end, the cutting device is open. At the distal end, it has a closed outer sleeve which is provided close to the closed end with a plurality of openings. The openings each form a slot and enable vitreous body tissue to be introduced into the lumen of the outer sleeve. Furthermore, the cutting instrument has an inner sleeve which is arranged concentrically relative to the outer sleeve and which is received so as to be able to be longitudinally moved in the outer sleeve and which comprises at the distal end thereof a sharp edge for cutting the vitreous body tissue when the inner sleeve is pushed forwards.

In the device known from US 5,630,827, it is significant that the inner tube has at the free front end thereof an open peripheral edge which acts as a cutting edge. Accordingly, this edge is shaped or ground. The outer edge region has a cutting action so that hereinafter an outer cutting edge of the inner tube will be referred to. This outer cutting edge cooperates with one or more inner cutting edges of the outer tube so that tissue which has been introduced into the device is cut or separated when the cutting edges slide past each other. Afterwards, the tissue can be drawn out of the inner side of the device, more specifically through the inner tube.

A generic cutting instrument for removing vitreous body tissue is also known from WO 98/52502. At the distal end of the instrument, there is provided a closed outer sleeve which has close to the distal end a plurality of slots through which the vitreous body tissue can be introduced. There is provided concentrically relative to the outer sleeve a longitudinally movable inner sleeve which has at the distal end thereof a sharp edge for cutting the vitreous body tissue which has been introduced. Furthermore, there is provided for the inner sleeve a drive mechanism, by which the inner sleeve can be moved with the cutting edge thereof in the region of the distal end over the slots which are arranged in the outer sleeve so that a cutting operation takes place in each case at that location.

US 5,106,364 discloses a device for cutting in accordance with the preamble of claim 1.

The known devices of the generic type are, however, problematic in two respects in practice. On the one hand, the operating speed is defined by the frequency with which the inner tube is moved back and forth, that is to say, with the outer cutting edge thereof, past the inner cutting edge(s) of the outer tube. It is thus possible with each travel operation of the inner tube to cut only a specific quantity of tissue, whereby the throughput is limited by the maximum frequency.

It is further disadvantageous that the known device imparts quite considerable pressure or reduced pressure fluctuations in the eye, that is to say, as a result of the fact that the opening(s) which is/are used for drawing off is/are sometimes completely closed and is/are sometimes completely open, depending on the position of the inner tube. There is consequently produced in the body or eye an alternating reduced pressure which can hardly be compensated for. The - considerable - pressure fluctuations which are thus brought about may lead to damage to the eye.

An object of the present invention is therefore to configure and develop the generic device for cutting and drawing tissue from the human or animal body, in particular for use in vitrectomy, in such a manner that a considerable cutting power and consequently a high throughput can be achieved, without the frequency for the back and forth movement of the inner tube being increased, where possible with pressure fluctuations in the body being prevented.

The above object is achieved by the features of patent claim 1. Accordingly, the generic device is characterised in that the inner tube, close to the free end, has at least one lateral opening with at least one additional outer cutting edge.

According to the invention, it has been recognised that, with respect to the cutting power, it is a quite significant advantage if the inner tube has at least one additional cutting edge which cooperates with the cutting edge or the cutting edges of the outer tube. This can be achieved in a surprisingly simple manner by the inner tube close to the free end having at least one lateral opening in a similar manner to the outer tube. This lateral opening in the inner tube comprises at least one additional outer cutting edge so that the inner tube is provided on the whole with at least two cutting edges. During the travel of the inner tube, the front cutting edge thereof, that is to say, the cutting edge at the free end of the inner tube and the at least one additional cutting edge, consequently moves past the inner cutting edge of the outer tube so that, based on the previously mentioned construction, at least two cutting operations are carried out per travel operation.

Based on the fact that the lateral opening of the inner tube, for example, in the form of a slot which is constructed in the manner of a partial annular segment, is provided with two additional outer cutting edges, the inner tube may comprise two outer cutting edges in the lateral opening and the front cutting edge, that is to say, a total of three outer cutting edges so that, in the event of a back and forth movement of the inner tube, three cutting operations are carried out, that is to say, twice during the forward movement and at least once during a backward movement of the inner tube.

According to the invention, it is in any case significant that the inner tube close to the free end may have at least one, but certainly also two or more lateral openings, which are provided with a total of three or four outer cutting edges. In the case of three openings, these may be provided with up to six additional cutting edges.

In a further advantageous manner, the openings in the inner tube are constructed as mutually parallel slots with parallel cutting edges opposite each other. Any other embodiments, for example, oval openings with correspondingly bent cutting edges, are conceivable.

The cutting power can again be increased, that is to say, by means of an additional structural measure, according to which the outer tube close to the free closed end has two adjacent openings which are provided with a total of three or four inner cutting edges. These cutting edges cooperate with the additional cutting edges of the inner tube so that on the whole a plurality of cutting operations are produced depending on the number of cutting edges which slide past each other, with each partial travel operation.

The openings which are constructed in the outer tube may, in the same manner as the openings in the inner tube, be constructed as mutually parallel slots with parallel cutting edges. It is also conceivable in this instance to provide the openings with different sizes and with different shapes, for example, lenticular or oval. Accordingly, the cutting edges may be constructed in a continuous manner so that, with respect to the forward travel and the backward travel, they act as two differently orientated cutting edges.

In principle, it is conceivable for the cutting edges to extend transversely relative to the longitudinal axis of the tubes. It is also conceivable for the cutting edges to extend in an oblique manner relative to the longitudinal axis of the tubes or even for them to be arranged offset relative to each other in the longitudinal direction.

In the context of another variant, it is conceivable for the cutting edges of the inner tube to have a different angle with respect to the longitudinal axis from that of the cutting edges of the outer tube. During the travel movement of the inner tube there is produced in this regard a type of scissor effect with respect to the cutting edges which are sliding past each other. This again promotes the cutting power.

In principle, the cutting edges may be constructed in a rectilinear, bent, undulating or even angled manner in order to achieve a specific cutting action with respect to the tissue which is intended to be cut.

It is also conceivable for the openings which extend inwards in the respective tube to extend orthogonally with respect to the longitudinal axis of the tubes. It is also possible for the openings or slots to be inclined inwards towards the free end of the tube or away from the free end of the tube, that is to say, at an angle which is different from 90°.

As already mentioned above, the outer tube has inner cutting edges and the inner tube has outer cutting edges, wherein the respective cutting edges slide past each other during the travel movement of the inner tube, whereby the cutting action is produced, both during forward travel and during backward travel. Cutting faces defined by the material thickness of the tubes extend from the cutting edges in a manner descending from the cutting edge outwards (in the case of the outer tube) and inwards (in the case of the inner tube). The respective cutting edge can thus be defined and also optionally sharpened or finished via the cutting face.

The openings or slots of the respective tubes are in principle axially spaced apart from each other. It is also conceivable for a plurality of openings or slots to be arranged offset with respect to each other in the peripheral direction in order to produce a cutting action in the peripheral direction of the device. According to requirements, extremely different arrangements, including nesting of openings, can be produced over the periphery of the respective tube.

With respect to avoiding pressure fluctuations in the body, it is quite particularly advantageous for the device to be configured by means of a simple, structural technical control measure in such a manner that during operation no pressure fluctuations at all occur in the respective body, although each opening per se is covered differently by the inner tube.

According to the invention, the openings and consequently the cutting edges of the tubes are arranged with respect to each other over the entire movement sequence of the inner tube in such a manner that the openings are sized in such a manner and the movement of the inner tube is limited or controlled in such a manner that at all times of the movement sequence, that is to say, over the entire forward travel and backward travel of the inner tube, the same cross-section of flow into the inner tube exists. This means that, for example, a front opening in the outer tube is completely open whilst a second rear opening in the outer tube is completely closed by the inner tube. During backward travel of the inner tube, the front opening is gradually closed, that is to say, to the same extent as the rear opening of the outer tube is released by the backward travel of the inner tube. Regardless of the number of openings, with a corresponding configuration it is possible to configure the arrangement of the outer tube and inner tube and the openings or slots provided therein in such a manner that the above provision is complied with at all times, that is to say that at all times of the movement sequence, that is to say, over the entire forward travel and backward travel of the inner tube, the effective cross-section of flow is the same through all the openings so that over the movement sequence no pressure fluctuations at all are produced as a result of the reduced pressure which exists inside the device and which is required for the drawing action. Quite the contrary, the outwardly acting suction or reduced pressure always remains the same so that possible damage to the eye resulting from pressure fluctuations is excluded, that is to say, with corresponding outwardly acting pressure fluctuations being prevented.

There are various possibilities for advantageously configuring and developing the teaching of the present invention. In this regard, reference may be made on the one hand to the patent claims which are dependent on patent claim 1 and on the other hand to the following explanation of a preferred embodiment of the invention with reference to the drawings. Together with the explanation of the preferred embodiment of the invention with reference to the drawings, generally preferred embodiments and developments of the teaching are also explained. In the drawings:

Figures 1-6 are partial schematic views of an embodiment of a device according to the invention for cutting and drawing tissue, wherein the Figures show the movement sequence of the inner tube in the outer tube and the openings and cutting edges which are provided at that location, and

Figure 7 is a schematic plan view of a variant of the device according to the invention, according to which the flow path which is directed into the inner tube is constant at all times of the movement sequence.

Figures 1 to 6 are schematic, highly enlarged views of the operating region of the device according to the invention, wherein it is in this instance a so-called vitrector for use in vitrectomy, that is to say, a device for removing the vitreous body from the human eye.

Figures 1 to 6 together show the movement sequence and, in this instance, the respective position of the movable components with respect to each other.

More specifically, Figures 1 to 6 - partially - show the outer tube 1, which is closed at the free end 2. In the embodiment shown in Figures 1 to 6, the outer tube 1 is provided with a total of two openings 3 which are constructed in the form of symmetrical slots. As a result of the provision of the two openings 3, the outer tube 1 has a total of four cutting edges 4.

In the outer tube 1 an inner tube 5 is arranged concentrically with little play so as to be able to be displaced alternately. Figures 1 to 6 show that the inner tube 5 is open at the front free end thereof. Accordingly, a first cutting edge 6 is constructed at that location. Depending on the configuration of the travel of the inner tube 5, the cutting edge 6 cuts each time it slides past a cutting edge 4 which is directed counter to the movement direction of the inner tube 5. In the embodiment shown in Figures 1 to 6, therefore, the cutting edge 6 cuts a maximum of two times when it is twice guided with a correspondingly configured travel past an oppositely directed cutting edge 4 of the outer tube 1.

The inner tube 5 may now be provided with one or two openings 7, which are also constructed in the form of a gap. The openings 7 of the inner tube 5 may have substantially the same degree of opening as the openings 3 of the outer tube 1.

When an opening 7 is provided, this may have two additional outer cutting edges 8 which bring about a cutting operation when they slide past oppositely directed cutting edges 4 of the outer tube 1.

Both when a single opening 7 is provided in the inner tube 5 and when two openings 7 of the inner tube 5 are provided, these may be sized and positioned in such a manner that, with an appropriate movement of the inner tube 5 within the outer tube 1, the same flow cross-section is always active, that is to say, when one opening 3 in the outer tube 1 is opened or closed, and the other opening 3 in the outer tube 1 is closed or opened. In this regard, reference may be made to the schematic illustration of Figure 7. In a central position, consequently, the openings 3 in the outer tube 1 would each be half-closed by the wall of the inner tube 5 or opened in accordance with the position of the cutting edges 8 of the inner tube 5.

At this point, it should be noted that the device according to the invention is illustrated only schematically in the Figures, in particular in order to show basic embodiments and the movement sequence. An illustration of details has been omitted for reasons of clarity.

Finally, it should be noted that the embodiment explained above serves only to explain the claimed teaching by way of example, but does not limit it to the embodiment.

List of reference numerals

- 1 Outer tube
- 2 Free end of 1
- 3 Lateral opening of 1
- 4 Inner cutting edges of 1
- 5 Inner tube
- 6 Outer cutting edges of 5
- 7 Lateral openings of 5
- 8 Additional outer cutting edges of 5

Készülék szövet kivágására és elszívására



Szabadalmi igénypontok

1. Készülék szövet kivágására és elszívására az emberi vagy állati testből, főként a vitrektómiában való felhasználásra, retina-lehántáshoz, amely készülék tartalmaz egy külső csövet (1) és egy a külső csőben (1) koncentrikusan, csekély játékkal alternálva eltolható belső csövet (5), ahol a külső cső (1) a szabad végén le van zárva és a szabad vég (2) közelében egy oldalsó nyílással (3) rendelkezik, amely legalább egy külső vágóélel (4) van ellátva, míg a belső cső (5) a szabad végen (2) nyitott és ott egy külső vágóélel (6) rendelkezik, amely vágóélek (4, 6) a belső cső (5) eltolásakor vágást végezve együttműködnek, emellett a belső cső (5) a szabad véghez (2) közel legalább egy oldalsó nyílással (7) rendelkezik, amely legalább egy további külső vágóélel (8) van ellátva, *azzal jellemezve*, hogy a nyílások (3, 7) és ezzel együtt a csövek (1, 5) vágóélei (4, 6, 8) a belső cső (5) teljes mozgásfolyamata során oly módon vannak egymáshoz hozzárendelve, a nyílások (3, 7) úgy vannak méretezve és a belső cső (5) mozgása oly módon van határolva, hogy a mozgásfolyamat mindegyik időpontjában ugyanaz az áramlási keresztmetszet áll fenn a belső csőbe (5) befelé.
2. Az 1. igénypont szerinti készülék, *azzal jellemezve*, hogy a belső cső (5) oldalsó nyílása (7) két külső vágóélel (8) van ellátva.
3. Az 1. vagy 2. igénypont szerinti készülék, *azzal jellemezve*, hogy a belső cső (5) a szabad vég közelében két oldalsó nyílással (7) rendelkezik, amelyek összesen három vagy négy külső vágóélel (8) vannak ellátva.
4. A 3. igénypont szerinti készülék, *azzal jellemezve*, hogy a nyílások (7) egymással párhuzamosan kiképzett, párhuzamos vágóélekkel (8) rendelkező részeként vannak kivitelezve.
5. Az 1-4. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a külső cső (1) a szabad, zárt vég (2) közelében két szomszédos nyílással (3) rendelkezik, amelyek összesen három vagy négy belső vágóélel (4) vannak ellátva.
6. Az 1-5. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a nyílások (3, 7) egymással párhuzamosan kiképzett, párhuzamos vágóélekkel (4, 8) rendelkező részeként vannak kivitelezve.
7. Az 1-6. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a vágóélek (4, 6) a csövek (1, 5) hossz tengelyére keresztirányban húzódnak.
8. Az 1-6. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a vágóélek (4, 6) a csövek (1, 5) hossz tengelyéhez képest ferdén húzódnak.
9. Az 1-8. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a belső cső (5) vágóélei (6, 8) más szöveget zárnak be a hossz tengellyel, mint a külső cső (1) vágóélei (4).
10. Az 1-9. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a vágóélek (4, 6, 8) egyenes vonalúan vannak kivitelezve.
11. Az 1-9. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a vágóélek (4, 6, 8) ívelt, hullámosan vagy leélezetten vannak kivitelezve.

12. Az 1-11. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a vágóélektől (4, 6, 8) kiindulva a csövek (1, 5) anyagvastagsága által meghatározott vágófelületek mindig a vágóéltől (4, 6, 8) kifelé ereszkedően (a külső cső (1) esetében) és befelé ereszkedően (a belső cső (5) esetében) terjednek ki.

13. Az 1-12. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a nyílások (3, 7), illetve rések egymástól bizonyos axiális távolságra helyezkednek el.

14. Az 1-12. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a nyílások (3, 7), illetve rések kerületi irányban egymáshoz képest eltoltan vannak elrendezve.

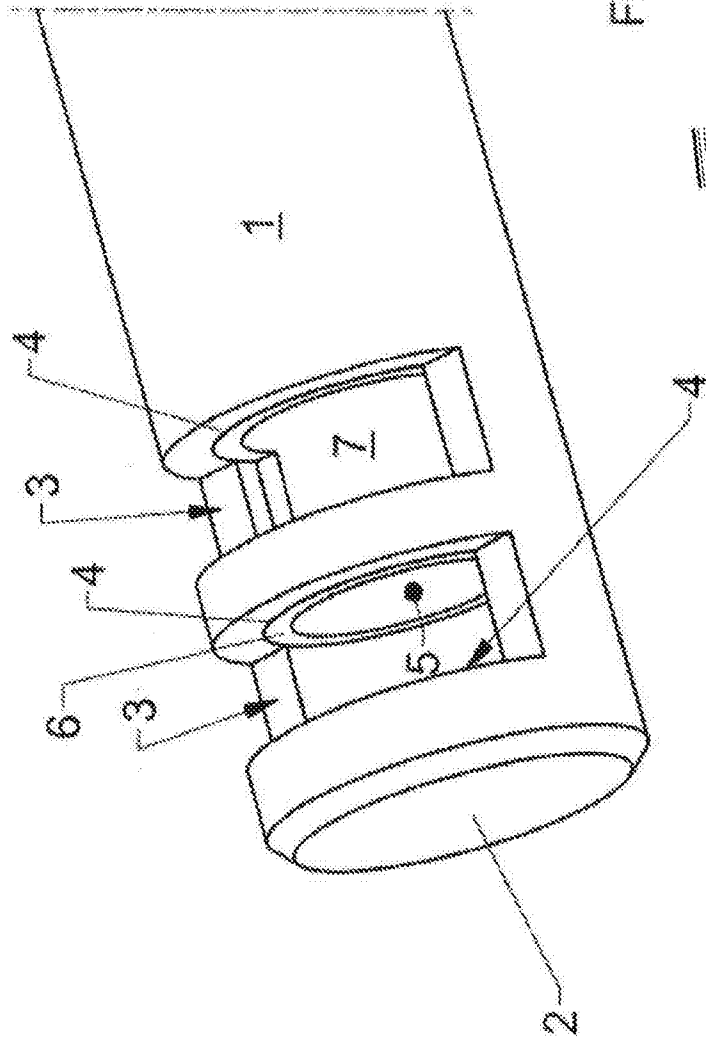
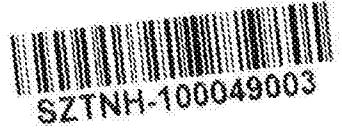


Fig. 1



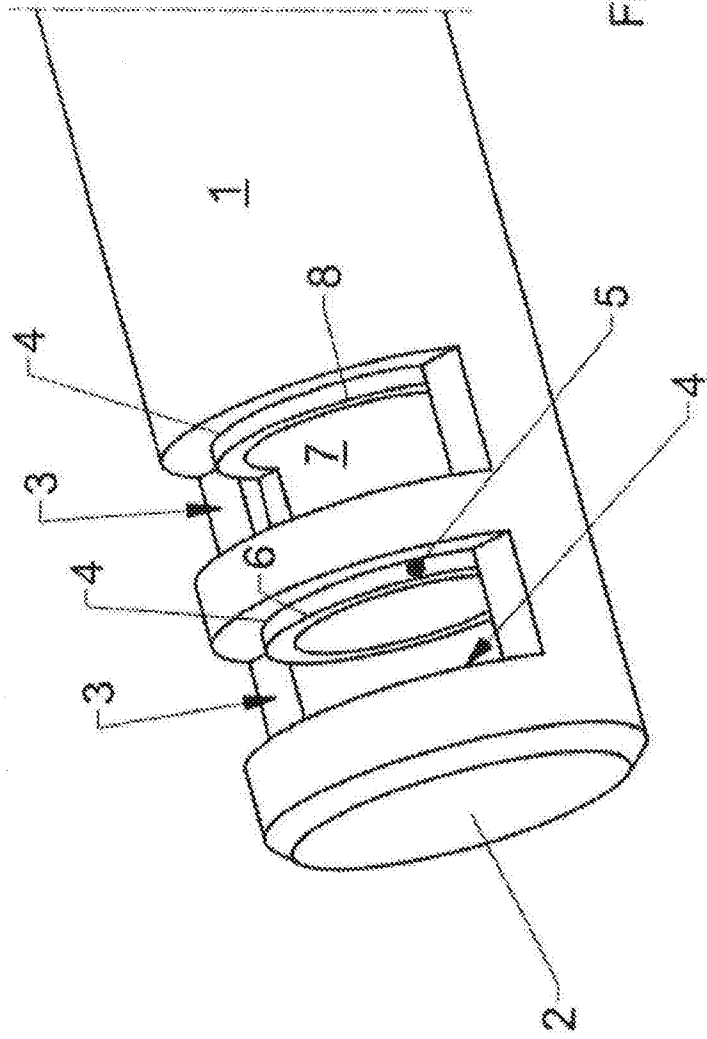


Fig. 2

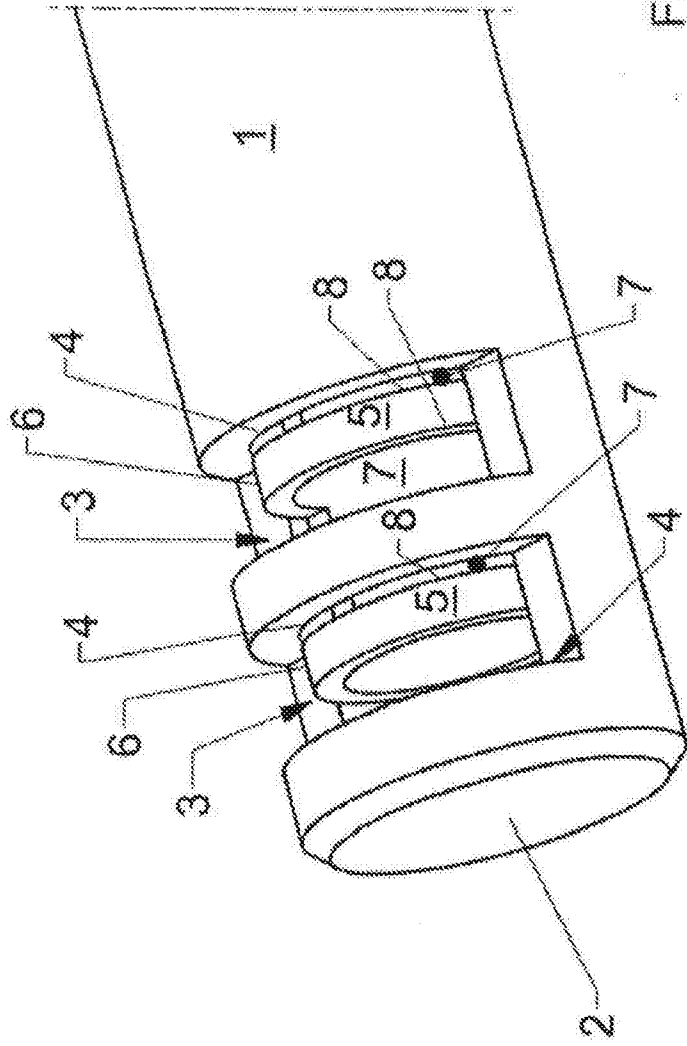


Fig. 3

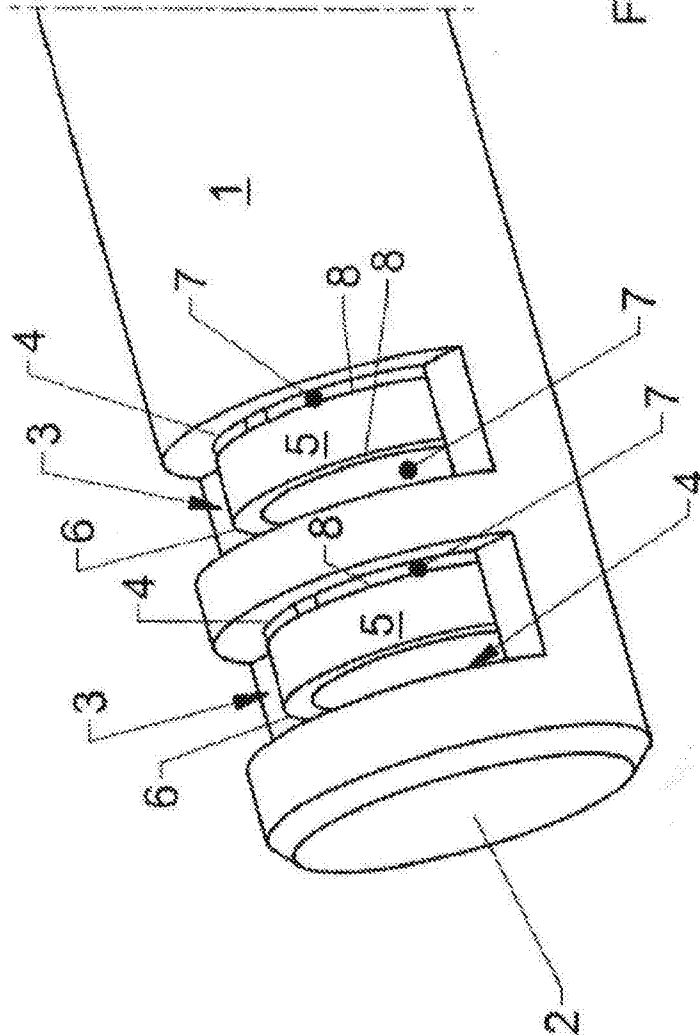


FIG. 4

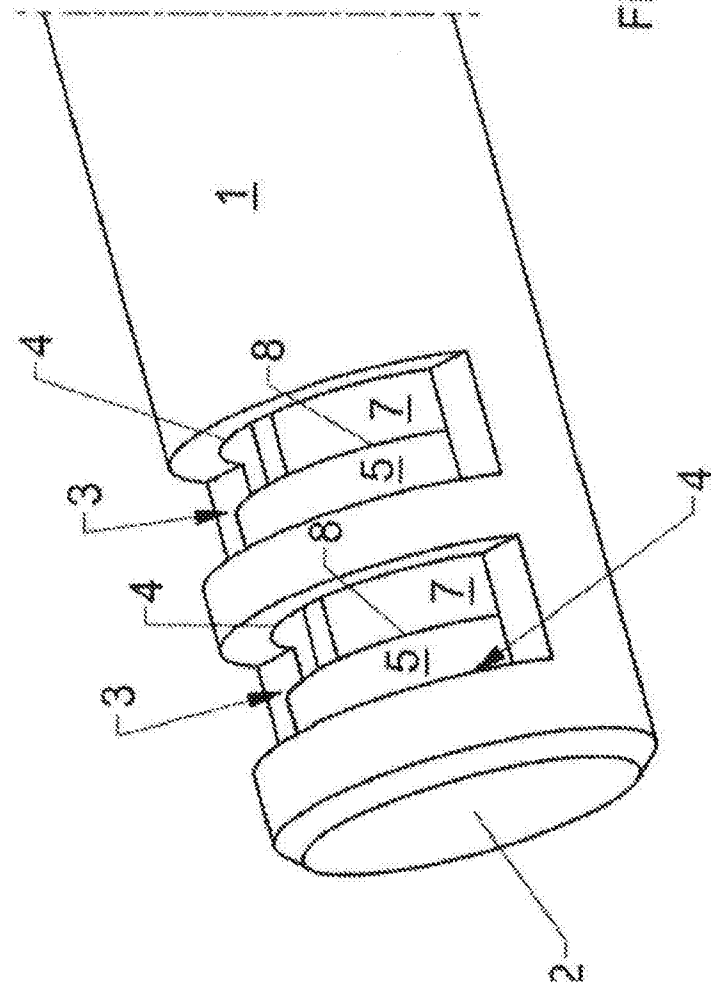


Fig. 5

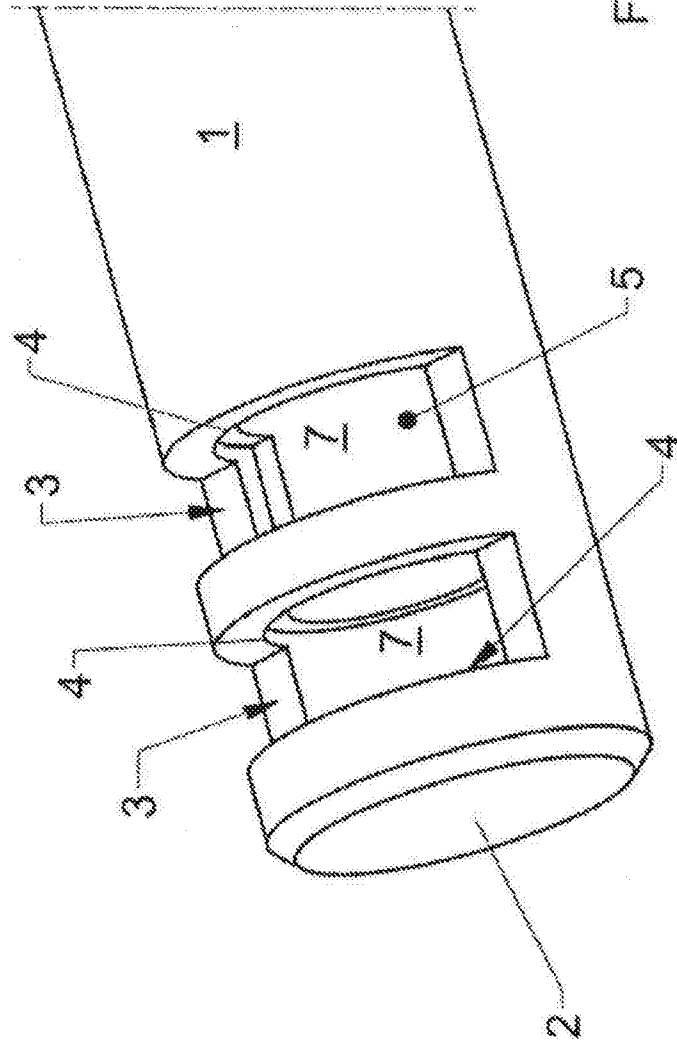


Fig. 6

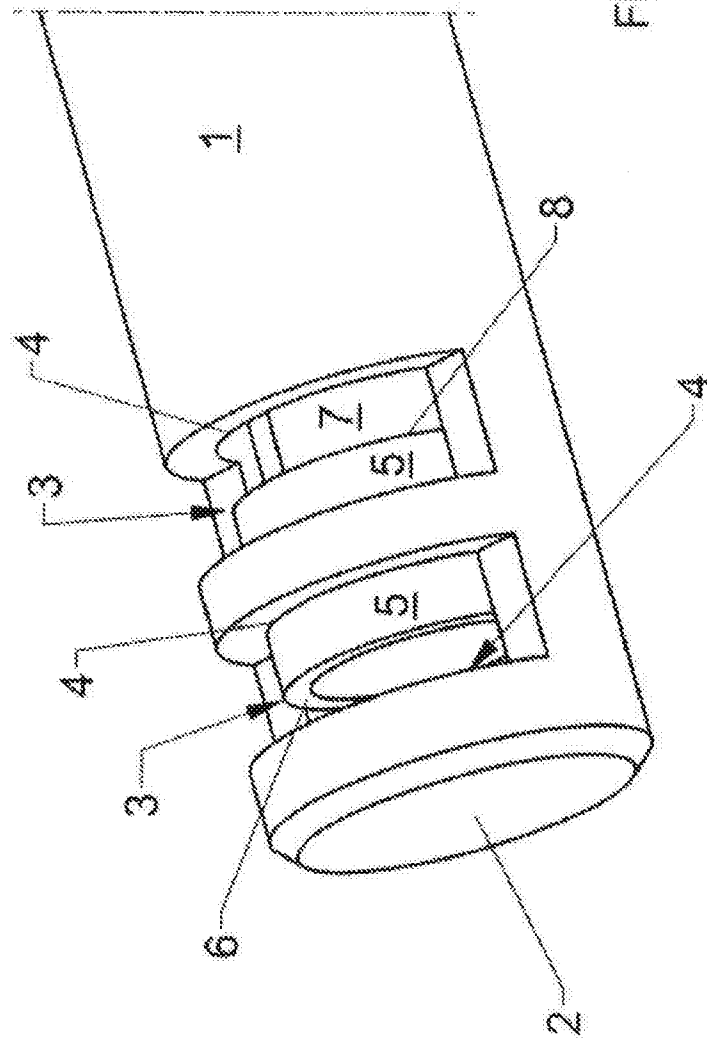


Fig. 7