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Készülék szövet kimetszésére

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.

DEVICE FOR CUTTING TISSUE

The invention relates to a device for cutting and drawing off tissue from the human or animal body, preferably for use in ophthalmology, in particular for vitrectomy, for retina peeling, etcetera, having an outer tube and an inner tube which can be displaced in an alternating manner in the outer tube concentrically with little play, wherein the outer tube is closed at the free end and has close to the free end a first and a second lateral opening each having at least one inner cutting edge, wherein the inner tube is open at the free end and at that location has an outer cutting edge, wherein the inner tube close to the free end has at least one lateral opening having at least one additional outer cutting edge and wherein the cutting edges of the outer tube and the inner tube cooperate in a cutting manner when the inner tube is displaced.

In principle, a surgical cutting instrument for removing tissue is involved. With the instrument, the tissue - on or in the body - can be cut and drawn off from the body or out of the body. More specifically, it may in this instance 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/drawn off from the eye. Using this instrument, it is also possible to remove blood, blood clots and connective-tissue-like changes and regions of the retina in the context of a retina peeling. A device of the generic type is in principle suitable for use in eye surgery.

With regard to the prior art, reference may be made to DE 10 2010 050 337 A1. From this specification, a device of the generic type is known, wherein both the outer tube and the inner tube therein each have two lateral recesses with a dual-cutting function. Similar devices are known from DE 10 2013 201 784 A1, US 5,630,827, US 5,474,532 and US 5,106,364. Furthermore, documents US 2010/106054 A1, US 2011/313346 A1 and US 4,834,729 A disclose corresponding devices.

With the generic device according to DE 10 2010 050 337 A1, two slots which are constructed parallel with each other with parallel cutting edges are provided in the outer tube. Furthermore, the free end of the inner tube is open and a lateral opening with an outer cutting edge is arranged close to the free end.

In the generic device, it is problematic that, depending on the tissue intended to be cut, a very high cutting force has to be applied in order to cut up the tissue. Furthermore, it is problematic that the tissue is not separated with a clean cut, but instead is punched out by the cutting edges. In particular when the device is used in ophthalmology, the tissue in the inner eye has to be separated with the smoothest possible cut in order not to damage the sensitive eye. Punching out tissue can lead to significant irritations and impediments to wound healing in the eye and is consequently intended to be avoided.

Furthermore, it is problematic that, in the generic device during the movement sequence of the inner tube, a constant flow of aspiration fluid and separated tissue cannot be achieved. There is therefore produced in the body or in the eye an - even though low - alternating reduced pressure which also leads to irritations in the eye, which has a negative effect on the healing process.

An object of the present invention is therefore to configure and develop a device for cutting and drawing off tissue from the human or animal body in such a manner that, using structurally simple means, a clean cutting of tissue is possible and irritations in the tissue and pressure fluctuations in the body are minimised.



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According to the invention, the above object is achieved by the features of claim 1. Accordingly, the device in question is characterised in that the first and the second opening are constructed in each case as an asymmetrical circle, as an asymmetrical ellipse or as an asymmetrical oval and in that through the asymmetrical region of the first and the second opening in the outer tube a thin web is formed.

In a manner according to the invention, it has first been recognised that, as a result of the arrangement of two openings which are constructed as an asymmetrical circle, ellipse or oval, the cutting power of the device is surprisingly improved. As a result of the circular, elliptical or oval region, the length of the outer cutting edges is maximised and a localised cutting force is achieved. A smooth guiding of the cut is thereby achieved and punching-out of the tissue which is intended to be cut is prevented. Furthermore, as a result of this region of the openings, an ideal flow behaviour is achieved, with occurrences of turbulence of the aspiration fluid being minimised so that, during the aspiration, a constant flow is ensured through the inner tube.

In another manner according to the invention, it has been recognised that, as a result of the asymmetrical construction of the openings, a thin web can be formed in the outer tube so that additional cutting edges can be provided, wherein this configuration does not have a negative effect on the flow behaviour of the aspiration fluid.

In order to achieve an ideal cutting power with the lowest possible cutting force, the web may extend at least partially in an orthogonal manner with respect to the longitudinal axis of the outer tube.

In order to produce the simplest possible construction and optimisation of the flow behaviour, the first opening and the second opening of the outer tube may be constructed in an axially symmetrical manner with respect to each other, wherein the web at least partially forms a portion of an axis of symmetry. That is to say, the web may be located at least partially on the mirror axis which extends between the first opening and the second opening. Another advantage of this construction is that, as a result of the axially symmetrical arrangement, it is possible in a particularly simple manner, at any time of the movement sequence of the inner tube, for the same flow cross-section into the inner tube to exist.

In an advantageous embodiment, at the first opening and the second opening a first cutting edge and a second cutting edge can be formed, respectively. Consequently, a total of four inner cutting edges are arranged in the outer tube so that the cutting power of the device is increased with structurally simple means.

In an advantageous manner, the first cutting edge is formed in the circular, elliptical or oval region of the first and the second opening. Alternatively or additionally, the second cutting edge may be formed in the asymmetrical region of the first and the second opening.

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 which are defined by the material thickness of the outer tube may extend outwards from the cutting edges of the outer tube. In this instance, it is conceivable for the cutting face or the cutting faces to extend orthogonally with respect to the longitudinal axis of the outer tube. Furthermore, the cutting faces or the cutting face may extend at an angle with respect to the longitudinal axis of the outer tube, that is to say, the cutting face or cutting faces extend obliquely with respect to the longitudinal axis of the outer tube. Depending on which type of tissue is intended to

be cut, the cutting face may be adapted accordingly. In this instance, it is further conceivable, for example, for the cutting edges of the first and second openings arranged on the web to be formed orthogonally with respect to the longitudinal axis of the outer tube and the cutting face of the first opening and the second opening which extends outwards from the first cutting edge to be arranged obliquely with respect to the longitudinal axis of the outer tube.

In order to adapt the device in an ideal manner to the tissue which is intended to be cut, the cutting face or the cutting faces may be constructed in a linear and/or concave manner. For example, cutting faces which are arranged on the web may be constructed in a linear manner, whereas the cutting faces which are arranged on the first cutting edge of the first and second openings are constructed in a concave manner.

In a further advantageous manner, the first cutting face of the first opening, which face extends outwards from the first cutting edge, and the first cutting face of the second opening, which face extends outwards from the first cutting edge, are arranged in a V-shaped manner with respect to each other. That is to say that the first cutting faces of the first opening and the second opening may each extend obliquely with respect to the longitudinal axis of the outer tube, wherein the cutting faces are arranged in a particularly advantageous manner at opposing angles relative to the longitudinal axis. Consequently, the first cutting face may be located during a forward movement of the inner tube at the same angle with respect to the inner tube as the second cutting face during a backward movement of the inner tube.

In order to further maximise the cutting power, the inner tube close to the free end may have two adjacent lateral openings which are provided in total with three or four outer cutting edges.

It is further conceivable for the outer tube to have a third and a fourth lateral opening, which are constructed in a similar manner to the first and second openings. The third and fourth lateral openings may in this instance be arranged with spacing axially or in a peripheral direction with respect to the first and second openings, wherein the third and fourth openings may each be constructed as an asymmetrical circle, as an asymmetrical ellipse or as an asymmetrical oval and an additional thin web may be formed through the asymmetrical region of the third and fourth openings on the outer tube.

There are now various possibilities to construct and develop the teaching of the present invention in an advantageous manner. To this end, on the one hand, reference may be made to the claims which are dependent on 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 to 3 are partially sectioned views of an embodiment of a device according to the invention for cutting and drawing off 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,

Figures 4 to 6 are partial schematic views of the embodiment according to Figures 1 to 3, 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 in each case, and

Figures 7 to 9 are schematic partial plan views of the embodiment according to Figures 1 to 3, 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 in each case.

Figures 1 to 9 are greatly enlarged schematic views of the operating region of the device according to the invention, wherein in this instance a so-called vitrector for use in vitrectomy is involved, that is to say, a device for removing vitreous bodies from the human eye.

Figures 1 to 9 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 9 show - partially - the outer tube 1, which is closed at the free end 2. In the embodiment shown in Figures 1 to 9, the outer tube has a first opening 3 and a second opening 4. The first opening 3 and the second opening 4 are constructed in each case as an asymmetrical ellipse or an asymmetrical oval. In this instance, it can clearly be seen that the asymmetrical region 5 of the first opening 3 and the second opening 4 on the outer tube 1 define a thin web 6.

Furthermore, a first cutting edge 7 and a second cutting edge 8 are formed in each case on the first opening 3 and the second opening 4. The outer tube 1 consequently has a total of four cutting edges 7, 8.

First cutting faces 9 which are defined by the material thickness of the outer tube 1 extend outwards from the first cutting edges 7. The first cutting faces 9 extend obliquely relative to the longitudinal axis of the outer tube 1 and are arranged in a V-shape relative to each other. Furthermore, it can clearly be seen that the first cutting faces 9 are constructed in a concave manner.

Additional second cutting faces 10 which are also defined by the material thickness of the outer tube 1 extend outwards from the second cutting edges 8. In contrast to the first cutting faces 9, the second cutting faces 10 extend orthogonally with respect to the longitudinal axis of the outer tube 1 and are constructed in a linear manner.

In particular in Figures 7 to 9, it is clearly shown that the first opening 3 and the second opening 4 are constructed in an axially asymmetrical manner with respect to each other, wherein the web 6 is located in the axis of symmetry of the first opening 3 and the second opening 4.

An inner tube 11 is arranged in the outer tube 1 concentrically with little play so as to be able to be displaced in an alternating manner. Figures 1 to 9 show that the inner tube 11 is open at the front free end thereof. Accordingly, a first cutting edge 12 is formed at that location. Depending on the configuration of the travel of the inner tube 11, the first cutting edge 12 cuts each time it slides past a cutting edge 7, 8 of the outer tube 1, which edge is directed counter to the movement direction of the inner tube 11. In the embodiment shown in Figures 1 to 9, therefore, the first cutting edge 12 cuts twice when it is guided twice past a respective inversely directed cutting edge 7, 8 of the outer tube 1 with correspondingly configured travel.

The inner tube 11 may be provided with one or more openings 13. In the embodiment illustrated here, the inner tube 11 has an opening 13, which has two additional outer cutting edges 14 which, when they slide past inversely directed cutting edges 7, 8 of the outer tube 1, bring about a cutting operation.

Both when a single opening 13 is provided in the inner tube 11 and when a plurality of openings 13 are provided in the inner tube 11, these may be sized and positioned in such a manner that, with an appropriate movement of the inner tube 11 within the outer tube 1, the same flow cross-section is always active, that is to say, when one opening 3, 4 in the outer tube 1 is opened or closed and the other opening 3, 4 in the outer tube 1 is closed or opened. In a central position, consequently, the openings 3, 4 in the outer tube 1 will be half-closed by the wall of the inner tube 11 or half-opened in accordance with the position of the cutting edge 14 of the inner tube 11.

With regard to other advantageous embodiments of the device according to the invention, in order to avoid repetition, reference may be made to the general portion of the description and to the appended claims.

Finally, it should be expressly noted that the embodiment of the device according to invention as described above serves only to explain the claimed teaching, but does not limit it to the embodiment.

List of reference numerals

- 1 Outer tube
- 2 Free end (outer tube)
- 3 First opening (outer tube)
- 4 Second opening (outer tube)
- 5 Asymmetrical region
- 6 Web
- 7 First cutting edge (outer tube)
- 8 Second cutting edge (outer tube)
- 9 First cutting face
- 10 Second cutting face
- 11 Inner tube
- 12 First cutting edge (inner tube)
- 13 Opening (inner tube)
- 14 Cutting edge (inner tube)

KÉSZÜLÉK SZÖVET KIMETSZÉSÉRE

Szabadalmi igénypontok

I. Készülék szövet kimetszésére és elszívására az emberi vagy az állati testből, előnyösen a szemészetben történő felhasználásra, főként vitrectomiához, retina-hántáshoz, stb., amely készülék egy külső csövet (1) és egy a külső csőben (1) koncentrikusan csekély játékkal ide-oda eltolható belső csövet (11) tartalmaz, ahol a külső cső (1) a szabad végén (2) zárt és a szabad vég (2) közelében egy első és egy második oldalsó nyílással (3, 4) rendelkezik, egyenként legalább egy belső vágóéllel (7, 8), ahol a belső cső (11) a szabad végén nyitott és ott egy külső vágóéllel (12) rendelkezik, emellett a belső cső (11) a szabad vég közelében legalább egy oldalsó nyílással



(13) rendelkezik legalább egy további külső vágóélel (14) és ahol a külső cső (1) és a belső cső (11) vágóélei (7, 8, 12, 14) a belső cső (11) eltolásakor vágást végző módon együttműködnek, *azzal jellemezve*, hogy az első és a második nyílás (3, 4) egyaránt aszimmetrikus körként, aszimmetrikus ellipszisként vagy aszimmetrikus oválisként van kialakítva és hogy az első és második nyílás (3, 4) aszimmetrikus tartománya (5) révén a külső csővön (1) egy vékony gerinc (6) van kiképezve.

2. Az 1. igénypont szerinti készülék, *azzal jellemezve*, hogy a gerinc (6) legalább szakaszonként merőlegesen húzódik a külső cső (1) hossz tengelyére.

3. Az 1. vagy 2. igénypont szerinti készülék, *azzal jellemezve*, hogy a külső cső (1) első és második nyílása (3, 4) egymással tengelyszimmetrikusan vannak kialakítva, ahol a gerinc (6) legalább szakaszonként a szimmetriatengely részét képezi.

4. Az 1-3. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy az első és a második nyíláson (3, 4) egyaránt egy első vágóél (7) és egy második vágóél (8) van kialakítva.

5. A 4. igénypont szerinti készülék, *azzal jellemezve*, hogy az első vágóél (7) az első és a második nyílás (3, 4) kör alakú, elliptikus vagy ovális tartományában van kialakítva és/vagy a második vágóél (8) az első és a második nyílás (3, 4) aszimmetrikus tartományában (5) van kialakítva.

6. Az 1-5. igénypontok bármelyike szerint készülék, *azzal jellemezve*, hogy a vágóélekről (7, 8) a külső cső (1) anyagvastagsága által meghatározott vágófelületek (9, 10) terjednek ki kifelé.

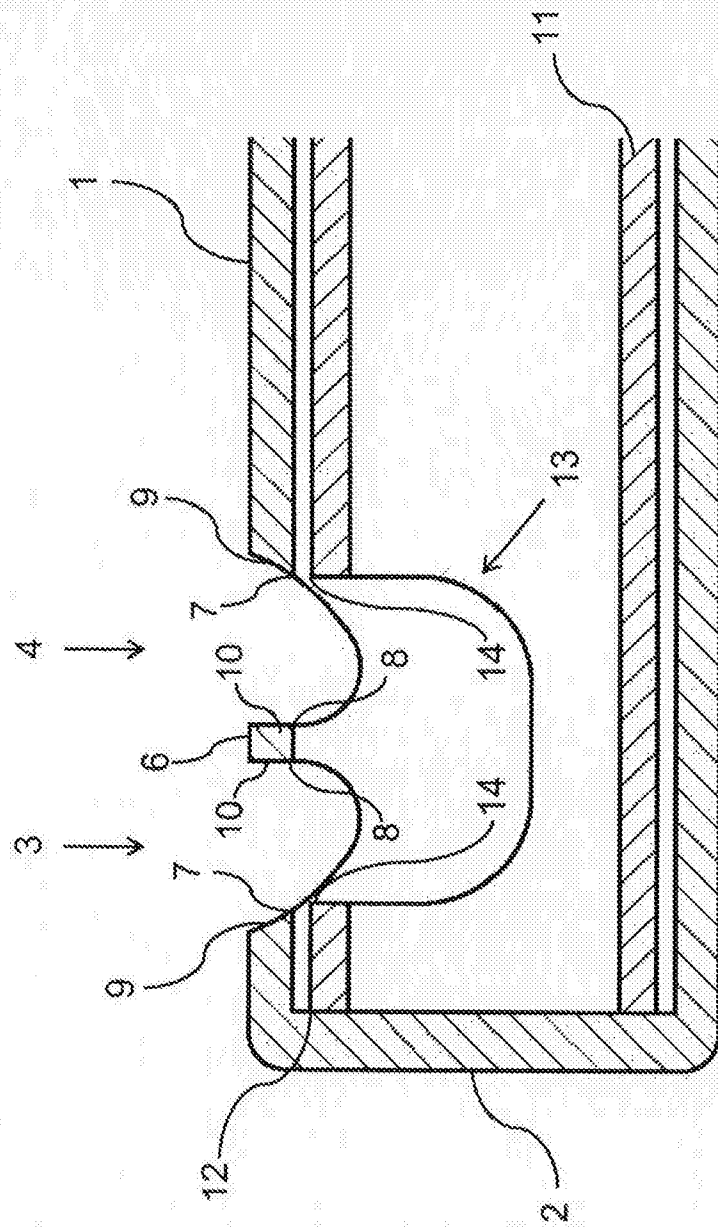
7. A 6. igénypont szerinti készülék, *azzal jellemezve*, hogy a vágófelület/vágófelületek (9, 10) a külső cső (1) hossz tengelyére merőlegesen és/vagy szög alatt terjed/terjednek ki.

8. A 6. vagy 7. igénypont szerinti készülék, *azzal jellemezve*, hogy a vágófelület/vágófelületek (9, 10) egyenes vonalúan és/vagy homorúan van/vannak kialakítva.

9. A 6-8. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy az első nyílásnak (3) az első vágóélről (7) kifelé húzódó első vágófelülete (9) és a második nyílásnak (4) az első vágóélről (7) kifelé húzódó első vágófelülete (9) egymáshoz képest V alakban van elrendezve.

10. Az 1-9. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a belső cső (11) a szabad vég közelében két szomszédos oldalsó nyílással rendelkezik, amelyek összesen három vagy négy külső vágóélel vannak ellátva.

11. Az 1-10. igénypontok bármelyike szerinti készülék, *azzal jellemezve*, hogy a külső cső (1) egy harmadik és egy negyedik oldalsó nyílással rendelkezik, amelyek az első és második nyíláshoz (3, 4) hasonlóan vannak kialakítva.



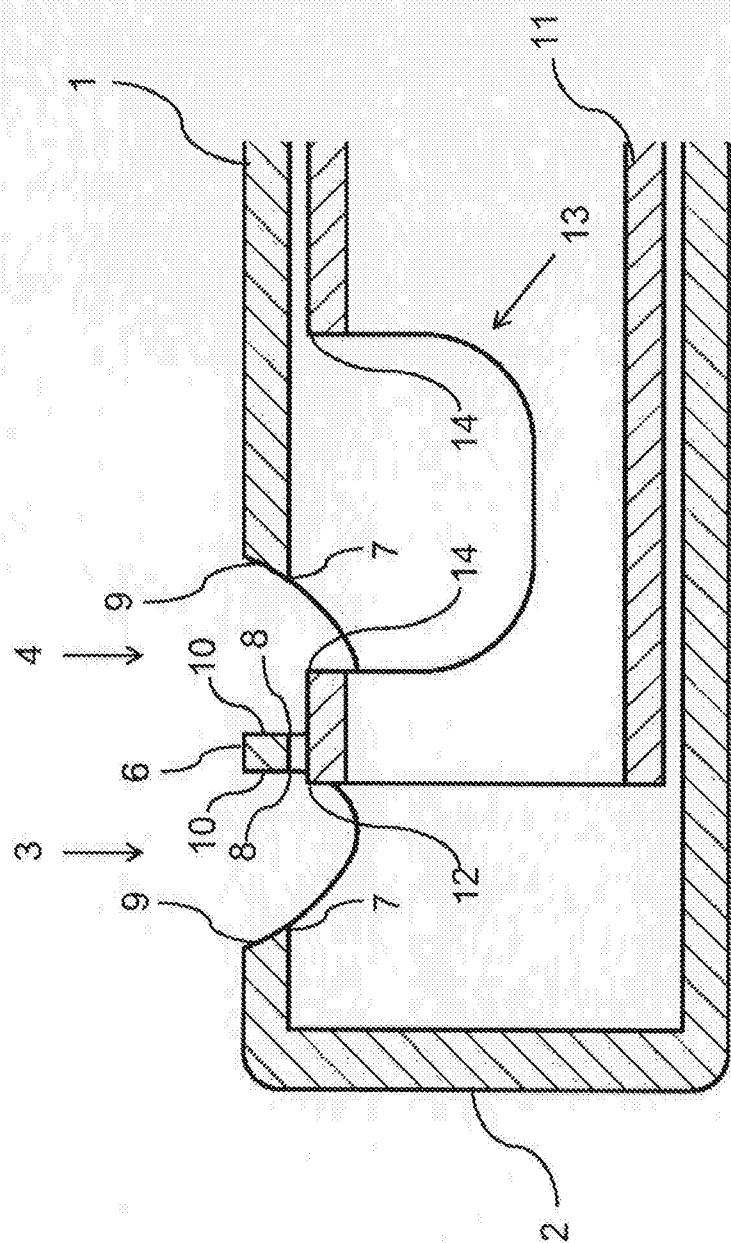


Fig. 2

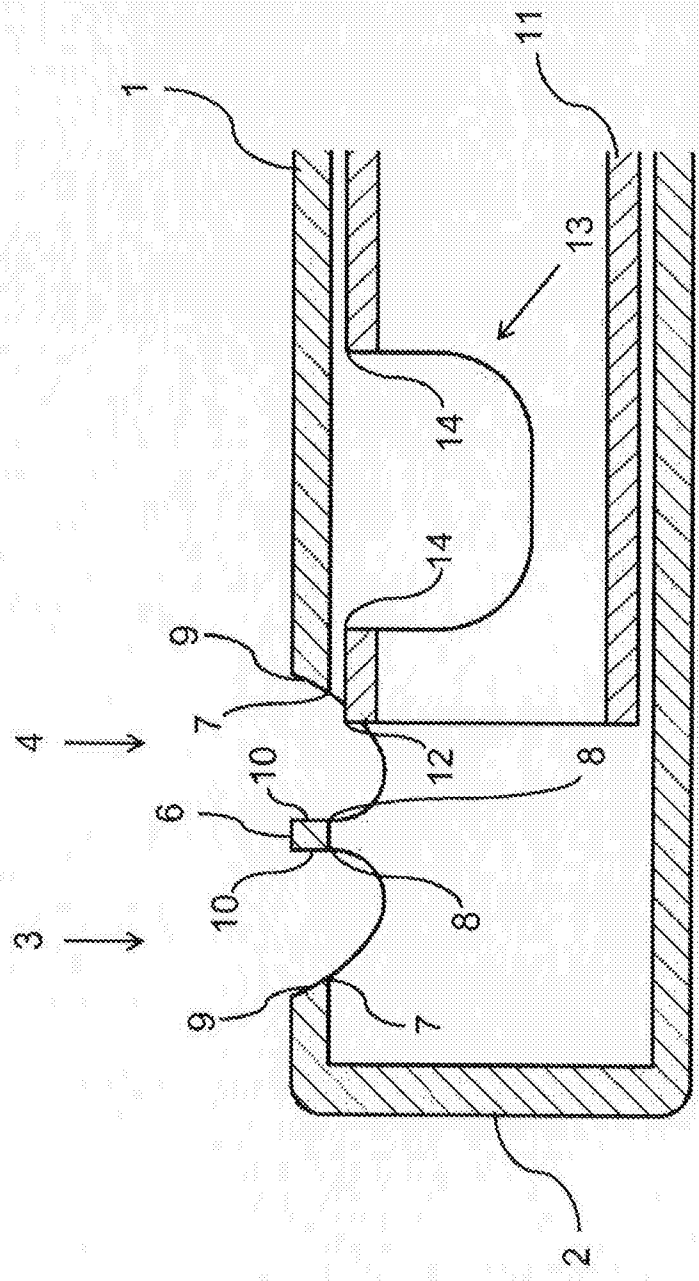


Fig. 3

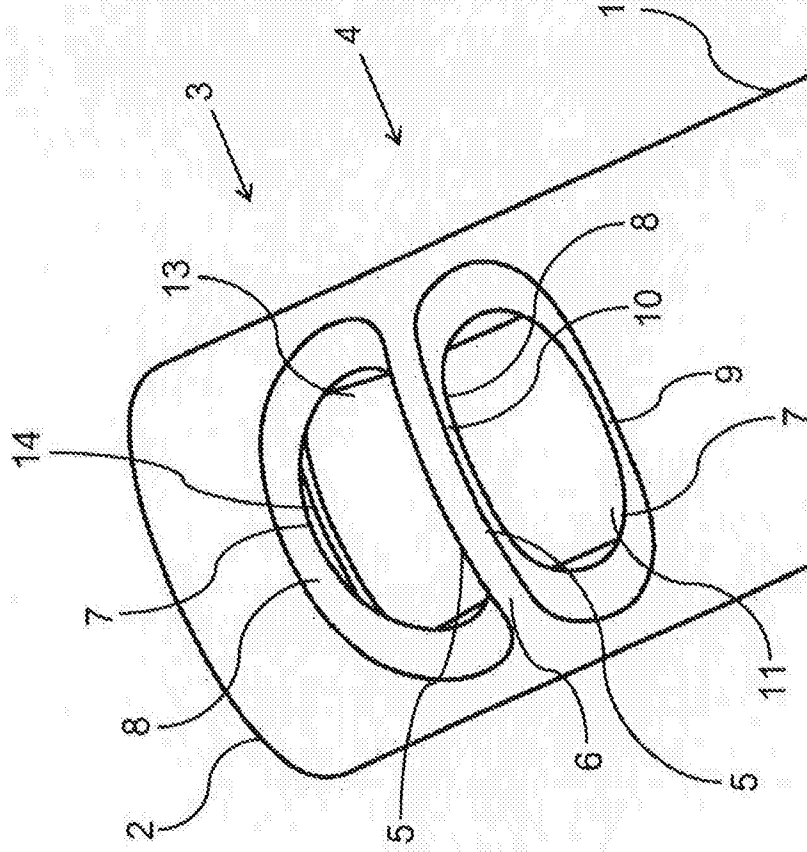


Fig. 4

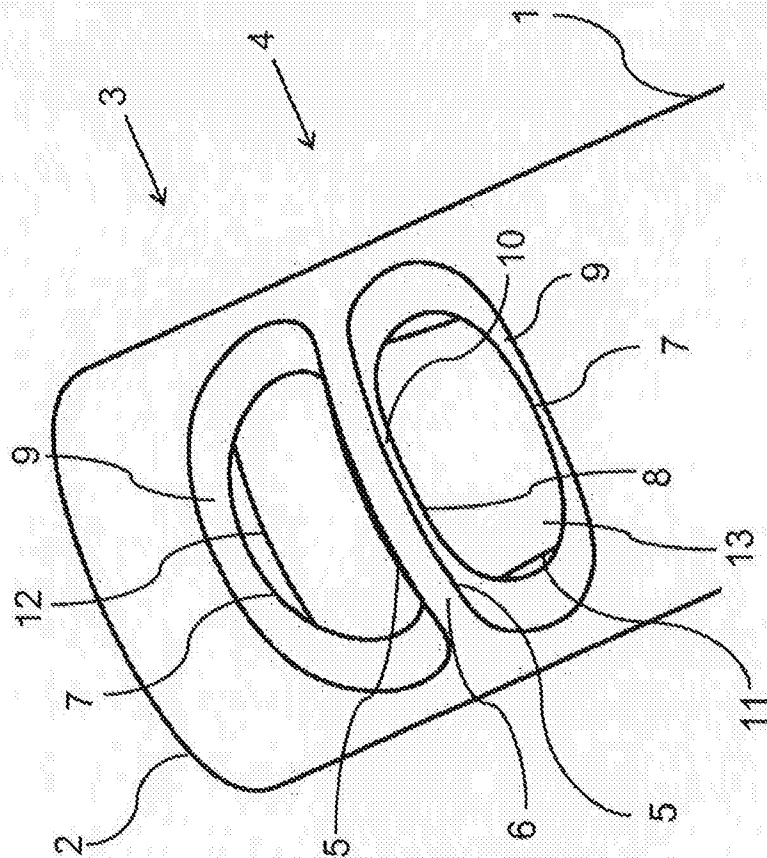


Fig. 5

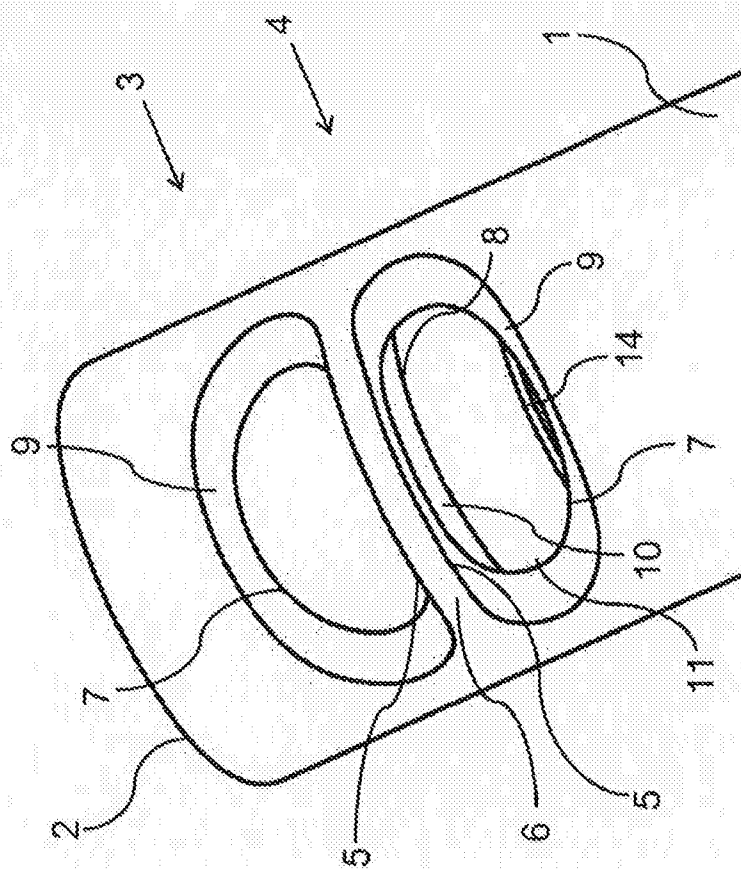


Fig. 6

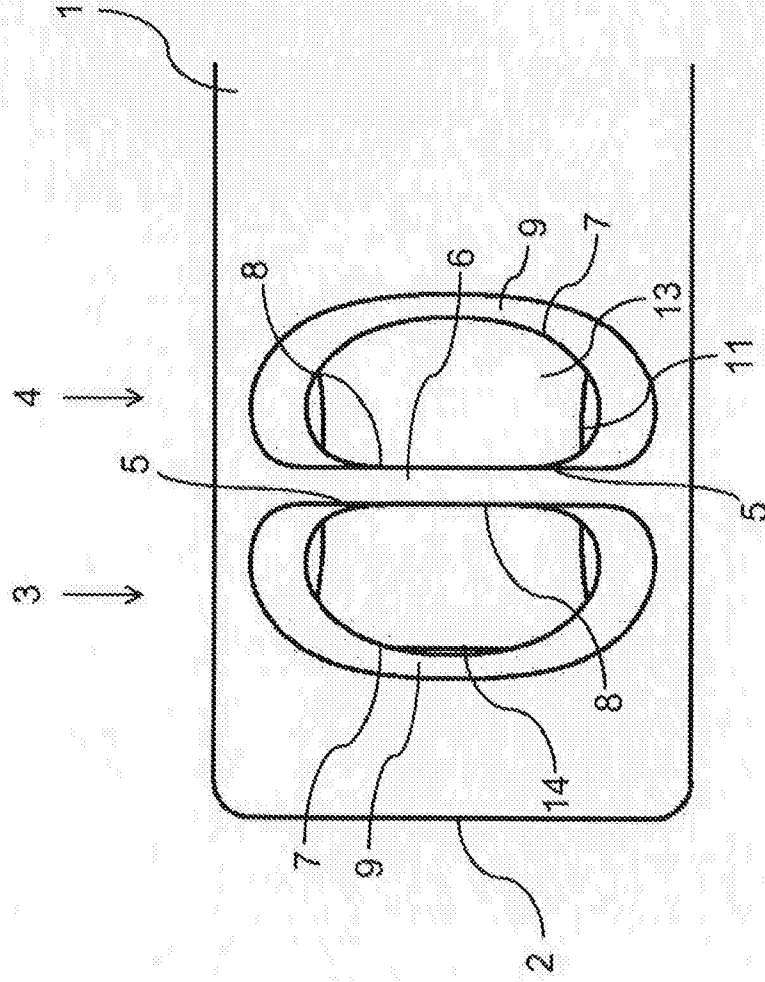


Fig. 7

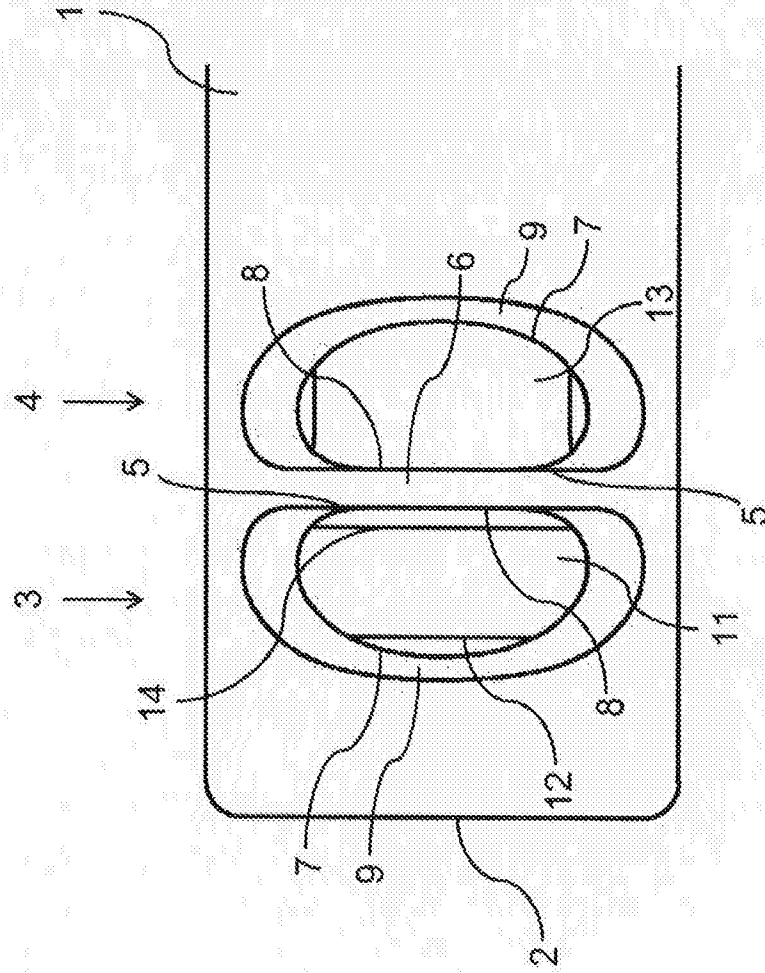


Fig. 8

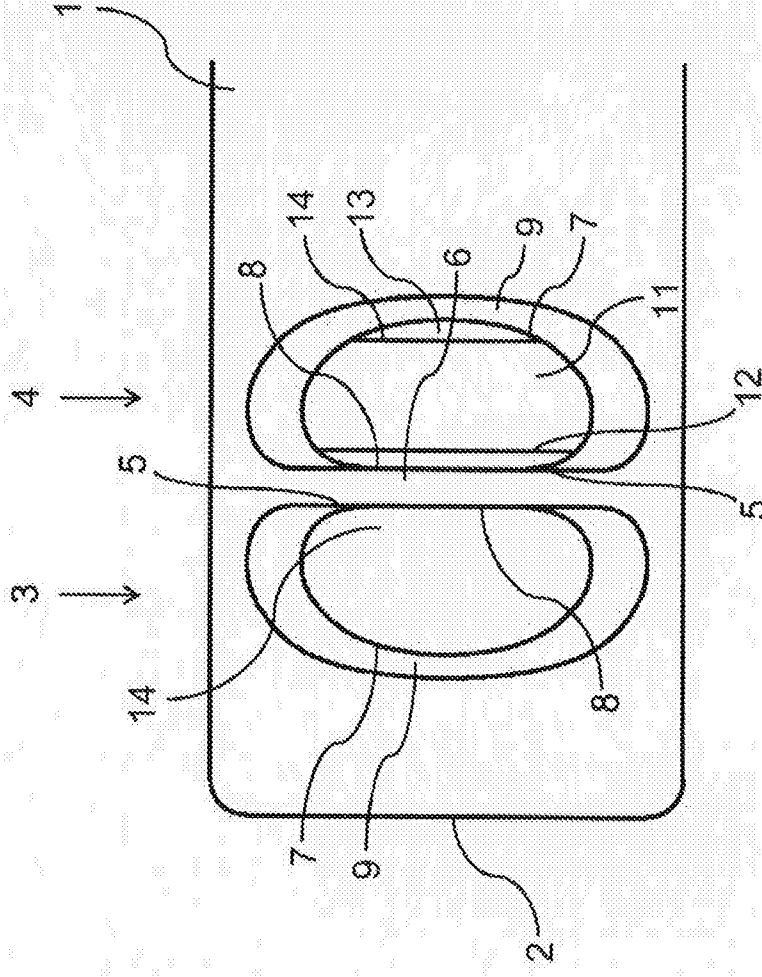


Fig. 9