(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 January 2013 (03.01.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/000463 A1

(51) International Patent Classification:
A61B 18/14 (2006.01)

(21) International Application Number:
PCT/DK2011/050298

(22) International Filing Date:
1 August 2011 (01.08.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PA 2011 00482 28 June 2011 (28.06.2011) DK

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

(54) Title: AN ELECTROSURGICAL INSTRUMENT AND ELECTROSURGICAL CONDUCTIVE ELECTRODE FOR USE WITH THE INSTRUMENT

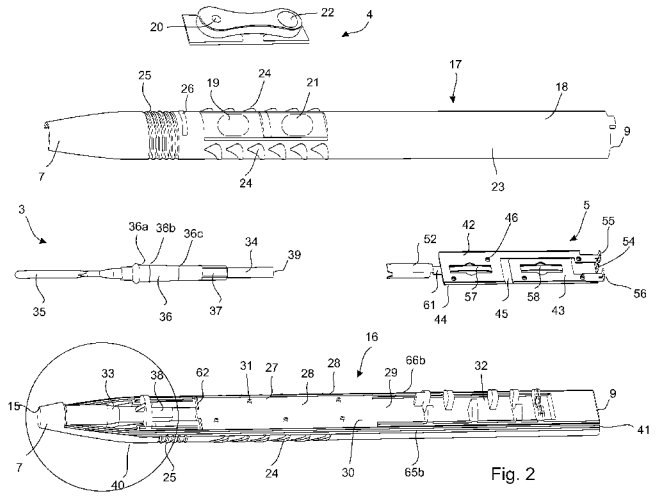

Fig. 2

(57) Abstract: An elongated electrosurgical instrument (1) comprises a first means (3) for at least cutting tissue of a patient during surgery by application of electrical energy supplied from an electrosurgical generator to a surgical site in response to operating a switch means (5). The instrument has an elongated main body (2) having a first end (7) with a first opening (15) through which the first means (3) protrudes. The first means (3) has a securing part (36) for securing to a holder (33) associated with the first end (7) of the elongated main body (2) of the electrosurgical instrument (1). The securing part (36) of the first means (3) has a first engagement part (37) of a first pentagonal cross-section, and the holder (33) includes a complementarily second engagement part (38) for receiving at least a part of the first engagement part (37).

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An electrosurgical instrument and electrosurgical conductive electrode for use with the instrument.

The present invention relates to an elongated electrosurgical instrument comprising

- a first means for at least cutting tissue of a patient during surgery by application of electrical energy supplied from an electrosurgical generator to a surgical site in response to operating a switch means,
- an elongated main body having a first end and an opposite second end, which first end has a first opening through which the first means protrudes, and which second end is configured for being electrically coupled to the electrosurgical generator, wherein
- the first means has a securing part for securing to a holder associated with the first end of the elongated main body of the electrosurgical instrument.

In electrosurgery high frequency (radio-frequency) current is applied by a first means in the form of an active electrosurgical electrode to cause e.g. a cutting action, hemostasis, or coagulation of bleeding tissue.

This electrode needs to be firmly secured to the main body of the instrument to inhibit unintended detachment when operated during surgery. Numerous designs of electrodes are commercially available and suited for various kinds of surgeries. Depending on kind, shape and design of the active part of the electrode certain electrodes need to be mounted at a certain angular position in relation to the main body, and in particular in relation to the switch means on the main body for the surgeon to perform properly and convenient. Unintended rotation of the first means, once inserted in the holder, must not occur either, and the securing part may be shaped to inhibit any unintended movement of the first means.

To that aspect some conventional electrodes is in solid firm engagement with the elongated main body and the switch means. If the first means is not disposable or intended for being exchangeable it may even be permanently secured, e.g. by glue. The shape of a securing part can in this case be any, including securing parts with cross-sections that are circular or semicircular. Hex-lock electrodes are however the most common. Hex-lock systems are known within the art, e.g. from German patent application no. DE 10 2008 044 887 A1, and is the most common way to inhibit unintended rotation of the first means about its longitudinal axis once the first means are arranged on the elongated main body. The hexagonal cross-section of the securing part and corresponding hexagonal cross-section of the holder of the elongated main body does however limit the surgeon's and the manufacturer's options and numbers of angular adjustment possibilities, in particular for an asymmetrical first means for at least cutting tissue of a patient during surgery by application of electrical energy.

Accordingly, it is a main aspect of the present invention to provide an electrosurgical instrument of the kind mentioned in the opening paragraph with an active electrode that can be firmly, angularly arranged and mounted to the elongated main body.

It is a second aspect of the present invention to provide a new design of a securing part for an active electrosurgical electrode, and a corresponding holder for said securing part on an electrosurgical instrument.

It is a third aspect of the present invention to provide an electrosurgical instrument with a detachable active electrode.

It is a fourth aspect of the present invention to provide a repositionable active electrode for an electrosurgical instrument offering plural angular position options.

The novel and unique features whereby these and other aspects are achieved according to the present invention consist in that the electrosurgical instrument comprises that

- the securing part of the first means has a first engagement part of a first pentagonal cross-section, and
- the holder has a complementary second engagement part for receiving at least a part of the first engagement part.

A first means with a “hex-lock” has six edges provided for engagement with the elongated main body’s holder that has an at least partly corresponding second engagement part with correspondingly shaped engaging edges and surfaces, often six edges and/or surfaces, although a recess may have e.g. only three. The disadvantages of a hex-lock system is particular evident when the electrosurgical instrument is used together with a symmetrical first means, such as e.g. a flat symmetrical cutting blade. The hex-lock limits the surgeon’s options of different angular positions to three due to the symmetry.

As an alternative to the hex-lock, the present invention provides a “penta-lock” thereby making five different positions of the symmetrical first means available to the surgeon or manufacturer when inserted in one and the same elongated main body that has the holder according to the present invention. Moreover, by reducing the number of edges of the first engagement part and of the second engagement part by just one, the risk that the first means unintentionally slips to rotate about its longitudinal axis is substantially reduced compared to a hex-lock. Any higher uneven number of edges of the first engagement means and the second engagement means potentially offers more angular positioning possibilities, however at the expense of securing safety due to the entire circumference being more and more rounded the more edges of the polygon. Thus higher numbers of edges are not considered expedient and safe. If a lower uneven number of edges are provided less adjusting and positioning possibilities are available to the surgeon and

manufacturer. In this latter case the surgeon needs to compensate for any inconvenient position of the first means, e.g. by tilting the hand or using an inadequate grip at the elongated electrosurgical instrument in order to operate both the switch means and the first means adequately at the same time. By means of the pentagonal cross-sections of the first engagement means and the second engagement means the surgeon can just arrange the first means in the best of the five possible positions for a given surgery and as he/she likes best. Another surgeon may prefer another angular arrangement by means of which he/she has experienced that he/she acts faster, safer and more relaxed than if he/she was forced to use a given prefixed, e.g. factory prefixed, angular position of the first means. Alternatively, other models of electrosurgical instruments must be purchased to comply with various surgeon's demands to safely perform the surgery.

An electrosurgical instrument with a penta-lock shaped holder can be provided with a plurality of penta-lock equipped first means. The first means can be provided as individual accessory components separate from the elongated main body to be secured to the elongated main body in five different positions as desired an occasion requires, or be permanently secured by the manufacturer to the elongated main body in one of the five optional different positions.

In one embodiment the second engagement part can be a channel, at least a section of which has a second pentagonal cross-section.

In an alternative embodiment the second engagement part can be a recess or cavity with at least two edges of a pentagon having a second pentagonal cross-section.

By means of both embodiments substantial costs can be saved because one elongated main body have a holder with a second

engagement part that can be fitted with many different kinds of first means, and in more different angular positions than in a hex-lock system.

The first engagement part may in a preferred embodiment be a male part and the second engagement part be a female part, so that the male first engagement part in an easy and controlled manner can be guided into firm engagement with the complementarily shaped female second engagement means. The male part fills out the hollowness of the female part so that the male part cannot rotate inside the female part. The opposite edges, five on each of said male pentagonal first engagement part and pentagonal second engagement part, abut and serves to prevent rotation of the first engagement means inside the second engagement means.

The engagement between the first engagement part and the second engagement part may advantageously be frictional to allow easy removal and replacement of the first means, without giving up or reducing strength and level of engagement force. Thus, in a preferred embodiment the first engagement part and the second engagement part can be detachably engaged.

In a design of the first means which is suited for being mounted at the elongated main body, the first means comprises a coupling rod for establishing electric communication to the switch means, which coupling rod extends into an electrode tip part via the securing part.

At least the electrode tip part may have a non-stick coating. to prevent building up eschar during surgery or at least make cleaning of the electrode tip easier. A suitable coating material may e.g. be a Teflon® coating however other compounds having similar properties are also foreseen within the scope of the present invention.

The first means may have a sleeve that extends axially over at least a part of the axial section of the first means. The sleeve may serve to seal the circumference of the first means in relation to the holder so as to keep liquid matter and gasses away from the switch means and the interior of the elongated main body. The sleeve increases the diameter and the cross-section of a distal section of the first means to serve as a sealing plug.

Preferably, the sleeve is made of insulation material or electrically non-conductive material to serve as an insulation sleeve for potential short circuit protection. The sleeve can be provided on the first means in any suitable way, e.g. being shrinked on or moulded onto the first means.

The part of the axial section of the first means that is covered by the sleeve can be at least a length of the coupling rod and/or at least a part of the securing part. The sleeve should not cover the electrode tip.

The diameter of the securing part, optionally when covered with the insulation sleeve, corresponds to or is slightly larger than the diameter of the first opening of the elongated main body, so that matter evolving during surgery cannot enter the elongated main body.

The holder may have an annular collar part through which at least the coupling rod of the first means extends for the first means to be set in electrical communication with the switch means. The annular collar part of the holder may advantageously serve to confer dimensional stability to the elongated main body when the first means are inserted into the holder via the first end of the elongated main body, and to ensure the position of the second engagement part.

The first means may preferably be a blade electrode. Most blade electrodes are symmetrical along their axial length and benefit from all five potential angular locking positions of the penta-lock system according to the present invention. Accordingly there are two extra angular positions for arranging a plane through the cutting blade and thus the cutting edge compared to a hex-lock.

Emphasize is made that the electrosurgical instrument according to the present invention need not include suction means but is also suited for such electrosurgical instrument that comprises suction means, which suction means includes a suction channel with a first suction port.

The suction channel with the suction port may expediently be constituted by a tubular part of the elongated main body that defines a hollow second compartment, which tubular part is joined with a cover part to define an elongated hollow first compartment for accommodating at least the switch means, which switch means then can be kept out of risk getting wet. A suction port is preferably provided adjacent the first means so that matter can be evacuated from the surgical site on demand to allow a clear view to the electrode tip of the first means. A suction tip may be provided over the suction port encircling the first means.

The holder may be made integral with the tubular part so that when the first means and the suction tip is both mounted on the elongated main body, i.e. cover part and tubular part is assembled, then the longitudinal axis of the first means and the longitudinal axis of the suction tip is substantially coaxial with the longitudinal axis of the elongated main body.

The present invention further relates to an electrosurgical conductive electrode for use with an electrosurgical instrument for at least cutting tissue of a patient during surgery by

application of electrical energy supplied from an electrosurgical generator.

The electrosurgical conductive electrode has a securing part with a first engagement part of a first pentagonal cross-section to provide a conductive electrode for use in the novel “penta-lock” system described above.

The electrosurgical conductive electrode advantageously comprises a coupling rod for establishing electric communication to a switch means of the electrosurgical instrument, which coupling rod extends into an electrode tip part via the securing part. To avoid building up debris, eschar and burnt tissue on the active surface of the electrode at least the electrode tip part has a non-stick coating.

The simplest embodiment of the electrosurgical conductive electrode may have a first engagement part that is a male part. Alternatively the first engagement part could be a female pentagonal channel part inside a section of an axial length of the securing part, optionally inside the coupling rod. In that case a corresponding second engagement means on the elongated main body may be a protruding male plug with a complementary fitting pentagonal second cross-section.

As described above the electrosurgical conductive electrode may include a sleeve that extends axially over at least a part of the axial section of the electrosurgical conductive electrode. The sleeve encapsulates or envelopes the axial section of the electrosurgical conductive electrode where it is provided, and beneficially serves to seal around this section as well as enhance frictional engagement.

Preferably, the sleeve is an insulation sleeve that ensures that current does not go astray to other parts of the instrument other than the electrode tip. Only parts of the

electrosurgical conductive electrode are exposed from the insulation sleeve, in particular the tip part is exposed.

In one embodiment of the electrosurgical conductive electrode the part of the axial section of the electrosurgical conductive electrode that is covered by the sleeve is at least a length of the coupling rod and/or at least a part of the securing part. Only the electrode tip part, that is intended for at least electrosurgical cutting may be exposed, to prevent accidental cutting or similar electrosurgical functions, including but not limited to coagulation, cauterization, fulguration, etc. depending on the choice of electrosurgical electrode with penta-lock. More or less of the coupling rod may or may not be surrounded by the insulation sleeve as long as electrosurgical connection to an electrosurgical instrument's switch means, and thus the electrosurgical generator, can be established.

The diameter or cross-section of the securing part, optionally when covered with the insulation sleeve, corresponds to or is slightly larger than the diameter or cross-section of a first opening of an elongated main body of an electrosurgical instrument through which the electrosurgical conductive electrode is to be fitted for getting into electrical communication with the electrosurgical generator via the switch means. Said electrode provides in itself, or together with the sleeve, a required sealing effect, as well as a securing effect that is sufficient to ensure any unintended dislocation of said electrode.

Preferably the securing part, or other part of the first means, may be provided with markings to facilitate proper orientation of the first means in relation to any of the switch means, actuator and/or the elongated body. The marking may be provided both for correct angular positioning and for correct axial positioning.

A switch means suited for use in the electrosurgical instrument according to the present invention is disclosed in the applicant's co-pending international patent application entitled "*An elongated electrosurgical instrument and a switch means for said instrument*".

A suction tip, a method for its use and kit assemblies suited for use in the electrosurgical instrument according to the present invention is disclosed in the applicant's co-pending international patent application entitled "*An elongated electrosurgical instrument, a suction tip for the electrosurgical instrument and method of adjusting the axial position of the suction tip on the electrosurgical instrument*".

A click-in coupling means and various kit assemblies suited for use in the electrosurgical instrument according to the present invention is disclosed in the applicant's co-pending international patent application entitled "*A coupling means connecting an electrosurgical instrument to a vacuum source, an electrosurgical instrument provided with the coupling means, a kit including the coupling means and their uses*".

The disclosures of the switch means, the first means, and the click-in coupling means made in the above international patent applications, including their special design features, functions and uses, are contemplated used in the present invention and incorporated by references.

The invention will be described in further details below with reference to the drawing, in which exemplary embodiments are shown in accordance with the present invention.

Fig. 1 shows a perspective top view of a first embodiment of an elongated electrosurgical instrument according to the present invention,

fig. 2 shows the elongated main body, the first means, and the switch means in an exploded, enlarged scale perspective view,

fig. 3 shows the tubular part of the first embodiment shown in fig. 1 in a perspective view seen from below,

fig. 4 is a sectional view of the elongated main body shown in fig. 1 taken along line IV-IV illustrating the joining of the tubular part and the cover part, but without the cable,

fig. 5 shows an exploded, perspective view of the switch means and a fragment of an associated cable,

fig. 6 shows an enlarged scale view of the switch means in assembled state with an actuator arranged above,

fig. 7 shows a perspective view seen inside the cavity of the cover part, wherein the switch means and the first means has been inserted,

fig. 8 is a top view of the cover part,

fig. 9 is a view inside the elongated cavity of the cover part provided with the actuator,

fig. 10 shows the cover part seen from the side,

fig. 11 is a fragmentary, enlarged scale view of the first end of the tubular part encircled in fig. 2,

fig. 12 is an axial sectional view taken along line XII-XII in fig. 11,

fig. 13 shows the tubular part seen through the first end of the elongated main body, and prior to inserting the first means,

fig. 14 is an oblique, cross-sectional view taken along line XIV-XIV in fig. 11 seen from the first end of the tubular part,

fig. 15 is a perspective view of the suction tip in front of the elongated main body,

fig. 16 is an end view of the suction tip seen inside the bore of the suction tip from the coupling end part,

fig. 17 is an enlarged scale axial, sectional view of the front end of the tubular part provided with a suction tip,

fig. 18 shows the elongated main body seen from the second end with a fragment of a cable,

fig. 19 is a perspective view seen oblique from a first plug end part of a first embodiment of the first coupling part used in the electrosurgical instrument seen in fig. 1,

fig. 20 shows the same seen oblique from a second plug end part,

fig. 21 shows the same mounted with cable and suction tubing,

fig. 22 is a perspective view seen oblique from a first plug end part of a second embodiment of the first coupling part for use in an electrosurgical instrument according to the present invention,

fig. 23 shows the same seen oblique from a second plug end part,

fig. 24 shows the same mounted with cable and suction tubing,

fig. 25 is a perspective view seen oblique from a first plug end part of a third embodiment of the first coupling part for

use in an electrosurgical instrument according to the present invention,

fig. 26 shows the same seen oblique from a second plug end part,

fig. 27 shows the same mounted with a cable,

fig. 28 is an oblique perspective view of the second coupling part seen from the end intended for being connected to the vacuum source,

fig. 29 shows the same seen from the opposite end for being connected to the second end of the suction tubing,

fig. 30 shows a modification of the second coupling seen in the same view as in fig. 29,

fig. 31 shows a second embodiment of an actuator for use with the present invention, and

fig. 32 shows the actuator seen directly from a short side, to illustrate the stems of the actuator buttons.

The electrosurgical instrument and switch means according to the present invention is described in more details below by way of exemplary embodiments. The electrosurgical instrument and switch means are versatile and the components of the electrosurgical instrument and switch means can be combined into a plurality of electrosurgical instrument having different properties, functionalities and designs.

Below selected embodiments are described as examples only, of the many ways the components can be combined into various electrosurgical instruments for various purposes. Functionality and design of the electrosurgical instrument can be changed

either at the manufacturing stage or by the surgeon in advance of or in relation to the surgical procedure, as will be understood by the following description. Thus electrosurgical instruments comprising other combinations and arrangements of the inventive components, such as e.g. actuators, first and second coupling parts, providing the cable for connecting to the electrosurgical generator outside and/or inside the suction tubing, kinds of electrodes, and shapes of the elongated main body, and how these components are combined are also intended within the scope of the present invention.

Thus the electrosurgical instrument according to the present invention may be provided to the consumer as a kit including various components to be assembled as desired, e.g. various electrosurgical electrodes, first and/or second coupling parts and tubings of various lengths and properties, to be mounted to the elongated main body according to the surgeons choice and surgical requirements for a given surgical procedure. The surgeon is able to modify the inventive electrosurgical instrument when desired and to compose exactly the instrument he/she prefers for a given surgical patient and medical condition.

Fig. 1 shows a perspective view, seen from an actuator side, of a first embodiment of an elongated electrosurgical instrument 1 according to the present invention. The electrosurgical instrument 1 is of the kind configured for at least cutting and coagulating tissue of a patient during surgery by application of electrical energy supplied from an electrosurgical generator (not shown) to a surgical site (not shown).

The electrosurgical instrument 1 comprises a hollow elongated main body 2, a first means 3 in the form of a blade electrode 3, an actuator 4 for manual application of a force to a switch means 5 below the actuator 4, which switch means 5 is incorporated inside the elongated main body 2 and thus not

visible in fig. 1. A suction tip 6 is mounted at a first end 7 of the elongated main body 2 to surround the blade electrode 3 as well as a first suction port 40 (not visible in fig. 1). A first embodiment of a first coupling part 8 is inserted into a second end 9 of the elongated main body 2 opposite the first end 7, which first coupling part 8 serves as an intermediate member for connecting the second end 9 of the elongated main body 2 to a first end 10 of a flexible suction tubing 11, in the present case e.g. of disposable transparent plastic material. A cable 12 is connected to the switch means 5 to deliver current from an electrosurgical generator (not shown) to the blade electrode 3 in response to actuation of the actuator 4. A logo may be provided on the elongated main body 2, as well as other kinds of decoration and information can be provided on the exterior surface of the elongated main body.

In the present embodiment of the electrosurgical instrument 1 the cable 12 extends inside the suction tubing 11 towards a second end 13 of the suction tubing 11, at which second end 13 a second coupling part 14 is mounted in order for said suction tubing 11 to be appropriately coupled to a vacuum source (not shown). In other embodiments the cable 12 can extend exterior to the suction tubing 11.

The structure and design of the elongated main body 2 is seen more clearly in the exploded, perspective, enlarged scale view of fig. 2.

The first end 7 of the elongated main body 2 has a first opening 15 into which the first means 3, in the present case the blade electrode 3, can pass, to be mounted to the elongated main body 2, thus the combined tubular part 16 and cover part 17, in conductive communication with the switch means 5, optionally in a replaceable manner, so that the surgeon can arrange the angle of the blade electrode 3 in relation to the

main body 2, as desired, or replace the blade electrode 3 with another kind of electrosurgical electrode.

The elongated main body 2 includes two main components, a tubular part 16 and a cover part 17 respectively, which parts 16,17 preferably are manufactured as individual parts which are joined, e.g. by heat sealing, in order to create the elongated main body 2, once all electrosurgical components relevant for the instrument's performance, such as switch means and wires, are mounted appropriately. The tubular part 16 and the cover part 17 may be manufactured by any suitable kind of moulding method and subsequently joined.

A wall 18 of the cover part 17 has a substantially semicircular cross-section for, inside the elongated main body 2, providing space for accommodating both the switch means 5 and at least the part of the actuator 4 that serves to engage said switch means 5. The actuator 4 protrudes only to a minimum extent beyond the outermost circumference of the wall 18 of the cover part 17, but sufficiently for the surgeon to be able to actuate the switch means 5 by using the actuator 4. The actuator 4 does not extend into the tubular part 16, which as will be described in further details later, defines a suction channel 27. In this way the overall exterior appearance of the first embodiment of the electrosurgical instrument 1 is kept elegant and slim in order not only to be easy to handle, but also to preserve a design of the electrosurgical instrument that allows said instrument to be introduced through a very small surgical incision, while at the same time obtaining an electrosurgical instrument with high suction efficiency. Other cross-sections of cover parts 17 may be appropriate too. The cover part 17 may thus be made without a perfect semicircular cross-section, e.g. be made more flat.

The wall 18 of the cover part 17 also has a first aperture part 19, through which a first actuator button 20 for application of

a cutting voltage can pass in order to actuate the cutting mode of the switch means 5, and a second aperture part 21 through which a second actuator button 22 for application of a coagulation voltage can pass in order to actuate the switch means 5 in a coagulation mode of the switch means 5. An exterior side 23 of the wall 18 of the cover part 17 has protruding ribs 24, barbs or other tactile means adjacent the first aperture part 19 and the second aperture part 21. The ribs 24 extend along the longitudinal axis of the cover part 17 on both longitudinal sides of the actuator 4 in order for, on the one hand providing guidance to the surgeon for locating the actuator buttons 20,22, and on the other hand helping the surgeon to get a good hold on the elongated main body 2 during operating the electrosurgical instrument 1. Although preferred, grasping ribs 24, barbs or tactile means at the actuator's position on the main body 2 are optional.

At the first end 7 of the elongated main body 2, both the cover part 17 and the tubular part 16 have opposite facing similar circumferential engagement means 25, e.g. an external thread or spaced apart circumferentially protruding beads, for securing the suction tip 6 in adjustable manner in selected suction position in relation to the longitudinal axis of the elongated main body 2, as shown in fig. 1. A stop web 26 defines an end position of the suction tip 6 on the elongated main body 2. Due to the stop web 26 the suction tip 6 cannot be accidentally pushed too far against the actuator 4 when adjusting the suction position of the suction tip 6. The closer the suction tip 6 gets to the stop web 26 the more of the first means, in the present case the blade electrode 3, is exposed from the suction tip 6. In this way the surgeon is able to choose the distance between the tip of the blade electrode and the suction opening of the suction tip.

The tubular part 16 constitutes a second elongated compartment 27 of the hollow elongated main body when the tubular part 16

is assembled with the cover part 17. The tubular part 16 has a substantially semi-circular exterior wall part 28, which circumferentially merges into an elongated wall part 29 having a substantially flat base 30. The base 30 of the wall part 29 becomes the partition wall 30 of the elongated main body 2 when assembled with the cover part 17. The wall part 29 seals the second compartment 27 from the surroundings to allow the second compartment 27 to serve as the suction channel 27.

The partition wall 30 has guide pins 31 projecting away from the suction channel 27, for arranging the switch means 5 in the correct position in relation to the elongated main body 2, e.g. as shown in fig. 2, closer to the first end 7 of the elongated main body 2 than to the second end 9 of said elongated main body 2. A cable trap 32, defined by a tortuous path for the cable 12, is provided on the partition wall 30 between the second end 9 of the elongated main body 2 and the projecting guide pins 31 for the switch means 5. The cable trap 32 serves to secure the cable 12 firmly inside the electrosurgical instrument 1 to prevent it from being teared off so that electrical connection to the switch means 5 accidentally is lost, e.g. when the surgeon uses the electrosurgical instrument 1.

Between the guide pins 31 and the first end 7 of the elongated main body 2 the tubular part 16 has a holder 33 for securing the blade electrode 3, which blade electrode 3 has a conductive coupling rod 34 that extends into a conductive electrode tip part 35 via a conductive securing part 36. The conductive securing part 36 includes a first engagement part 37 of first pentagonal cross-section, which first engagement part 37 is provided opposite a coupling end 39 of the coupling rod 34. An insulation sleeve 36a may extend axially over at least the part of the length of the securing part not including the first engagement part 37, but can also extend over the first engagement part 37, in which case the pentagonal circumference

and thus the first pentagonal cross-section of the first engagement part is due to shaping of the insulation sleeve 36a. Furthermore the securing part 36 may, as shown in fig. 2 have a scale denominator or one or more indicator lines 36b,36c to help in achieving the correct axial position of the first means 3. As will be described later with reference to e.g. figs. 11 - 14, the holder 33 of the tubular body 16 is shaped complementary to at least a longitudinal section, including the first engagement part 37, of the blade electrode 3 in order to firmly secure the blade electrode 3 or other first means correct inside the holder 33. Thus the holder 33 defines a channel 71, as seen in figs. 11 - 14, with recesses and cavities that accommodate and secure different parts or longitudinal sections of a first means 3. Accordingly, the holder 33 has a second engagement part 38 with a bore with an interior second pentagonal cross-section for engaging the first engagement part 37 of the blade electrode 3 or other first means, which first engagement part 37 has a mating first pentagonal cross-section. Thus, the first engagement part 37 and the hollow second engagement part 38 are dimensioned to mate so intimately that the orientation of the first means 3 maintains fixed during operation of the electrosurgical instrument 1. In case the electrosurgical instrument 1 is intended for use with replaceable first means 3, said first means 3 can advantageously be detachably mounted in the holder 33, and detachably coupled to the switch means 5.

The tubular part 16 can advantageously be moulded as a unit piece including a.o. the exterior wall 28, partition wall 30, protruding guide pins 31, holder 33, exterior ribs 25, and cable trap 32.

As is seen more clearly in fig. 3, the tubular part 16 has the first suction port 40 arranged facing the first means 3 opposite a second suction port 41 at the second end 9 of the elongated main body 2.

A switch means 5 to be provided on the partition wall 30 of the tubular part 16 of the elongated main body 2 is arranged for supplying the electrical energy to the first means 3 in response to operating the actuator 4 above the switch means 5.

The switch means 5 has a first electrical contact 42, another first electrical contact 43 out of physical contact with the first electrical contact 42, and a second electrical contact 44 superjacent the first electrical contacts 42,43. Thus there is a very small distance between the plane of the first electrical contacts 42,43 and the plan of the second electrical contact 44 in the assembled state of the switch means 5, which distance defines a gap into which an insulating insert 45 is provided to prevent unintended closure of circuits and diverted current flow.

The first electrical contact 42 is activated for application of a cutting voltage by means of the first actuator button 20, and the other first electrical contact 43 is activated for application of a coagulation voltage by means of the second actuator button 21. Both first electrical contacts 42,43, the second electrical contact 44, and the insulating insert 45 has holes 46 for receiving the protruding, confronting guide pin 31 on the partition wall 30.

In this way the switch means 5 can in a very simple and fast manner be built on the partition wall 30 by stacking the very few individual components of the switch means on top of each other on the partition wall 30, connecting the cable 12 appropriately to put the switch means 5 into electrical contact with the first means 3, and enclose the switch means 5 by putting the cover part 17 on top of the tubular part 16 to define a first compartment 59a, as seen in figs. 4 and 18, where inside the first compartment 59a the cable 12 for putting the switch means 5 and the first means 3 in electrical communication with the electrosurgical generator extends.

By proper dimensioning of the holes 46 in the electrical contacts 42,43,44 and the diameter of the guide pins 31 on the partition wall 30, individual distances between the first electrical contacts 42,43, and well-defined gaps between any of the first electrical contacts 42,43 and the second electrical contact 44 can be defined in a simple manner. Tapered guide pins 31 can e.g. only pass through the hole 46 just to the extent where the tapered guide pin's 31 diameter's and the hole's diameter's are the same. Simply by making larger holes 46 in the second electrical contact 44, said second electrical contact 44 is able to receive e.g. the full length of the guide pins 31, while smaller holes 46 in the first electrical contacts 42,43 serve to preserve the required insulation distance between any of the first electrical contacts 42,43 and the second electrical contact 44 without the absolute requirement of inserting the insulating insert 45, although such an insulation insert 45 is preferred in most embodiments. The lateral distance between the two first electrical contacts 42,43 is obtained by corresponding suitable allocation of the guide pins 31 across the partition wall 30.

Fig. 4 is a cross-sectional view taken along line IV-IV in fig. 1 shown without the cable 12 or any other component inside the cover part 17 to better illustrate the size of the compartments. The suction channel 27 is the second compartment 27 of the tubular part 16, and the first compartment 59a is created when a cavity 59 of the cover part 17 is placed arching the partition wall 30 of the tubular part 16. Due to the partition wall 30 all electronic components can be kept inside the first compartment 59a isolated from the large suction flow pathway 27. The unobstructed large cross-section of the suction channel 27 provides a very high flow velocity and therefore confers high suction performance to the electrosurgical instrument according to the present invention.

Fig. 5 is an exploded perspective view of the switch means 5, which was shown in assembled state in fig. 2, and is seen in the perspective view in fig. 6 with the actuator arranged aligned above.

The first electrical contact 42 has a first main body part 47 configured as a first conductive sheet component 47, the other first electrical contact 43, i.e. the second first electrical contact 43 has a second first main body part 48 configured as a second first conductive sheet component 48. The second electrical contact 44 has a second main body part 50 configured as a second conductive sheet component 50. The second conductive sheet component 50 has an electrode contacting end 51 with an electrode connection terminal 52 for securing the first means 3, and an opposite cable connection end 53 with a third wire connection terminal 54. The electrode connection terminal 52 is configured as a clamp 52 to fittingly engage the conductive coupling rod 34 of the blade electrode 3. The conductive coupling rod 34 is inserted into the electrode connection terminal 52 of the second conductive sheet component 50 to establish electrical contact to the conductive blade electrode tip 35. In the present embodiment the electrode connection terminal 52 is illustrated as a clamp, however other designs are foreseen within the scope of the present invention.

The third wire connection terminal 54 is used for securing a third 12c of three wires of the cable 12 so that the correct voltage can be supplied to the first means 3 from an electrosurgical generator in response to a measurement of an electrical parameter representing an identification of which actuator buttons 20,22 that have been actuated. To that aspect the first 42 of the first electrical contacts 42,43 has a first wire connection terminal 55 for securing a first 12a of three wires of the cable 12, and the second 43 of the first electrical contacts 42,43 has a second wire connection terminal 56 for securing a second 12b of three wires of the cable 12. In

the present case the cable 12 is a Schneider cable, where the conductor insulation is penetrated once the wire is introduced in a respective wire connection terminal.

The first conductive sheet component 47 of the first 42 of the first electrical contacts 42,43 has a raised or projecting contact part 57, and the second first conductive sheet component 48 of the second 43 of the first electrical contacts 42,43 has a raised or projecting contact part 58. The insulating insert 45 has actuating apertures 49a,49b, to allow passage of the aligned selected raised or projecting contact part 57,58 of the respective first electrical contacts 42,43 towards the second conductive sheet component 50 in response to a force application on the similarly aligned respective actuator button 20,21. When a raised or projecting contact part 57,58 touch the second conductive sheet component 50, a circuit is closed so that current of a voltage level related to the actuated actuator buttons 20,21 can flow from the electrosurgical generator to the conductive blade electrode 3 via the cable 12. No expensive optical switches or thick and complex PCB's are required. The use of simple, thin, substantially flat stacked conductive sheet components makes it possible to create a switch means 5 that appear considerable flatter than known switch means used in conventional electrosurgical instruments for similar purposes. The conductive sheets components 47,48,50 used in the inventive switch means 5 can easily be stamped, punched or cut from of thin plate, e.g. of metal. The holes for the guide pins and cutting of slits to make the raised parts can be made in the same process step. Wire connection terminals and the terminal for the first means can be made by subsequent or simultaneous bending or folding.

In the exemplary embodiment of the switch means 5 shown in figs. 2, 5 and 6 the first 42,43 electrical contacts have bended sides or walls, that facilitates fitting of the first

electrical contacts 42,43 on the partition wall 30. Bended sides or walls are expedient when placing the sheet components on the partition wall, however not mandatory features of the first electrical contacts 42,43, but can if desired be made in the same bending process as the terminals 55,56. In case further electrical functionalities in addition to cutting and coagulation is desired implemented in the electrosurgical instrument 1 according to the present invention, more than two first electrical contacts can be included in the switch means 5, and the actuator 4 be adapted accordingly, at minimal further costs. For example, it is possible to make an electrosurgical instrument where the surgeon is able to switch between more that two voltage levels by using easy accessible buttons on the instrument instead of reaching to the electrosurgical generator simply by including an inexpensive further first electrical contact and wiring in the switch means, and corresponding actuator button.

In fig. 6 the switch means 5 is illustrated with the actuator 4 arranged above so that the actuator buttons 20,21 are aligned with the raised or projecting parts 57,58.

Fig. 7 is a fragmentary perspective view inside the elongated opening or cavity 59 of the cover part 17 of the elongated main body 2. The switch means 5 is inserted in the cover part 17 and seen from a bottom side 60 of the second electrical contact 44. The electrode connecting terminal 52 protrudes towards the first end 7 of the elongated main body 2's cover part 17, and the coupling rod 34 of the blade electrode 3 is clamped into said electrode connecting terminal 52, while the remainder of the first means 3 extends through the holder 33 of the tubular part 16 when joined with the cover part. The switch means 5 is isolated from the suction channel and cannot get into contact with sucked matter from the surgical site. Appropriate sealing can e.g. be obtained by providing a sealing material 62 at a conductive transition 61 between the electrode connecting

terminal 52 and the second conductive sheet component 50. The sealing material 62 can e.g. be provided during the process of heat-sealing the cover part 17 together with the tubular part 16. The sealing material 62 can also be provided as a transverse wall or a sealing part distal to or around e.g. the conductive transition 61. The insulation material 62 can be of the same or other plastic material as used for the elongated main body 2.

The cavity 59 of the cover part 17 has a first cable guide member 63 disposed a short distance from the second end 9 of the cover part 17 of the elongated main body 2. Proximal to the first cable guide member 63 said second end 9 is designed to receive the first coupling part 8 for providing communication to the vacuum source. In order for the cable 12 to pass smoothly without kinks inside the cover part 17 a second cable guide member 64 is made integral with the wall of the cover part 17 proximal to the first cable guide member 63. One or both of the cable guide members 63,64 can be left out if expedient or more cable guide members be included if necessary.

The elongated edges of the circumferential wall 18 of the cover part 17 has respective coupling webs 65a,66a to mate with complementary coupling webs 65b,66b, as seen in fig. 2, on the tubular part 16 when tubular part 16 and cover part 17 are joined to create the double-lumened elongated main body. A plurality of distance members 67 is distributed inside the cavity 59 along the elongated sides to further serves to locate the tubular part 16 on the partition wall 30 correct, as well as to enforce the joined structure 16,17 and provide structural stability to the elongated main body 2.

An alternative method of joining the tubular part 16 and the cover part 17 could be gluing, however combinations of methods are within the scope of the present invention. Glue can be applied if considered expedient at any surfaces, such as e.g.

at any of the coupling webs 65a,66a, the complementary coupling webs 65b,66b and the distance members 67.

Fig. 8 is a top view of the cover part 17. The actuator 4 is illustrated with different designs of actuator buttons 20,22. The differences in designs helps the surgeon to identify the correct button, and thus serves as a safety means for application either cutting voltage or coagulation voltage. The ribs 24 on both sides of the cover part 17's circumferential wall 18 next to the actuator 4 helps the surgeon to find and maintain the hand and fingers on the correct longitudinal position on the elongated main body 2. If the elongated main body 2 gets slippery the surface irregularities provided by the ribs 24 that are shaped substantially as barbs in the present embodiment prevents the surgeon from loosing his/her grip.

In the view of the cover part 17 seen in fig. 9 the switch means has been left out, so that stems 68,69 of the first actuator button 20 and the second actuator button 22, respectively, can be seen. When the free ends of the stems 68,69 are forced towards the raised parts 57,58 of the first conductive sheets components 47,48 towards the second conductive sheet component 50 a circuit is closed and current allowed to flow to the first means, as previously described.

Fig. 10 shows the cover part seen from the side and how the stems 68,69 pass through respective first 19 and second 21 aperture halves. The very limited extent of projection of the actuator 4 from the wall 18 of the cover part 17 is due to the very flat switch means 5 that gives the electrosurgical instrument 1 a very streamlined appearance and small largest diameter. The actuator 4 is of the kind that has a common hinge 70 for the first actuator button 20 and the second actuator button 22, but other kinds of actuators having individual actuator buttons are also foreseen, as illustrated in figs. 30 and 31.

The first means 3 needs to be mounted or be mountable to the elongated main body in a safe manner. Longitudinal displacement or accidentally dropping out must be avoided, and the correct angular position in relation to the location of the actuator may be important to the surgeon. A hook electrode bent as an L must e.g. be positioned so that operating tip of the hook electrode faces towards the tissue when the surgeon holds the instrument in a manner that enables him/her also to operate the actuator, and thus to operate the switch means.

These problems are solved according to the present invention by providing a specially designed holder 33 at the first end 7 of the elongated main body 2.

Fig. 11 is a fragmentary, enlarged scale view of the first end 7 of the tubular part 16 encircled in fig. 2.

The holder 33 has a holder body with a channel 71 for accommodating the blade electrode 3, and securing both the angular and axial position of said blade electrode 3 to the elongated main body 2. The second engagement part 38 of the holder 33 has an interior section crosswise the longitudinal axis of the channel of the holder. The second engagement part 38 has a second pentagonal cross-section sized to intimately engage the first pentagonal cross-section of the first engagement part 37 of the blade electrode 3. In case the electrosurgical instrument 1 is intended for use with replaceable first means 3, said first means 3 can advantageously be detachably mounted in the holder 33, thus also be detachably coupled to the switch means 5.

Each of the pentagonal cross-sections of blade electrode 3 and second engagement part 38 of holder 33, respectively, have five engaging edges thereby providing five potentially different positions and angular orientations into which a first means 3 can be placed and arranged. Conventionally first means 3 has

first engagement parts 37 with hexagonal cross-section, and if the electrode tip 35 has a symmetrical design, such a conventional electrode tip can only be positioned and orientated in three different angular positions. Thus a pentagonal cross-section of the first engagement part confers more versatile positioning of in particular a first means with a symmetrical electrode tip, i.e. a symmetrical electrode tip part for cutting and coagulation of tissue.

Thus, the first engagement part 37 and the second engagement part 38 engage intimately so that the orientation of a first means 3, in this case the blade electrode 3, maintains firmly fixed during operation of the instrument. In contrast most engagement parts on conventional electrosurgical electrodes have six edges, thus they have hexagonal cross-sections. However, the more edges the more circular the cross-section becomes and the higher the risk that the electrosurgical electrode be dislocated during use, or is not placed correct during the assembling process, in particular gets angular dislocated. Engagement parts with less than five edges, e.g. having squared cross-sections, are less preferred due to the limited number of possible angular positions.

The conductive securing part 36 of the first means 3 includes the enveloping insulation sleeve 36a that improves sealing and engagement at the first opening 15 of the tubular part when the conductive securing part 36 is fitted into the hollow socket 72 of the holder 33 distal to said second engagement part 38. The conductive securing part 36 with enveloping insulation sleeve 36a has a larger cross-section or is wider than the second pentagonal cross-section of the second engagement part 38 of the holder 33, so that the securing part 36 with enveloping insulation sleeve 36a can serve as a plug or stop in a socket 72 to thereby prevent displacement of the first means 3 in relation to the longitudinal axis of the elongated main body 2 towards the second end 9 of said elongated main body 2 so that

the switch means 5 gets damaged. In summary the arrangement of the securing part 36 with enveloping insulation sleeve 36a and the socket 72 ensures the axial position and engagement of pentagonal part 37 of first means 3 and pentagonal part 38 of holder 33 in relation to each other. The pentagonal parts 38,37 of the holder 33 and first means 3, respectively, with pentagonal cross-sections serve to prevent any unintended angular dislocation or repositioning while still offering the possibility of deliberate, preselected, angular positioning of the first means 3. The holder 33 has an annular collar part 73 proximal to the pentagonal second engagement part 38 of holder 33 and a hollow connection piece 74 proximal to the annular collar part 73. The hollow connection piece 74 extends with the bore of the hollow connection piece 74 on both sides of the annular collar part 73, through said annular collar part 73, into the pentagonal second engagement part 38 of holder 33, and ends in hollow socket 72 thereby creating channel 71, with the first opening 15 at the first end 7 of the elongated main body 2 and an opposite channel entry 75, through which the coupling rod 34 of the first means 3 protrudes for engaging the electrode connection terminal 52 of the switch means 5. The first end 7 of the elongated main body 2 tapers towards the hollow socket 72 and the holder 33 can be configured to extend above the plane of the partition wall 30 to an extent that allows the first means to protrude from the opening 15 substantially concentric with the suction opening 77, as seen in fig. 15, of the suction tip, thus so that it is ensured that electrode tip part 35 and suction tip 6 does not contact.

Fig. 12 is a sectional view taken along line XII-XII in fig. 11 to visualize the longitudinal channel 71 of the holder 33 that serves to accommodate and secure the first means 3. The second engagement part 38 of pentagonal cross-section appears proximal to annular socket 72 and distal to annular collar part 73.

Fig. 13 is a front view inside the channel 71, seen from the tapering, hollow, annular socket 72 of the tubular part 16, prior to inserting the first means 3. Fig. 14 shows substantially the same but is a cross-sectional view taken along line XIV-XIV in fig. 11, distal to the first suction port 40 of the tubular part 16, but seen slightly oblique from the first end 7 of the tubular part 16, in order to better see the location of the pentagonal cross-section of the second engagement part 38 of the holder 33 inside channel 71.

The suction tip 6 is seen in perspective view in fig. 15 in front of the first suction port 40 of the elongated main body 2, which elongated main body 2 includes joined cover part 17 and tubular part 16.

The suction tip 6 has a coupling end part 76 opposite the suction opening 77. The coupling end part 76 is dimensioned to fit sealingly over the first end 7 of the elongated main body 2 to cover the first suction port 40, optionally in detachable manner. The coupling end part 76 of the suction tip 6 has a first engagement means 78 for engagement with the second engagement means 25, the circumferential second engagement means 25, as an example in form of an exterior thread, on the first end 7 of the elongated main body 2 proximal to the first suction port 40. The first engagement means 78 and the second engagement means 25 are configured so that an axial position of the suction tip 6 in relation to the first means 3 is adjustable in response to movement of the suction tip 6 about and/or along a longitudinal axis A of said suction tip 6. In a preferred embodiment the suction tip 6 is transparent to allow the surgeon to monitor, not only adjusting axial location of suction tip 6 in relation to the blade electrode 3, but also to see composition of sucked matter at any convenient point of time during surgery.

The first engagement means 78 is provided on an interior side of a circumferential coupling wall 79 of the coupling end part 76 and protrudes radially inside a bore 80 of suction tip 6 at the coupling end part 76 in order to engage the second engagement means 25 of the elongated main body 2, as is seen more clearly in figs. 16 and 17. The first engagement means 78 can e.g. be an interior thread, at least one annular bead, one or more spaced apart engagement elements, or combinations of the aforementioned.

The coupling end part 76 of the suction tip 6 extends via an intermediate, optionally tapering, suction part 81 into a suction end part 82 part with a tubular, non-tapering mouth 83 that ends in the suction opening 77. Other designs or modifications of the mouth 83 are intended within the scope of the present invention. The mouth 83 can e.g. have a flared skirt part (not shown) to further improve turbulence at the suction opening 77 and through the suction channel 27 out of the second end 9 of the elongated main body 2. Regarding transparency, it is most preferred that at least the suction end part 82, the intermediate suction part 81 and the mouth 83 are made of a transparent material, e.g. a plastic material that can be recycled.

The coupling end part 76 of the suction tip 6 has exterior tactile means 84 to allow the surgeon to actually feel operation of the suction tip 6 when manipulating the axial position of the suction tip 6, should he/she suddenly discover that it would be better to expose more or less of the blade electrode part 35 from the suction opening 77 at a given moment during the surgical procedure, e.g. in order to change distance of mouth 83 to the wound created by the voltage applied by the blade electrode tip part 35. Thus, not only can the surgeon operate the actuator 4 with his/hers fingers without looking at the electrosurgical instrument 1, he/she can also make a qualified adjustment of the axial position of the suction tip 6

without actually being able to see what he/she is doing because he/she knows the position of the tactile means 84, e.g. one or more ribs, beads, corrugations, indents or other uneven surface topography.

In the present exemplary embodiment the first engagement means 78 is achieved by five spaced apart engagement elements 78a,78b,78c,78d,78e in the form of radial webs provided close to the opening at the coupling end 76 of the suction tip, as can be seen in the end view of the suction tip 6 seen in fig. 16 inside the bore 80. Alternative engagement elements can be provided. An interior thread may e.g. serve to be screwed on the exterior thread 25 on the elongated main body 2. Just one radial web may be required to achieve the beneficial inventive adjustable engagement between suction tip and hollow elongated main body.

The interaction of the first engagement means 78 and the second engagement means 25 creates a further tactile means for adjusting and fine tuning axial position of suction tip 6 on the first end 7 of the elongated main body 2. In the present embodiment adjusting of mutual axial position between first engagement means 78 and second engagement means 25 can, as an example, be done by screwing or rotating the coupling end part 76 of the suction tip 6 onto the second engagements means 25, or by application of a small axial force to the suction tip 6, e.g. by pushing the suction tip 6 towards and away from the stop element in form of a stop web 26 on the cover part 17 of the elongated main body 2. When webs 78a,78b,78c,78d,78e snaps into valleys 85 between ribs 86 of the thread or other circumferential projections of the second engagement means 25 the surgeon can easily feel it. So the surgeon easily experiences displacement or adjusting actions. Pushing the suction tip 6 may be preferred in preference to or in combination with rotation for initial adjusting and fine adjustment, but it is up to the surgeon to decide if rotation

or axial force application are most preferred, e.g. in dependency of the surgical condition and spatial limitations and requirements. Embodiments including just on radial web are contemplated within the scope of the present invention.

The enlarged scale view of fig. 17 shows a fragment of the first end 7 of the tubular part 16 with the suction tip mounted at the elongated main body 2 to illustrate how the exterior tactile means 84 of the suction tip is arranged encircling the first engagement means 25. Only one of the webs 78, namely web 78e can be seen in fig. 17. Web 78e engages valley 85 to ensure the axial position in relation to the second engagement means 25.

The second end 9 of the elongated main body 2 could, as conventional electrosurgical instruments be adapted to be directly coupled to the vacuum source. It is however intended that the electrosurgical instrument 1 can be used with the cable outside the suction tubing, the cable inside the suction tubing or without the suction tubing.

To that aspect the electrosurgical instrument or the assembly kit for the electrosurgical instrument may, e.g. as an accessories comprise one or more different first coupling parts designed for fitting into the second coupling end 9 of the elongated main body 2, which second coupling end 9 is seen in fig. 18. The cable 12 is bedded in second cable guide member 64 of the cover part 17 and emerges from a first click-in opening 87 of the elongated first compartment 59a at the second end 9 of the elongated main body 2 above a second click-in opening 88 of the suction channel 27.

Fig. 19 is a perspective view seen oblique from a first plug end part 89 of a first embodiment of the first coupling part 8 used in the electrosurgical instrument 1 seen in fig. 1, and fig. 20 is the same seen from the opposite end.

The first plug end part 89 has a first end-closed click-in part 90 for engaging, e.g. by force-fitting into frictional engagement, and closing off the first click-in opening 87 of the elongated first compartment 59a. Below the first end-closed click-in part 90 the first plug end part 89 has a hollow second click-in part 91 for engaging the second click-in opening 88 of the suction channel 27, to thereby allow suction from the surgical site to a waste receptacle.

The first plug end part 89 extends via a circumferential collar 92 into a bevelled second plug end part 93 that fits into the first end 10 of the suction tubing 11. Coupling barbs 94 is provided on the exterior side of the second plug end part 93 to prevent unintended detachment of the suction tubing 11 once connected.

The circumferential collar 92 has substantially the same outline as or slightly larger than the outline of the second end 9 of the elongated main body 2. The collar 92 serves to end fit said elongated main body 2, as well as a stop for the suction tubing 11.

The hollow second click-in part 91 has a suction inlet 95 that extends into the bore 96 of the second plug end part 93 towards a suction outlet 97 thereby allowing passage of sucked matter from the elongated main body 2, through the first coupling part 8, and into the suction tubing 11.

A first cable groove 98 is provided in the first plug end part 89 to receive the cable 12 when the first end-closed click-in part 90 is mounted inside the first click-in opening 87. The first cable groove 98 becomes substantially axially aligned with a corresponding cable groove of at least any of the first and second cable guide members 63,64 of the cover part 17, to allow the cable 12 to pass in recessed manner and the suction tubing 11 to be mounted to surround the cable 12. When using

the first embodiment of a first coupling part 8 the cable 12 passes inside the suction tubing 11, as is seen more clearly in fig. 21.

Figs. 22 and 23 show a second embodiment of a first coupling part 8' that corresponds substantially to the first coupling part 8, and for like parts same reference numerals are used.

The second embodiment of a first coupling parts 8' is modified in that the circumferential collar 92' is thicker, i.e. has a longer axial extent, and that the first cable groove 98' ends blind in the circumferential collar 92' to enable exit of the cable 12 at this location, as illustrated in fig. 24.

Fig. 25 and 26 show a third embodiment of a first coupling part 8'' for use in an elongated main body 2 according to the present invention. The third embodiment of a first coupling part 8'' has a modified first plug end part 89', and for like parts same reference numerals are used.

The first plug end part 89'' has a first end-closed click-in part 90'' for engaging, e.g. by force-fitting into frictional engagement, and closing off the first click-in opening 87 of the elongated first compartment 59a. Below the first end-closed click-in part 90'' the first plug end part 89'' has a blind second click-in part 99 for engaging the second click-in opening 88 of the suction channel 27, to thereby close the suction channel 27 and allow the electrosurgical instrument 1 to be used without suction, thus as a simple electrosurgical pencil if desired.

In a manner similar to the first cable groove 98 of the first embodiment of the first end-closed click-in part 90, the first cable groove 98'' extends into the first end-closed click-in part 90'' through the circumferential collar 92'' where the first cable groove 98'' exits into a bevelled second plug end

part 93'' that is end capped by base surface, wall part or cap 100.

Fig. 27 shows the third embodiment of a first coupling part 8'' with a cable 12 arranged inside the first cable groove 98'', thus the suction channel 27 will be closed by the second plug end part 93''.

Fig. 28 is an oblique perspective view of the second coupling part 14 seen from a vacuum source coupling end part 101, i.e. from the end intended for being connected to the vacuum source.

The vacuum source coupling end part 101 has two concentric tubes, an inner tube 102 and an outer tube 103 of larger internal diameter than the inner tube 102. Due to the different diameters of the tubes 102,103 the second coupling part 14 can be connected to vacuum sources having vacuum connection pieces of two different sizes. Use of the second coupling part therefore facilitates use of the electrosurgical instrument according to the present invention, as well as other medical devices that requires connection to a vacuum source, using one and the same second coupling part 14. Accordingly, often it is not necessary to invest in new vacuum sources or adapters for being able to make use of suction from a conventional vacuum source.

The vacuum source coupling end part 101 extends into the suction tubing end part 104 defined by an annular wall 105 with a second cable groove 106 and serrations 107. The cable groove 105 is provided in a manner similar to the first cable groove 98 of the first coupling end part 8 to allow the cable 12 to exit the suction tubing 11 just in form of vacuum source coupling end part 101, i.e. close to the vacuum source. A evacuation channel 108 extends via the inner tube 102 and into suction tubing end part 104, as seen in fig. 29 that shows the

second coupling part from the end to be connected to the second end 13 of the suction tubing 11.

In a modified embodiment of the second coupling part 14 no second cable groove 105 is provided. The modified second coupling part 14 without second cable groove 106 is suited for use with for example the second embodiment of the first coupling part 8''.

A modification of a second coupling part is shown in fig. 30. The modified second coupling part corresponds to the embodiment shown in fig. 28 and 29 and for like parts same reference numerals are used. The modified second coupling part 14 only differs in that outer tube 103 has one or more slots 109 extending from the free end 110 and inside the other tube. Due to the one or more slots 109, of which only one is shown in fig. 30, the circumferential skirt that defines the wall of the outer tube is split to allow the sides of the slots to overlap and reduce the diameter of the outer tube, so that the outer tube can be compacted to be inserted into a connection piece instead of surrounding the connection piece.

The second coupling parts according to the present invention thus fit standard connection pieces of many different diameters.

A second embodiment of an actuator 4' is seen in fig. 31. The actuator corresponds substantially to the first embodiment of an actuator 4, and for like part same reference numerals are used.

The first embodiment of an actuator 4' is configured as a rocker with opposite rocker arms merging into each other. In contrast the second embodiment of an actuator 4' has no rocker arm. Instead the actuator buttons 20',22' is provided as separate parts with respective stem 68',69'. The buttons

20',22' has different height and surface texture and/or surface to enable the surgeon to identify the relevant button, as seen more clear in the view of fig. 32, where the second embodiment of an actuator 4' is seen from the left side of fig. 31.

The present inventive electrosurgical conductive electrode and electrosurgical instrument with penta-lock system provide the possibility of mounting an electrosurgical conductive electrode into multiple different positions on different electrosurgical instruments. Surgeons and/or manufacturers are offered a hitherto unknown possibility of arranging the electrode on the instrument in his/her favourite position.

Claims

1. An elongated electrosurgical instrument (1) comprising
   - a first means (3) for at least cutting tissue of a patient during surgery by application of electrical energy supplied from an electrosurgical generator to a surgical site in response to operating a switch means (5),
   - an elongated main body (2) having a first end (7) and an opposite second end (9), which first end (7) has a first opening (15) through which the first means (3) protrudes, and which second end (9) is configured for being electrically coupled to the electrosurgical generator, wherein
   - the first means (3) has a securing part (36) for securing to a holder (33) associated with the first end (7) of the elongated main body (2) of the electrosurgical instrument (1),

   characterised in that
   - the securing part (36) of the first means (3) has a first engagement part (37) of a first pentagonal cross-section, and
   - the holder (33) includes a complementary second engagement part (38) for receiving at least a part of the first engagement part (37).

2. An elongated electrosurgical instrument (1) according to claim 1, **characterised** in that the second engagement part (38) is a channel, at least a section of which has a second pentagonal cross-section.

3. An elongated electrosurgical instrument (1) according to claim 1, **characterised** in that the second engagement part (38) is a recess or cavity with at least two edges of a pentagon being part of a second pentagonal cross-section.

4. An elongated electrosurgical instrument (1) according to any of the claims 1, 2 or 3, **characterised** in that the first engagement part (37) is a male part and the second engagement part (38) is a female part.

5. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 4, **characterised** in that the engagement between the first engagement part (37) and the second engagement part (38) is frictional.

6. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 5, **characterised** in that the first engagement part (37) and the second engagement part (38) are detachably engaged.

7. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 6, **characterised** in that the first means (3) comprises a coupling rod (34) for establishing electric communication to the switch means (5), which coupling rod (34) extends into an electrode tip part (35) via the securing part (36).

8. An elongated electrosurgical instrument (1) according to claims 7, **characterised** in that at least the electrode tip part (35) of the first means (3) has a non-stick coating.

9. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 8, **characterised** in that the first means (3) has a sleeve (36a) that extends axially over at least a part of the axial section of the first means (3).

10. An elongated electrosurgical instrument (1) according to claim 9, **characterised** in that the sleeve (36a) is an insulation sleeve.

11. An elongated electrosurgical instrument (1) according to any of the claims 9 or 10, **characterised** in that the part of the axial section of the first means (3) that is covered by the sleeve (36a) is at least a length of the coupling rod (34) and/or at least a part of the securing part (36).

12. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 11, **characterised** in that the diameter of the first means (3), optionally when covered with the insulation sleeve (36a), corresponds to or is slightly larger than the diameter of the first opening (15) of the elongated main body (2).

13. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 12, **characterised** in that the holder (33) has an annular collar part (73) through which at least the coupling rod (34) of the first means (3) extends proximally for the first means (3) to be set in electrical communication with the switch means (4).

14. An elongated electrosurgical instrument (1) according to any of the preceding claims 1 - 13, **characterised** in that the first means (3) is a blade electrode (3).

15. An electrosurgical instrument (1) according to any of the preceding claims 1 - 14, **characterised** in that the electrosurgical instrument (1) comprises suction means, which suction means includes a suction channel (27) with a first suction port (40).

16. An electrosurgical instrument (1) according to claim 15, **characterised** in that the suction channel (27) with the suction port (40) is constituted by a tubular part (16) of the elongated main body (2) that defines a hollow second compartment (27), which tubular part (16) is joined with a

cover part (17) to define an elongated hollow first compartment (59a) for accommodating at least the switch means (5).

17. An electrosurgical instrument (1) according to claim 16, **characterised** in that the holder (33) is made integral with the tubular part (16).

18. An electrosurgical conductive electrode (3) for use with an electrosurgical instrument (1) for at least cutting tissue of a patient during surgery by application of electrical energy supplied from an electrosurgical generator, **characterised** in that the electrosurgical conductive electrode (3) has a securing part (36) with a first engagement part (37) of a first pentagonal cross-section.

19. An electrosurgical conductive electrode (3) according to claim 18, **characterised** in that the electrosurgical conductive electrode (3) comprises a coupling rod (34) for establishing electric communication to a switch means (5) of the electrosurgical instrument (1), which coupling rod (34) extends into an electrode tip part (35) via the securing part (36).

20. An electrosurgical conductive electrode (3) according to claim 19, **characterised** in that at least the electrode tip part (35) has a non-stick coating.

21. An electrosurgical conductive electrode (3) according to any of the claims 18, 19 or 20 **characterised** in that the first engagement part (37) is a male part.

22. An electrosurgical conductive electrode (3) according to any of the preceding claims 18 - 21, **characterised** in that the electrosurgical conductive electrode (3) has a sleeve

(36a) that extends axially over at least a part of the axial section of the electrosurgical conductive electrode (3).

23. An electrosurgical conductive electrode (3) according to claim 22, **characterised** in that the sleeve (36a) is an insulation sleeve (36a).

24. An electrosurgical conductive electrode (3) according to any of the claims 22 or 23, **characterised** in that the part of the axial section of the electrosurgical conductive electrode (3) that is covered by the sleeve (3) is at least a length of the coupling rod (34) and/or at least a part of the securing part (36).

25. An electrosurgical conductive electrode (3) according to any of the preceding claims claim 18 - 24, **characterised** in that the diameter or cross-section of the securing part (36), optionally when covered with the insulation sleeve (36a), corresponds to or is slightly larger than the diameter or cross-section of the first opening (15) of the elongated main body (2).

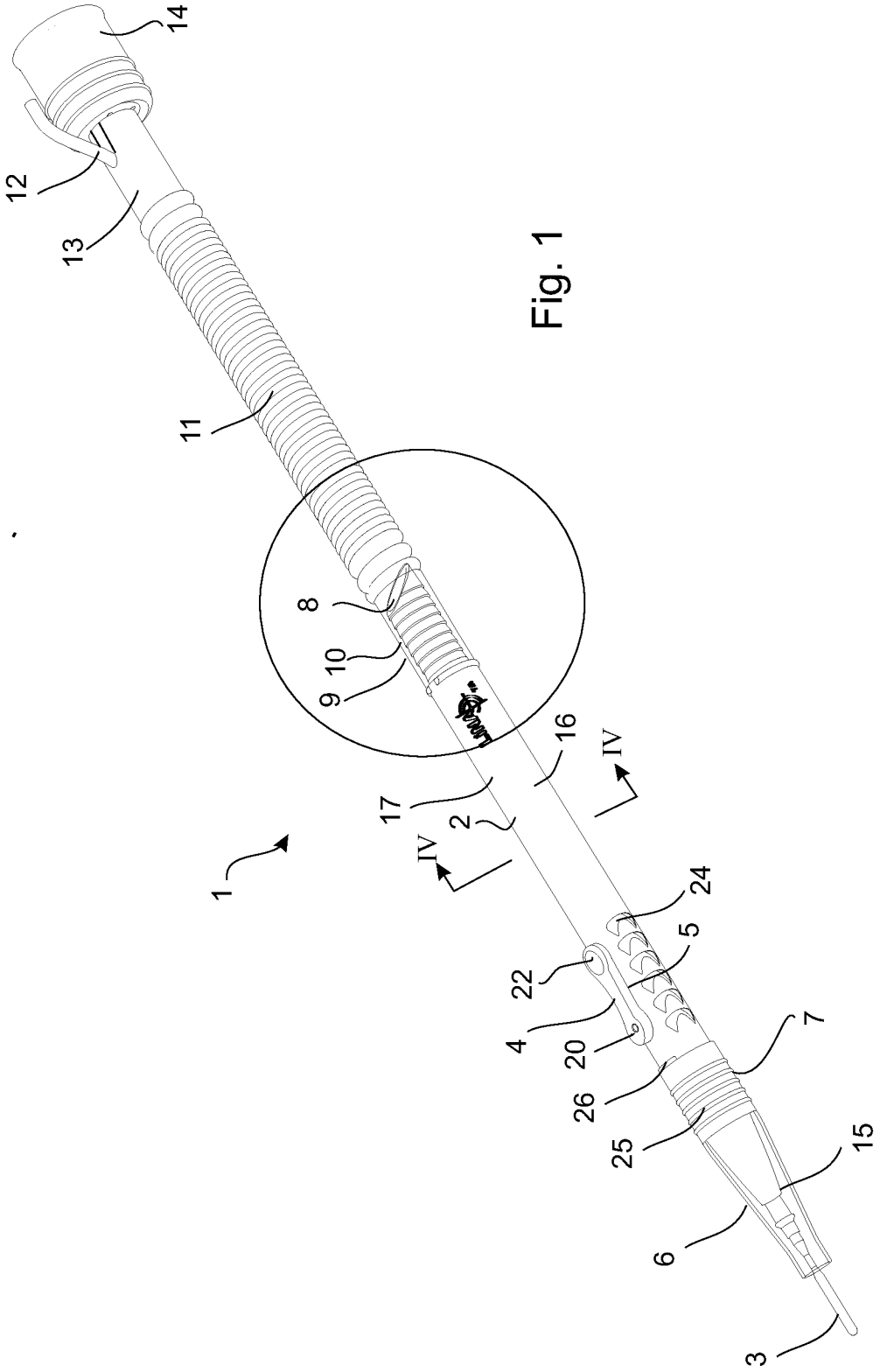

Fig. 1

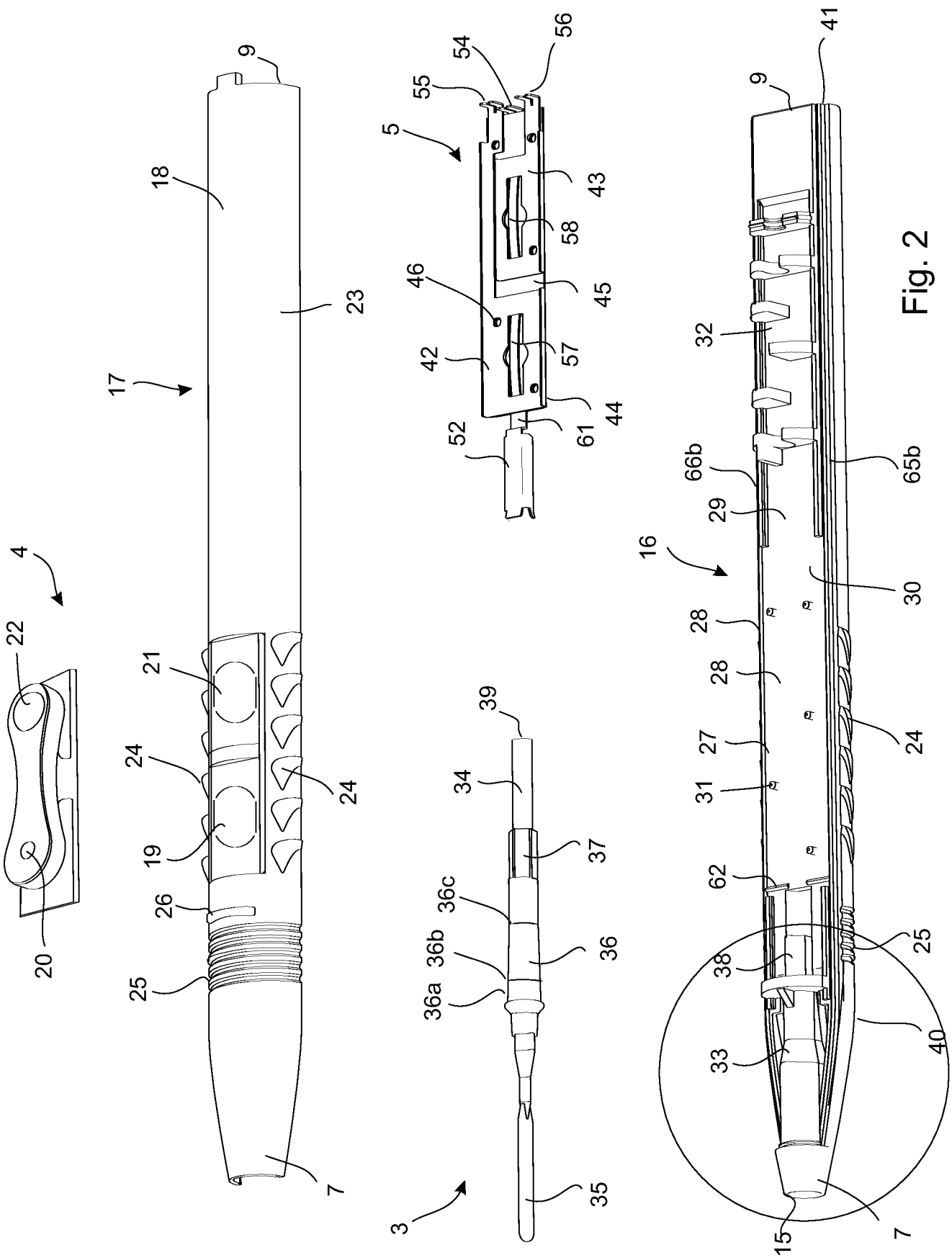
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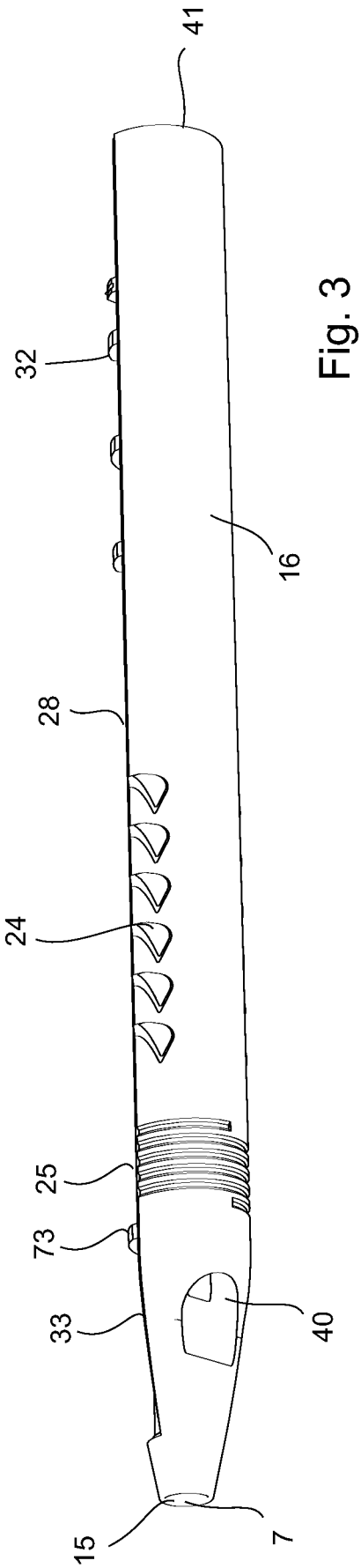
Fig. 2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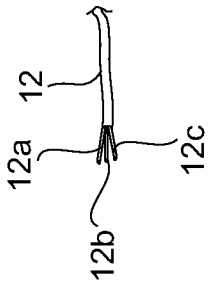
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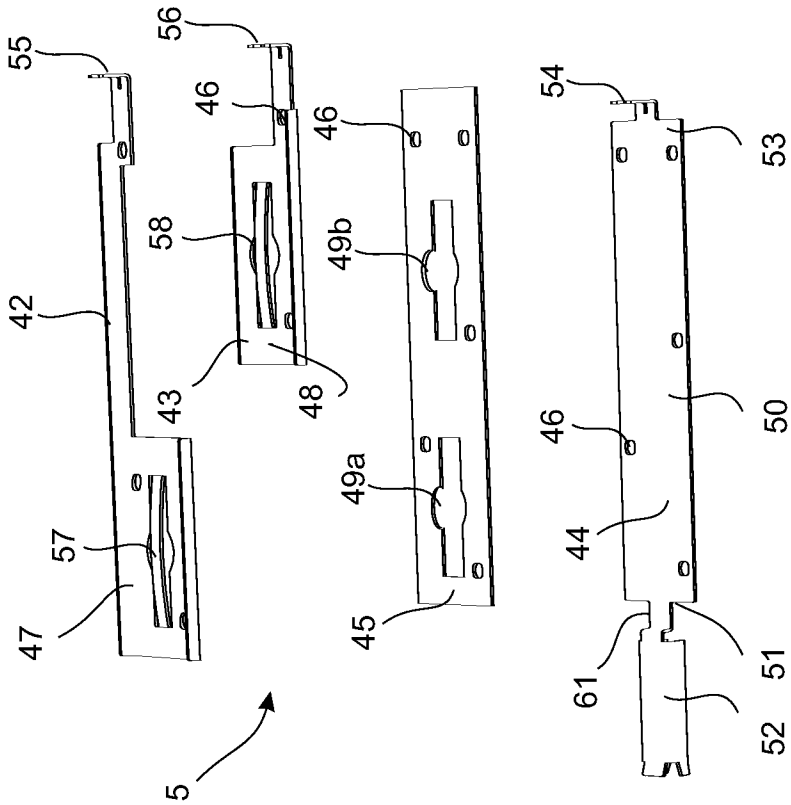
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Fig. 5

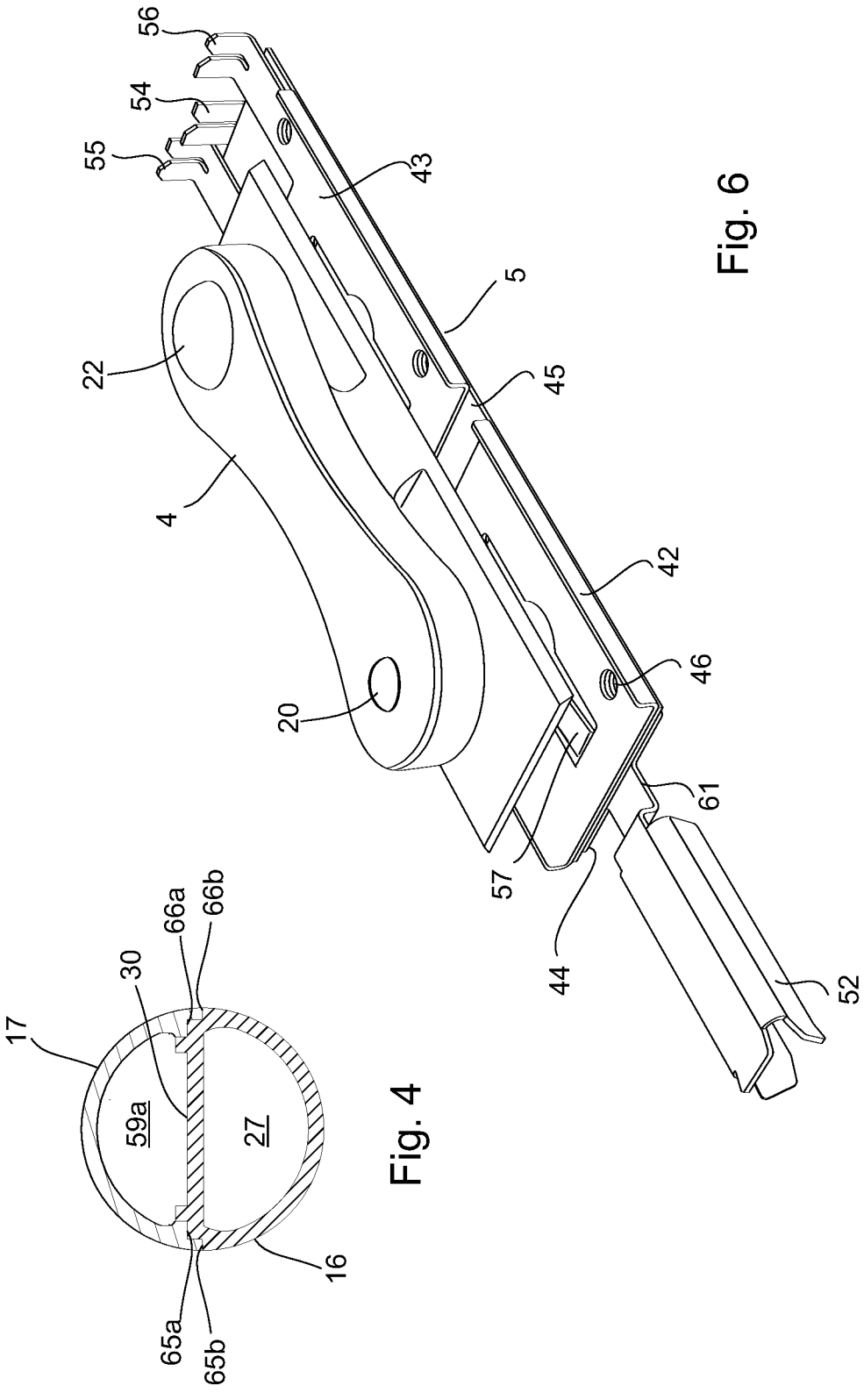
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Fig. 6

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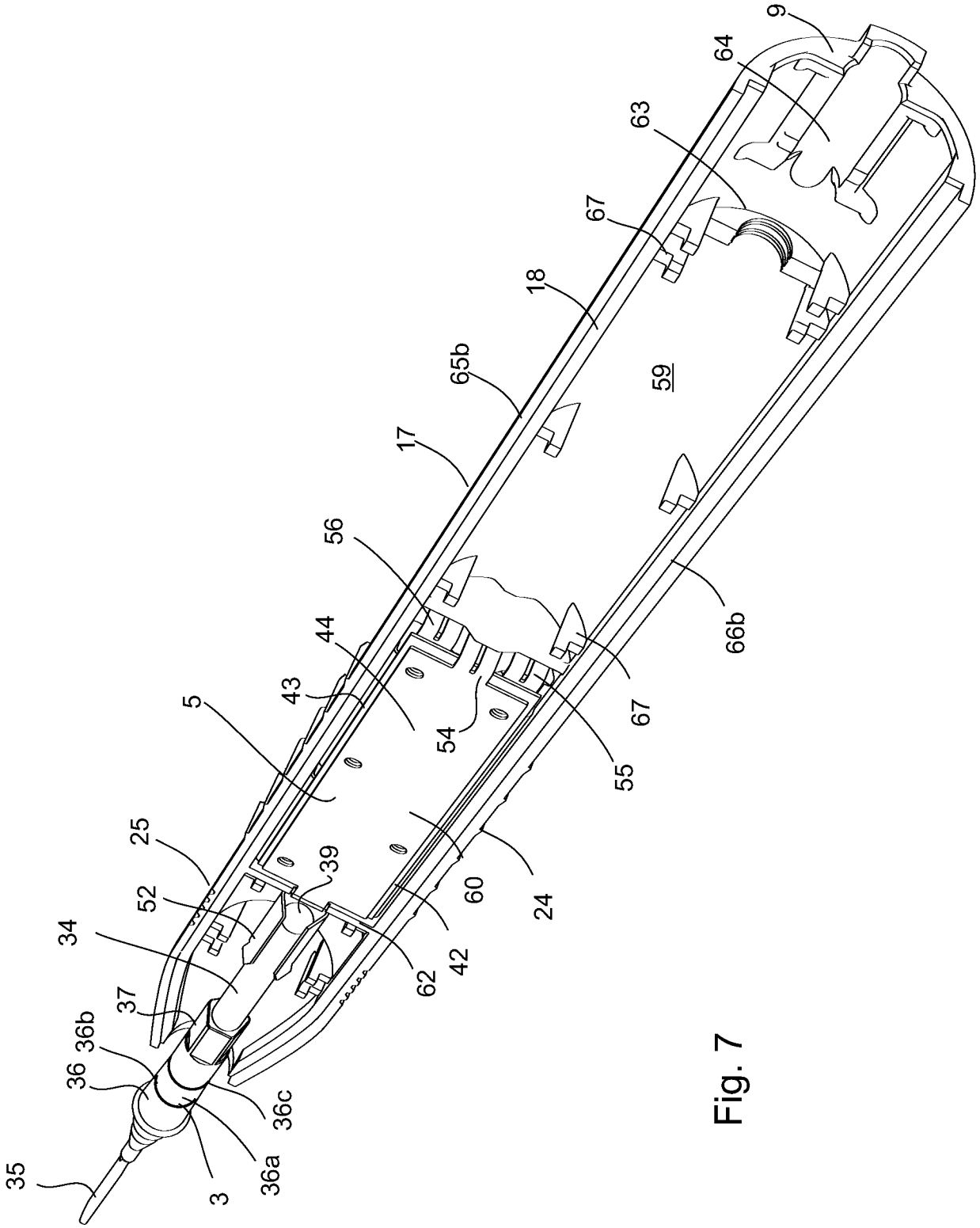
16
65a
65b

Fig. 4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36c
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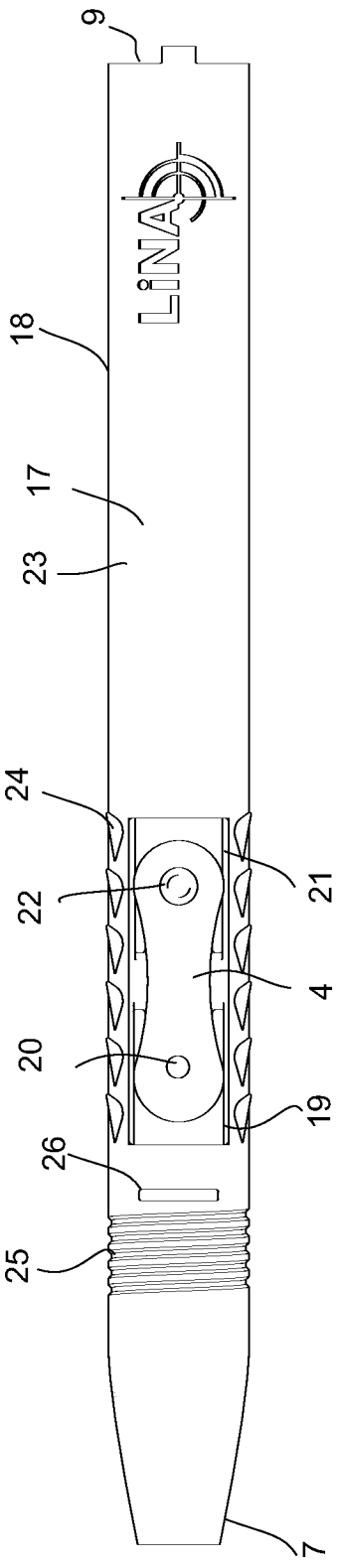
36a

Fig. 7

Fig. 8



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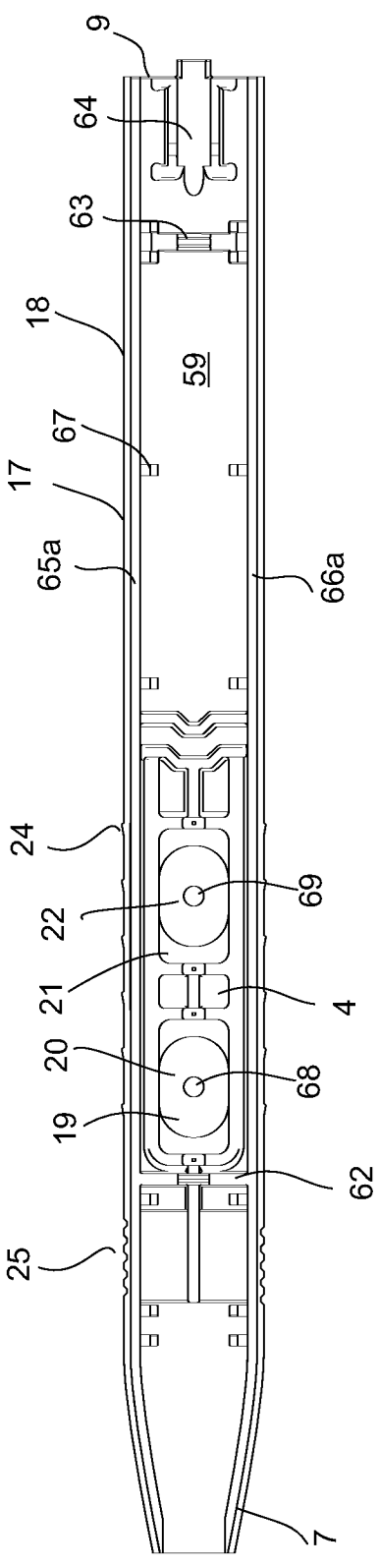

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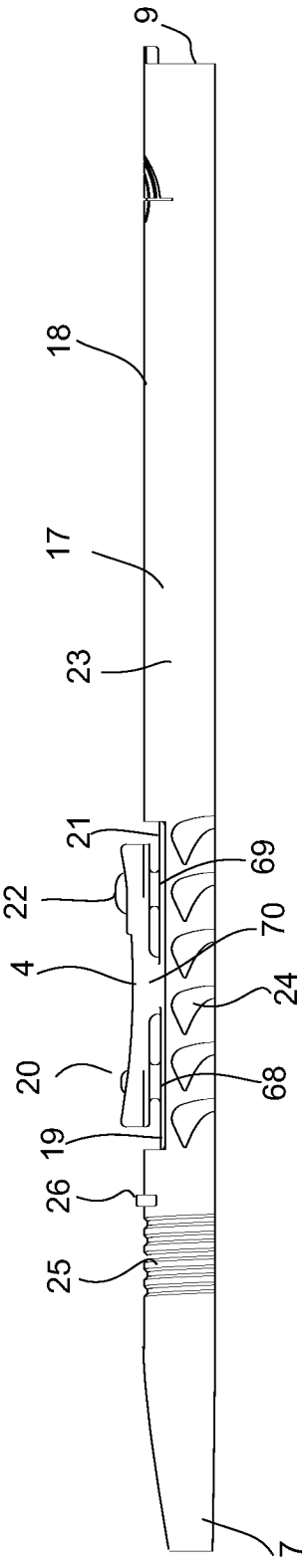

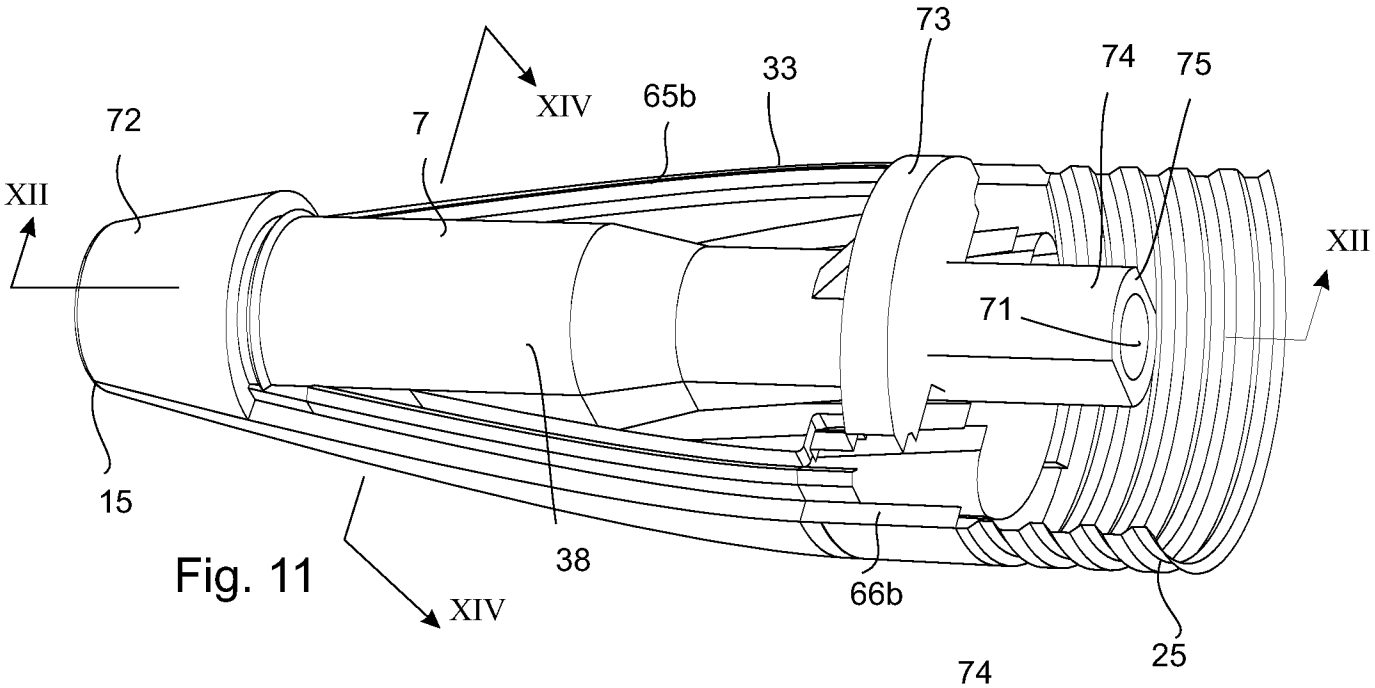

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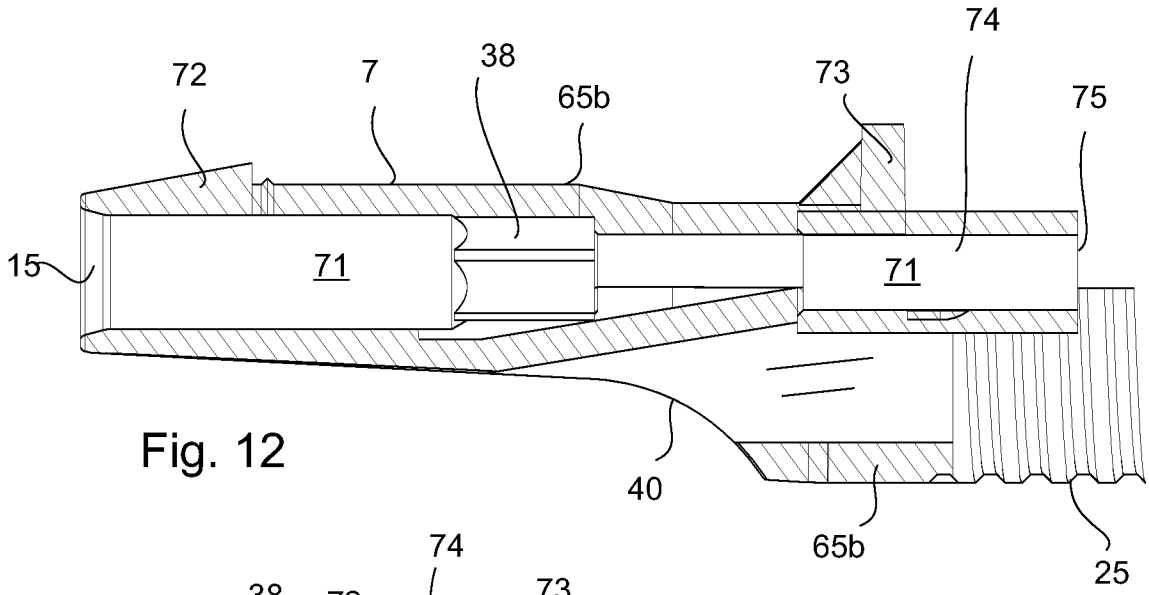

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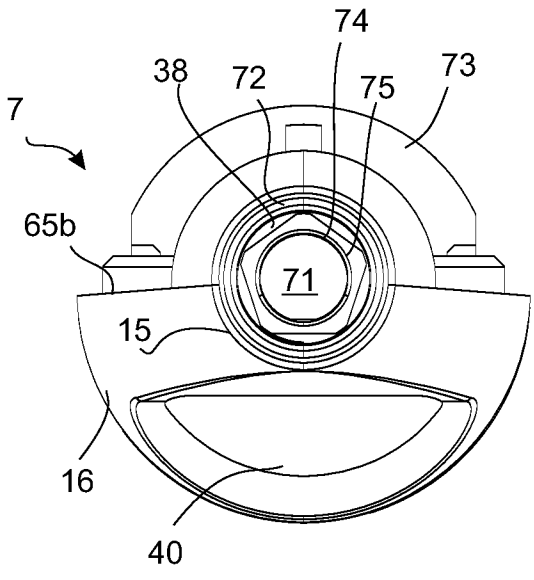

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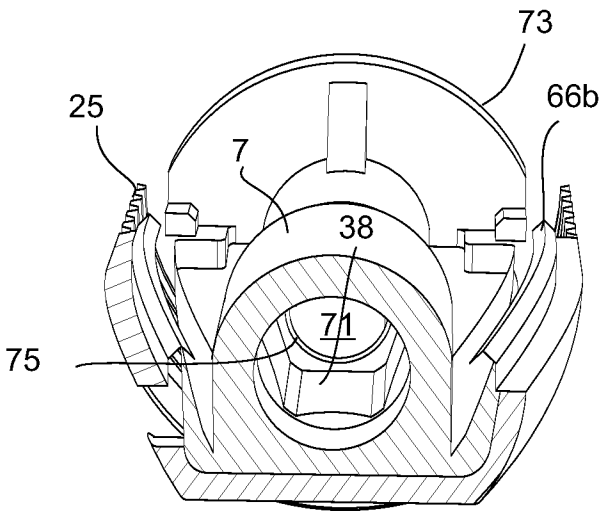

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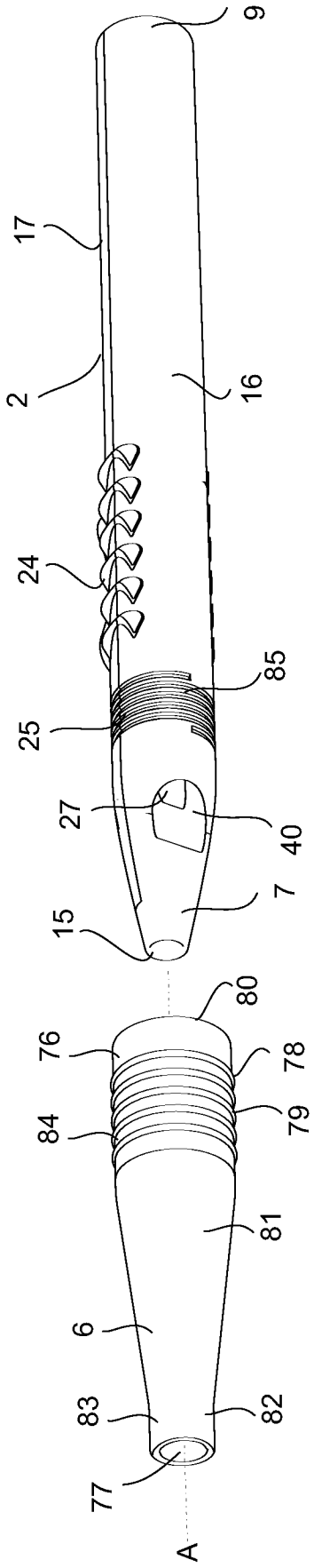

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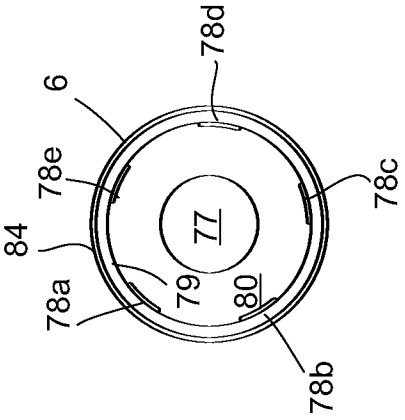

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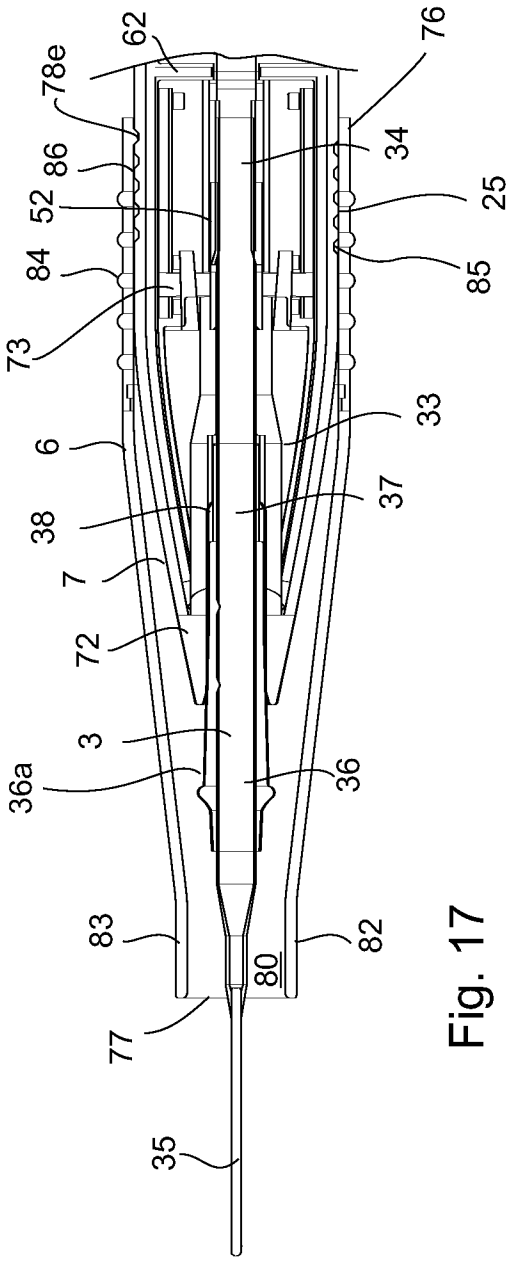


Fig. 17

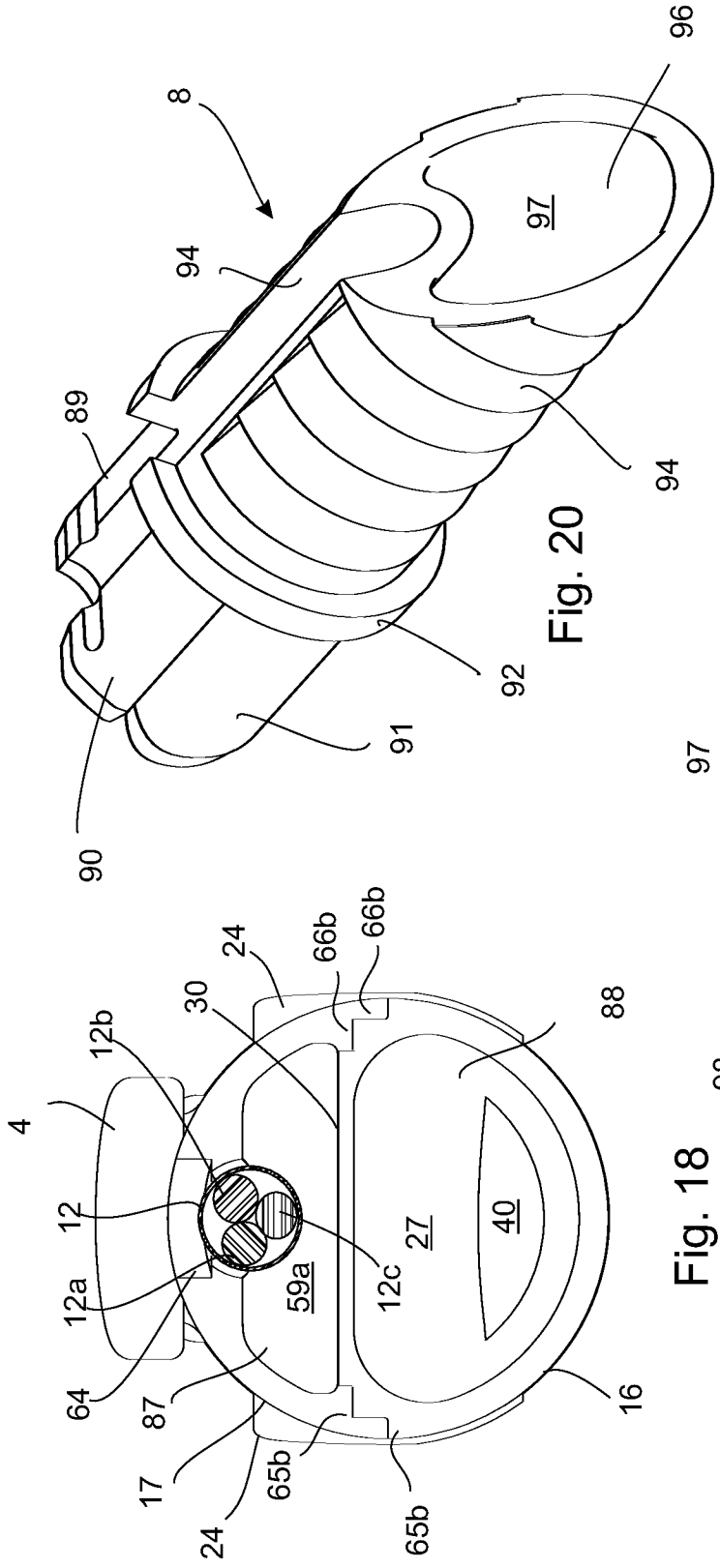
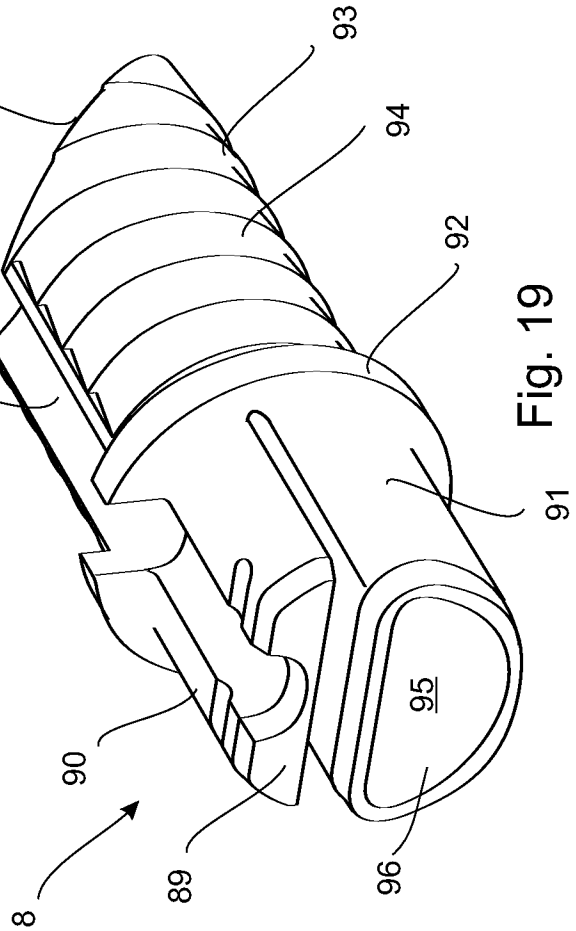


Fig. 18

Fig. 20



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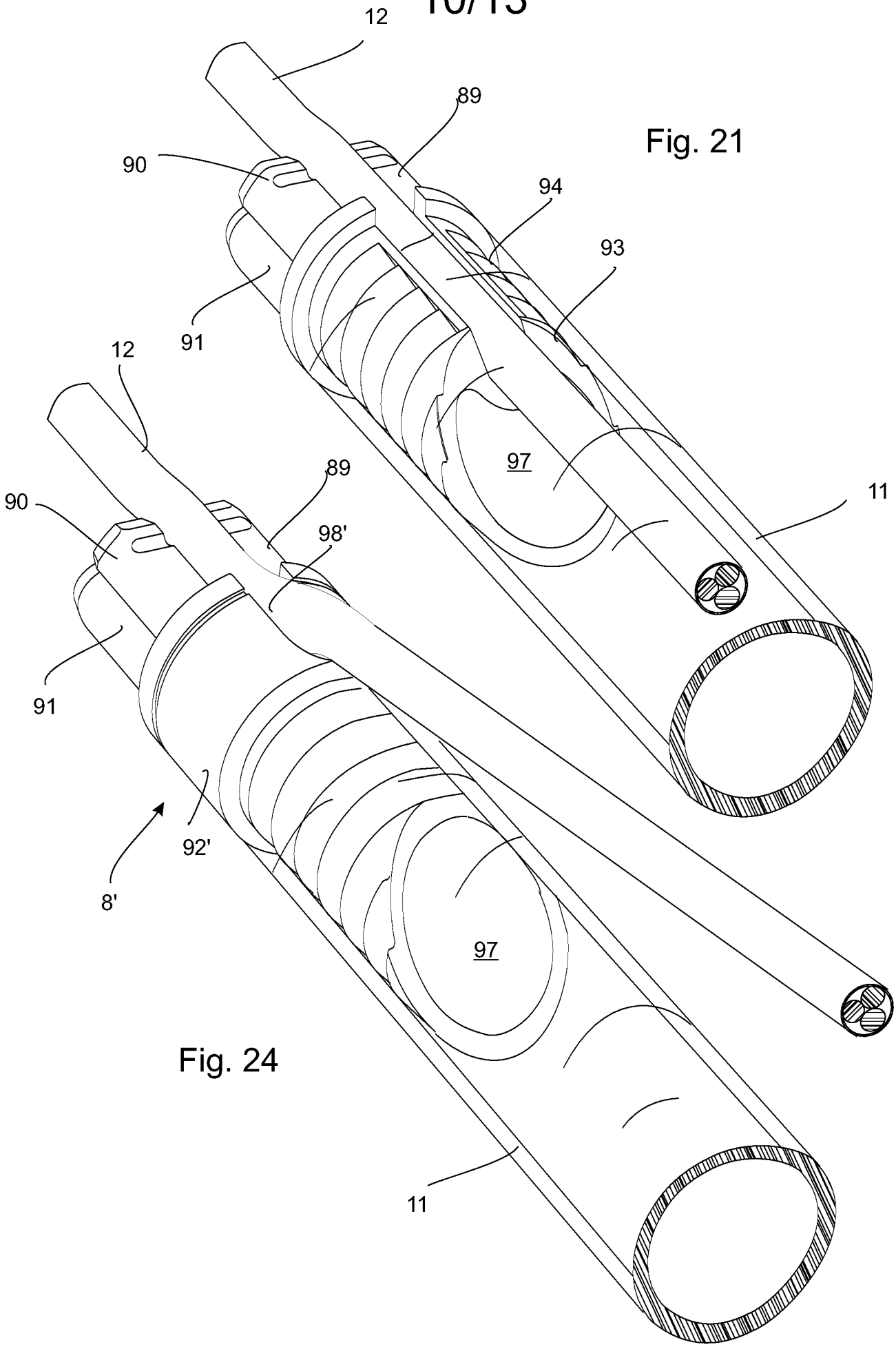


Fig. 21

Fig. 24

Fig. 22

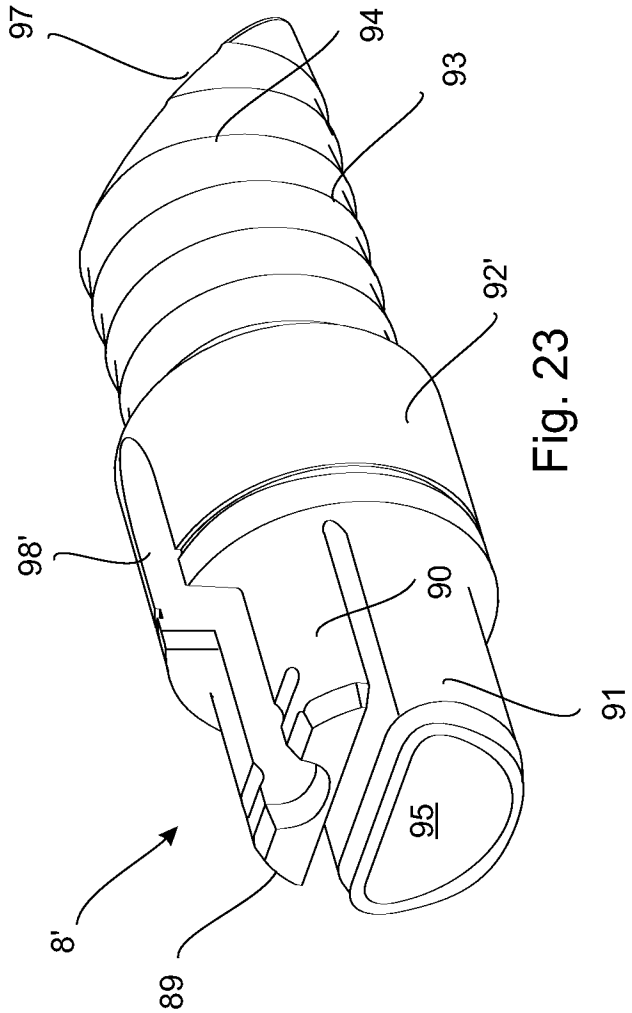


Fig. 23

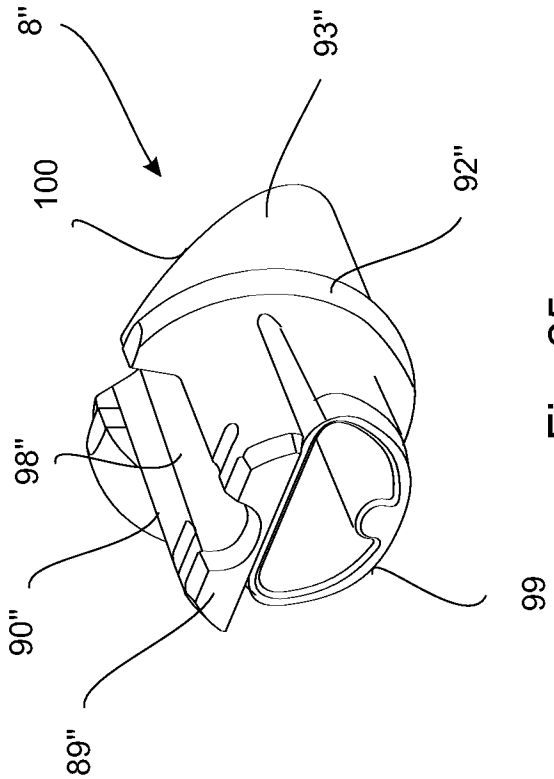
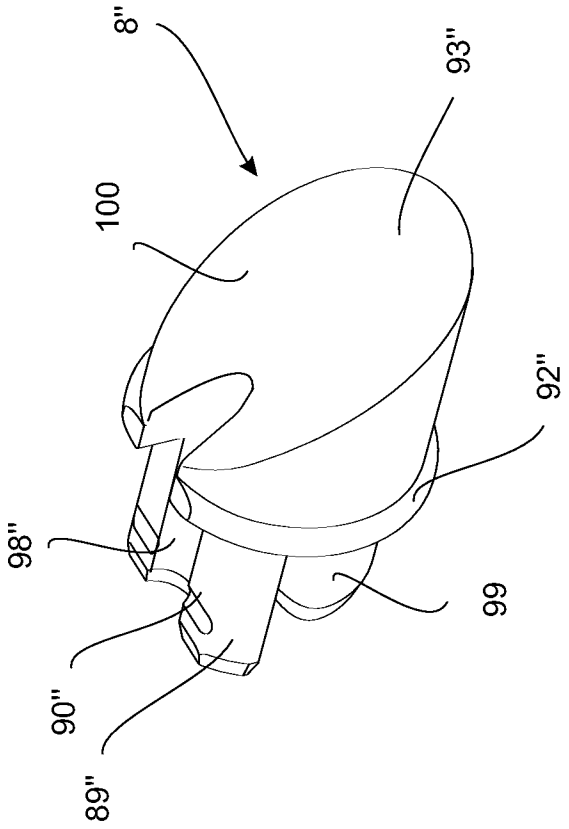


Fig. 25



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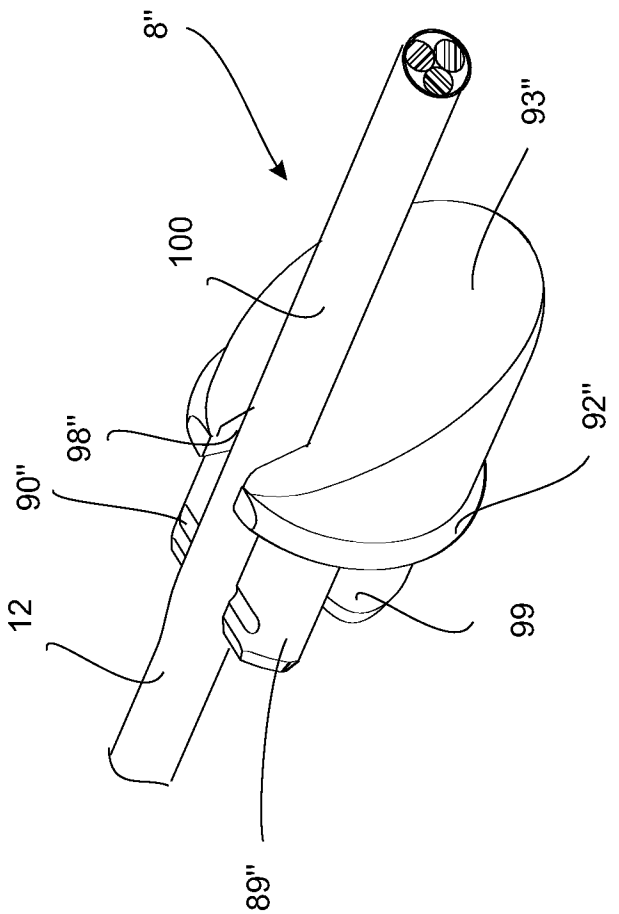

Fig. 27

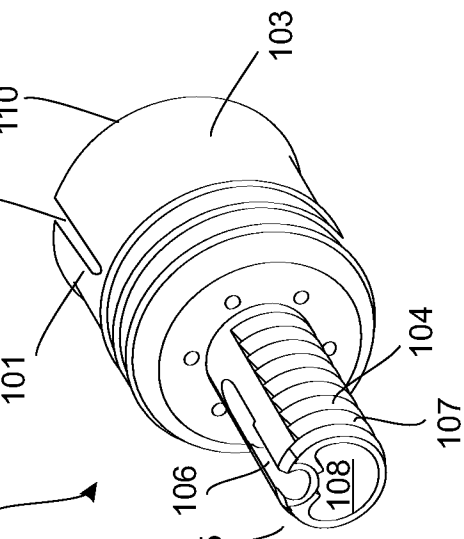

Fig. 30

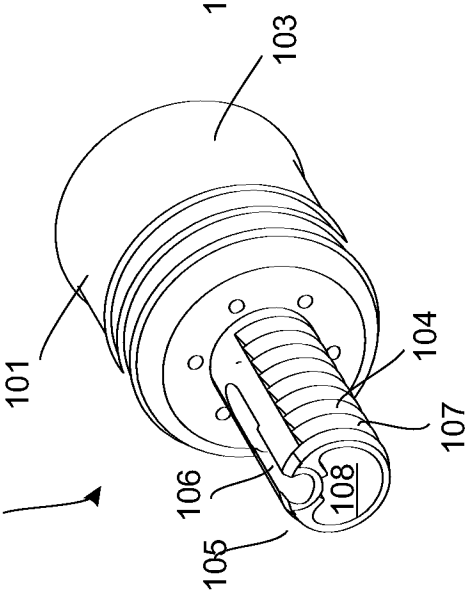

Fig. 29

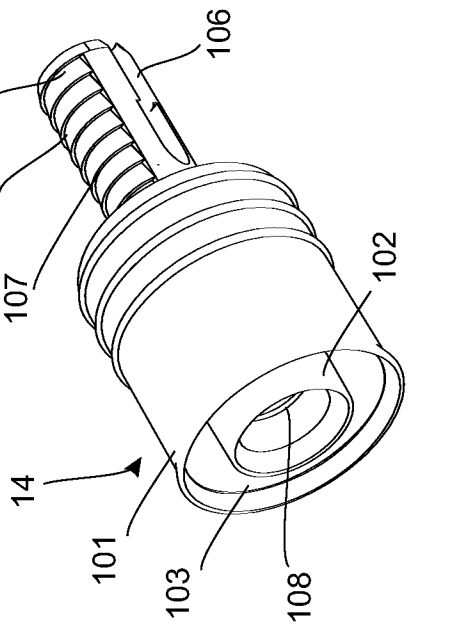

Fig. 28

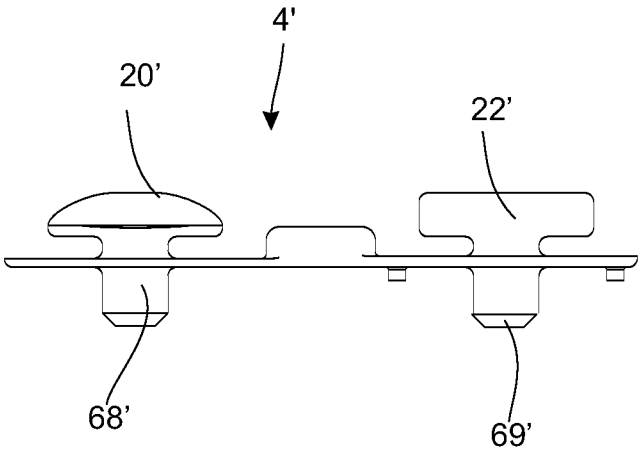

Fig. 31

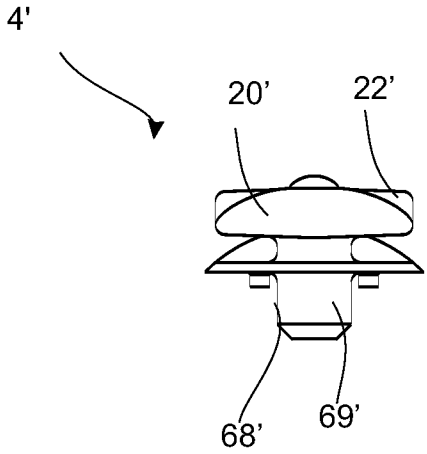

Fig. 32

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2011/050298

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B18/14
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)
A61B

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 practical, 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.
X	US 2009/012520 A1 (HIXSON DAVID W [US] ET AL) 8 January 2009 (2009-01-08) paragraphs [0153], [0183]; figures 11,16,17d	1-4,6, 14,18,21
X	EP 1 707 145 A2 (SHERWOOD SERV AG [CH] COVIDIEN AG [CH]) 4 October 2006 (2006-10-04) paragraph [0138]; figure 41	1-25
A	EP 2 039 298 A2 (VIDACARE CORP [US]) 25 March 2009 (2009-03-25) figure 6A	1,18

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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

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

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

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 March 2012	14/03/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Mayer-Martenson, E

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/DK2011/050298

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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