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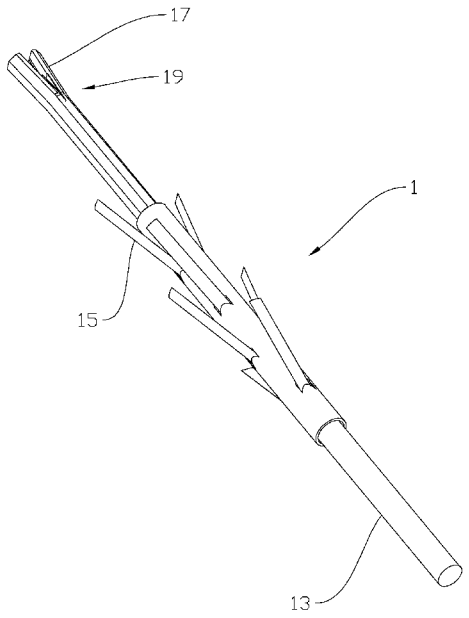


Fig. 9

(57) Abstract: The invention relates to a method for dividing a stipe (13) of a seaweed into different portions, wherein the method comprises the step of separating a radially inner portion (25) of the stipe (13) from a radially intermediate portion (17). The invention further relates to an apparatus for dividing a stipe (13) of a seaweed into different portions, the apparatus comprising: a peeling means (3) for separating a radially outer portion (15) of the stipe (13) from a radially intermediate portion (17); a cutting means (19) for separating a radially inner portion (25) of the stipe (13) from a radially inter- mediate portion (17); and a guiding means (35) for guiding the stipe (13) appropriately onto the peeling means (3) and cutting means (19).

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METHOD FOR DIVIDING A SEAWEED STIPE INTO FRACTIONS AND AN APPARATUS FOR SUCH DIVIDING

The invention relates to a method for dividing a stipe of a seaweed and an apparatus for such dividing.

Seaweed such as brown algae, and in particular kelp, may contain useful substances, for example alginates and derivatives thereof. To extract these substances, the seaweed must be harvested and processed. Often the substances are preferred to be white or light in colour to avoid undesired colouring of the end products. However, during harvesting of the seaweed, polyphenols may be released and react with oxygen. This reaction may cause the interior of the seaweed, which is light in colour, to become brown. To avoid the oxidation reaction, formaldehyde may be used for conservation of the seaweed. Formaldehyde may also be used later in the process when extracting alginate. However, formaldehyde may have undesired side effects and may be unsuitable for many applications. It would therefore be beneficial to provide an effective method for harvesting and processing seaweed, *e.g.* for extraction of alginates and other useful substances, which requires less use of formaldehyde.

WO 2015/067971 A1 discloses a method for the processing of seaweed and extraction of alginate which reduces the amount of formaldehyde used. Only the stipe of the seaweed is used, and the outer surface of the stipe is removed. The rest of the stipe, which is mostly white, is used in the rest of the processing.

GB 191405146 A discloses a process for producing an adhesive substance from seaweed. US 2006021522 A1 discloses machines for peeling and coring fruits. KR 101394782 B1 discloses a cucumber slicer.

The invention has for its object to remedy or to reduce at least one of the drawbacks of the prior art, or at least provide a useful alternative to prior art. The object is achieved through features specified in the description below and in the claims which follow. The invention is defined by the independent patent claims, while the dependent claims define advantageous embodiments of the invention.

In a first aspect the invention relates more particularly to a method for dividing a stipe of a seaweed into different portions, wherein the method comprises the step of separating a radially inner portion of the stipe from a radially intermediate portion. The method may additionally comprise the step of separating a radially outer portion of the stipe from the radially intermediate portion.

The seaweed may be *e.g.* brown algae, such as a kelp. The kelp may be tangle (*Laminaria hyperborea*). The stipe of a seaweed may be substantially cylindrical and comprises three distinctive regions depending on the radial distance from the centre axis: The radially inner portion in the centre comprises a core region of the stipe, the radially intermediate portion around the core comprises a tissue region, and the radially outer portion comprises a protective surface layer. As these regions are different in terms of their physical and chemical properties, it may be beneficial to separate the regions from each other prior to the processing. The core region of the stipe may typically require milder processing, for example fewer processing steps, lower temperature, or less use of chemicals, than the tissue region or the protective surface layer. Thus, milder processing may generally be more cost-effective and better for the environment than less mild processing.

The step of separating the radially outer portion of the stipe from the radially intermediate portion may comprise peeling off the radially outer portion of the stipe using peeling means, *e.g.* peeling blades. The stipe may be led through a peeling passage having peeling blades on the inside, whereby the radially outer portion of the stipe may be peeled off. The peeling passage may comprise *e.g.* a tube or an orifice. The peeling blades in the peeling passage may be offset from each other in the direction parallel to the axis of the stipe. This offset may reduce the force required to separate the radially outer portion of the stipe from the radially intermediate portion, since the stipe is not impacted by all peeling blades simultaneously. The peeling blades may be positioned on flexible parts which are directed inwards towards the centre of the peeling passage. The flexible parts may be resilient such that they will accommodate stipes with different radii. In this way the radially outer portion of stipes with different radii may be peeled off by being led through the same peeling passage. The peeling blades in the peeling passage may be arranged such that the radially outer portion of the stipe may be led to a different compartment than the rest of the stipe when said outer portion has been peeled off. For example, the radially outer portion of the stipe may be led to an outside of the peeling passage through holes in the wall of said peeling passage, while the rest of the stipe may continue at the inside of said peeling passage. This may be accomplished *via* the arrangement of the peeling blades or flexible parts.The step of separating the radially inner portion of the stipe from the radially intermediate portion may comprise splitting the stipe along a longitudinal centre axis. Thereby the radially inner portion of the stipe may be easier separated from the radially intermediate portion. Splitting of the stipe and separating the radially inner portion from the radially intermediate portion may be performed by forcing the stipe onto splitting blades which cut in the direction parallel to the longitudinal axis. The stipe may be split along the longitudinal axis prior to separation of the radially inner portion from the radially intermediate portion. Thereby less force may be needed than if the splitting of the stipe and the separating of the radially inner portion from the radially intermediate portion was done simultaneously, since the impact area is spread out. Likewise, the splitting blade may have a shape which minimises the impact force of the stipe required to split said stipe. For example, the splitting blade may be slanted or be pointy like an arrowhead.

The separation of the radially inner portion of the stipe from the radially intermediate portion may be performed using a cutting blade. To obtain as precise a separation as possible, the cutting blade for separating the radially inner portion of the stipe from the radially intermediate portion may be curved, *e.g.* substantially circular or semicircular, as the core of the stipe is substantially cylindrical. However, the blade may also comprise straight sections and edges, whereby it will be *e.g.* squared or 6- or 8-canted. As for the splitting blade described above, the blade for separating the radially inner portion of the stipe from the radially intermediate portion may be arranged such that the initial impact is of the blade on the stipe is minimised, whereby less force is required for the separation. For example, the blade may be slanted.

An axial movement of the stipe may for example be provided by a tubing system comprising tubing, a pump, and a peeling passage. The stipe may be introduced into the tubing, and the pump may provide a flow of *e.g.* water through the tubing, whereby the stipe will follow the flow through said tubing. The tubing may lead the stipe to the peeling passage and the cutting blades where the dividing of the stipe into different portions may be performed. The water flow may provide the force for both steps of the method, *i.e.* the step of separating the radially outer portion of the stipe from the radially intermediate portion and the step of separating the radially inner portion from the radially intermediate portion. For example, the water flow may lead the stipe through the peeling passage and push it onto the splitting and cutting blades.

The tubing system may comprise different compartments downstream of the peeling passage and the splitting and cutting blades. It was already mentioned that the radially outer portion of the stipe may be led through holes in the outer wall of the peeling passage to a different compartment. Likewise, after the separation of the radially inner portion of the stipe from the radially intermediate portion, said portions may be led to different compartments after separation. The tubing system may for example comprise three coaxial tubes of different radii downstream of the peeling passage and the cutting blades, whereby said coaxial tubes may constitute three compartments: an inner tube, an annular space between the inner tube and a middle tube forming a first annulus, and an annular space between the middle tube and an outer tube forming a second annulus. Thereby, for example, the radially outer portion of the stipe may continue in the second annulus, the radially intermediate portion of the stipe may continue in the first annulus, and the radially inner portion of the stipe may continue within the inner tube. One or more pumps may provide the water flow to the tubes.

The tubing system may thus be used during seaweed harvesting. The holdfast and the lamina of the seaweed may be cut off, and the stipe may be led into the tubing system where it will be divided into different portions. This may for example be performed on a vessel, *e.g.* a boat or a barge, after the seaweed has been harvested, whereby any unused parts of the seaweed may be discarded. Alternatively, a portion of the tubing system may be submerged into the water. Thereby, the holdfast and the lamina may be cut off below the surface, and the stipe may be led into the tubing system. This may have the advantage that the seaweed may be in water during the entire

harvesting process, whereby said seaweed will be less exposed to oxygen and subsequent oxidation reactions, while requiring less formaldehyde.

In a second aspect the invention relates more particularly to an apparatus for dividing a stipe of a seaweed into different portions, wherein said apparatus comprises a peeling means for separating a radially outer layer of the stipe from a radially intermediate layer, a cutting means for separating a radially inner layer of the stipe from the radially intermediate layer, and a guiding means for guiding the stipe appropriately onto the peeling and cutting means. The peeling means may comprise peeling blades on the inside of a peeling passage, whereby the peeling passage may function as the guiding means, and said peeling means may also comprise a flexible part to accommodate stipe of different radii. Alternatively, the peeling means may for example comprise a substantially cylindrical outer blade having a substantially circular cutting edge for separating the radially outer portion of the stipe from the radially intermediate portion by cutting said radially outer portion of the stipe off said radially intermediate portion. The peeling means may be removably attached, whereby they can be removed if it is desired only to separate the inner portion of the stipe from the intermediate portion. The cutting means may comprise cutting blades for cutting out the radially inner portion of the stipe, for example a substantially cylindrical inner blade having a substantially circular cutting edge for separating the radially inner portion of the stipe from the radially intermediate portion. The effect of the guiding means may be to guide the stipe with a correct orientation onto the peeling and cutting means to obtain a correct, reproducible, and efficient separation of the stipe into the radially inner portion, the radially intermediate portion, and the radially outer portion.

The apparatus may also comprise a first splitting means for splitting the radially intermediate portion of the stipe along a longitudinal axis. By splitting the radially intermediate portion of the stipe, said radially intermediate portion may more easily be separated from the radially inner portion. Since the stipe may be relatively long, if the radially intermediate portion is not split, friction within the stipe between the radially inner and intermediate portions may make it very difficult to separate the two. The first splitting means may for example be one or more splitting blades which span a distance between the inner and outer substantially cylindrical blades, for example in a radial direction. If the splitting blades are oriented radially, the segment of stipe which is split is minimized, whereby less force of the stipe is required compared to *e.g.* tangential orientation of the splitting blades. If more splitting blades are used, less friction between the radially inner and intermediate portions will remain, however, more impact force of the stipe may be required. The number of first splitting blades may for example be 2, 3, 4, 5, or 6.

The apparatus may further comprise a second splitting means for splitting the radially outer portion of the stipe along the longitudinal axis to more easily separate said radially outer portion of the stipe. Splitting of the radially outer portion of the stipe may be particularly advantageous if the peeling means comprises a substantially cylindrical outer blade having a substantially circular cutting edge for cutting off the radially outer portion of the stipe to avoid the friction between the radially intermediate and radially outer portions of the stipe. Similarly to the first splitting means, the second

splitting means may for example be one or more second splitting blades which span a distance between the outer substantially circular blade and an inner edge of the guiding means, for example in a radial direction. The number of second splitting blades may for example be 2, 3, 4, 5, or 6. The number of second splitting blades can be different than the number of first splitting blades.

The cutting edge of peeling means may be offset relative to the cutting edge of the cutting means. This may have the effect as to reduce the initial impact by the peeling and cutting means on the stipe, whereby less force may be required to separate the stipe into its different radial portions. Similarly, the first and second splitting means may also be offset relative to the peeling and cutting means for a similar effect. For example, the second spitting means may be offset relative to the peeling means such that the stipe will hit the second splitting means at first, whereby the radially outer portion of the stipe will be at least partly split before the stipe hits the peeling means. This may have the effect to reduce the friction between the radially outer portion of the stipe and the peeling means. Similarly, the first splitting means may be offset relative to the cutting means such that the radially intermediate portion of the stipe will be at least partly split before the radially inner and intermediate portion hits the cutting means.

The cutting edges of the cutting means, the peeling means, and the splitting means may be slandered. The guiding means may comprise a tube, which is a simple and cost-effective guiding means. A tube may have the additional benefit that it may be tight and be able to confine a liquid, whereby a flow of liquid, for example sea water, may be used to provide the driving force for separating the stipe into different portions, *e.g.* by forcing the stipe onto the cutting means and peeling means.

In a third aspect, the invention relates to a harvesting system comprising tubing, a pump, and the apparatus according to the second aspect of the invention. The harvesting system may be arranged on a vessel, *e.g.* a boat or a barge, whereby said harvesting system may easily be moved between different harvesting sites. Thus, in a forth aspect, the invention relates to a vessel comprising the harvesting system according to the third aspect of the invention. The vessel may additionally comprise a means for removing the holdfast and the lamina from the stipe, *e.g.* blades or scissors, and a means for orienting the stipe of the seaweed towards the tubing system. Thereby, the vessel may be moved to the harvest site, the holdfast and the lamina of the seaweed may be removed, and the stipe may be pumped onto the vessel *via* the tubing system. The stipe may additionally be divided into different portions and separated into different compartments within the harvesting system.

In the following is described examples of embodiments illustrated in the accompanying drawings, wherein:

Fig. 1 shows a peeling passage with peeling blades on the inside, viewed in perspective;

Fig. 2 shows on a similar scale the peeling passage from figure 1, viewed from the end;

Fig. 3 shows on a smaller scale the peeling passage from figure 1 and 2 together with a portion of a seaweed stipe passing through the peeling passage, viewed in perspective;

Fig. 4 shows on a similar scale the peeling passage and seaweed stipe from figure 3, viewed from the end;

Fig. 5 shows on a larger scale a cutting means comprising a splitting blade and a cutting blade, viewed in perspective;

Fig. 6 shows on a similar scale the cutting means from figure 5, viewed from the end;

Fig. 7 shows on a smaller scale the cutting means from figure 5 and 6, together with the radially intermediate portion of a seaweed stipe wherefrom the radially inner portion has been halfway separated, viewed in perspective;

Fig. 8 shows on a similar scale the cutting means and seaweed stipe from figure 7, viewed from the end;

Fig. 9 shows on a smaller scale the peeling passage of figure 1-4 and the cutting means from figure 5-8 together with a seaweed stipe which is partly divided into portions, viewed in perspective;

Fig. 10 shows an alternative embodiment of the cutting means from figure 5 and 6, where the splitting blade and the cutting blade are slanted; and

Fig. 11 shows another embodiment of the invention comprising peeling, cutting, splitting, and guiding means.

In the drawings, the reference numeral 1 indicates a peeling passage. Identical reference numerals indicate identical or similar features in the drawings. The drawings are presented in a simplified and schematic manner, and the features therein are not necessarily drawn to scale.

Figure 1 and 2 show a peeling passage 1 which comprises means for separating a radially outer portion of a seaweed stipe from a radially intermediate portion, said means shown here as peeling blades 3. The peeling blades 3 are directed towards the inside of the peeling passage 1 (best seen in figure 2) and are arranged with holes 5 in the wall 7 of the peeling passage 1. The peeling passage 1 forms a first end 9 and a second end 11.

Figure 3 and 4 show the peeling passage 1 from figure 1 and 2, together with a stipe 13 of a seaweed. A portion of the stipe 13 is passing through the peeling passage 1 and has entered said

peeling passage 1 from the first end 9. The peeling blades 3 are separating a radially outer portion 15 of the stipe 13 from a radially intermediate portion 17 when the stipe 13 is forced through the peeling passage 1 from the first end 9. The holes 5 in the wall 7 of the peeling passage 1 cause the radially outer portion 15 of the stipe 13 to exit the peeling passage 1 through said holes 5. Thereby the radially outer portion 15 of the stipe 13 may be led to another compartment (not shown) than the radially intermediate portion 17.

Figure 5 and 6 show a cutting means 19 comprising a splitting blade 21 with a splitting blade edge 22 for splitting a seaweed stipe 13, and a semicircular cutting blade 23 with a cutting blade edge 24 for separating a radially inner portion 25 (see figure 7 and 8) from the radially intermediate portion 17. The splitting blade edge 22 and the cutting blade edge 24 are offset from each other to reduce the impact of the blades 21, 23 on the stipe 13. The sides 27 of the splitting blade 21 are arranged to diverge from each other, which results in a void 29 between said sides 27 on the opposite end of the cutting means 19 than the splitting blade edge 22. The cutting blade 23 is positioned on the side 27, and a hole 31 in the side 27 is present below the cutting blade 23. Note that in figure 6 the cutting means 19 is viewed from the end opposite to the blade edge 22.

Figure 7 and 8 show the cutting means 19 from figure 5 and 6 together with a portion of the stipe 13 without the radially outer portion 15 (not shown). The cutting means 19 is positioned within the stipe 13 and has divided said stipe 13 into a radially inner portion 25 and a radially intermediate portion 17. As the cutting means 19 comprises a splitting blade 21, the stipe 13 is initially split along a longitudinal axis. Thus, the stipe 13 is divided into two radially inner portions 25 and two radially intermediate portions 17.

Figure 9 shows the peeling passage 1 from figure 1-4 and the cutting means 19 from figure 5-8 arranged in series. A portion of the stipe 13 is within the peeling passage 1, and a radially outer portion 15 of the stipe 13 has been peeled off and are protruding from the peeling passage 1. The rest of the stipe 13 continues within the peeling passage 1 and subsequently meets the cutting means 19. Here, the radially inner portion 25 (not visible) is separated from a radially intermediate portion 17. The peeling passage 1 and the cutting means 19 may for example be arranged within a tubing system (not shown), such that the radially other portion 15 is transferred to one compartment, the radially intermediate portion 17 is transferred to a second compartment, and the radially inner portion may be transferred to third compartment. The tubing system may *e.g.* comprise three coaxial tubes of different radii, whereby the compartments may be the inner tube, the annulus between the inner tube and the middle tube, and the annulus between the middle tube and the outer tube.

Figure 10 shows another embodiment of a cutting means 19 for separating a radially inner portion of the stipe 13 from a radially intermediate portion 17. This embodiment is similar to the one shown in figure 5, however, the splitting blade 21 and the cutting blade 23 are slanted. In this way, only a part of the blades 21, 23 impacts the end of the stipe 13 at a time, whereby less force may be re-

quired to separate the radially inner portion 25 of the stipe 13 from the radially intermediate portion 17.

Figure 11 shows another embodiment of an apparatus for dividing a stipe 13 of a seaweed according to the invention. The shown apparatus comprises peeling means 3 for separating the radially outer portion 15 of the stipe 13 from the radially intermediate portion, cutting means 19 for separating the radially intermediate portion 17 of the stipe 13 from the radially inner portion 25, first splitting means 33 for splitting the radially intermediate portion 17 of the stipe 13, second splitting means 34 for splitting the radially outer portion 15 of the stipe 13, and guiding means 35 for guiding the stipe 13 appropriately onto the peeling means 3, the cutting means 19, and first 33 and second 34 splitting means. In the shown embodiment, the guiding means 35 is a tube with a diameter which may be chosen to complement stipes 13 with a typical diameter. The stipe 13 should enter the guiding means 35 through the end 32 of the guiding means 35 which is opposite the peeling means 3, cutting means 19, and splitting means 33, 34, and should be displaced axially through the guiding means 35. The peeling means 3 is a substantially cylindrical outer blade 38 with a diameter which corresponds to the interface between the radially outer portion 15 of the stipe 13 and the radially intermediate portion 17. The substantially cylindrical outer blade 38 has a substantially circular cutting edge 36. The second splitting means 34 is shown with four blades which span the region from the substantially cylindrical outer blade 38 to the inner edge of the guiding means 35 in a radial direction. In this way the radially outer portion 15 of the stipe 13 will be split into four different parts to avoid friction with the outer substantially cylindrical blade 38 and the radially intermediate portion 17 of the stipe 13. The rest of the stipe 13, *i.e.* the radially inner 25 and intermediate 17 portion, will continue onto the cutting means 19 and the first splitting means 33. The cutting means 19 is an inner substantially cylindrical blade 39 with a diameter which corresponds substantially to the interface between the radially inner portion 25 of the stipe 13 and the radially intermediate portion 17. The inner substantially cylindrical blade 39 has a substantially circular cutting edge 37. The first splitting means 33 is shown with four blades which each span the distance between the inner substantially cylindrical blade 39 and the outer substantially cylindrical blade 38. In this way the radially intermediate portion 17 of the stipe 13 will be split into four parts to avoid friction with the inner substantially cylindrical blade 39 and the radially inner portion 25 of the stipe 13. The inner 39 and outer 38 substantially cylindrical blades and the guiding means 35 are substantially coaxial to separate the stipe 13 correctly into the radially inner 25, intermediate 17, and outer 15 portions. The inner 39 and outer 38 substantially cylindrical blades and the first 33 and second 34 splitting means are offset relative to each other whereby the stipe 13 impacts the second splitting means 34 first, then the outer substantially circular blade 38, the first splitting means 34, and finally the inner substantially cylindrical blade 39. This has the effect that less force is required during the initial impact of the stipe 13 to start the separation than if said stipe 13 would hit *e.g.* the inner 39 and the outer 38 substantially cylindrical blades simultaneously.It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended

claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

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Claims

1. A method for dividing a stipe (13) of a seaweed into different portions, characterised in that the method comprises the step of separating a radially inner portion (25) of the stipe (13) from a radially intermediate portion (17).

2. The method according to claim 1, wherein the method additionally comprises the step of separating a radially outer portion (15) of the stipe (13) from the radially intermediate portion (17).

3. An apparatus for dividing a stipe (13) of a seaweed into different portions, the apparatus comprising

   - a peeling means (3) for separating a radially outer portion (15) of the stipe (13) from a radially intermediate portion (17);
   - a cutting means (19) for separating a radially inner portion (25) of the stipe (13) from a radially intermediate portion (17); and
   - a guiding means (35) for guiding the stipe (13) appropriately onto the peeling means (3) and cutting means (19).

4. The apparatus according to claim 3, wherein the apparatus further comprises a first splitting means (33) for splitting the radially intermediate portion (17) along a longitudinal axis of the stipe (13).

5. The apparatus according to claims 3 or 4, wherein the apparatus further comprises a second splitting means (34) for splitting the radially outer portion (15) along the longitudinal axis of the stipe (13).

6. The apparatus according to any of the claims 3-5, wherein a cutting edge (36) of the peeling means (3) is offset relative to a cutting edge (37) of the cutting means (19).

7. The apparatus according to any of the claims 3-6, wherein the guiding means (35) comprises a tube.

8. A harvesting system comprising tubing, a pump, and the apparatus according to any of the claims 3-7.

9. A vessel comprising the harvesting system according to claim 8.

10. The vessel according to claim 9, said vessel additionally comprising means for removing a holdfast and a lamina from the stipe (13), and a means for orienting the stipe (13) of the seaweed towards the tubing.

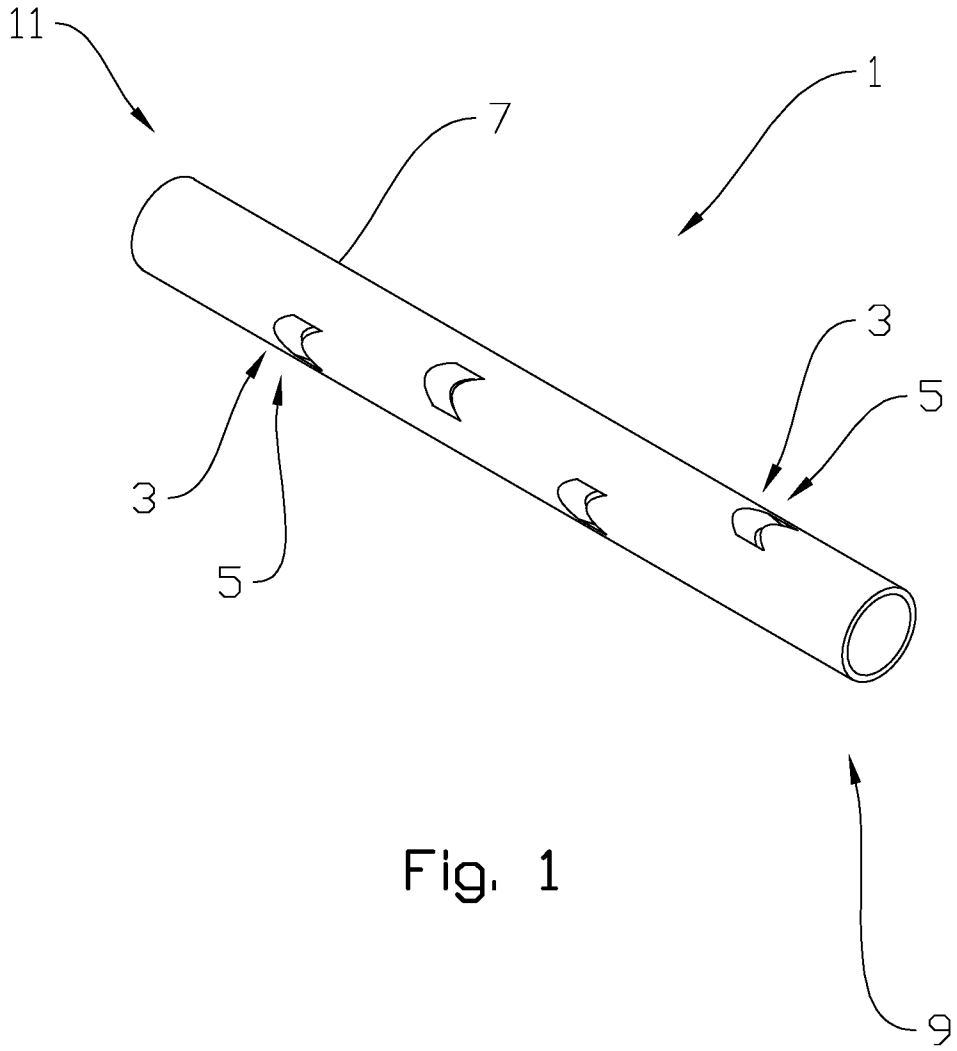


Fig. 1

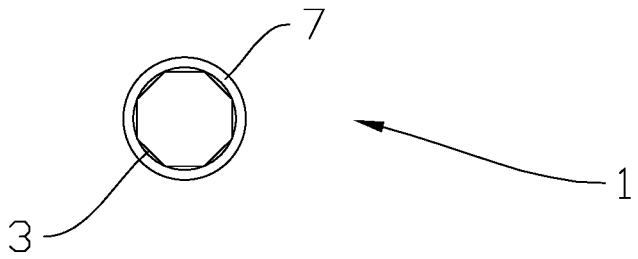


Fig. 2

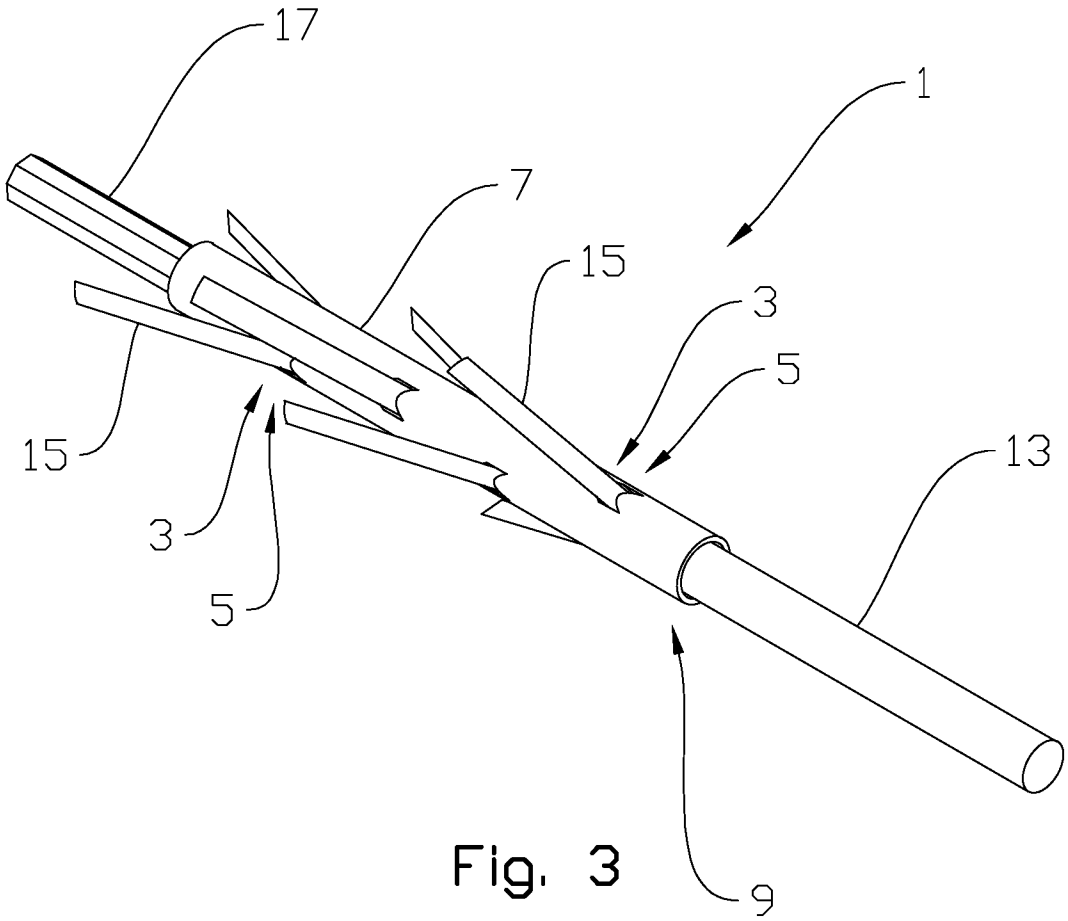


Fig. 3

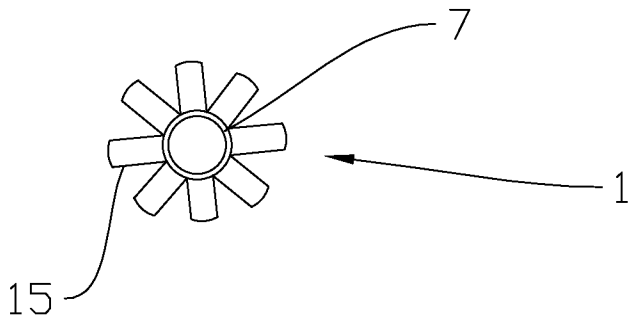


Fig. 4

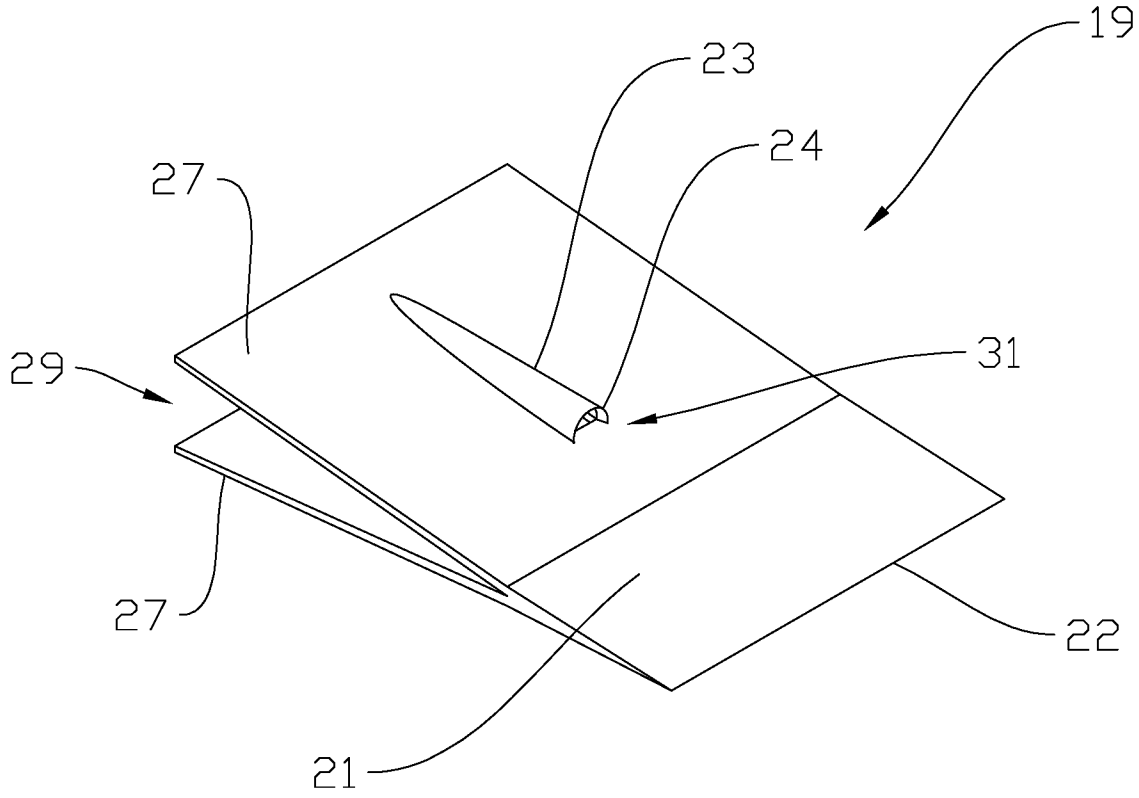


Fig. 5

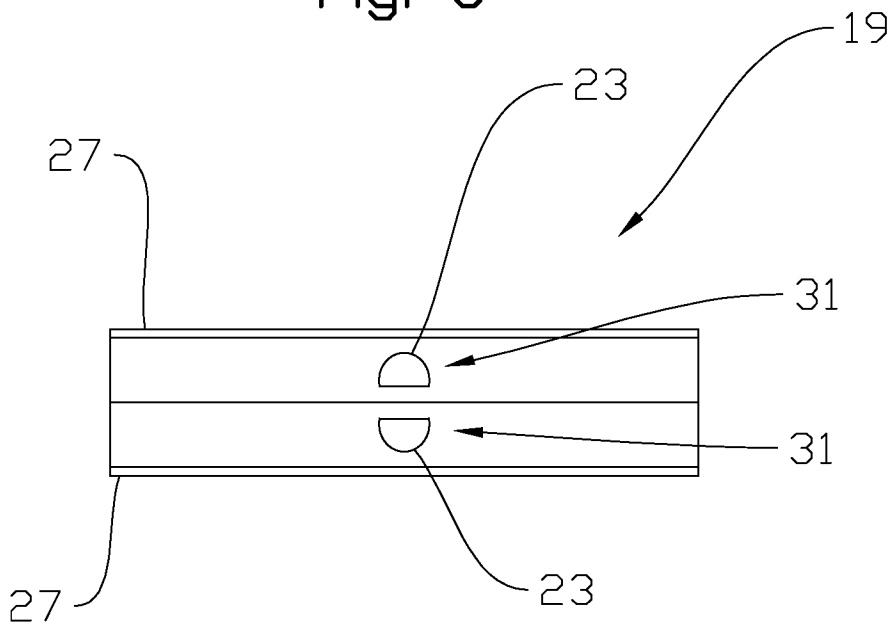


Fig. 6

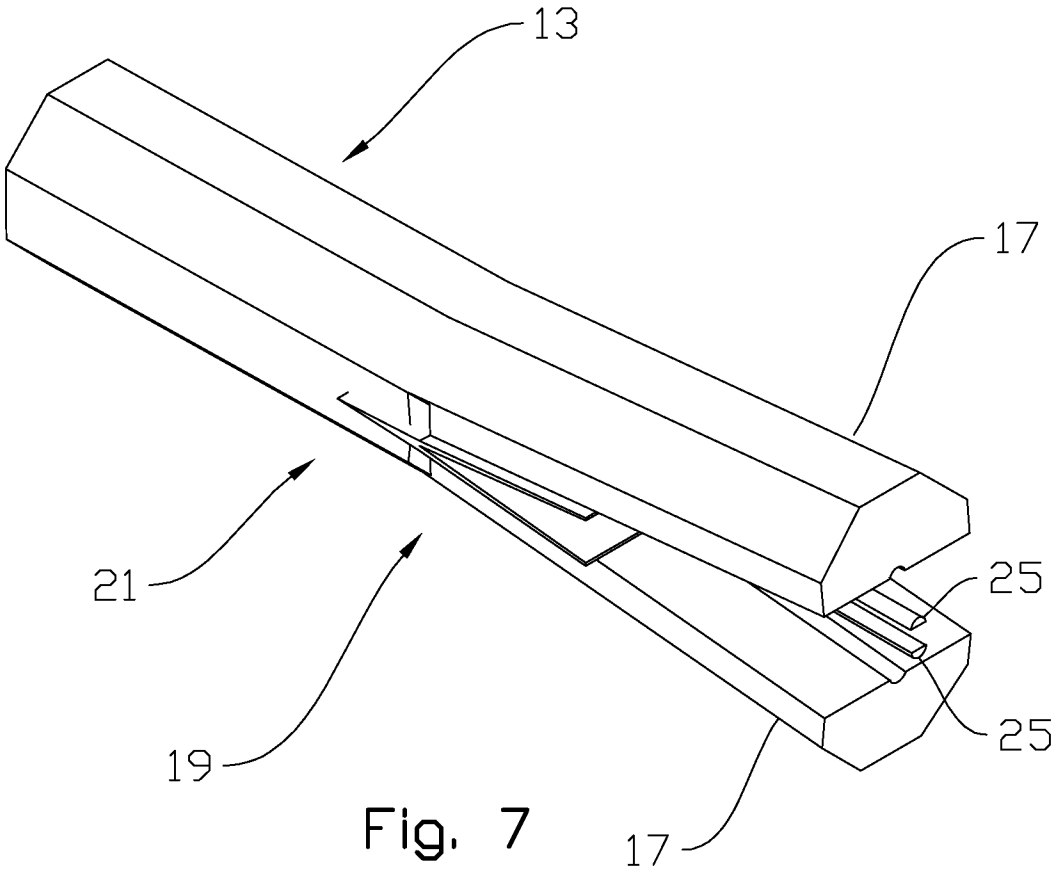


Fig. 7

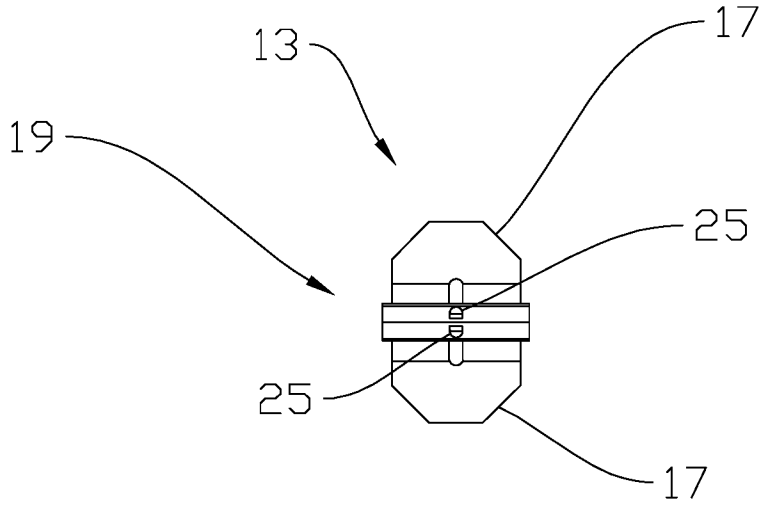


Fig. 8

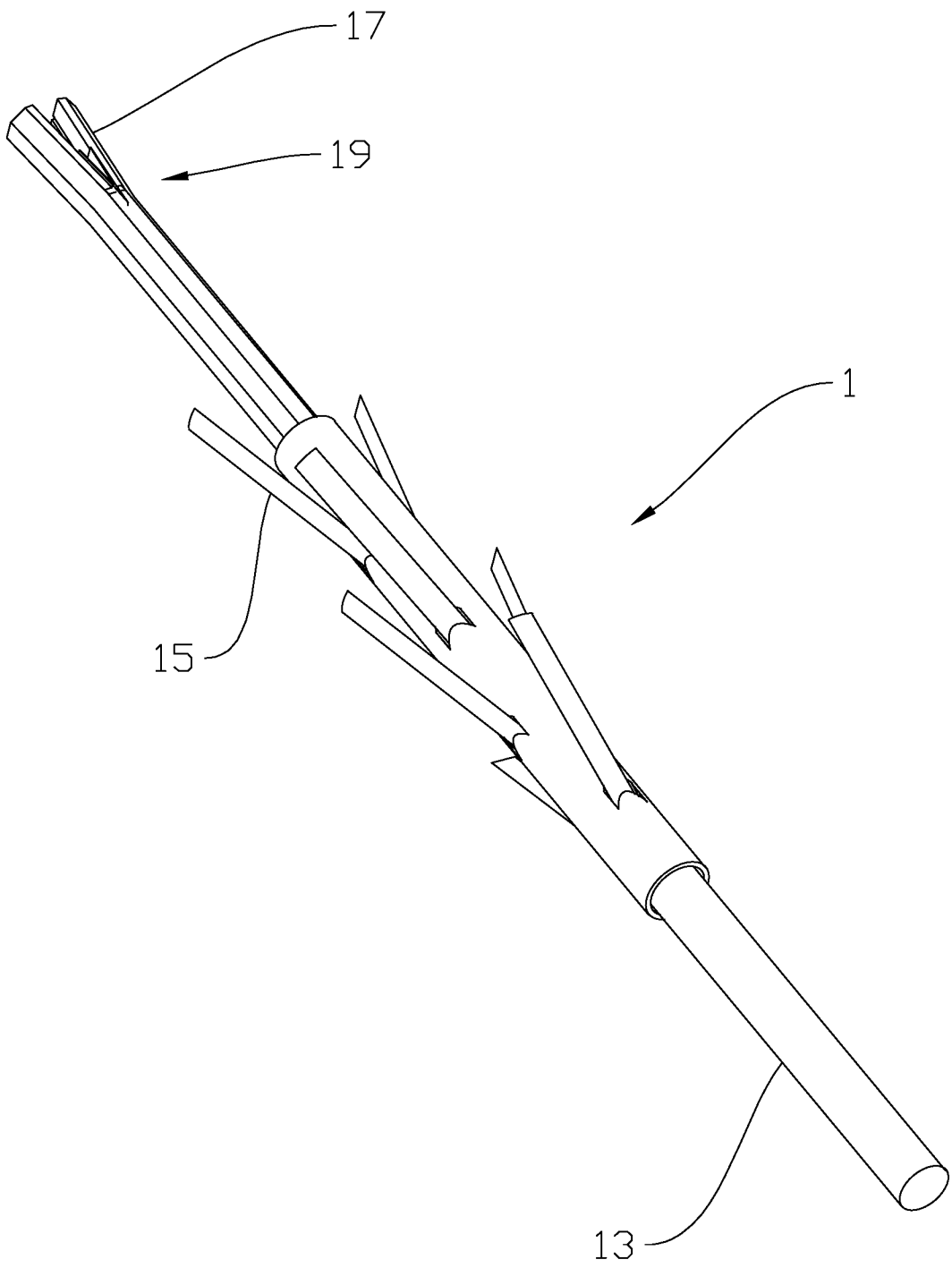


Fig. 9

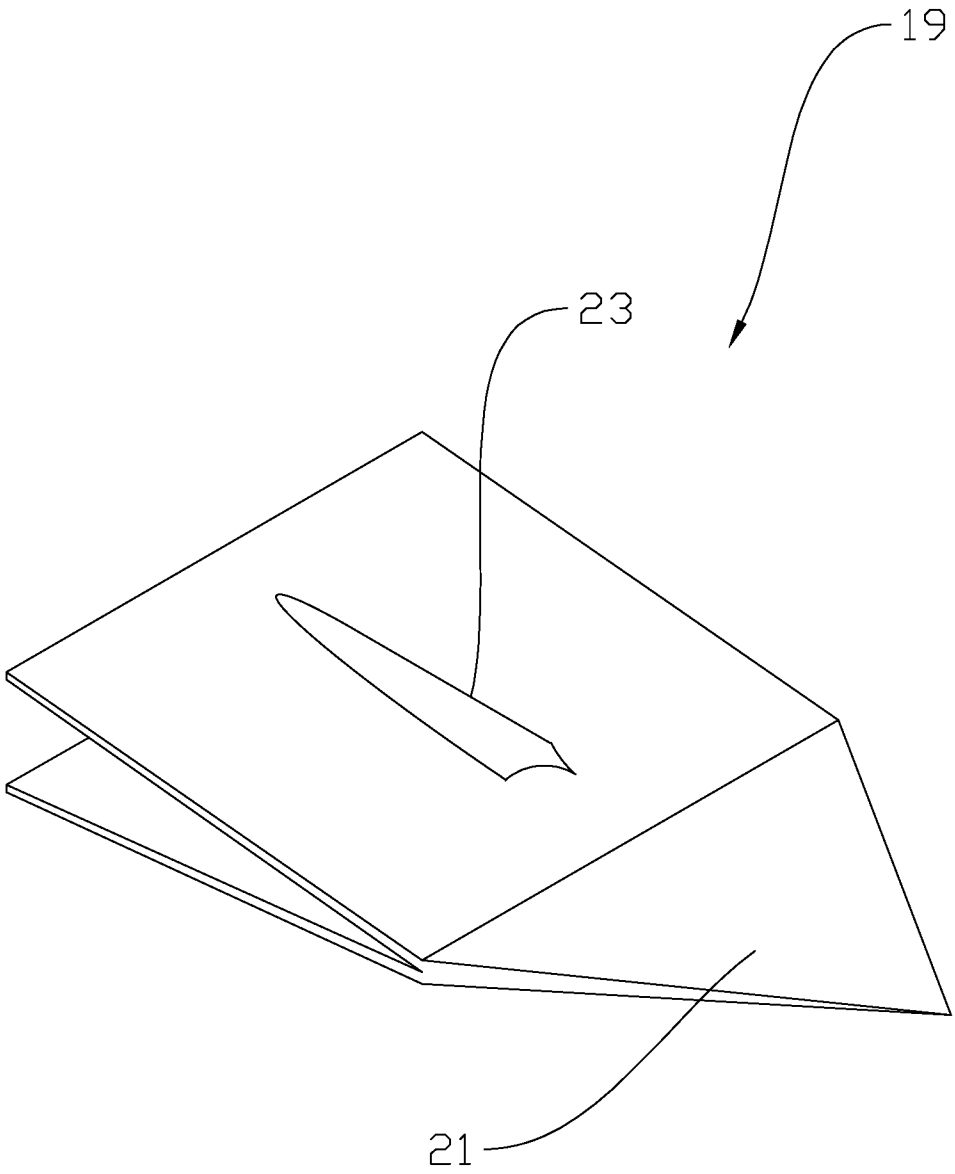


Fig. 10

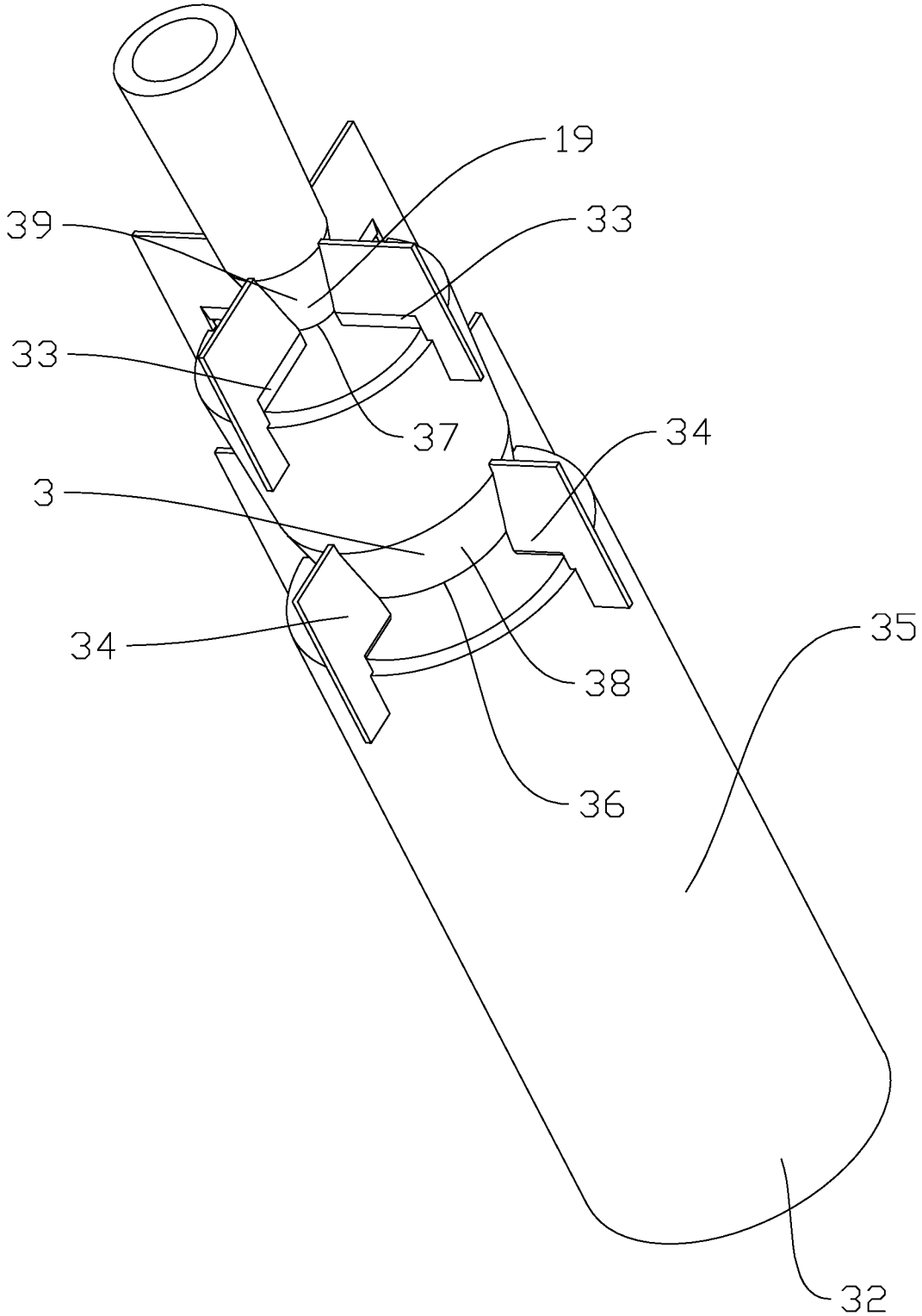


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2018/050275

A. CLASSIFICATION OF SUBJECT MATTER

A01D 44/00 (2006.01), A01G 33/00 (2006.01), B26D 3/28 (2006.01)

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)

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

DK, NO, SE, FI: Classes as above.

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

EPODOC, WPI, FULDTEKST: ENGELSK, TYSK, FRANSK

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2015067971 A1 The whole document	1
A		2-10
X	GB 191405146 A The whole document	1-10
A	US 2006021522 A1 Figurs 20-22	1-10
A	KR 20130036974 A Abstract	

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15/01/2019	28/01/2018
Name and mailing address of the ISA Nordic Patent Institute Helgeshøj Allé 81 DK - 2630 Taastrup, Denmark. Facsimile No. + 45 43 50 80 08	Authorized officer Heidi Sire Berner Telephone No. +47 22 38 74 67

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NO2018/050275

Patent document cited in search report / Publication date	Patent family member(s) / Publication date
WO 2015067971 A1 2015.05.14	EP 3068804 A1 2016.09.21
GB 191405146 A 1914.08.07	NONE
US 2006021522 A1 2006.02.02	ITMO 20040017U U1 2004.10.28
KR 20130036974 A 2013.04.15	NONE