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(54) **FLEXIBLE ASPIRATION SYSTEM**

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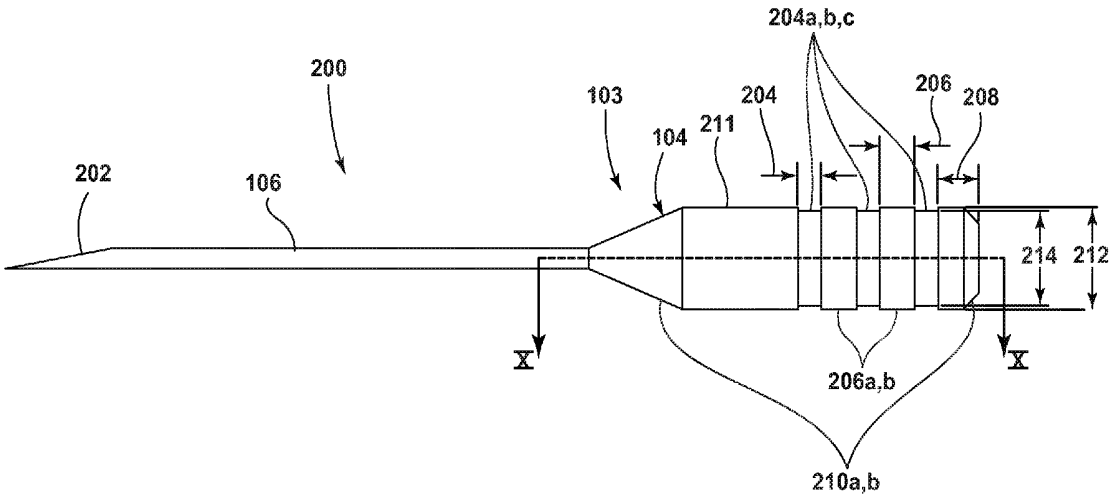
A61B 5/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A61M 25/0084*** (2013.01); ***A61B 10/0283*** (2013.01); *A61B 2010/045* (2013.01); ***A61B 5/6848*** (2013.01); ***A61B 10/04*** (2013.01)

(57) **ABSTRACT**

A flexible needle system may comprise a tubular body, a needle assembly and a connector body. The tubular body may include a leading end and a trailing end. The tubular body may be configured to flex between an initial configuration and a flexed configuration. The needle assembly may include a needle body with a needle extending therefrom. The leading end of the tubular body may be configured to selectively receive the needle body, and the trailing end of the tubular body may be configured to selectively receive the connector body. A method may include providing a flexible needle system.



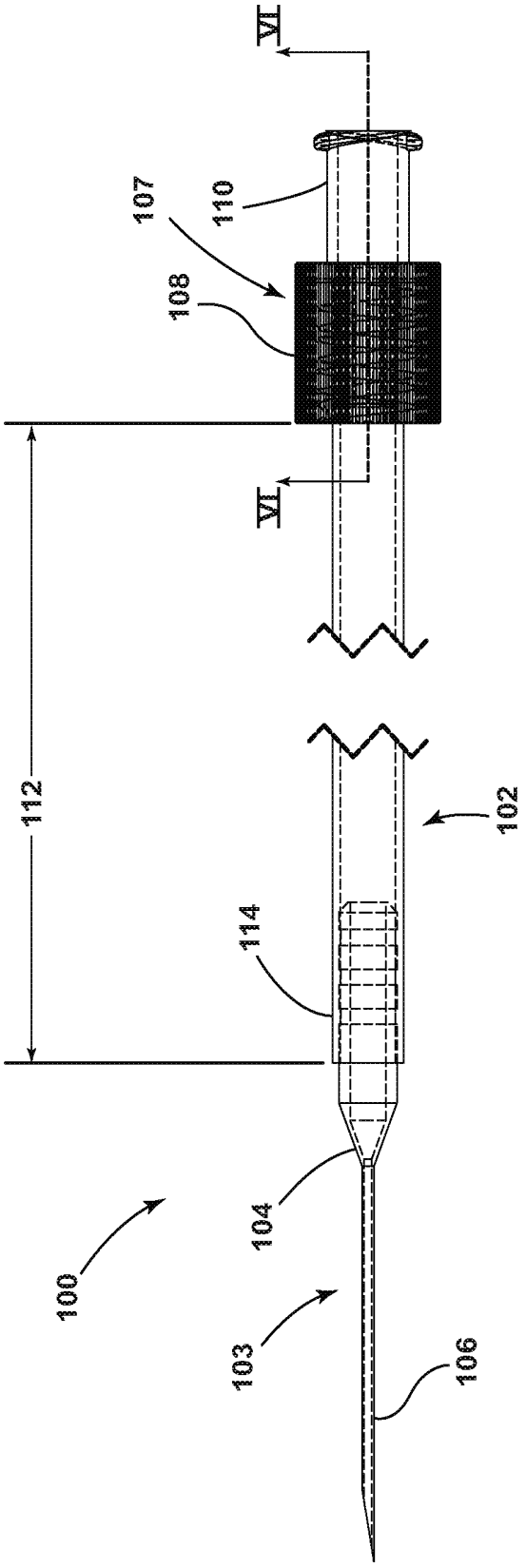


FIG. 1

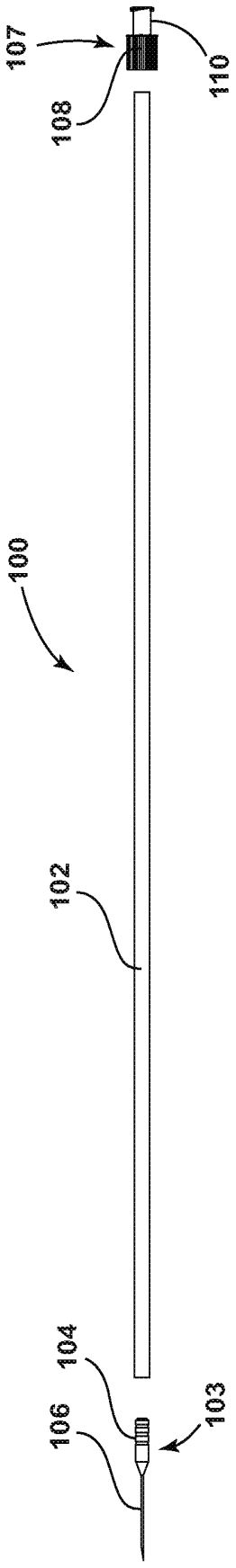


FIG. 2

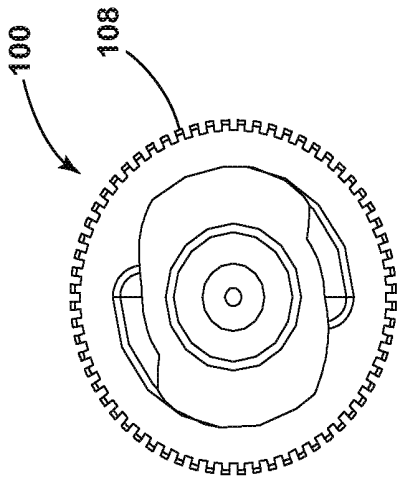


FIG. 4

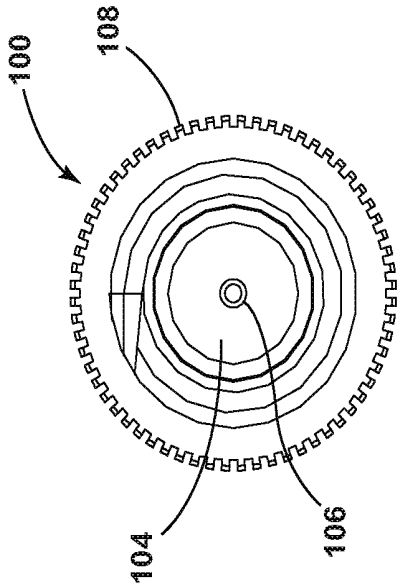


FIG. 3

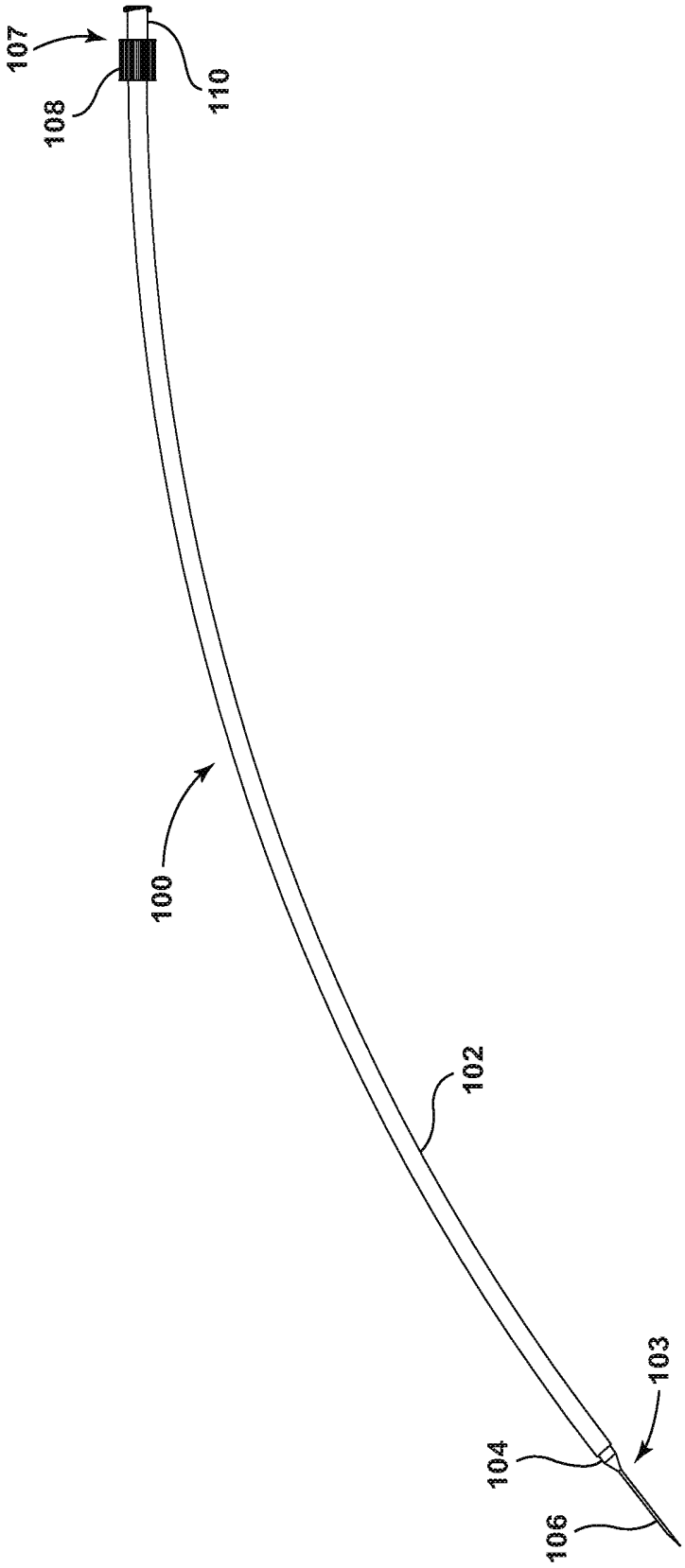


FIG. 5

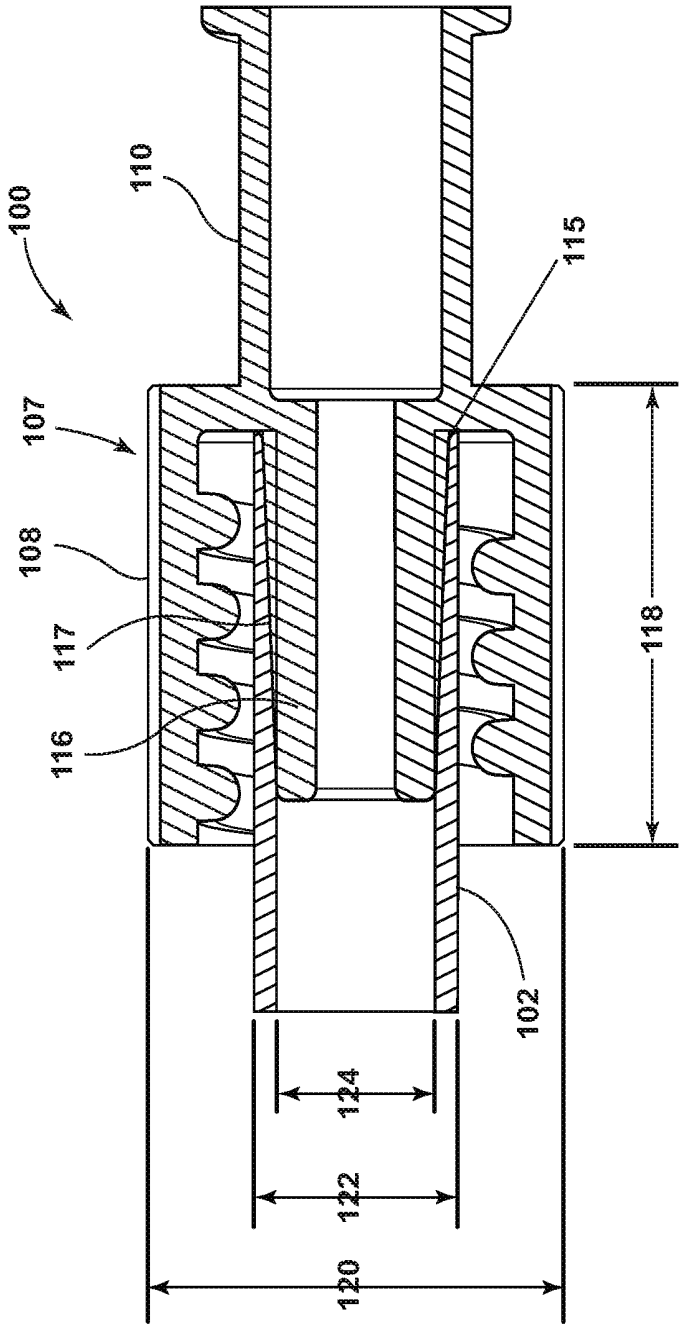


FIG. 6

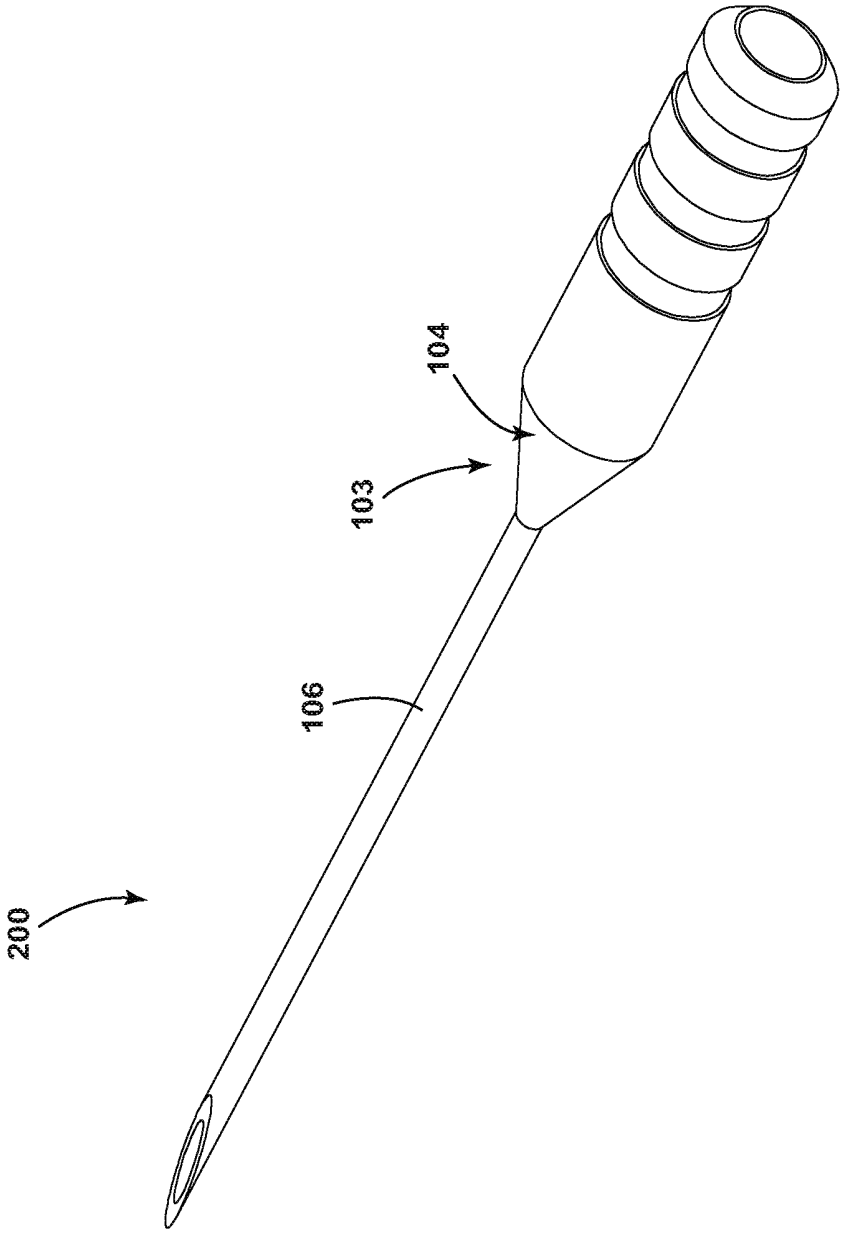
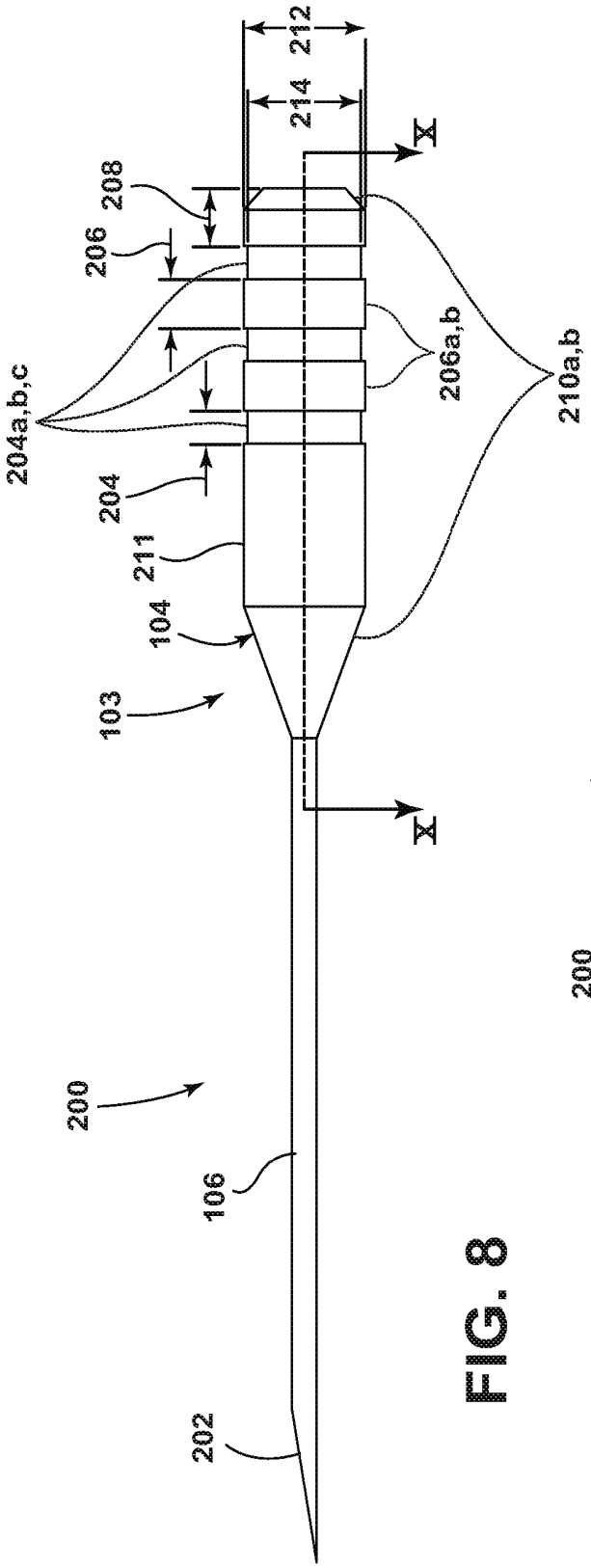


FIG. 7


212
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X
X
208
206
206a,b
210a,b
204a,b,c
204
211
104
103
200
106
202

FIG. 8

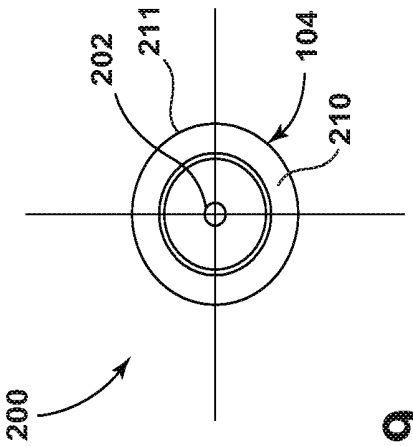
202
211
104
210
200

FIG. 9

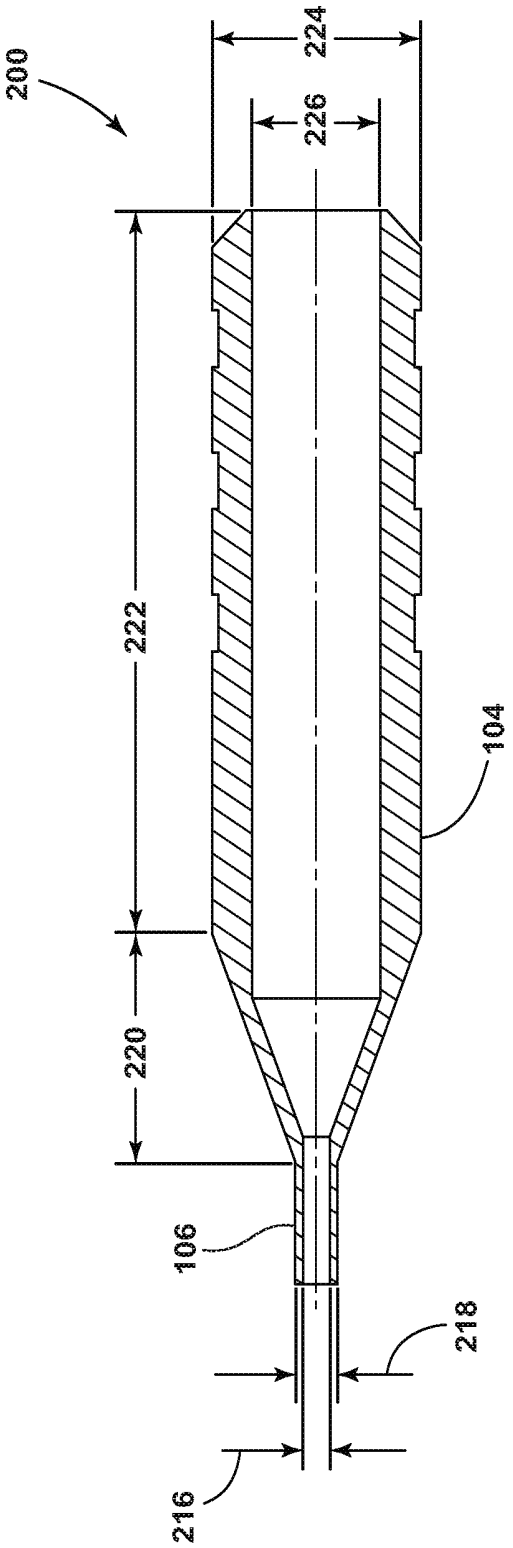

FIG. 10

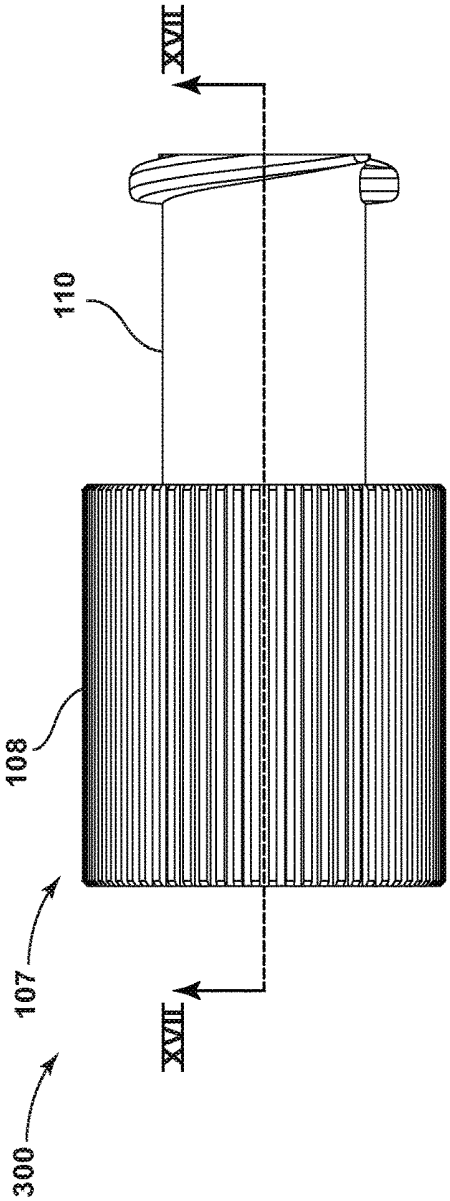

FIG. 11

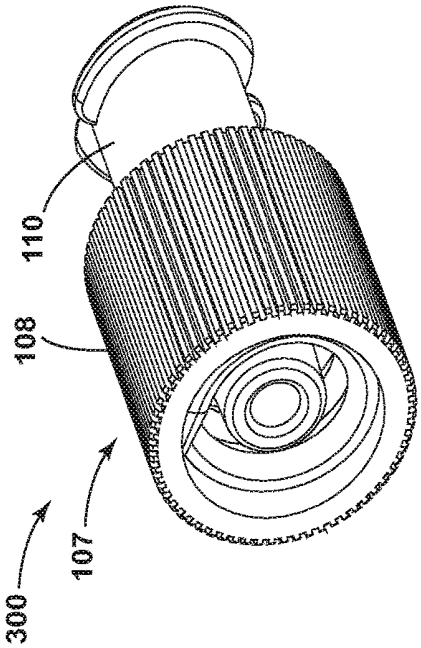

FIG. 13

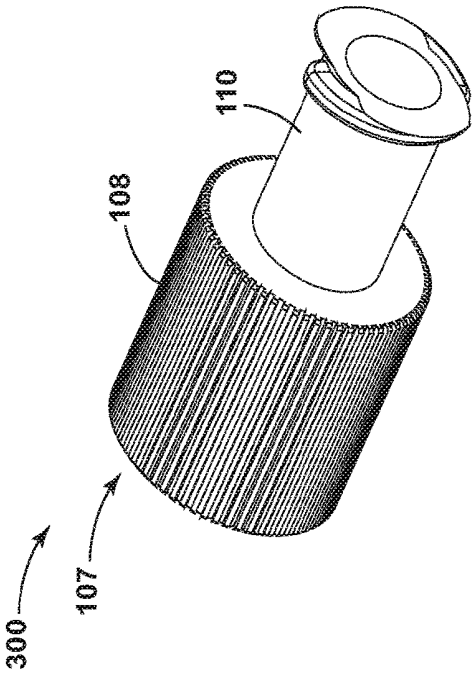

FIG. 12

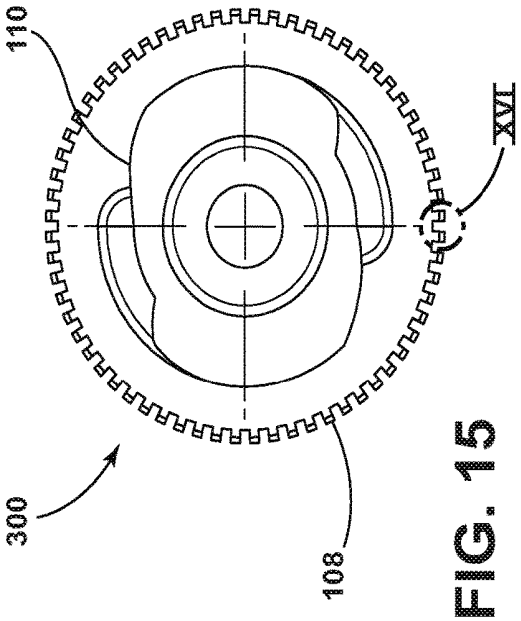

FIG. 15

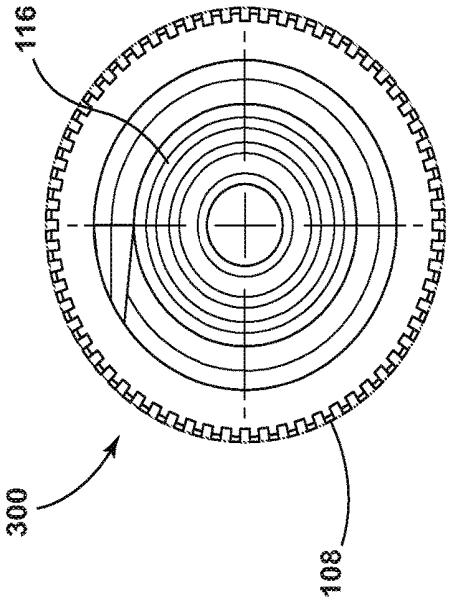

FIG. 14

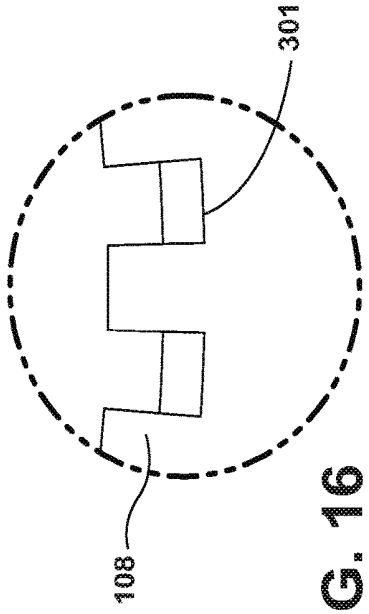

FIG. 16

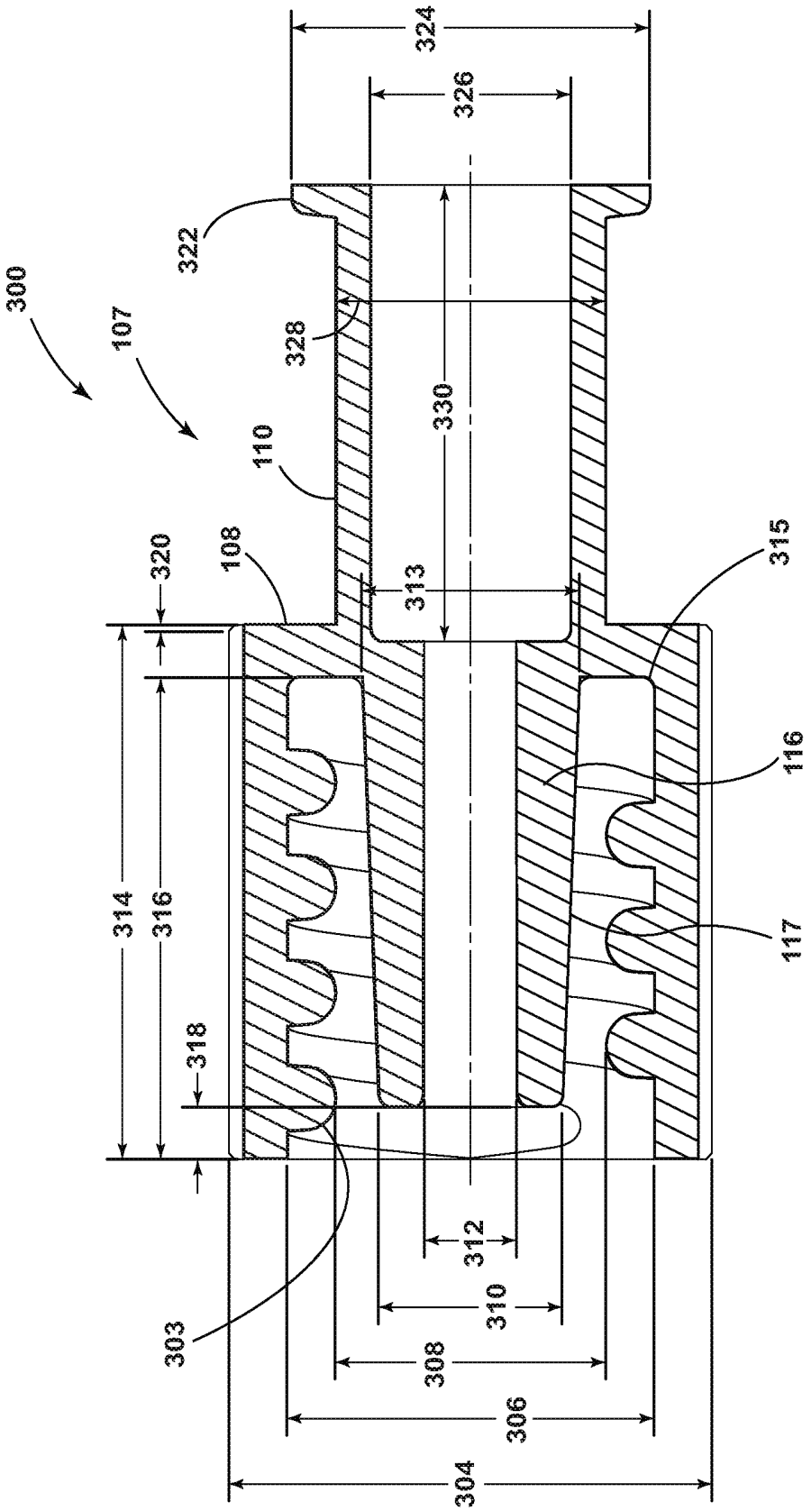
324
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FIG. 17

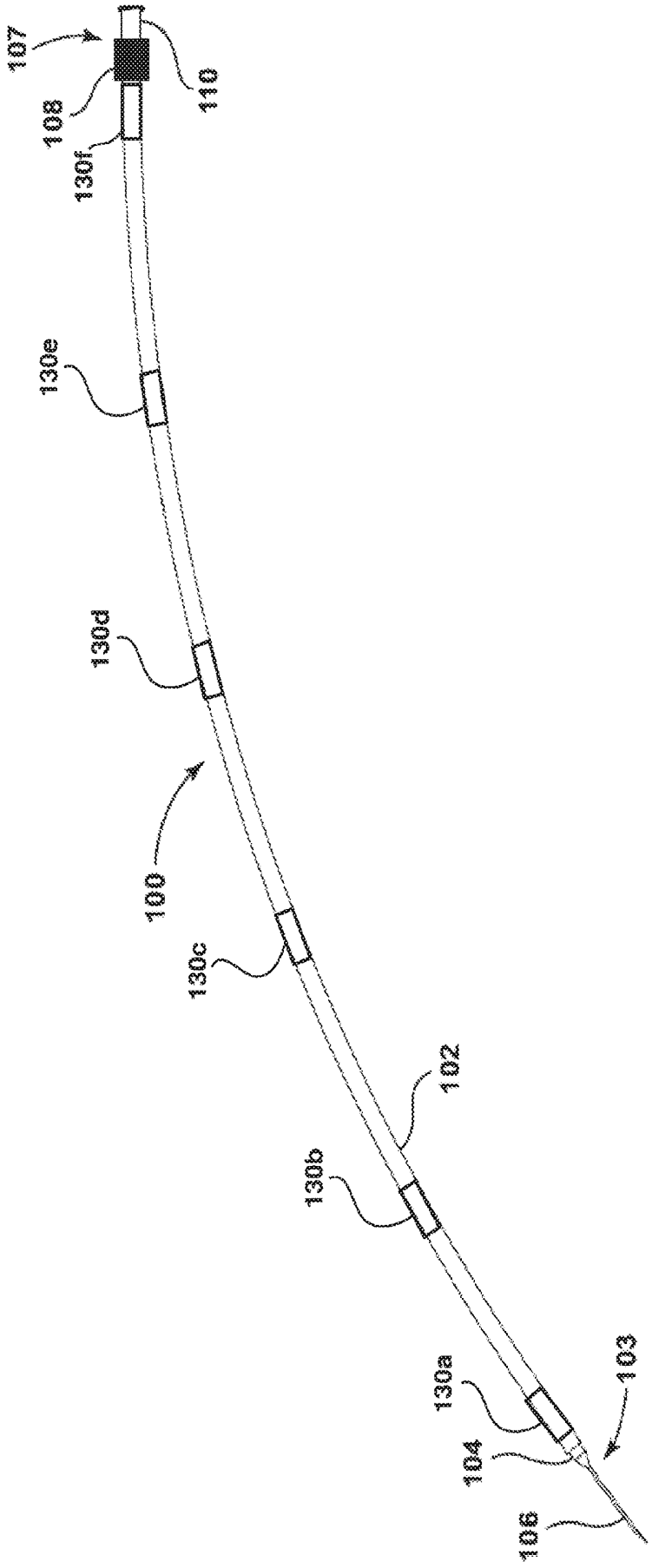

FIG. 18

FLEXIBLE ASPIRATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a non-provisional application that is based on and claims priority to U.S. Provisional Application No. 62/645,845 filed Mar. 21, 2018, which is incorporated by reference in its entirety.

BACKGROUND

[0002] Traditional aspiration techniques employ inflexible, visually obstructive and unsanitary structures. Typical instruments are positioned in a patient, but these instruments are inflexible and limit the access capabilities relative to curved or tortuous pathways therein. Further, typical instruments are non-transparent and thus obstruct visualization by surgeons. If the surgeon has limited direct or indirect visualization of the instrument, the trajectory of instrument within the anatomical structures of the patient may be unknown. Typical instruments also lack the ability for the surgeon to see materials flowing therethrough, or provide any indication of whether the procedure is complete. After use, traditional instruments are merely sterilized without any indication of whether biohazards still remain in the instrument and thus are prone to infection and spread of disease to the patient and others. There is a need for improved systems, devices and methods for optimized access, positioning, visualization, and sanitary practices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] While the claims are not limited to a specific illustration, an appreciation of the various aspects is best gained through a discussion of various examples thereof. Referring now to the drawings, exemplary illustrations are shown in detail. Although the drawings represent the illustrations, the drawings are not necessarily to scale and certain features may be exaggerated to better illustrate and explain an innovative aspect of an example. Further, the exemplary illustrations described herein are not intended to be exhaustive or otherwise limiting or restricted to the precise form and configuration shown in the drawings and disclosed in the following detailed description. Exemplary illustrations are described in detail by referring to the drawings as follows:

[0004] FIG. **1** illustrates a side view of an exemplary needle system of the present disclosure, e.g., in an initial configuration;

[0005] FIG. **2** illustrates an exploded view of the exemplary needle system of FIG. **1**;

[0006] FIG. **3** illustrates a front view of the exemplary needle system of FIG. **1**;

[0007] FIG. **4** illustrates a rear view of the exemplary needle system of FIG. **1**;

[0008] FIG. **5** illustrates another view of the exemplary system of FIG. **1** including, for example, a flexed configuration.

[0009] FIG. **6** illustrates a closer, cross section view of the exemplary needle system of FIG. **1**;

[0010] FIG. **7** illustrates an isometric view of a needle assembly of an exemplary needle system;

[0011] FIG. **8** illustrates a side view of the needle assembly of FIG. **7**;

[0012] FIG. **9** illustrates a front view of the needle assembly of FIG. **7**;

[0013] FIG. **10** illustrates a cross section view of the needle assembly of FIG. **7**;

[0014] FIG. **11** illustrates a side view of a connector body of an exemplary needle system;

[0015] FIG. **12** illustrates a front isometric view of the rear connection assembly;

[0016] FIG. **13** illustrates a rear isometric view of the rear connection assembly;

[0017] FIG. **14** illustrates a front view of the rear connection assembly;

[0018] FIG. **15** illustrates a rear view of the rear connection assembly;

[0019] FIG. **16** illustrates a closer view of FIG. **15**;

[0020] FIG. **17** illustrates a cross section view of the rear connection assembly; and

[0021] FIG. **18** illustrates another exemplary needle system of the present disclosure.

DETAILED DESCRIPTION

[0022] Embodiments of the present disclosure may employ more flexible, visually non-obstructive and sanitary structures. The present disclosure provides systems, devices and method for positioning aspiration systems for transfer of fluid with respect to a body opening of a patient, but with flexible and bendable structures to enhance access capabilities relative to curved or tortuous pathways through the anatomical structures within the patent. Further, embodiments may be transparent including semi-transparent and fully transparent so as to not obstruct and optimize visualization of the materials therein. Independently or in conjunction with direct or indirect visualization, embodiments may employ a plurality of sensors for providing sensor information with respect to the materials within and outside the system, and determining the sensor positions and trajectory relative to each other and surrounding anatomical structures of the patient. Moreover, embodiments may be configured for users to visualize or sensors to detect the consistency, flow rate, and type of materials flowing therethrough, or determine when appropriate materials have been removed from or injected into the patient. In addition, embodiments may include disposable or single use materials that may be disposed of along with contaminants thereby reducing infections and spread of disease. As a result, the systems, devices and methods herein are optimized for access, positioning, visualization, and sanitary practices.

[0023] A flexible needle system may comprise a tubular body, a needle assembly and a connector body. The system may be configured for any medical procedure for the aspiration, injection or withdrawal of any bodily, medical or other materials (e.g., fluids, tissues, or a combination thereof) with respect to a patient. The tubular body may include a leading end and a trailing end. The tubular body may be configured to flex between an initial configuration and a flexed configuration. The needle assembly may include a needle body with a needle extending therefrom. The leading end of the tubular body may be configured to selectively receive the needle body, and the trailing end of the tubular body may be configured to selectively receive the connector body.

[0024] A tubular body may be configured to be bent between an initial configuration that is substantially straight and to a flexed configuration that is substantially curved. At

least one of the tubular body, needle body and connecter body may include a substantially transparent material to view fluid therein. The tubular body may be configured to reduce bulging of the tubular body over the needle assembly. The leading end of the tubular body may be configured to selectively receive the needle body, and the trailing end of the tubular body may be configured to selectively receive the connector body.

[0025] All or any of the tubular body, needle assembly, and connector body may include an inner or outer surface having at least one of a luer taper, threaded (e.g., single, double or multi), press fit, mechanical interlock, rib-recess, adhesive, heated, melted, or bonded connection or a combination thereof relative to a corresponding inner or outer surface of each other or any other component herein. For example, at least one of the leading end and trailing end of the tubular body may include internal thread, external threads, or a combination thereof. The tubular body and the needle body may engage each other with at least one of a luer taper. The tubular body may be is received in the connection body, twisted relative to the connection body, and releasably secured thereto by way of a single, double or multi tooth thread.

[0026] Embodiments may include one or a plurality of sensors. The sensors may be along any of the tubular body, the needle assembly and connector body **103**. The sensors may be positioned on or anywhere between a leading end and a trailing end of the tubular body, needle assembly, connector body **103**, or a trocar with a straight or curved body positioned about and for receiving the tubular body and/or needle assembly therein. The sensors may be embedded in the tubular body, needle assembly, connector body, trocar or a combination thereof. The sensors may be positioned on an outer or inner surface of the tubular body, needle assembly, connector body **103**, trocar or a combination thereof.

[0027] FIGS. **1-5** illustrate needle system **100**. System **100** may include a flexible needle system configured to bend between an initial or substantially straight configuration (e.g. FIG. **1**) and a flexed or substantially bent configuration (e.g., FIG. **5**). System may include a tubular body **102**, a needle assembly **103**, and a connector body **107**. All or any portion of system **100** may be configured to be rigid, semi-rigid, flexible, bendable, transparent and/or opaque. System **100** may be optimized for direct or indirect visualization, robotic surgery, and use of one or more sensors.

[0028] With reference to FIG. **1**, the needle assembly **103** may be configured to penetrate skin of a patient and transfer fluid to the patient (e.g., inject fluid) or transfer fluid from the patient (e.g., withdraw fluid). The needle assembly **103** may include a needle body **104** with a needle **106** extending therefrom.

[0029] The tubular body **102** may be configured to provide fluid communication between the needle assembly **103** and the connector body **107**. The tubular body **102** may include a flexible, bendable, semi-rigid, or rigid material, a transparent, semi-transparent, or opaque material, or combination thereof. The tubular body **102** may include leading end **114** configured to prevent or reduce bulging area **114** of the tubular body **102** over the needle assembly **103**, e.g., by way of a rib-recess connection with the needle assembly **103**. The tubular body **102** may include any working length **112**.

[0030] FIG. **6** illustrates the fluid connection between tubular body **102** and connector body **107**. Tubular body **102** may include end face **115**. The connector body **107** may include a hub **108**. Hub **108** may include fitting **116** with taper **117** (e.g., luer type) configured to connect the hub **108** relative to the connector body **107**, e.g., in combination with a threaded connection. The connector body **107** may include a connector **110** (e.g., a single, double or multi tooth thread) configured to connect to a corresponding connector of the cannula, catheter or tube.

[0031] FIGS. **7-10** illustrate assembly **200** including needle assembly **103**. As shown in the isometric view of FIG. **7**, needle assembly **103** may include needle **106** with needle tip **202** (e.g., beveled). With reference to the side view of FIG. **8**, needle body **104** may include chamfer **204***a* (e.g., a leading chamfer), outer body surface **211**, and a trailing chamfer **204***b*. Needle body **104** may include recesses **204**, ridges **206** and end **208** with chamfer **210**. Recesses **204** may be in an alternating arrangement of a plurality of recesses and ridges, e.g., a first recess **204***a*, a first ridge **206***a*, a second recess **204***b*, a second ridge **206***b*, and a third recess **204***c*. The recesses **204** and/or ridges **206** may have constant, varying, increasing, decreasing, or staggered outer diameters. As shown in the front or leading end view of FIG. **9**, needle assembly **103** may include needle tip **202**, chamfer **201** (e.g., leading chamfer **201***a*), and outer body surface **211**.

[0032] FIG. **10** illustrates a cross section view of assembly **200**. Needle **106** may include an outer surface **218** and an inner surface **216**. Needle body **104** may include tapered portion **220**, rib-recess portion **222**, outer surface **224**, and inner surface **226**. Outer surface **224** may be configured to be positioned in a portion of needle body **104**. Alternatively, inner surface **226** may be configured to receive a portion of needle body **104**.

[0033] FIGS. **11-17** illustrate assembly **300** including connector body **107**. A shown in the side view of FIG. **11**, connector body **107** may include hub **108** and connector **110**. Hub **108** may include an outer surface that tapers inward or outward relative connector **110** and that includes a plurality of circumferential grips or ridges in an axial direction. Connector **110** may include a proximal end extending from hub **108** and a distal end having one or more external spiral protrusions or threads configured to engage an inner surface of tubular body **102**. Hub **108** may include internal locking features configured to engage tubing in fluid communication with a positive or negative pressure source.

[0034] As shown in FIGS. **12-16**, connector **110** may include external spiral protrusions or threads (e.g., FIGS. **12** and **15**) and hub **108** may include internal locking features (e.g., FIGS. **13** and **14**). As shown in FIG. **16**, the internal locking features of hub **108** may include a textured, channeled or geared surface **301** to improve grip of hub **108**, e.g., for turning and connecting connector body **107** relative to tubular body **102**.

[0035] As shown in FIG. **17**, hub **108** of connector body **107** may include any outer surface **304**. Hub **108** may include threaded connection **303** (e.g., internal) having an outer threaded surface **306** and an inner threaded surface **308**. Fitting **116** may include inner surface **312** and outer surface **310** with taper **117** (e.g., luer type) extending to fitting base **313**. Hub **108** may include rounds **315** between outer threaded surface **306**, outer surface **310**, thread depth **316**, or a combination thereof. Hub **108** may include any length **314**, thread depth **316**, and fitting offset depth **318**. One or both ends of hub **108** may include chamfer **320**.

Connector **110** of connector body **107** may include thread **322**, e.g., single, double or multi tooth thread. Connector **110** may include inner surface **326**, outer surface **328**, and cavity **330**.

[0036] With reference to FIG. **18**, needle system **100** may include one or a plurality of sensors **103***a-f*, tubular body **102**, needle assembly **103** and connector body **107**. The tubular body **102** may be configured to flex between an initial configuration and a flexed configuration. The needle assembly may include needle body **104** with a needle **106** extending therefrom. The leading end of the tubular body **102** may be configured to selectively receive the needle body **104**, and the trailing end of the tubular body may be configured to selectively receive the connector body **107**.

[0037] The sensors **130** may be along any of the tubular body **102**, needle assembly **103** and connector body **103**. The sensors **130** may be positioned on or anywhere between a leading end and a trailing end of the tubular body **102**, needle assembly **103**, connector body **103**, or a trocar with a straight or curved body positioned about and for receiving the tubular body **102** and/or needle assembly **103** therein. The sensors **130** may be embedded in the tubular body **102**, needle assembly **103**, connector body **103**, trocar or a combination thereof. The sensors **130** may be positioned on an outer or inner surface of the tubular body **102**, needle assembly **103**, connector body **103**, trocar or a combination thereof.

[0038] Sensors **130** may be operatively connected to each other. The sensors **130** may be in wired or wireless communication with each other, one or more user interface devices having a processor for performing operations on the sensor information, memory to store the sensor information and a display to display the sensor output, or a combination thereof. Sensors **130** may be configured to generate sensor information including at least one of flow rate, material type, material density, material translucence, material inductance, vibration, pressure, and temperature. One or the plurality of sensors **130** may include a flow rate sensor, pressure sensor, proximity sensor, photoelectric sensor, optical sensor, piezoelectric sensor, transducer, electrostatic sensor, and thermocouple configured to generate the sensor information. The sensors **103** may be configured to determine the relative position or trajectory of any of sensors **103***a-f* relative to any one of the other sensors **103***a-f* or anatomical structures within the patient.

[0039] The sensor information generated by sensors **130** may be based on the relative or aggregate sensor information of sensors **103***a-f* of materials inside or outside of the system **100**. The sensor information may be based on fluid (e.g., blood, body tissue or medicine) in or flowing through system **100**. The sensor information may be based on fluid or structures outside the system **100**. The sensor information may be based on fluid that is at least one of inside and outside the tubular body. The sensor information may be based on body tissue that is at least one of inside and outside the tubular body.

[0040] A method of a flexible needle system may comprise providing a tubular body, a needle assembly and a connector body. The tubular body may include a leading end and a trailing end. The tubular body may be configured to flex between an initial configuration and a flexed configuration. The needle assembly may include a needle body with a needle extending therefrom. The leading end of the tubular body may be configured to selectively receive the needle body, and the trailing end of the tubular body may be configured to selectively receive the connector body.

[0041] It will be appreciated that the aforementioned method and devices may be modified to have some components and steps removed, or may have additional components and steps added, all of which are deemed to be within the spirit of the present disclosure. None of the components or steps herein are essential elements nor is their interdependency required. Even though the present disclosure has been described in detail with reference to specific embodiments, it will be appreciated that the various modifications and changes can be made to these embodiments without departing from the scope of the present disclosure as set forth in the claims. The specification and the drawings are to be regarded as an illustrative thought instead of merely restrictive thought.

What is claimed is:

1. A flexible needle system comprising:

a tubular body having a leading end and a trailing end, the tubular body being configured to flex between an initial configuration and a flexed configuration;

a needle assembly including a needle body with a needle extending therefrom; and

a connector body,

wherein the leading end of the tubular body is configured to selectively receive the needle body, and the trailing end of the tubular body is configured to selectively receive the connector body.

2. The system of claim **1**, wherein the tubular body includes a plurality of sensors along the tubular body and positioned between the leading end and trailing end, and wherein the plurality of sensors are at least one of embedded in the tubular body, on an outer surface of the tubular body, and on an inner surface of the tubular body.

3. The system of claim **2**, wherein the plurality of sensors are operatively connected to each other and configured to generate sensor information including at least one of flow rate, material type, material density, material translucence, material inductance, vibration, pressure, and temperature.

4. The system of claim **3**, wherein at least one of the plurality of sensors includes at least one of a flow rate sensor, pressure sensor, proximity sensor, photoelectric sensor, optical sensor, piezoelectric sensor, transducer, electrostatic sensor, and thermocouple configured to generate the sensor information.

5. The system of claim **3**, wherein the sensor information is based on fluid that is at least one of inside and outside the tubular body.

6. The system of claim **1**, wherein the tubular body is configured to be bent from the initial configuration that is substantially straight and to the flexed configuration that is substantially curved.

7. The system of claim **1**, wherein at least one of the tubular body, needle body and connecter body include a substantially transparent material to view fluid therein.

8. The system of claim **1**, wherein the tubular body is configured to reduce bulging of the tubular body over the needle assembly.

9. The system of claim **1**, wherein the leading end of the tubular body is configured to selectively receive the needle body, and the trailing end of the tubular body is configured to selectively receive the connector body.

10. The system of claim **1**, wherein the tubular body is received in the connection body, twisted relative to the

connection body, and releasably secured by at least one of a luer taper, threaded, press fit, mechanical interlock, rib-recess, adhesive, heated, melted, and bonded connection.

11. The system of claim **1**, wherein at least one of the leading end and trailing end of the tubular body includes threads.

12. The system of claim **1**, wherein the tubular body and the needle body engage each other with at least one of a luer taper, threaded, press fit, mechanical interlock, rib-recess, adhesive, heated, melted, and bonded connection.

13. The system of claim **1**, wherein the tubular body and the connector body engage each other with at least one of a luer taper, threaded, press fit, mechanical interlock, rib-recess, adhesive, heated, melted, and bonded connection.

14. A flexible needle system comprising:

a tubular body having a leading end and a trailing end, the tubular body being configured to flex between an initial configuration and a flexed configuration; and

a needle assembly including a needle body with a needle extending therefrom;

wherein the tubular body is configured to receive a plurality of sensors along the tubular body, and

wherein the leading end of the tubular body is configured to selectively receive the needle body.

15. The system of claim **14**, wherein the plurality of sensors are at least one of embedded in the tubular body, on an outer surface of the tubular body, and on an inner surface of the tubular body.

16. The system of claim **14**, wherein the plurality of sensors are operatively connected to each other and configured to generate sensor information including at least one of flow rate, material type, material density, material translucence, material inductance, vibration, pressure, and temperature based on fluid that is at least one of inside and outside the tubular body.

17. The system of claim **14**, wherein the tubular body is configured to be bent from the initial configuration that is substantially straight and to the flexed configuration that is substantially curved.

18. The system of claim **14**, wherein at least one of the tubular body, needle body and connecter body include a substantially transparent material to view fluid therein.

19. A method of a flexible needle system, comprising:

providing a tubular body having a leading end and a trailing end, the tubular body being configured to flex between an initial configuration and a flexed configuration;

providing a needle assembly including a needle body with a needle extending therefrom; and

providing a connector body adapted to the tubular body,

wherein the leading end of the tubular body is configured to selectively receive the needle body, and the trailing end of the tubular body is configured to selectively receive the connector body.

20. The method of claim **19**, further comprising providing a plurality of sensors along the tubular body and positioned between the leading end and trailing end, and wherein the plurality of sensors are at least one of embedded in the tubular body, on an outer surface of the tubular body, and on an inner surface of the tubular body.

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专利名称(译)	灵活的抽吸系统		
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摘要(译)

柔性针系统可以包括管状主体，针组件和连接器主体。管状主体可以包括前端和后端。管状主体可以构造成在初始构造和挠曲构造之间挠曲。针头组件可包括具有从其延伸的针头的针头主体。管状主体的前端可构造成选择性地容纳针头主体，并且管状主体的尾端可构造成选择性地容纳连接器主体。一种方法可以包括提供柔性针系统。