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(54) **Title:** ELASTICALLY DEFORMABLE SURGICAL ACCESS DEVICE HAVING TELESCOPING GUIDE TUBE

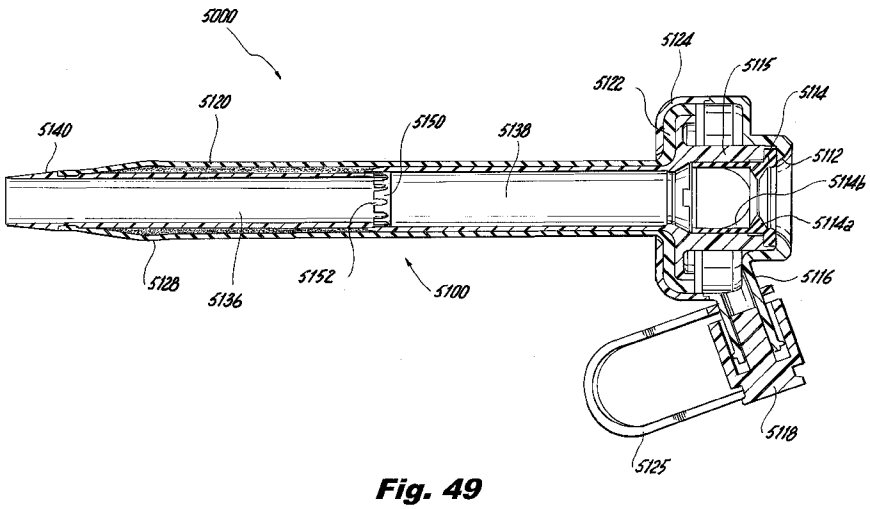


Fig. 49

(57) **Abstract:** A surgical access device is disclosed that includes an access port having an elongated body with opposed proximal and distal end portions and defining a longitudinal axis, the body having a central lumen extending there through and having a resilient bulb portion formed between the proximal and distal end portions thereof, wherein the resilient bulb portion is adapted and configured to transition between a first condition in which the bulb portion has a first diameter and a first length and a second condition in which the bulb portion has a second diameter that is less than the first diameter and a second length that is greater than the first length, and wherein a telescoping guide tube assembly is disposed within the central lumen of the access port body for accommodating an elongated insertion device, wherein the guide tube assembly is adapted and configured to transition between a first length corresponding to the first condition of the bulb portion and a second length corresponding to the second condition of the bulb portion.

WO 2008/128142 A2

ELASTICALLY DEFORMABLE SURGICAL ACCESS DEVICE HAVING TELESCOPING GUIDE TUBE

CROSS-REFERENCE TO RELATED APPLICATIONS

This international application claims priority to U.S. patent application serial number 11/786,832 filed April 13, 2007, which is a continuation-in-part application of U.S. patent application serial number 11/544,856, filed October 6, 2006. The disclosures of each of these foregoing applications are incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to sealable surgical access devices, and more particularly, to such devices that are capable of deforming to a low-profile configuration to facilitate percutaneous insertion, for example, into the abdominal wall of a patient.

2. Description of Related Art

A variety of surgical access devices are known in the art for providing access to a surgical cavity during minimally invasive surgical procedures. Such devices typically include a rigid tubular element, which defines a channel or lumen therethrough. The tubular element provides an open channel through the abdominal wall and into a surgical cavity, through which surgical instruments can pass. Typically, a seal is provided to inhibit insufflation gas from exiting to the surrounding environment while surgical instruments are removed from the lumen.

Such conventional devices generally have been considered satisfactory for their intended purpose. However, such devices are relatively costly to manufacture, being made from relatively expensive materials, such as polycarbonate plastic. Such devices also inhibit movement of surgical instruments, due to the long, rigid and narrow lumen defined therein. As a result, a surgeon must tilt the entire rigid access device, in order to manipulate his

instruments. Further, such devices are not typically provided with a facility for anchoring to the abdominal wall, and therefore can be accidentally removed therefrom during a procedure. Although some solutions to the foregoing problems have been developed, devices remedying some of these problems have been relatively complex and expensive. Therefore, there remains a continued need in the art for a surgical access device that provides access to a surgical cavity, which is a reduced encumbrance on a surgical procedure. There also remains a need in the art for such a surgical access device that is inexpensive and easy to manufacture. The present invention provides a solution for these problems.

SUMMARY OF THE INVENTION

The purpose and advantages of the present invention will be set forth in and apparent from the description that follows. Additional advantages of the invention will be realized and attained by the devices and methods particularly pointed out in the written description and claims hereof, as well as from the appended drawings.

In accordance with one aspect of the invention, a surgical access device having an access port is provided. The access port has an elongated body with opposed proximal and distal end portions, and defines a longitudinal axis. The body has a central lumen extending therethrough, which in-turn includes a resilient bulb portion formed between the proximal and distal end portions of the body. The resilient bulb portion is adapted and configured to transition between a first condition in which the bulb portion has a first diameter and a first length and a second condition in which the bulb portion has a second diameter and a second length; the second diameter is less than the first diameter, and the second length is greater than the first length. In accordance with this aspect, a first engagement means is arranged in the distal end portion of the body, for engagement with a distal end portion of an insertion device, such as a trocar. The insertion device is adapted and configured to releasably engage

the distal end portion of the access port body so as to facilitate a transition from the first condition to the second condition of the bulb portion of the access port body.

In accordance with another aspect of the invention, a surgical access device having an access port and an elongated trocar is provided. The access port has an elongated body with opposed proximal and distal end portions, and defines a longitudinal axis. The body has a central lumen extending therethrough, which in-turn includes a resilient bulb portion formed between the proximal and distal end portions of the body. The resilient bulb portion is adapted and configured to transition between a first condition in which the bulb portion has a first diameter and a first length and a second condition in which the bulb portion has a second diameter and a second length. The second diameter of the bulb portion is less than the first diameter, and the second length of the bulb portion is greater than the first length.

The elongated trocar is adapted to extend into the central lumen of the access port body and configured to releasably engage the distal end portion of the access port body so as to facilitate a transition from the first condition of the bulb portion of the access port body to the second condition of the bulb portion of the access port body.

In accordance with either of the foregoing embodiments the following features can be incorporated therewith, as desired. The bulb portion can have, for example, a generally spherical, generally ovoid, or other shape configuration in the first condition. The bulb portion of the access port body can be formed at least in part from an elastomeric material, such as silicone rubber. The bulb portion can have an outer surface with a substantially convex arcuate contour. The proximal end portion of the access port body can have a substantially constant outer diameter. Further, the bulb portion in the first condition can include an expanded diameter, or can be substantially straight. Additionally or alternatively, the bulb portion can include one or more circumferential longitudinally spaced ribs or longitudinal circumferentially-spaced ribs.

An insert sleeve can be disposed within the distal end portion of the access port body for engaging a distal end portion of the trocar and can be arranged at the distal end of the access port body, forming a tip thereof. Such insert sleeve can be formed from a material having a greater rigidity than the access port body, and can be, for example, Nylon. The insert sleeve can include a plurality of proximally extending expandable guide fingers for lining an inner surface of the bulb portion to accommodate or facilitate insertion of the trocar. Additionally, if desired, an elongated guide tube can be provided, which extends through the proximal portion of the access port body and at least partially into the bulb portion of the access port body.

Further, if desired, a substantially rigid generally planar flange portion can be associated with the proximal end portion of the access port body, and can define an access port communicating with the lumen of the access port body. Such access port can have a conically tapering lead-in surface. If provided, the insertion device can include a handle with releasable locking means for releasably engaging aforementioned flange portion.

If desired or required, the proximal portion of the access port body can be provided with longitudinal, circumferentially spaced ribs formed on an outer surface of the body, for inhibiting elongation of the proximal end portion of the access port body during the transition from the first condition of the bulb portion to the second condition of the bulb portion. Alternatively or additionally, the proximal portion of the access port body can be provided with circumferential, longitudinally spaced ribs formed on an outer surface of the body, for inhibiting circumferential expansion of the proximal end portion of the access port body during the transition from the first condition of the bulb portion to the second condition of the bulb portion. Additionally or alternatively, the body can be provided with circumferential, longitudinally spaced ribs formed on an outer surface of the body, for inhibiting removal of the bulb portion from an abdominal wall of a patient.

In accordance with the invention, a seal member can be disposed within the lumen, in the proximal end portion of the access port body. Such seal member can be, for example, a duckbill type valve, ball valve, or a fluid seal as set forth, for example in U.S. Patent Application No. 11/517,929 filed September 8, 2006. Additionally or alternatively, an integrally formed seal can be provided within the lumen, in the proximal end portion of the access port body. Such seal can be, for example, a protrusion provided on the wall of the lumen, to seal a space between the wall of the lumen and a surgical instrument. Alternatively or additionally, sealing can be accomplished by way of a collapsible region defined in the proximal end portion of the body such that the collapsible region can be collapsed by an outside force, to seal the lumen. Such outside force can be, for example, force exerted by the abdominal wall of a patient.

The body can be provided with a first engagement means in the distal end portion thereof, such that a distal end portion of a trocar can engage the first engagement means. Such engagement means can be tabs, which are configured and arranged to be grasped by the trocar, or alternatively, a substantially rigid stepped element, for engaging a mating portion of the trocar. If desired, the body can be provided with second engagement means in the proximal end portion thereof, with a proximal end of the trocar, obturator or other insertion device being adapted for engaging the second engagement means.

In the foregoing embodiments, the trocar or insertion device preferably has a length greater than the first length of the bulb portion of the body, and therefore causes extension of the bulb portion to the second length. If a second engagement means is arranged in the proximal end portion of the body, for engagement with a proximal end portion of the trocar or insertion device, the insertion device can maintain the access port body in the second condition while engaged therewith.

In accordance with another preferred embodiment of the subject invention, there is provided a surgical access device that includes, among other things, a telescoping guide tube assembly disposed within the central lumen of the access port body for accommodating the elongated insertion device. The guide tube assembly is adapted and configured to transition between a first length corresponding to the first condition of the bulb portion and a second length corresponding to the second condition of the bulb portion. In addition, the insertion device is configured to extend through the guide tube assembly and releasably engage the guide tube assembly to facilitate the transition of the access device from the first condition of the bulb portion to the second condition of the bulb portion.

Preferably, the telescoping guide tube assembly includes a proximal tube section and a distal tube section. The proximal tube section is fixed relative to the access port body and the distal tube section is adapted to translate relative to the proximal tube section. The distal tube section of the guide tube assembly includes a nosepiece that extends from the distal end portion of the access port body and has a tapered outer surface. Preferably, the tapered outer surface of the nosepiece merges into the bulb portion of the access port body, to provide a smooth transition between the two structures. The guide tube assembly has an interior engagement ring therein for mating with an exterior engagement ring provided on the insertion device.

The access port body also includes a plurality of axially spaced apart annular retaining ribs. The plurality of axially spaced apart annular retaining ribs includes two different rib structures. These include a first rib structure having a horizontal ledge and an angularly inclined riser and a second rib structure having a generally V-shaped cross-section.

In addition, the access port includes a proximal housing portion that includes an inlet opening communicating with the guide tube assembly. The housing portion has an interior chamber that houses a seal member designed to interact with the insertion device or a surgical

device inserted through the access port. The seal member preferably includes a duckbill seal portion and an annular wiper seal portion.

The insertion device used to facilitate the transition of the bulb portion between the first and second conditions includes a proximal handle assembly and an elongated trocar shaft that extends distally from the handle assembly. The handle assembly preferably includes means for engaging the proximal housing portion of the access port. In this regard, the proximal housing portion of the access port includes a proximal engagement flange and the handle assembly of the insertion device includes a pair of opposed pivoting latching arms for releasably engaging the flange of the access port.

Preferably, the pivoting locking arms of the handle assembly are normally biased into a latching position by spring arms or the like disposed within the handle assembly. The insertion device preferably has a tissue-penetrating tip at the distal end of the trocar shaft. The tissue-penetrating tip preferably includes at least two cutting surfaces or facets, and more preferably, the facets define optical lens areas for visualization during the tissue penetration procedure.

In addition, the handle assembly includes means for receiving a laparoscope that would communicate with the optical lens areas of the trocar tip. In this regard, the handle assembly includes means for securing the position of a laparoscope relative to the insertion device. Preferably, the means for securing the position of the laparoscope relative to the insertion device includes a rotatable cam lock that interacts with a silicone washer designed to compressively engage an outer periphery of the laparoscope. These and other unique features of the access device and the insertion device will become more readily apparent from the following detailed description of the preferred embodiments of the invention taken in conjunction with the associated figures.

In accordance with still another aspect of the invention, a method of forming an access port in a patient is provided. The method includes the steps of providing an access port in accordance with the invention, as set forth herein; providing an insertion device configured to engage the distal end portion of the access port body; extending the insertion device into the central lumen of the access port body so as to engage the distal end portion of the access port body; elongating the access port with the insertion device, the end of the insertion device being engaged with the distal end portion of the access port body; inserting the access port and insertion device through an abdominal wall of a patient to a predetermined position, while maintaining the access port in an elongated configuration; and removing the insertion device from the access port, allowing the access port to revert to the first configuration, with the bulb portion of the access port engaging an interior surface of the abdominal wall.

The method can further include the step of performing surgery by inserting a surgical instrument through the lumen of the access port, and through an optional rigid member associated with a portion of the body. The method can further include sealing the central lumen, either upon itself, or between the access port and a surgical instrument. Such sealing can occur by radially inwardly directed force acting on the access port, exerted by the abdominal wall of the patient.

Additionally or alternatively, the step of elongating the access port with the insertion device can further include engaging the insertion device with a first engagement means at the distal end of the access port and elongating the port along the insertion device. Additionally or alternatively, the method can further include the step of engaging a second engaging means associated with the proximal end of the access port with a corresponding engagement means on the insertion device to selectively maintain the access port body in an elongated configuration.

In accordance with the invention, the step of inserting the port can include inserting the access port through the abdominal wall with the insertion device in engagement with the first and second engagement means of the access port. The methods set forth herein can further include removing the access port from the abdominal wall. Such removal can include reengaging the insertion device with the first and second engagement means to elongate the access port body, and withdrawing the elongated access port from the abdominal wall.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and are intended to provide further explanation of the invention claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute part of this specification, are included to illustrate and provide a further understanding of the devices and methods of the invention. Together with the description, the drawings serve to explain the principles of the invention, wherein:

Figure 1 is an isometric view of a first representative embodiment of a surgical access device in accordance with the present invention, including an insertion device and an access port;

Figure 2 is an isometric view of the access port of Figure 1;

Figure 3 is a partial cross-sectional view of the surgical access device of Figure 1, showing the insertion device advancing through the access port;

Figure 4 is a detail view of region 4 in Figure 3;

Figure 5 is a partial cross-sectional view of the surgical access device of Figure 1, showing the insertion effecting extension of the through the access port, the figure also illustrating an initial insertion being made through an abdominal wall by the insertion device;

Figure 6 is a detail cross-sectional view of the initial insertion of the surgical access device, the figure also illustrating the engagement between the insertion device and access port at the distal end of the surgical access device;

Figure 7 is a partial cross sectional view illustrating the surgical access device of Figure 1, inserted through the abdominal wall, with the insertion device partially withdrawn from the access port;

Figure 8 is a partial cross sectional view illustrating the surgical access device of Figure 1, inserted through the abdominal wall, with the insertion almost fully withdrawn from the access port;

Figure 9 is a cutaway view the access port of the surgical access device of the preceding figures, illustrating the access port in use, with a surgical instrument inserted therethrough;

Figure 10 is an isometric view of another embodiment of an access port of a surgical access device in accordance with the invention, having longitudinal ribs on a neck portion thereof;

Figure 11 is a partial cross-sectional view of the access port of Figure 10, taken along line 11-11 of Figure 10;

Figure 12 is a cross-sectional view of the access port of the access port of Figure 10, taken along line 12-12 of Figure 10;

Figure 13 is a cutaway view of the access port of Figure 10, shown in an elongated configuration, with an insertion device inserted therein;

Figure 14 is a cutaway view of a further embodiment of an access port in accordance with the invention, having inwardly projecting guide fingers for facilitating insertion of surgical instruments through the access port;

Figure 15 is a partial cross-sectional view of the access port of Figure 14;

Figure 16 is a cutaway view of the access port of Figure 14, shown in an elongated configuration, with an insertion device inserted therein;

Figure 17 is a cutaway view of a further embodiment of an access port in accordance with the invention, having a valve and a central guide tube for facilitating insertion of surgical instruments through the access port;

Figure 18 is a partial cross-sectional view taken along line 18-18 of the access port of Figure 17;

Figure 19 is a partial cross-sectional view taken along line 18-18 of the access port of Figure 17, shown in an elongated configuration, having an insertion device inserted therein;

Figure 20 is a cutaway view of still another embodiment of an access port in accordance with the invention, including a reinforcing backstop for engagement with an insertion device in accordance with the invention;

Figure 21 is a partial cross-sectional view of the access port of Figure 20, taken along line 21-21;

Figure 22 is an isometric view of a surgical access device in accordance with the invention, including the access port of Figure 20, and an insertion device having a latching mechanism for engaging the access port;

Figure 23 is an isometric view illustrating the surgical access device of Figure 22, showing the access port in an elongated configuration in engagement with an insertion device, prepared for insertion through the abdominal wall of a patient;

Figure 24 is an isometric view of a further embodiment of an access port in accordance with the invention, having a relatively longer neck portion than foregoing embodiments;

Figure 25 is an isometric view of an additional embodiment of an access port in accordance with the invention, having a tip with flexible anchor elements provided thereon, for securing the tip to the access port body, and optionally for guiding surgical instruments through the lumen of the access port;

Figure 26 is an isometric view of still another embodiment of an access port in accordance with the invention, having a flange reinforcing element provided thereon;

Figure 27 is an isometric view of another embodiment of an access port in accordance with the invention, having a guide tube, valve and flange reinforcing element;

Figure 28 is an exploded view of the access port of Figure 27;

Figure 29 is a cross-sectional view taken along line 29-29 of the access port of Figure 27, shown in a non-elongated configuration;

Figure 30 is a detail view of region 30 in Figure 29;

Figure 31 is a detail view of region 31 in Figure 29;

Figure 32 is a cross-sectional view of the access port of Figure 27, shown in an elongated configuration with an insertion device inserted in the access port;

Figure 33 is an isometric view of a further embodiment of an access port in accordance with the invention, having a generally flared configuration in the distal end portion thereof and circumferential ribs arranged thereon;

Figure 34 is a partial cross-sectional view of the access port of Figure 33;

Figure 35 is a partial cross-sectional view of the access port of Figure 33, shown in an elongated configuration with an insertion device inserted in the access port;

Figure 36 is an isometric view of yet another access port in accordance with the invention, having a generally flared configuration in the distal end portion thereof with longitudinal ribs extending the length of the body thereof;

Figure 37 is a partial cross-sectional view of the access port of Figure 36;

Figure 38 is a partial cross-sectional view of the access port of Figure 36, shown in an elongated configuration with an insertion device inserted in the access port;

Figure 39 is an isometric view of still another access port in accordance with the invention, having longitudinal ribs in a neck portion and circumferential ribs in the distal end portion thereof;

Figure 40 is a partial cross-sectional view of the access port of Figure 39;

Figure 41 is a partial cross-sectional view of the access port of Figure 39, shown in an elongated configuration with an insertion device inserted in the access port;

Figure 42 an isometric view of a further embodiment of access port in accordance with the invention, which access port has an enlarged, generally barb-shaped region and a

plurality of barb-shaped ribs to inhibit pullout of the access port from the abdominal wall of a patient;

Figure 43 is an exploded view of the access port of Figure 42, illustrating the various components thereof;

Figure 44 is a side view of the access port of Figure 42, illustrating in hidden line the arrangement of internal components thereof;

Figure 45 is a front view of the access port of Figure 42, also illustrating in hidden line the arrangement of internal components thereof;

Figure 46 is a perspective view of another embodiment of the elastomeric surgical access device of the subject invention, shown in a relaxed or unstretched condition in which the anchoring bulb has a first diameter and a first length;

Figure 47 is a perspective view of the elastomeric surgical access device of Figure 46, shown in an elongated or stretched condition in which the anchoring bulb has a second diameter less than the first diameter and a second length greater than the first length;

Figure 48 is a cross-sectional view of the elastomeric surgical access device of the subject invention taken along line 48-48 of Figure 46;

Figure 49 is a cross-sectional view of the elastomeric surgical access device of the subject invention taken along line 49-49 of Figure 47;

Figure 50 is a perspective view of an insert device designed to deploy the elastomeric surgical access device of Figure 46, which includes a handle assembly and a longitudinally extending trocar having a tissue-piercing tip;

Figure 51 is cross-sectional view of the insert device of the subject invention taken along line 51-51 of Figure 50;

Figure 52 is a perspective view of the insert device of Figure 50 together with the surgical access device of Figure 46 in an unstretched condition;

Figure 53 is cross-sectional view taken along line 53-53 of Figure 52 showing the insert device of Figure 50 together with the surgical access device of Figure 46 in an unstretched condition;

Figure 54 is a perspective view of the insert device of Figure 50 together with the surgical access device of Figure 46 in an elongated stretched condition; and

Figure 55 is cross-sectional view taken along line 55-55 of Figure 54 showing the insert device of Figure 50 together with the surgical access device of Figure 46 in an elongated stretched condition.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference will now be made in detail to the selected embodiments of the invention, examples of which are illustrated in the accompanying drawings. The devices and methods presented herein relate to providing a surgical access port to allow insertion and removal of surgical instruments during a procedure. The present invention is particularly suited for use in minimally-invasive surgical procedures of the abdomen, and is suitable for procedures where the abdominal cavity is pressurized with insufflation gas.

For purpose of explanation and illustration, and not limitation, an isometric view of an exemplary embodiment of a surgical access device in accordance with the invention is shown in Fig. 1 and is designated generally by reference character 100. Other embodiments of surgical access devices in accordance with the invention, or aspects thereof, are provided in Figs. 2–34, as will be described.

Figures 1- 9 illustrate the surgical access device 100, and components thereof alone, and in conjunction with an abdominal wall (i.e., 530 of Figs. 5-9) of a patient, additionally illustrating the steps of insertion and use the surgical access device 100. The surgical access device 100 includes, generally, an access port 110 and an inserter 120. The access port is at least partially flexible in its construction, and depending on the particular embodiment can be primarily composed of one or more flexible materials. The access port includes a body 118, with a proximal flange 101 and distal tip 107 arranged thereon, at opposed ends thereof. The body 118 includes bulb portion 105 and a neck portion 103, each of which defines a respective portion of a lumen 106 passing therethrough. Upon insertion, as will be understood, the bulb portion 105 assists in anchoring the access port 110 into the abdominal wall 530 (e.g., in Fig. 8) of the patient, while the neck portion 103 maintains a passageway through the abdominal wall 530.

The insertion device 120 includes a handle 121 for gripping by a user, a shaft 123, and a distal tip 125. The tip 125 can include an engagement feature, such as the stepped portion illustrated, which engages a mating stepped interior of the distal tip 107 of the access port 110. The insertion device can include a cutting tip at its distal end, or can have a blunt tip at the end thereof. The insertion device 120, therefore, can be a trocar, a blunt-tip obturator, or a visualization device (e.g., an obturator with a visualization tip and a channel to receive an endoscope), for example. The flange 101, serves multiple purposes. Firstly, the flange 101 serves as a location for a user to grip when preparing the access port 110 for insertion. Secondly, the flange 101 acts as a stop to abut the outer surface (skin) of the patient's abdominal wall, preventing the entire access port 110 from passing through the incision made to insert the access port. Further, the flange 101 can be provided with a lead in surface 102, which helps guide the insertion device 120, or other instruments therein and therethrough.

The tip 107 is provided at the distal end of the body 118 of the access port 110. The tip 107 is insert molded, adhered, or otherwise secured to the body 118, details of which are set forth below in connection with other embodiments. Since the tip 107 must securely engage the insertion device 120, the tip 107 is preferably made of a relatively rigid material. However, although illustrated as extending distally from the body 118, the tip can be provided within the body 118, near the distal end thereof, if desired. As such, the tip 107 can be concealed from view, while still having the necessary rigidity to withstand forces exerted by the insertion device 120, for example. Variations of the bulb portion 105, neck portion 103, tip 107 and flange 101 are described below in connection with other embodiments. Naturally, these specific features can be interchanged and combined as needed or desired.

Figure 4 is a detail view of the respective region of Figure 3. As can be seen, the lead in surface 102 can facilitate insertion of a surgical instrument. Additionally, an integral O-ring seal 104 is provided, which seals between an instrument shaft (illustrated as insertion

device shaft 123), and the access port 110. Thus, egress of insufflation gas is inhibited. Naturally, such feature can be applied to any embodiment set forth herein. Additionally, the precise configuration of the seal 104 can vary, if desired, but the seal 104 can, as illustrated, be a simple projection of the seal 104 from the neck portion 103 of the access port 110. Moreover, a plurality of seals, such as seal 104 can be provided in series to further enhance sealing capability.

As shown in Figures 5 and 6, in use, the insertion device 120 is inserted through the lumen 106 of the access port 110, with the tip 125 of the insertion device 120, passing through and engaging the tip 107, preventing proximal movement of the tip 107, relative to the insertion device 120 (Figure 6). Next, the flange 101 is pulled proximally by the user, toward the handle 121 of the insertion device 120, longitudinally elongating the access port 110, reducing its cross-sectional profile, to facilitate insertion (e.g., in Fig. 5). The access port 110 is maintained in an elongated configuration during insertion, as the surgical access device passes through the abdominal wall 530 of the patient. Because the access port 110 includes a flexible material, the access port 110 can be additionally radially compressed by the abdominal wall during insertion.

The surgical access device 100 is urged through the abdominal wall 530 of the patient until the flange 100 meets the surface 531, or skin of the abdominal wall 530. Figure 7 illustrates the surgical access device 100 in such a position, with the insertion device 120 slightly withdrawn from the access port 110. As the insertion device is withdrawn, the bulb portion 105, now held within the abdominal cavity 535, reverts toward its original configuration, expanding in diameter. The bulb portion 105, therefore, engages the inside surface 532 of the abdominal wall 530. If the access port 110 is configured in such a way that the neck 103 elongates during insertion, upon release of tension in the access port applied by the insertion device 120, the neck 103 attempts to contract, thereby pulling the bulb

portion 105 toward the flange 101, helping secure the access port 110 to the abdominal wall 530. If provided, however, ribs (e.g., ribs 1004 shown in Figure 10) can inhibit the elongation of the neck 103, allowing the force exerted in longitudinally elongating the access port 110 to be focused on reducing the cross sectional profile of the bulb portion 105. Advantageously, as the bulb reverts to its original configuration with the bulb expanded in diameter, the surgical access port foreshortens, the benefits of which will be described below.

Figure 9 illustrates the access port 100 of Figures 1-8, with a surgical instrument 930 inserted therethrough. As illustrated, the flange 101 maintains engagement with the upper and lower surfaces 531, 532 of the abdominal wall 530, even when the access port 110 is manipulated to angle an instrument. Because the surgical access port foreshortens during insertion and is firmly held in place relative to the abdominal wall by the bulb portion 105 and flange 101, the length of the access device interacting with the surgical instrument is minimized and the forces, which must be exerted to angle and manipulate the surgical instrument can therefore be reduced. Further, as can be seen, access ports in accordance with the invention can be sized such that contact is maintained between the interior neck wall 913 and the shaft 933 of the instrument 930, thereby maintaining an airtight seal. Additional seal elements, such as one or more internal ribs, can be arranged circumferentially on the inner wall 913 of the neck 103, if desired. If a plurality of ribs are provided, they can be longitudinally spaced from one another so as to provide even greater sealing.

In this embodiment, upon withdrawal of the instrument 930, the abdominal wall 530, which continually exerts an inward force on the access port 110, causes the lumen 106 in the region of the neck 103 to close, thus sealing the lumen 106, inhibiting escape of insufflation gas from the surgical cavity (e.g., a pneumoperitoneum). Such behavior can be seen, for example, in Figure 8, illustrating withdrawal of the insertion device 120 from the access port 110. This occurs if the neck portion 103 is configured so as to allow this to happen. For

example, the material selection must be such that the neck region is sufficiently compliant, compressible and/or collapsible to be affected by the force of the abdominal wall 530—that is, not excessively rigid. For this reason, it may be desirable to not include longitudinal ribs (e.g., ribs 1004 shown in Figure 10).

In other instances, however, ribs or other stiffening means may be desirable. As an alternative to ribs, if desired, a material having directional reinforcement can be utilized, such as a fiber-reinforced polymer. As such, the access port 110 can be formed so as to have longitudinal resistance to elongation, for example at the neck 103, while still easily collapsing radially, so as to seal between the access port and a surgical instrument.

It should be noted, that if the neck 103 of the access port 110 is configured so as to be relatively compliant, the neck can adapt to different sizes of surgical instruments inserted therethrough— expanding to the appropriate size to accommodate each tool.

Figures 10-13 illustrate an alternate embodiment of a surgical access device in accordance with the invention, designated generally by reference number 1000, which access device 1000 includes an insertion device 1020 and access port 1010. The access port 1010 is similar to the access port 110 of Figures 1-9 in many respects. However, in this embodiment, the bulb portion 1005 is more spherical than that of access port 110, which itself is somewhat more elongate in shape. Naturally, the precise shape can be tailored as seen appropriate. The more spherical shape of the bulb portion 1005 of the access port 1010 of Figures 10-13 is particularly advantageous in areas where reduced clearance is present, such as, for example, along lateral sides of the abdominal cavity. In the medial portion of the abdominal cavity, particularly if the abdominal cavity is insufflated, more space is available than is available in the lateral regions of the abdominal cavity. The shortened shape of the bulb portion 1005, allows placement of the access port 1010, and allows manipulation of the access port 1010 and tools inserted therethrough, within the cavity.

Additionally, elongation-prevention ribs 1004 are provided on the neck 1003. As evident, particularly from the cross-sectional view of Figure 12, the increased cross-sectional area of the neck 1003 affords increased resistance to the applied tension needed to elongate the access port 1010 prior to insertion, while not substantially affecting the ability of the neck 1003 to contract or expand radially. As mentioned briefly above, all or a portion of the access port 1010 can be composed of one or more materials having directional properties. For example, the neck 1003 can be provided with reinforcing fibers embedded within the material thereof. Such fibers can be as rigid as desired, to impart the desired properties on the access port.

Alternatively or additionally, the bulb 1005 or flange 1001 can similarly include materials having directional properties. If, for example, the bulb 1005 is reinforced or is otherwise composed of material(s) having directional properties, when tension is applied to the access port 1010 the bulb 1005 will simply deform to a point, elongating as a whole, but without the material itself elongating or "stretching." Thus, it can therefore be understood that elongation or "stretching" of the material itself used for this and other access ports described herein, is not essential to practice of the invention.

Figure 12 is a cross-sectional view taken across the neck 1003 of the access port 101 of Figure 10. The ribs 1004 of the neck 1003 are evident thereon, and the tip 1007 can be seen though the lumen 1006 of the access port 1010. Figure 13 illustrates the access port 1010 of Figure 10 in an elongated configuration. As can be seen, the relatively spherical shape of the bulb portion 1005 does not yield an access port 1010 that is incapable of assuming a low-profile shape.

Figures 14-16 illustrate a further embodiment of an access port 1410 in accordance with the invention. The general shape of the access port 1410 is similar to that of the access port 1010 of Figures 10-13. The access port 1410 includes a flange 1501 with a lead-in

surface 1502, a body 1518 having a neck portion 1503 with longitudinal ribs 1504, and a bulb portion 1505. A distal tip 1507 is also provided thereon for engaging an insertion device.

However, the access port 1410, and more specifically the tip 1507. includes axially inwardly and radially outwardly directed flexible fingers 1508, which are provided to line the distal end portion of the lumen 1506, defined within the bulb portion 1505. The fingers 1508 serve to guide surgical instruments toward the lumen of the tip 1507, so as to more easily pass through the access port 1410 and into surgical cavity. While the access port body 1518 (i.e., the bulb 1505 and the neck 1503) may be made of a material that is relatively soft to allow flexure, the fingers 1508 and additionally the tip 1507 itself can be made of a relatively rigid material. Such material preferably also has a relatively low coefficient of friction against materials used in surgical instruments (e.g., metals and plastics), so that the instruments are easily guided through the lumen and into the surgical cavity.

The fingers 1508 also serve to reinforce the distal end portion of the bulb portion 1505, if they are embodied such that they are at least partially secured to the bulb 1505. Alternatively, they can simply be in contact with the inner surface 1506 of the bulb 1505, resiliently contacting the surface 1506. In the illustrated embodiment, particularly as seen in Figure 15, the fingers 1508 each include a longitudinal, inwardly projecting portion 1519, extending from the tip 1507. The longitudinal portion 1519 is connected to a second, angled portion 1517 at a resilient hinge 1520, the geometry of which is configured to maintain the angled portion 1517 of each finger 1508 in abutment with the interior surface 1506 of the bulb portion 1505, if the fingers 1508 are not already secured thereto. The hinge 1520 can be a so-called living hinge, defined in the material of the finger 1508 by a reduced thickness region, for example. Alternatively, the fingers 1508 and hinges 1520 can simply be made of material that is flexible enough to bend during elongation of the access port 1410.

With reference to Figure 16, it can be seen that when the access port 1410 is elongated to result in a reduced cross-sectional profile prior to insertion, the fingers 1508 flex in conjunction with the bulb 1505. The relative dimensions of the fingers 1508 can be selected as desired. For example, the fingers can widen toward their distal ends (distal with respect to the tip 1507), in order to better guide instruments through the lumen 1506. When in the elongated state, as shown in Figure 16, such widened fingers can lay adjacently to one another, or can be configured to overlap one another. As such, the fingers cover an increased area, while the access port 1410 is in a first configuration (Figs. 14, 15), and still allow the elongated, reduced profile configuration of Figure 16.

With reference to Figures 17-19, a further embodiment of an access port 1710 in accordance with the invention is provided. The access port 1710 includes a proximal flange 1701, a neck 1703 having longitudinal ribs 1704, and a bulb portion 1705 terminating in a distal tip 1707. The distal tip 1707 is attached to the bulb 1705 in this embodiment by extensions 1709, which provide a location for the material of the bulb 1705 to engage the tip 1707. Such engagement can be effected, for example, by way of insert molding the tip 1707 with the material of the body (i.e., the bulb 1705 and neck 1703). In the case of the flange 1701, as with other flanges set forth herein in connection with other embodiments, the flange 1701 can be molded integrally with the neck 1703 and bulb 1705 portions.

The access port 1710 of Figures 17-19 differs from the forgoing embodiments in that the access port 1710 includes a guide tube 1711 and a valve 1709 provided in the lumen 1706 thereof. The guide tube is provided with a proximal flange 1819, which rests in a recess formed in the flange 1701 of the access port 1710. The flange 1819 of the guide tube 1711 maintains the tube 1711 in place, and can be insert molded, adhered or otherwise attached to the access port body. The tube 1711 serves as a guide during insertion of surgical instruments, helping lead the instruments toward the tip 1707, reducing the chances that such

instruments will veer toward the inner wall 1706 of the bulb 1705, which might delay the surgical procedure being performed. The guide tube 1711 is also preferably made out of material having a relatively low coefficient of friction, with respect to the surgical instruments being inserted therethrough, in order to further facilitate insertion of surgical instruments.

The valve 1709, is shown as a duckbill type valve, but can be of any type desired. Alternatively or additionally, a ball valve and/or or a fluid seal can be utilized, as set forth, for example in U.S. Patent Application No. 11/517,929 filed September 8, 2006, which is incorporated herein by reference in its entirety. The valve 1709 is arranged within the guide tube 1711 and serves to reduce leakage of insufflation gas from the surgical cavity (e.g., a pneumoperitoneum), when instruments are removed from the access port 1710. While certain of the foregoing embodiments, such as the access port 110 of Figures 1-9, seal upon removal of an instrument due to the compressive forces exerted by the abdominal wall, the guide tube 1711, which is relatively rigid, prevents this embodiment from sealing in that manner. Accordingly, the valve 1709 is provided to seal when an instrument is removed from the access port 1710.

Figures 20-23 illustrate a surgical access device, including an access port 2010 and an insertion device 2220. The access port 2010 is similar in many respects to the foregoing access ports, with the exception of a reinforcing backstop 2012 provided on the underside of the flange 2001. The backstop 2012 rigidifies the flange 2001, and provides a secure surface for engagement with locking pawls 2223a, 2223b of the insertion device 2220. The pawls 2223a, 2223b are preferably resiliently biased toward a closed position, where protrusions 2225 at the distal end thereof engage the backstop 2012, inhibiting removal of the insertion device 2220 from the access port 2010. A user can disengage the pawls 2223a, 2223b by

depressing the release end 2224 of the pawls 2223a, 2223b, which pivot the protrusions 2225 away from the access port 2010 and the backstop 2012.

While the above-described latching mechanism can be incorporated into any of the embodiments set forth herein, the access port 2010 illustrated includes a flange 2001, which holds the backstop 2012, a neck 2003 having longitudinal ribs 2004, a bulb portion 2005, and a tip 2007, secured to the bulb portion 2005 with extensions 2008.

In use, the user places the insertion device 2220 through the lumen 2006 of the access port 2010, elongating the access port 2010 until the pawls 2223a, 2223b engage the backstop 2012 (See Figure 23). The access device is then inserted through the abdominal wall of the patient. The user then depresses the release ends 2224 of the pawls 2223a, 2223b, and withdraws the insertion device 2220 from the access port 2010, allowing the access port 2010 to revert toward its original configuration (as in Figure 20, for example). The access port may deviate slightly from its original configuration when inserted because of the forces acting on the access port 2010. However, it is to be understood that the configuration of the access port 2010 prior to elongation is very similar to that of the access port 2010 when inserted through the abdominal wall.

Figures 24-26 illustrate further embodiments of access ports 2410, 2510 and 2610 in accordance with the invention, each of which includes an extended neck portion 2403. The extended neck portion 2403 can be particularly advantageous when the access ports 2410, 2510 and 2610 are used in a patient having a relatively thick layer of abdominal fat, or an otherwise thick abdominal wall. The access port 2410 of Figure 24 is substantially similar to many of the foregoing embodiments, with the exception of the elongated neck portion 2403. A proximal flange 2401 is connected to the elongated neck 2403, which in-turn includes longitudinal ribs 2404. The bulb 2405 extends from the neck portion 2403 and terminates in the distal tip 2407, which is connected thereto via extensions 2408.

The access port 2510 of Figure 25 differs from that of Figure 24, in the connection between the tip 2507 and the bulb portion 2505. While the construction of the flange 2401, neck portion 2403, and ribs 2404 is identical to that of the access port 2410 of Figure 24, the tip 2507 includes anchor elements 2508, which extend into and are at least partially embedded into the material of the bulb 2505. The anchor elements 2508 include a longitudinal, inwardly oriented spine 2519 and one or more transverse protrusions 2518, which are embedded into the wall of the bulb 2505. The spine 2519, if desired, can be embedded within the bulb 2505, or can be arranged such that it is exposed to the lumen 2406 of the access port to aid passage of surgical instruments through the access port 2510.

The access port 2610 of Figure 26 includes a configuration having an identical bulb 2505, tip 2507 and anchor elements 2508 to those of the embodiment of Figure 25. Similarly, the neck 2403 is identical to each of the embodiments of Figure 24 and 25. The access port 2610 of Figure 26 includes a rigid flange reinforcement 2612 arranged at the proximal end of the access port 2610. The flange reinforcement 2612 is provided, and in this case, recessed into the flange 2601 to impart increased rigidity to the flange 2601. While the flange 2601 can be integrally formed, e.g., molded, with the neck 2403 and bulb 2505 without such reinforcement 2612, such material may be undesirably soft to alone provide adequate rigidity for the flange 2601, because the flange 2601 must be pulled by a user when preparing the access port 2610 for insertion.

Figures 27-31 illustrate an access port 2710 in accordance with the invention composed of a plurality of components. As with the access port 1710 of Figures 17-19, the access port 2710 includes a guide tube 2711, a valve 2709, and a body 2718, which in-turn includes a flange 2701, neck 2703, bulb 2705, and terminates in a tip 2707. The valve 2709 resides within the guide tube 2711, which in-turn is inserted into the body 2718 of the access

port 2710. A proximal flange 2713 of the guide tube 2711 is received by a recess 2813 defined in the flange 2701 of the access port body 2718.

The access port 2710 additionally includes a flange reinforcement 2712, having a lead in surface 2702 to help guide insertion of surgical instruments. As with the access port 2610 of Figure 26, the flange reinforcement 2712 imparts additional rigidity to the flange 2701. The flange reinforcement 2712 can be applied to the proximal surface of the flange 2701, or partially or fully recessed therein, as in the access port 2610 of Figure 26. The individual components can be mutually secured by way of any suitable means, including, but not limited to heat welding, ultrasonic welding, solvent welding, adhesive, cohesive or, if desired, mechanical interlocking features. Figure 31, which is a detail view of the respective portion of Figure 29, illustrates an intermediate bonding material 3140, which can be an adhesive, for example. In a preferred embodiment, the bonding material 3140 is a material that melts upon application of heat energy, thereby mutually bonding the components of the access port 2710. As best seen in Figure 30, which is a detail view of the respective region of Figure 29, the tip 2707 includes an interior step 3009, which engages a mating component on the tip 125 of the insertion device (e.g., see Fig. 32). As can be seen, Figure 29 illustrates the access port 2710 in a first configuration, prior to insertion through the abdominal wall, and Figure 32 illustrates the access port 2710 in a second configuration, prepared for insertion through the abdominal wall of the patient.

Figure 33 is an isometric view of a further embodiment of an access port 3310 in accordance with the invention, having a generally flared configuration in the distal end portion of the body 3318. The flared region constitutes a bulb 3305, in that the expanded diameter of this region generally resembles such a configuration, and acts to anchor the access port 3310 in the abdominal wall of the patient. The access port 3310 includes a proximal flange 3301, with a flange reinforcing element 3312 arranged thereon, and a distal

tip 3307 connected by the body 3318. Longitudinal ribs 3304 are formed on the neck portion 3303, and include a distal taper 3314 so that the ribs gradually approach the contour of the bulb portion 3305, as the diameter of the body 3318 increases toward the distal end of the access port 3310.

Circumferential ribs 3315 further increase the diameter of the bulb portion 3305, providing additional anchoring capability. While the foregoing embodiments can be made from elastomeric materials or non-elastomeric materials, this embodiment preferably includes a material having a predetermined degree of elasticity, particularly because the relative diameter of the bulb portion 3305 to the remainder of the body 3318 of the access port 3310 is not as great as in many of the foregoing embodiments. Accordingly, when elongated, the material of the access port 3310 will stretch, and while the bulb 3305 decreases in profile, the ribs 3315, which are part of the bulb 3305, will also stretch longitudinally, effecting a reduction in their cross-sectional profile.

Figure 34 is a partial cross-sectional view of the access port of Figure 33 and Figure 35 is a partial cross-sectional view of the access port 3310 of Figure 33, shown in an elongated configuration with an insertion device 120 inserted in the access port.

Figure 36 is an isometric view of a further embodiment of an access port 3610 in accordance with the invention, also having a generally flared configuration in the distal end portion of the body 3618. The flared region constitutes a bulb 3605, which serves to anchor the access port 3610 in the abdominal wall of the patient. The access port 3610 includes a proximal flange 3301, with a flange reinforcing element 3312 arranged thereon, and a distal tip 3607, joined via the body 3618, as with the foregoing embodiment of Figure 33. Longitudinal ribs 3604 are formed on the body 3618, which extend along the length thereof. The ribs 3604 include an increased height portion 3614 toward the distal end thereof, superimposed at an increased diameter portion of the body 3618. This embodiment also

preferably includes a material having at least some degree of elasticity. Accordingly, when elongated, the material of the access port 3610 will stretch, with the bulb 3605 and ribs 3604 decreasing in profile.

Figure 37 is a partial cross-sectional view of the access port of Figure 36 and Figure 38 is a partial cross-sectional view of the access port of Figure 36, shown in an elongated configuration with an insertion device 120 inserted in the access port 3610.

Figure 39 is an isometric view of still another access port 3910 constructed in accordance with the invention, having longitudinal ribs 3904 in a neck portion 3903 and circumferential ribs 3915 in the distal bulb portion 3905 thereof. A tip 3907 is also provided, which is connected to the flange 3301 and reinforcing member 3312 by the body 3918 of the access port 3910. The ribs 3904 in the neck portion 3903 serve the purpose of preventing excessive elongation of the neck portion, when preparing the access port 3910 for insertion. The circumferential ribs 3915 in the bulb portion 3905 serve to resist unintended pullout of the access port 3910 from the abdominal wall of the patient. Therefore, it should be noted that as used herein, the term "bulb" refers to a region of expanded diameter, but which does not necessarily resemble a "bulb" shape. Accordingly, when elongated, the material of the access port 3910 will stretch, and while the bulb 3905 decreases in profile, the ribs 3915, which are part of the bulb portion 3905, will also stretch longitudinally, effecting a reduction in their cross-sectional profile, thereby facilitating insertion of the access port 3910 into the abdominal wall of the patient.

Figure 40 is a partial cross-sectional view of the access port 3910 of Figure 39, and Figure 41 is a partial cross-sectional view of the access port 3910 of Figure 39, shown in an elongated configuration with an insertion device 120 inserted in the access port.

Figures 42-45 illustrate an access port 4210 in accordance with the invention composed of a plurality of components, similar to the access port 2710 of Figures 27-31. The

access port 4210 includes a guide tube 4211, a valve 4209, and a body 4218, which in-turn includes a flange 4201, neck 4203, bulb 4205, and terminates in a tip 4207. The valve 4209 resides within the guide tube 4211, which in-turn resides in the body 4218 of the access port 4210. A proximal flange 4213 (Figures 43-45) of the guide tube 4211 resides in a recess defined in the flange 4201 of the access port 4210.

The access port 4210 further includes a flange reinforcement 4212, having a lead in surface 4202 to help guide insertion of surgical instruments therethrough. As with other access ports set forth herein, the flange reinforcement 4212 helps impart rigidity to the flange 4201. The flange reinforcement 4212 can be applied to the proximal surface of the flange 4201, or partially or fully recessed therein.

In this embodiment, as best seen in the exploded view of Figure 43, for example, the proximal flange 4213 of the guide tube 4211 is relatively large, and in combination with the enlarged flange reinforcement 4212, secures the valve 4209 to the body 4218 of the access port 4210 by engaging the valve 4209 therebetween.

As also can be seen in Figures 42-45, the bulb 4205 includes a single distal enlarged portion 4216, having an angled, generally barbed shape, and a plurality of ribs 4217 arranged along the length of the body 4218, which also have a generally barbed shape. Such shape, due to the angled contours thereof, enables relatively easy insertion, while still resisting pullout of the access port 4210 from the patient's abdominal wall.

As with foregoing embodiments, the individual components of the access port 4210 can be mutually secured by way of any suitable means, including, but not limited to heat welding, ultrasonic welding, solvent welding, adhesive, cohesive or, if desired, mechanical interlocking elements.

In order to remove an access port in accordance with the invention from the body of a patient, one can pull the proximal flange (e.g., flange 101 of Figure 8) away from the

abdominal wall. The counteracting force exerted by the abdominal wall will cause the surgical access port, and particularly the bulb portion (e.g., bulb 105 of Figure 8) to elongate for removal from the body cavity into which it was inserted. Alternatively, in order to remove the port, the insertion device, or a similar blunt-tipped tool for engaging the distal end portion of the access port, can be inserted into the access port to elongate the access port for removal. The latter method, however, may be preferred in order to minimize trauma to the abdominal wall of the patient.

Referring now to Figures 46 through 49, there is illustrated another embodiment of the surgical access device of the subject invention, which is designated generally by reference numeral 5000. Access device 5000 is functionally similar to the previously described access devices in that it is adapted and configured to transition between a relaxed or unstretched condition shown in Figures 46 and 48 and an elongated or stretched condition shown in Figures 47 and 49, facilitated by a unique insertion device shown in Figure 50. The construction of access device 5000 differs from the previously described access devices in certain respects, as described in more detail hereinbelow.

Access device 5000 includes an elongated body portion 5100 and a proximal seal housing 5110. Seal housing 5110 has a funnel shaped opening 5112 for receiving a trocar or surgical device and in interior cylindrical chamber 5115 for supporting a sealing member 5114 (see Figure 48). As best seen in Figures 48-49, seal member 5114 is a one-piece seal assembly that includes a proximal seal section 5114a in the form of a wiper seal and a distal valve seal section 5114b in the form of a duckbill seal. The duckbill seal may be a single plane valve as shown or a double plane valve having two intersecting duckbills.

The seal housing 5110 of access device 5000 also includes a tubular insufflation port 5116 for mating with a source of pressurized fluid by way of a leur lock fitting or a similar type of connective arrangement known in the medical arts. The insufflation port 5116 of

proximal seal housing 5110 includes a removable cap 5118 that is connected to the seal housing 5110 by a living hinge 5125 so that the cap 5118 does not become displaced during a surgical procedure and can be easily reused.

The body portion 5100 of access device 5000 includes an axially extendable elastomeric sheath 5120 defining a pathway for permitting minimally invasive access to the abdominal cavity of a patient by a surgical device. The elastomeric sheath 5120 has a generally radially outwardly tapering cross-sectional configuration, in its unstretched condition, shown in Figure 48. The proximal end portion of the sheath 5120 has a flange section 5122 of increased thickness (relative to the body portion of the sheath) that is secured to the proximal housing 5110 by an underplate 5124. A radially enlarged anchoring bulb 5128 is formed adjacent the distal end of sheath 5120 for securing the access device 5000 against the interior wall of the abdominal cavity, once it has been deployed.

The elastomeric sheath 5120 of access device 5000 includes a plurality of axially spaced apart annular retaining ribs 5130. More particularly, the sheath 5120 includes two types of alternating ribs 5130, including a first type 5132 that has a horizontal ledge 5132a and an angularly inclined riser 5132b and a second type 5134 that has a generally V-shaped cross-section. The ledged ribs 5132 prevent movement of the sheath 5120 in a proximal direction during use, as does the V-shaped ribs 5134, although to a lesser extent. The V-shaped ribs 5134 differ from the ledged ribs 5132 in that they have the same wall thickness as the sheath 5120 itself, and thus more easily flatten out when the sheath 5120 is stretched during deployment, thereby reducing insertion resistance, as best seen in Figure 48.

Access device 5000 further includes telescoping guide tubes that include an inner tube 5136 and an outer tube 5138. Together, the telescoping guide tubes 5136, 5138 define a passage for a trocar during deployment of the access device 5000 and a pathway for the introduction of surgical instruments. The proximal end of the outer tube 5138 is preferably

integrally formed with the proximal housing portion 5110 of access device 5000. However, it is envisioned that the outer guide tube 5138 could be separate from and secured to the housing portion 5110. The distal end of the inner tube 5136 extends from the distal end of sheath 5120 and defines a tapered nosepiece 5140 for the access device 5000. The nosepiece 5140 provides a smooth transition surface to the radially enlarged anchoring bulb 5128.

As discussed above and throughout this specification, an insertion device is utilized to effectuate the transition of the access device 5000 between the unstretched and stretched conditions shown in Figures 52 and 54, respectively. An embodiment of the insertion device of the subject invention is illustrated in Figures 50 and 51, and is designated generally by reference numeral 6000. Together, the insertion device 6000 and the access device 5000 form a cooperative system for gaining ready access to the abdominal cavity of a patient in order to perform a laparoscopic surgical procedure.

Insertion device 6000 includes a proximal handle assembly 6100 that includes a barrel section 6112 and depending ergonomically shaped grip section 6114. An elongated trocar shaft 6116 extends distally from the barrel section 6112 of handle assembly 6100. The distal tip 6118 of trocar shaft 6116 is preferably adapted and configured to pierce through tissue, including the abdominal wall, and thus includes at least two cutting facets 6118a, 6118b.

It is also envisioned and well within the scope of the subject disclosure, that trocar shaft 6116 can be configured as an optical trocar assembly for purposes of visualizing the penetration into the abdominal cavity. Thus, the distal tissue-piercing tip 6118 of trocar shaft 6116 may include at least two optical facets or viewing windows 6118a, 6118b that communicate with light transmitting structures within the trocar shaft (not shown). Trocar shaft 6116 also includes a medial engagement collar 6120 having circumferentially spaced apart fingers 6122 for interfingering or otherwise meshing with a complementary spaced

apart fingers 5152 of a collar 5150 provided at the proximal end of the inner guide tube 5136 of access device 5000, as best seen in Figure 55.

It is envisioned that the engagement collar 6120 on trocar shaft 6116 could be alternatively located at the distal end of the shaft, adjacent the cutting tip 6118, and the complementary collar 5150 could be located at the distal end of the inner guide tube 5136. The cooperative engagement of collars 5150 and 6120 effectively prevents relative radial movement of the trocar shaft 6115 and body portion 5120, caused by the torque transmitting by handle assembly 6100 during use.

Referring now to Figure 51, the proximal end of the trocar shaft 6116 has a flared end section 6124 that serves to axially secure the trocar shaft 6116 within the barrel section 6112 of housing assembly 6100. Handle assembly 6100 further includes a pair of latching arms 6126 and 6128 for releasably engaging a flange 5170 formed at the proximal end of access device housing 5110, as best seen in Figures 52 and 53. The latching arms 6126, 6128 pivot about respective pivot pins 6136, 6238 and have respective inwardly facing engagement fingers 6126a, 6128a and respective integral biasing legs 6126b, 6128b that urge the latching arms 6126 and 6128 into a latching position. The latching arms 6126, 6128 are released from the latching position by depressing the opposing integrally formed buttons 6126c, 6128c, which cause the latching arms 6126, 6128 to pivot away from one another.

Referring to Figures 51 and 53, the handle assembly 6100 of insertion device 6000 is adapted and configured to receive a laparoscope (not shown) used to communicate with the optical piercing tip 6118 of trocar haft 6116. More particularly, the proximal end of barrel section 6112 has a reception port 6130 for receiving a laparoscope.

In addition, the handle assembly 6100 of insertion device 6000 includes a mechanism for securing the position of a laparoscope relative to the handle assembly 6100 of the insertion device 6000. This mechanism includes a rotatable barrel cam 6132 having a cam

slot 6134 that interacts with a corresponding cam follower (not shown). The barrel cam 6132 is rotated by way of a toggle switch 6136, which causes a corresponding axial translation of the barrel 6132. When the barrel cam 6132 moves in a distal direction, it axially compresses an aligned silicone washer 6135 against an aligned hard plastic retaining washer 6138. The silicone washer 6135 is restricted from expanding radially outwardly by the walls of the housing assembly 6100. Consequently, upon becoming axially compressed against hard plastic washer 6138, the pliable silicone washer 6135 will compress radially inwardly against the outer surface of the tubular laparoscope extending there through. As a result, the laparoscope is maintained is a fixed position with respect to the barrel section 6112 of handle assembly 6100.

In use, trocar tip 6118 and shaft 6116 are inserted into the proximal opening of access device 5000, as illustrated in Figure 52. As the trocar shaft 6116 is inserted, the fingers 6122 on collar 6120 (see Figure 50) engage corresponding fingers 5152 of collar 5150, at the proximal end of inner guide tube 5136 (see Figure 48). Engagement of fingers 6122 and 5152 orients the inner guide tube 5136 and trocar shaft 6116 in a key and slot style. Housing 5110 is then drawn toward handle assembly 6100 to elongate and stretch elongate body portion 5100, until the latching arms 6126, 6128 engage flange 5170 to releasably lock the access device in the elongated configuration shown in Figures 49, 54 and 55).

The length of the trocar shaft 6116 from collar 6120 to penetration tip 6118 is selected so that the penetrating tip extends out of the inner guide tube to protrude from the end of the elongated body portion with the elongated body portion in the stretched position shown in Figures 54 and 55. Advantageously, because the fingers 6122 and 5152 at a location proximal to the trocar tip 6118 permits the trocar tip and the nosepiece 5140 to be configured to have a low profile and a very smooth gradual transition from trocar tip 6118 to the

elongated body 5100 across nosepiece 5140. Engagement of fingers 6122 and 5152 also acts to extend the inner and outer guide tubes 5136, 5138 within the elongated body portion 5100.

With the elongated body portion 5100 mounted to the trocar 6116 as shown in Figure 54, the access device 5000 is ready for use. The device 5000 may be inserted through the abdominal wall until the trocar tip 6118 enters the abdomen. If desired, an optical device such as an endoscope may be optionally inserted through a central bore of the trocar shaft 6116 to permit visualization through the optical window portions of the trocar tip 6118, to observe insertion of the trocar through the abdominal wall into the abdomen. With the trocar tip 6118 positioned inside the abdomen, the latching arms 6126, 6128 are released from flange 5170, which permits elongated body portion 5120 to resiliently return toward its initial unstretched configuration.

The elongated body portion 5120 may or may not return all the way to the original unstretched position, depending upon the thickness and gripping force of the surrounding tissue. However, the elongated body portion 5120 will return sufficiently toward the initial unstretched configuration so that the bulb portion 5128 expands radially outward to help secure or otherwise anchor the access device 5000 within the incision for surgery. The ribs 5130 variously disposed along the body portion 5120 also resume their rest position, extending radially outward from the body portion 5120 to assist in securing the access device 5000 relative to the patient's body.

At such a time, guide tubes 5136, 5138 return toward the nested configuration shown in Figure 48. In this configuration, the access device 5000 presents a desirably low profile relative to the skin, so that instruments can be inserted and removed without obstruction from adjacent access devices. Thus, surgical instruments may be inserted and removed in the ordinary course of laparoscopic surgery to perform a surgical procedure. Guide tubes 5136, 5138 guide the surgical instruments into the body and protect the elastomeric elongated body

portion 5120 from damage or puncture due to engagement with instruments having aggressively configured tips (such as clip appliers, staplers, etc.).

After surgery is complete, the trocar tip 6118 may be reinserted into the access device 5000 to elongate and stretch the elongated body 5120 for ease of removal from the patient's body. Alternatively, it is contemplated that the access device 5000 may simply be pulled out of the body, such as by grabbing and pulling on housing 5110. As the housing is pulled away from the body, elongate body 5120 will partially elongate and stretch against the resistance of the tissue until the bulb portion 5128 and ribs 5130 stretch sufficiently to slip out of the tissue and be removed.

Surgical access devices in accordance with the invention can serve many purposes, only one of which is use in minimally-invasive surgical procedures. It should be appreciated by those skilled in the art, that access ports in accordance with the invention can be used wherever access, particularly sealable access, into a body cavity is needed.

The specific dimensions of surgical access devices, including access ports, in accordance with the invention can be selected as needed. Specifically, it is envisioned that a wide variety of sizes will be available to a user to enable the user to select the most appropriately dimensioned device for the patient and procedure at hand. The overall length of access ports in accordance with the invention can vary, as well as the relative lengths of the neck portions, diameters and lengths of bulb portions, dimensions of the flange dimensions of the access port, and the like. It is envisioned that the access ports set forth herein can replace typical rigid cannulas. Accordingly, general dimensions similar to such typical rigid cannulas are possible, although an operative (during surgery) length of the surgical access port, which is less than that of typical cannulas, is preferable.

Materials for access ports in accordance with the invention can include, as set forth above, plastics, composites, elastomers or metals if necessary, for any component or

components thereof. For example, the flange and or tip can be reinforced by rigid plastic or metal components. As set forth above, materials having directional properties may be desirable.

The devices and methods of the present invention, as described above and shown in the drawings, provide for a surgical access device with superior properties including secure anchoring to the abdominal wall, low manufacture costs, and sealable access to a pneumoperitoneum. It will be apparent to those skilled in the art that various modifications and variations can be made in the device and method of the present invention without departing from the spirit or scope of the invention. For example, an insufflation port can be incorporated into the subject surgical access port, if desired. Thus, it is intended that the present invention include modifications and variations that are within the scope of the appended claims and their equivalents.

What is claimed is:

1. A surgical access device comprising:

a) an access port having an elongated body with opposed proximal and distal end portions, the body having a central lumen extending therethrough and having a resilient bulb portion formed between the proximal and distal end portions thereof, wherein the resilient bulb portion is adapted and configured to transition between a first condition in which the bulb portion has a first diameter and a first length and a second condition in which the bulb portion has a second diameter that is less than the first diameter and a second length that is greater than the first length; and

b) a telescoping guide tube assembly disposed within the central lumen of the access port body, wherein the guide tube assembly is adapted and configured to transition between a first length corresponding to the first condition of the bulb portion and a second length corresponding to the second condition of the bulb portion.

2. A surgical access device as recited in Claim 1, further comprising an insertion device adapted to extend into the central lumen of the access port body, through the guide tube assembly, and configured to releasably engage the guide tube assembly so as to facilitate the transition of the bulb portion from the first condition to the second condition.

3. A surgical access device as recited in Claim 1, wherein the telescoping guide tube assembly includes a proximal tube section and a distal tube section, and wherein the proximal tube section has a fixed position relative to the access port body and the distal tube section is adapted to translate relative to the proximal tube section.

4. A surgical access device as recited in Claim 3, wherein the distal tube section of the guide tube assembly includes a nosepiece extending from the distal end portion of the access port body and having a tapered outer surface.

5. A surgical access device as recited in Claim 4, wherein the tapered outer surface of the nosepiece merges into the outer surface of the bulb portion of the access port body.

6. A surgical access device as recited in Claim 2, wherein the guide tube assembly has an engagement ring therein for mating with a corresponding engagement ring provided on the insertion device.

7. A surgical access device as recited in Claim 3, wherein the access port body includes a plurality of axially spaced apart annular retaining ribs.

8. A surgical access device as recited in Claim 7, wherein the plurality of axially spaced apart annular retaining ribs includes two different rib structures, including a first rib structure having a horizontal ledge and an angularly inclined riser and a second rib structure having a generally V-shaped cross-section.

9. A surgical access device as recited in Claim 8, wherein the access port body includes alternating axially spaced first and second rib structures.

10. A surgical access device as recited in Claim 1, wherein the access port includes a housing portion associated with the proximal end portion of the access port body, the housing portion containing a seal member for interacting with the insertion device.

11. A surgical access device as recited in Claim 10, wherein the seal member includes a duckbill seal portion and an annular wiper seal portion.

12. A surgical access device as recited in Claim 10, wherein the proximal housing portion of the access port includes an insufflation port.

13. A surgical access device as recited in Claim 12, wherein the insufflation port includes a removable cap.

14. A surgical access device as recited in Claim 2, wherein the insertion device includes a handle assembly and an elongated trocar shaft extending distally from the handle assembly.

15. A surgical access device as recited in Claim 14, wherein the access port includes a housing portion associated with the proximal end portion of the access port body, and the housing portion includes a proximal engagement flange.

16. A surgical access device as recited in Claim 15, wherein the handle assembly of the insertion device includes means for releasably engaging the engagement flange of the housing portion.

17. A surgical access device as recited in Claim 16, wherein the means for releasably engaging the engagement flange of the housing portion includes a pair of opposed pivoting latching arms for releasably engaging the flange of the access port.

18. A surgical access device as recited in Claim 17, wherein the pivoting latching arms of the handle assembly are normally biased into a latching position.

19. A surgical access device as recited in Claim 14, wherein the trocar shaft has a distal tissue-penetrating tip that includes at least one optical window.

20. A surgical access device as recited in Claim 19, wherein the at least one optical window includes at least two facets, and each of the facets defines an optical lens area.

21. A surgical access device as recited in Claim 20, wherein the handle assembly includes means for receiving a laparoscope for communicating with the optical lens areas of the distal tissue-penetrating tip of the insertion device.

22. A surgical access device as recited in Claim 21, wherein the handle assembly of the insertion device includes means for securing the position of a laparoscope relative to the insertion device.

23. A surgical access device as recited in Claim 22, wherein the means for securing the position of a laparoscope relative to the insertion device includes a rotatable barrel cam for compressing an elastomeric washer about an outer periphery of a laparoscope.

24. A method of performing surgery comprising:

a) providing an access port having an elongated body with opposed proximal and distal end portions, the body having a central lumen extending therethrough and having a resilient bulb portion formed between the proximal and distal end portions thereof, wherein the resilient bulb portion is adapted and configured to transition between a first condition in which the bulb portion has a first diameter and a first length and a second condition in which the bulb portion has a second diameter that is less than the first diameter and a second length that is greater than the first length, and a telescoping guide tube assembly disposed within the central lumen of the access port body, wherein the guide tube assembly is adapted and configured to transition between a first length corresponding to the first condition of the bulb portion and a second length corresponding to the second condition of the bulb portion;

b) inserting a trocar shaft into the central lumen to extend the body and transition the bulb portion from the first diameter to the second diameter and to transition the guide tube assembly from the first length to the second length; and

c) inserting the access device through tissue with the bulb portion in the condition of the second diameter and the guide tube assembly in the condition of the second length.

25. A method according to Claim 24, further comprising releasing the body from the trocar shaft, thereby permitting the bulb portion to return to the first diameter to anchor the access device in tissue.

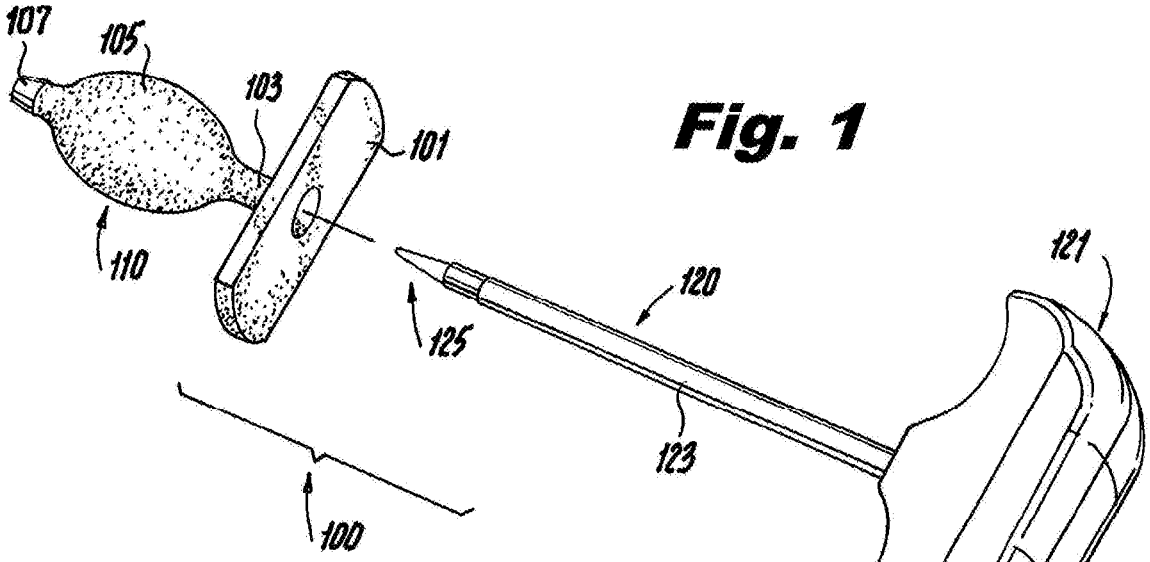
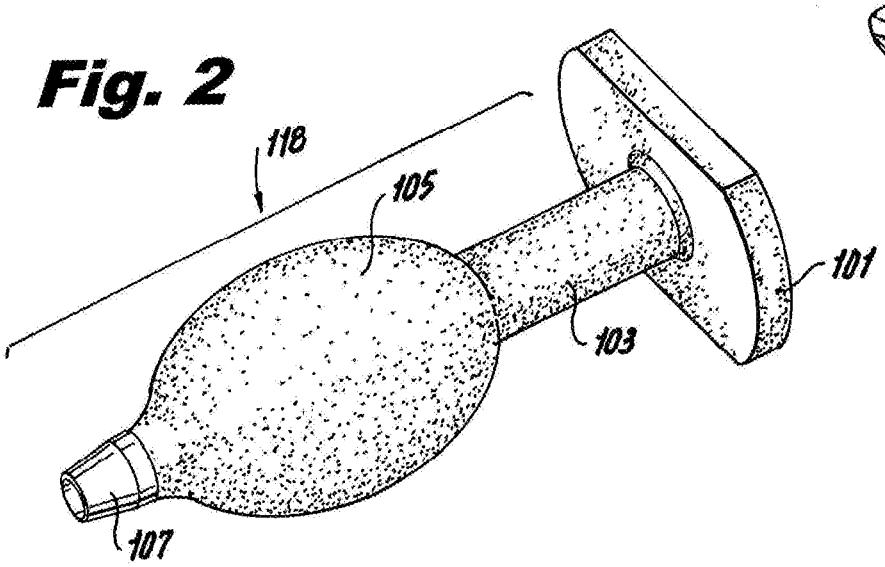


Fig. 1

Fig. 2



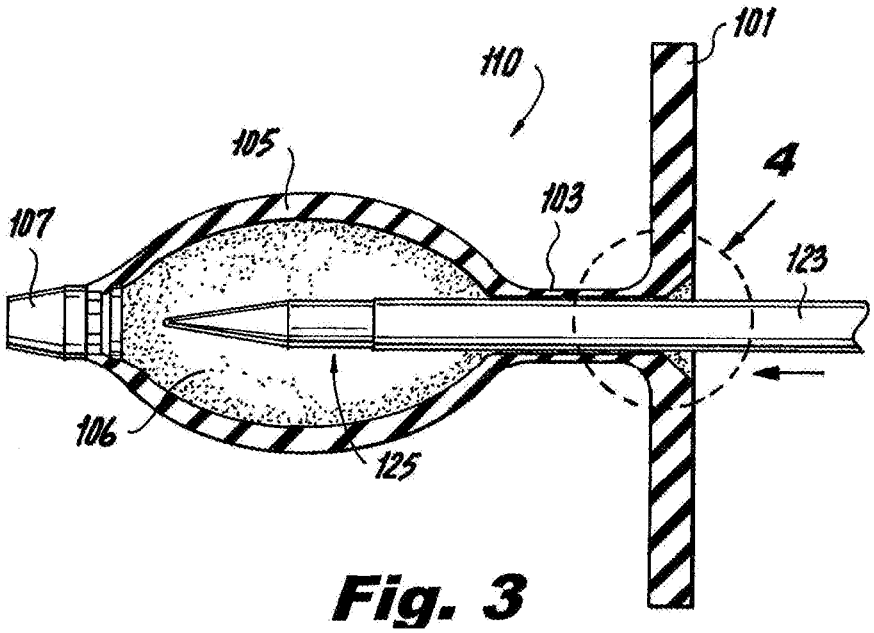
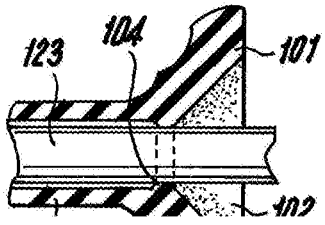


Fig. 3

Fig. 4



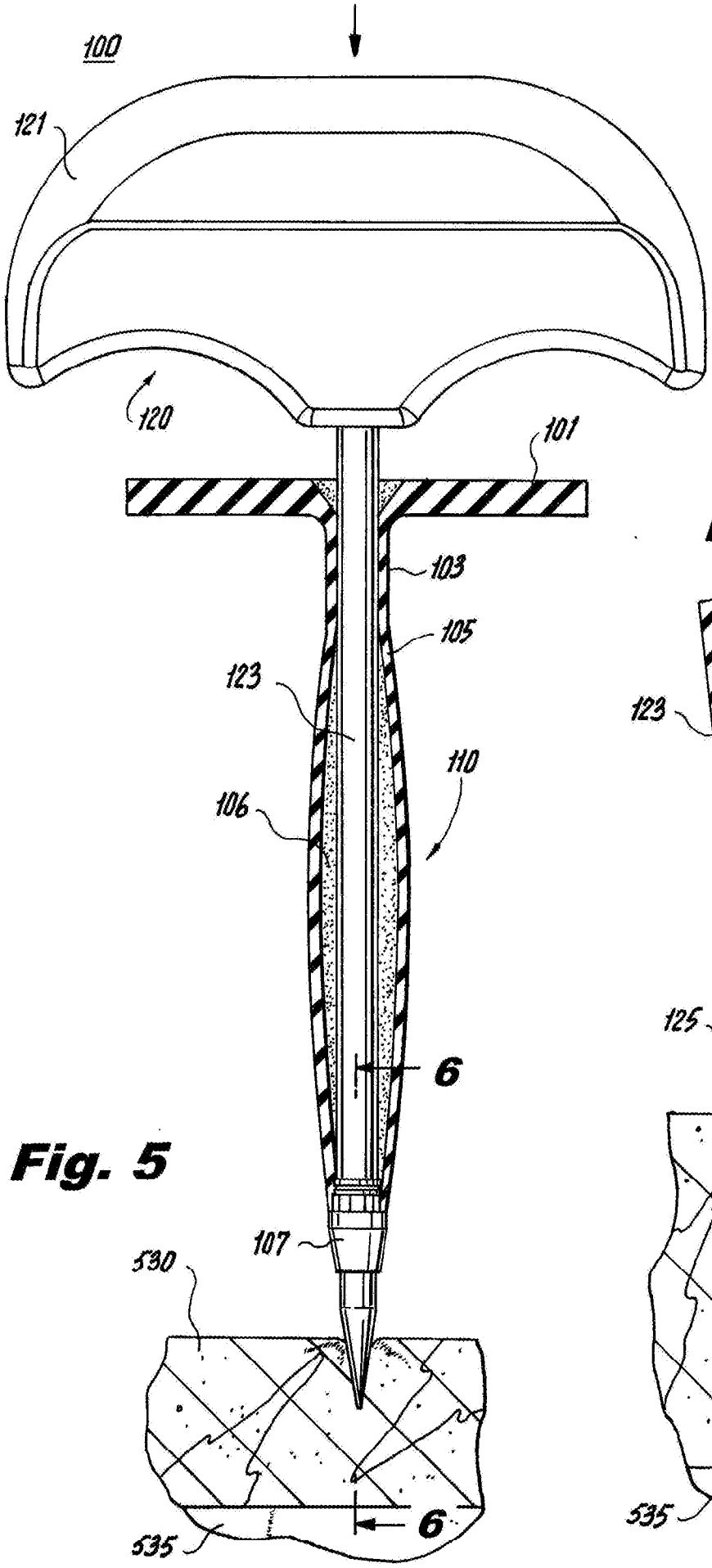

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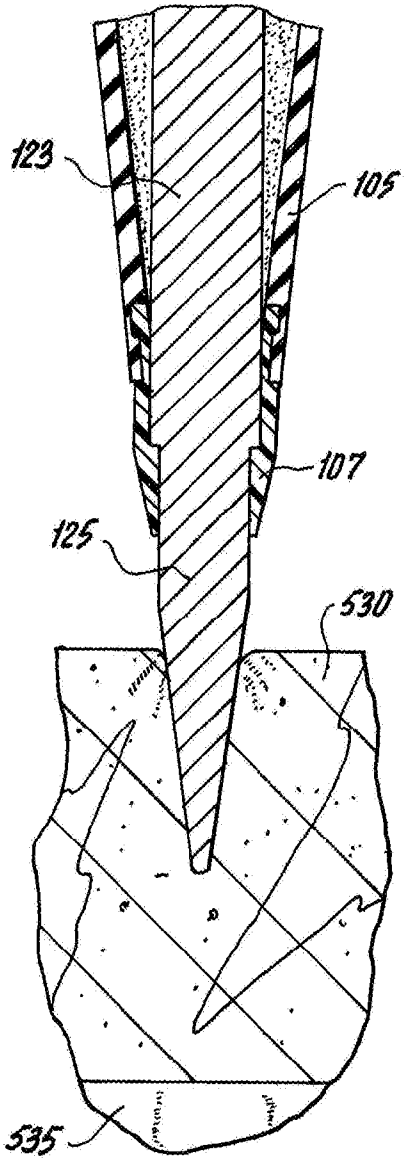
Fig. 5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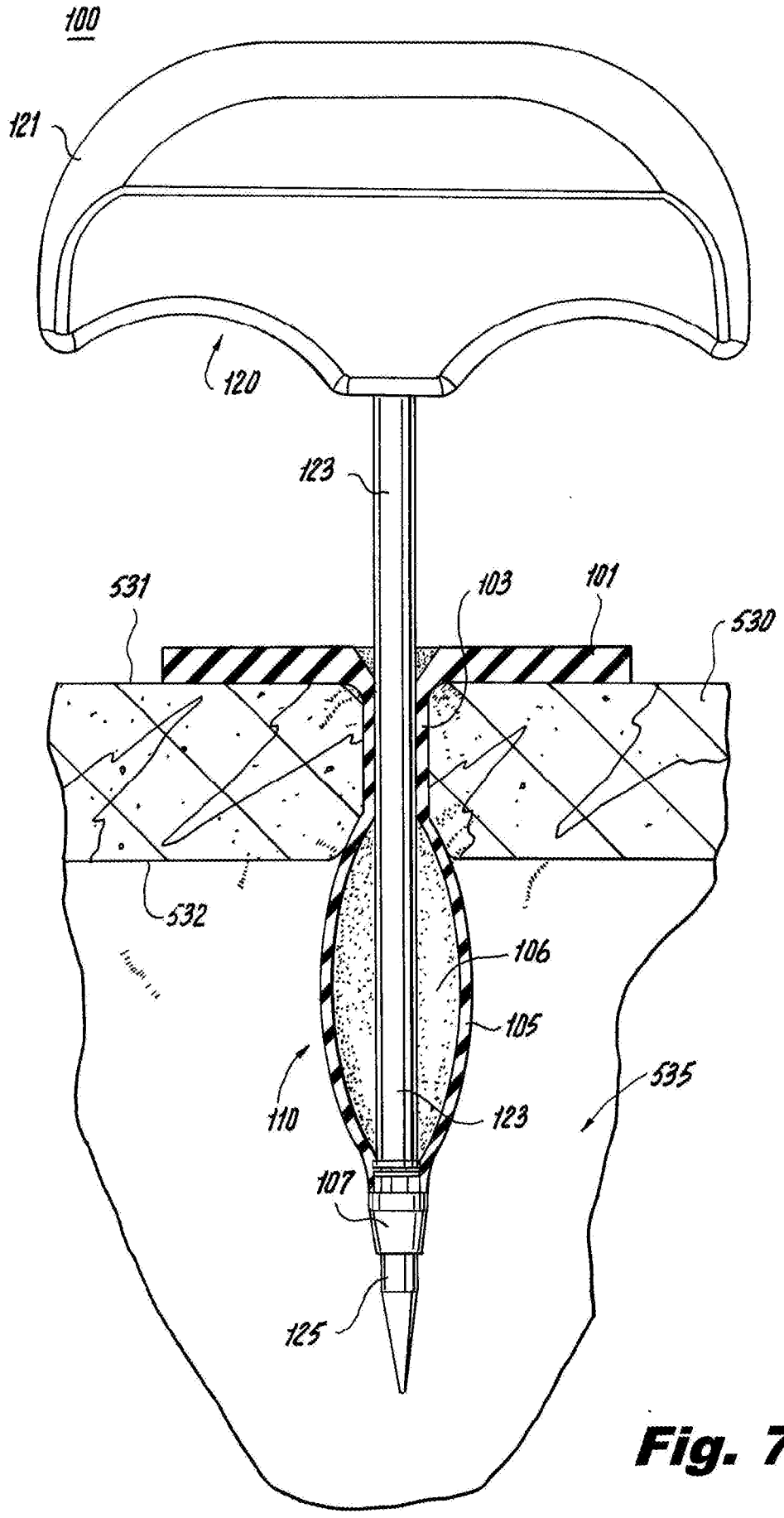

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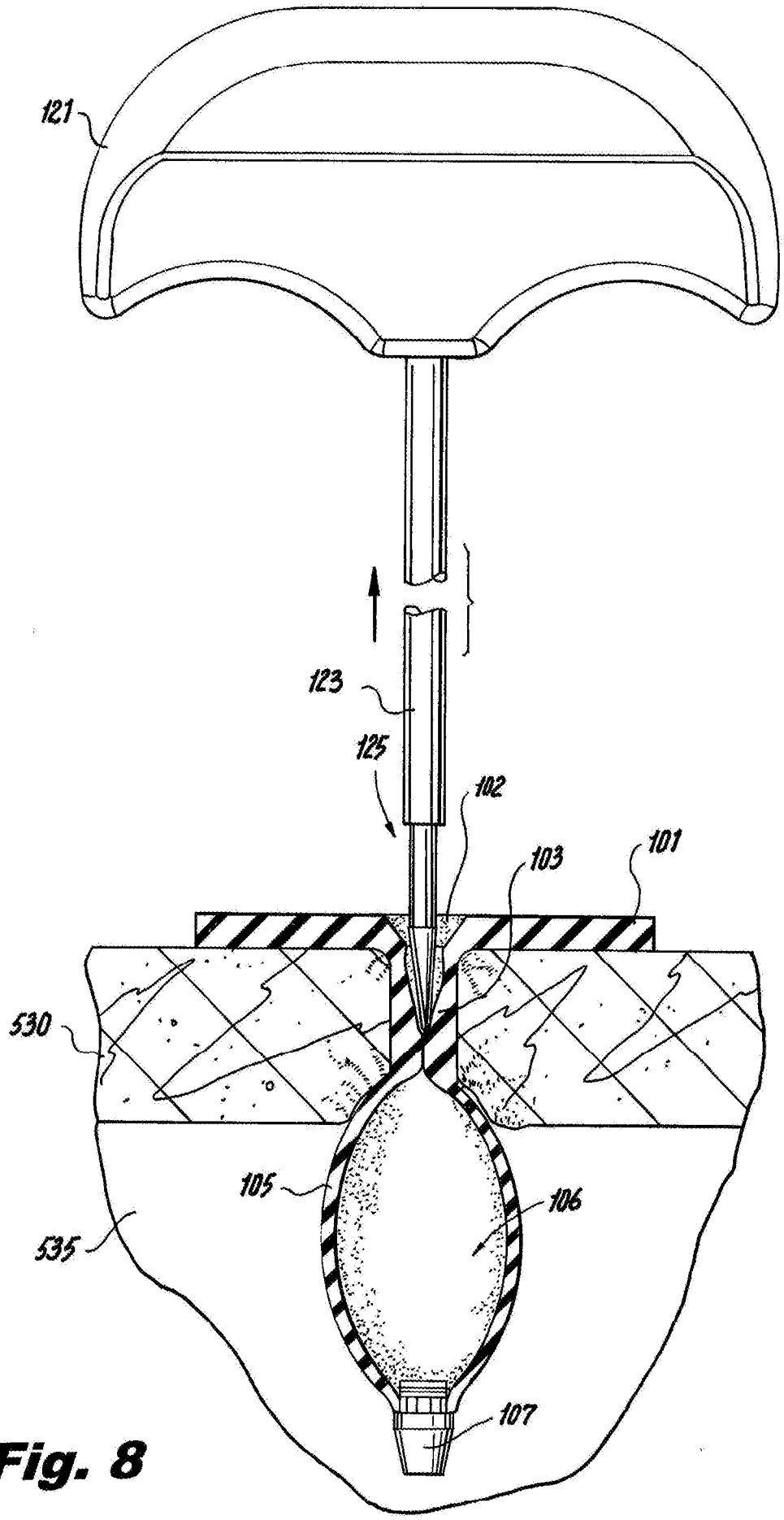

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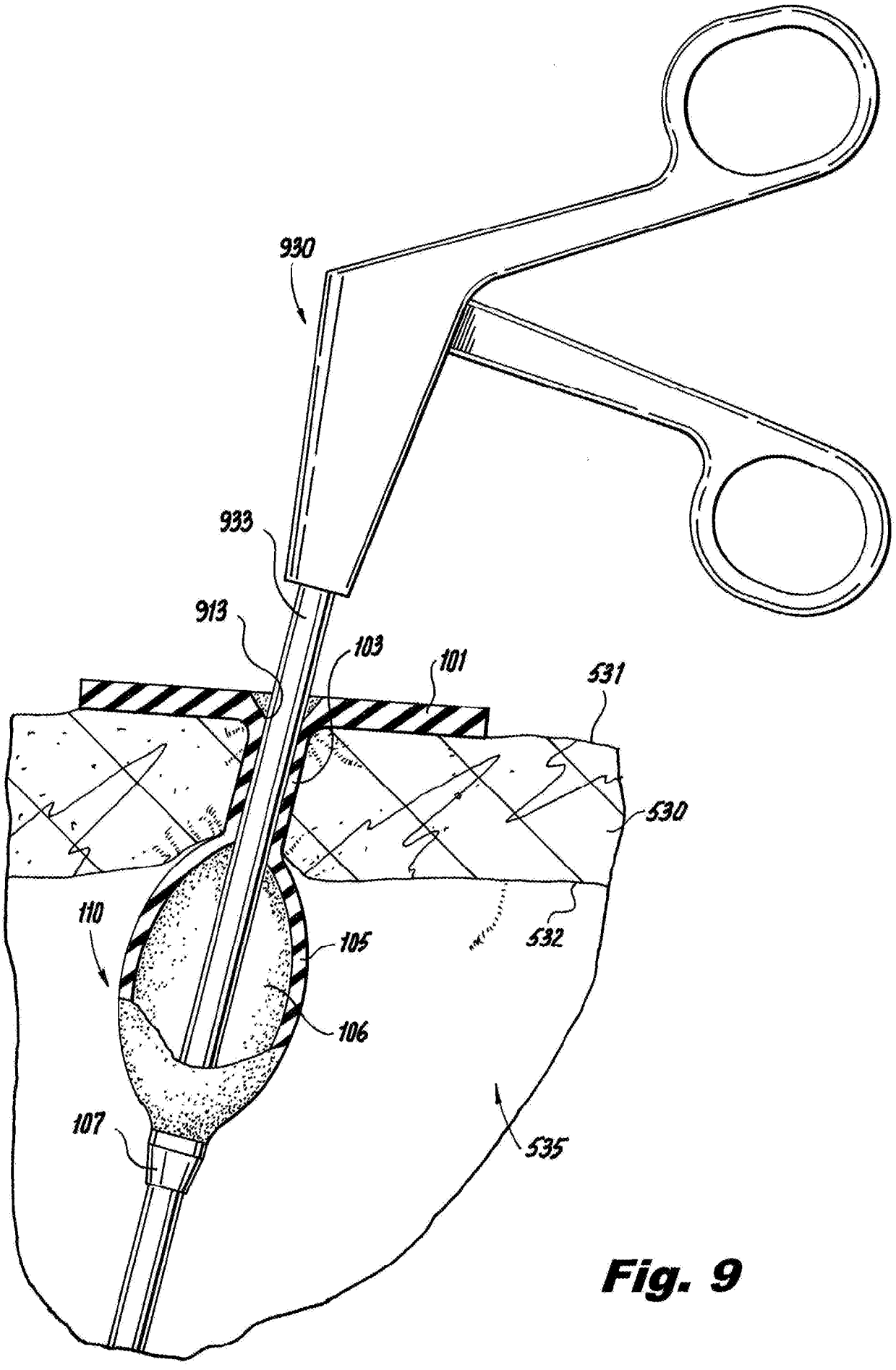
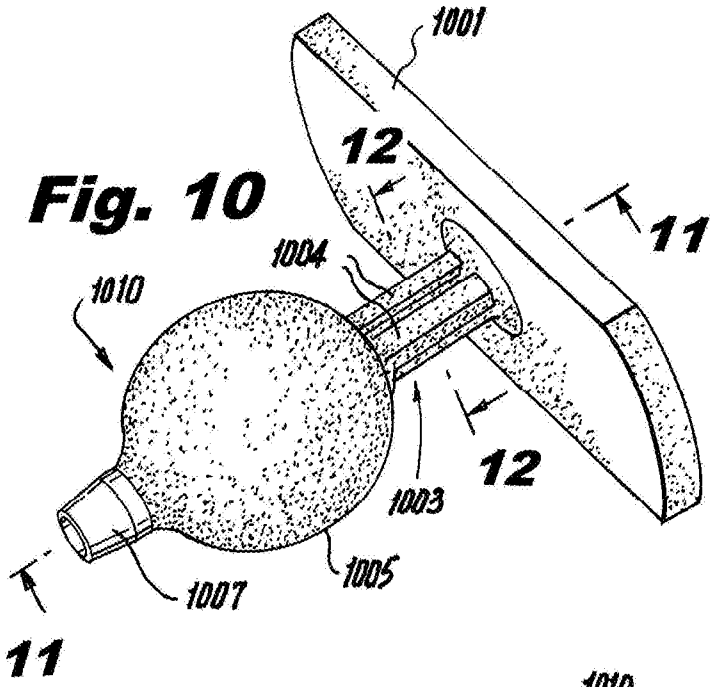


Fig. 9

Fig. 10



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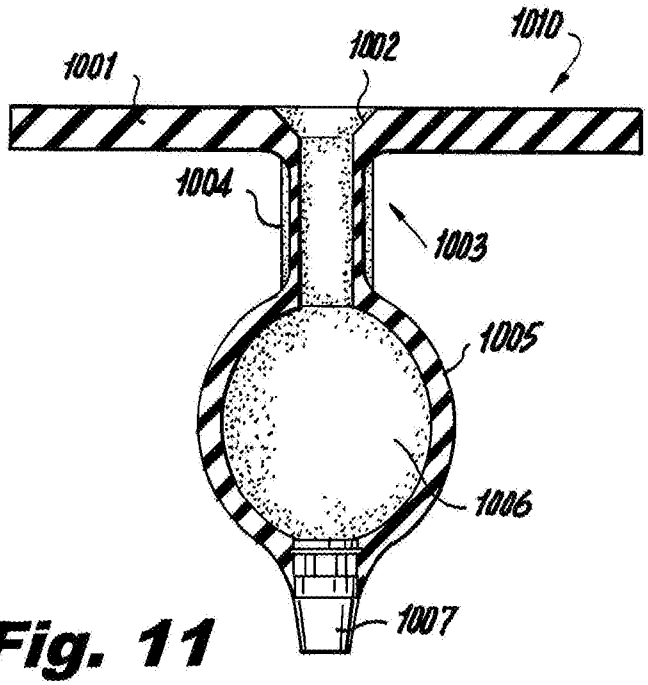

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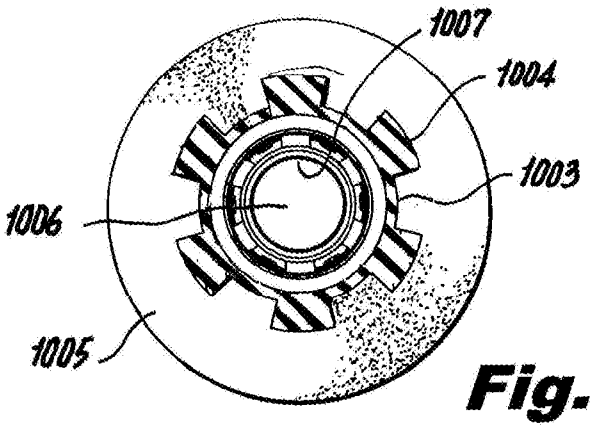

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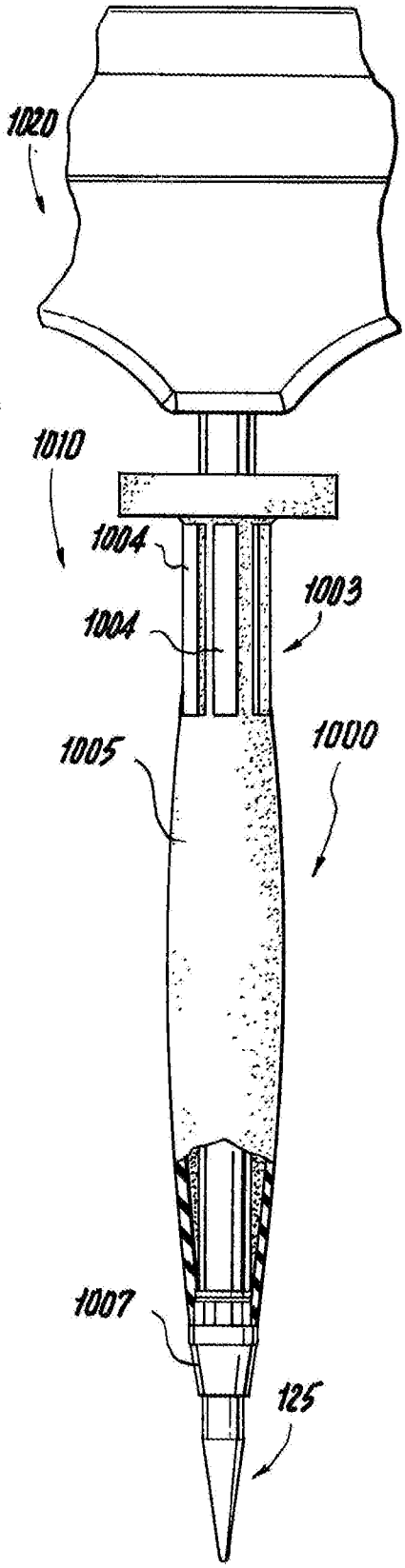

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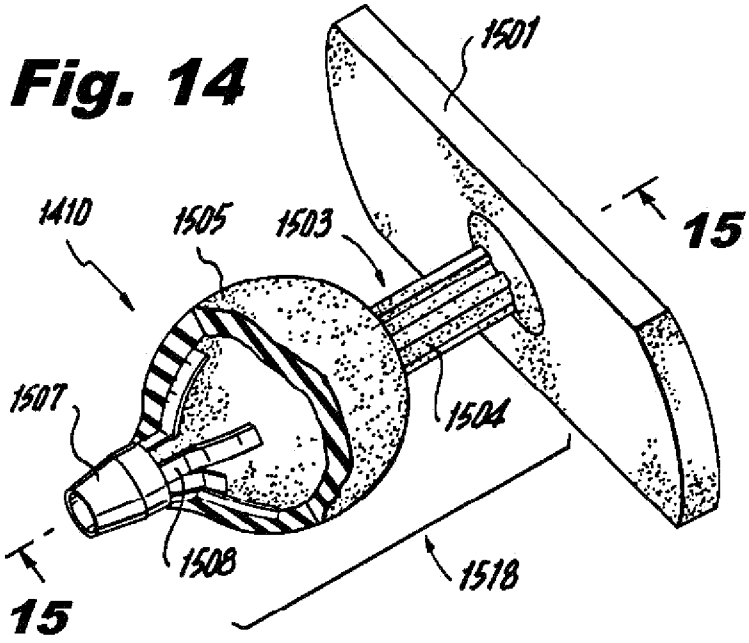


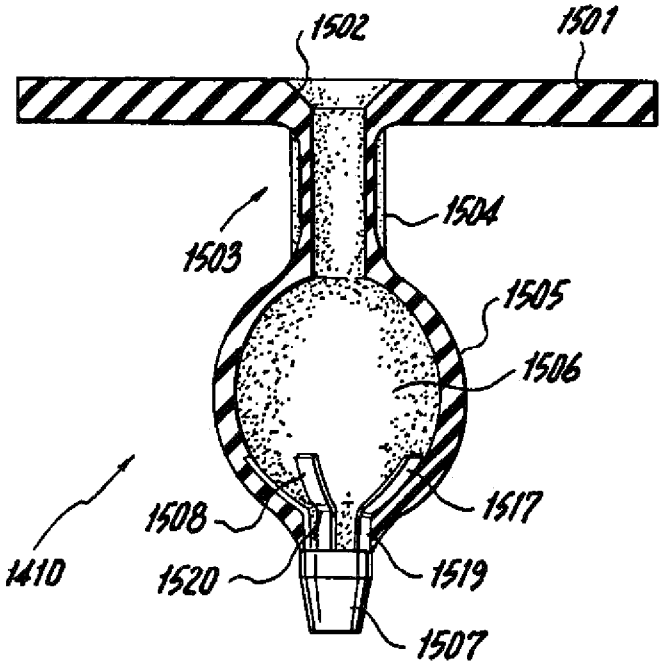
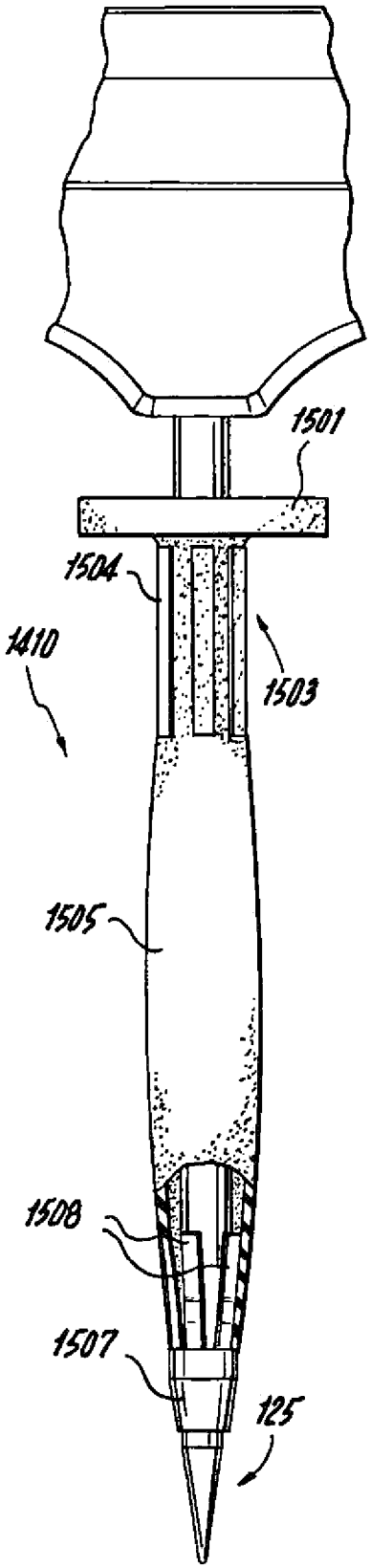
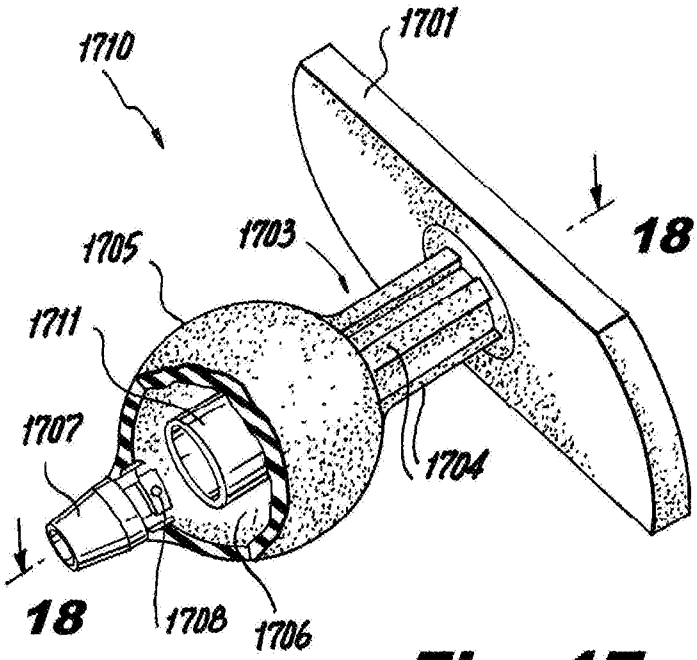


Fig. 15

Fig. 16





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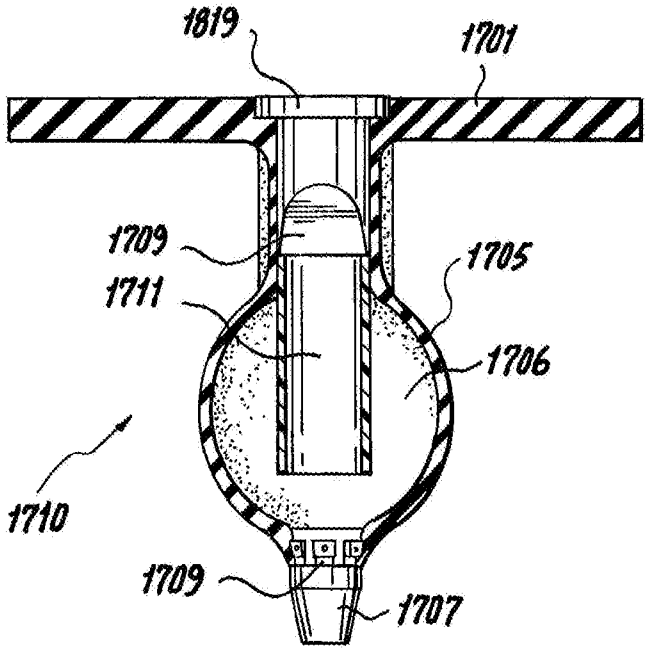
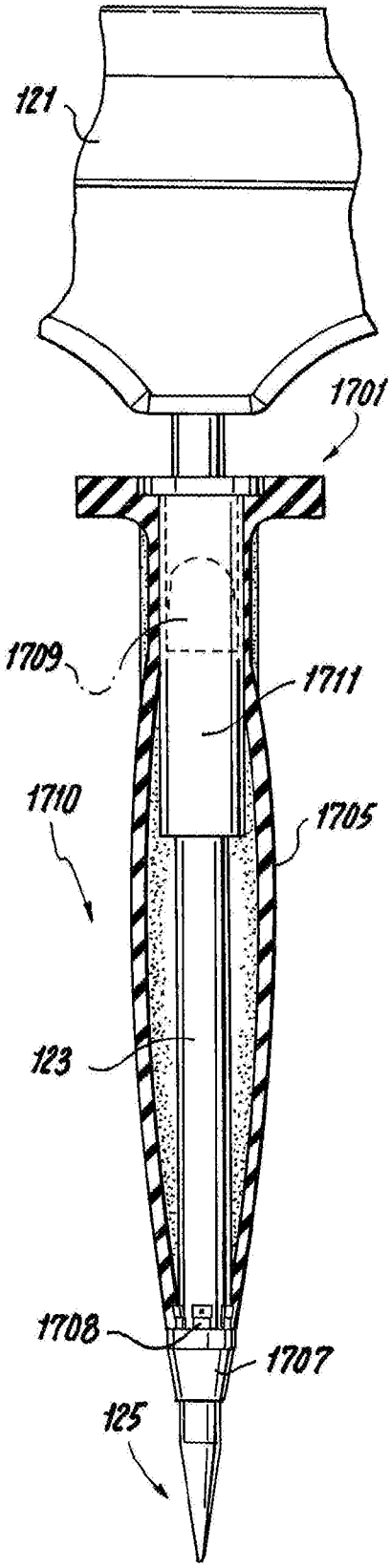


Fig. 18

Fig. 19



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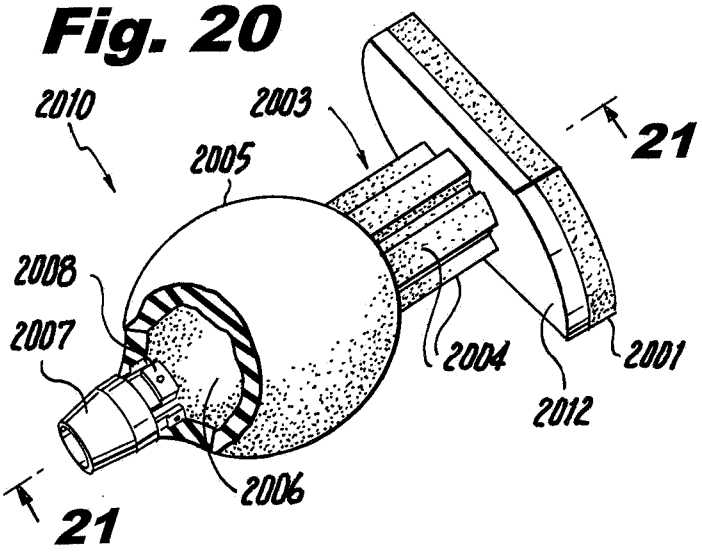

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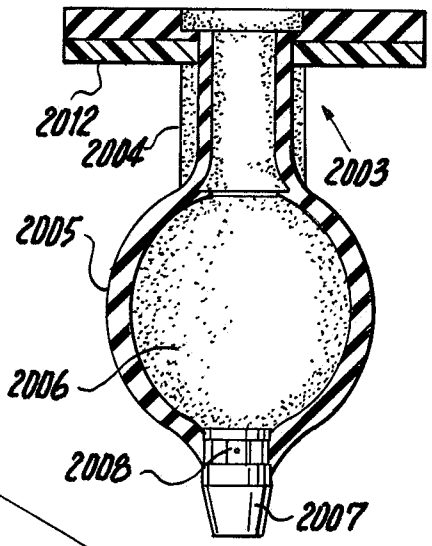

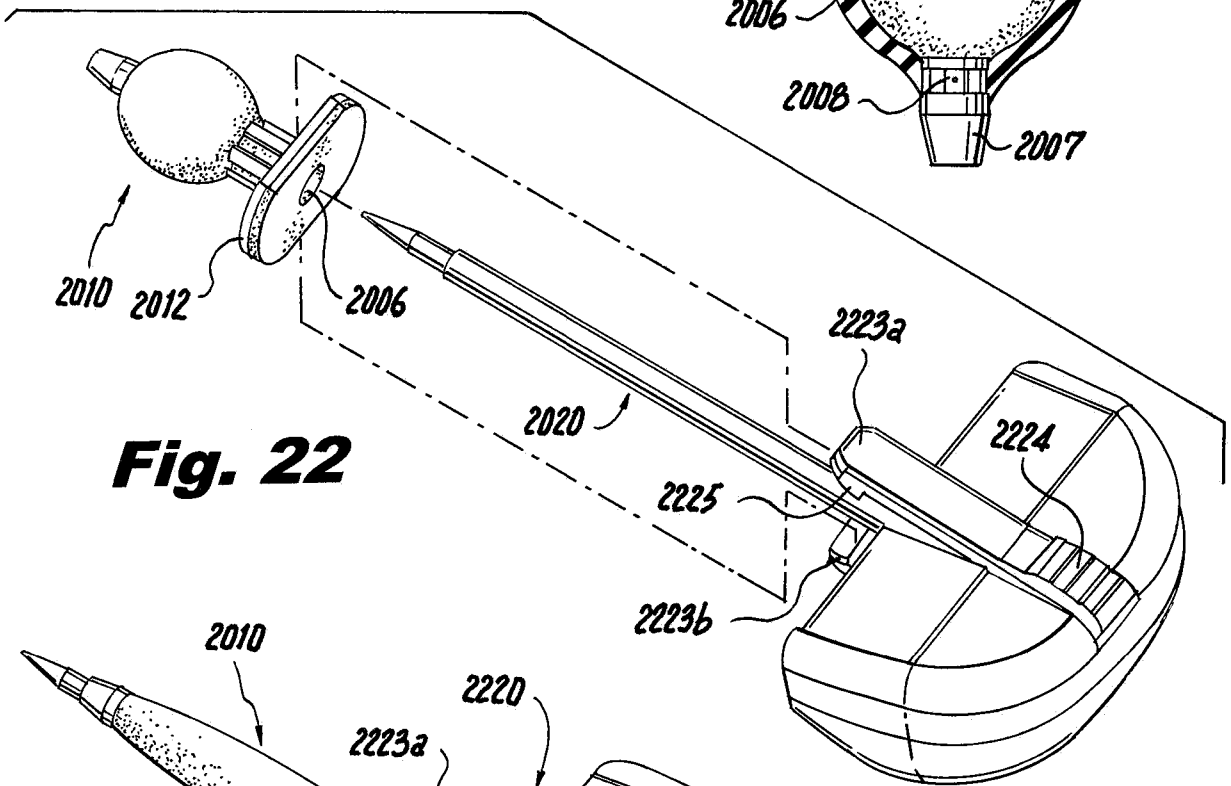

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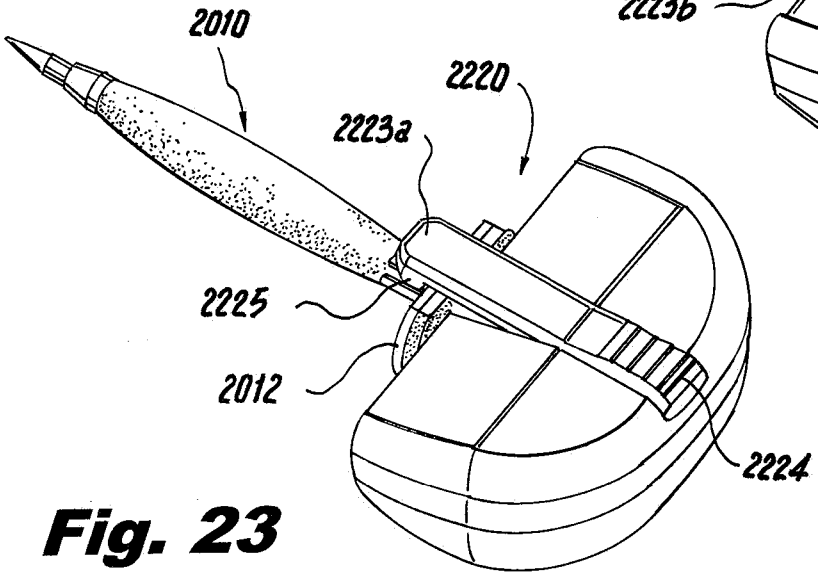
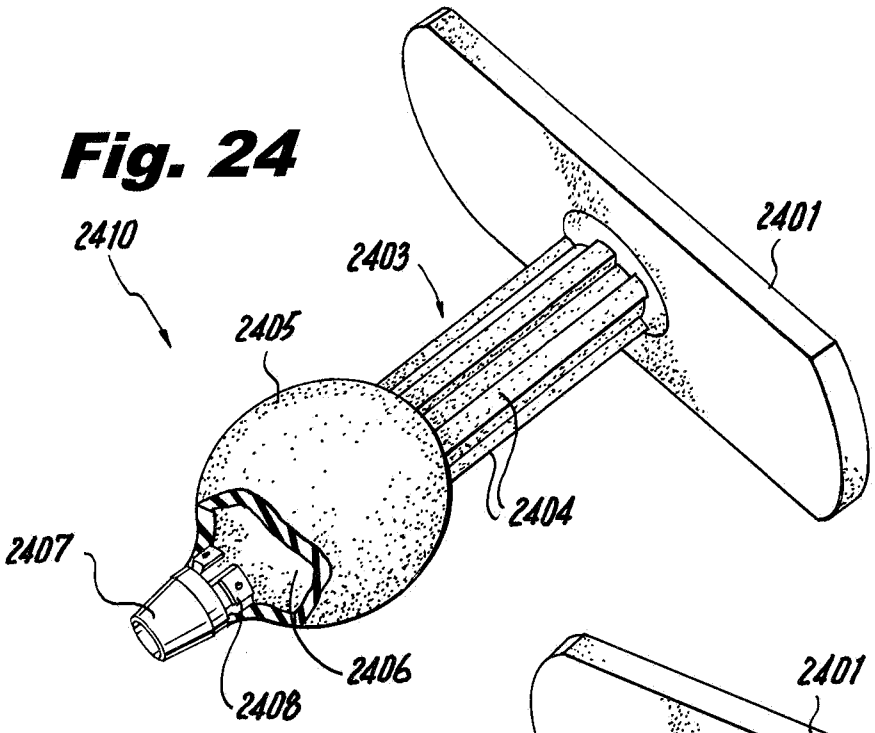


Fig. 23

Fig. 24



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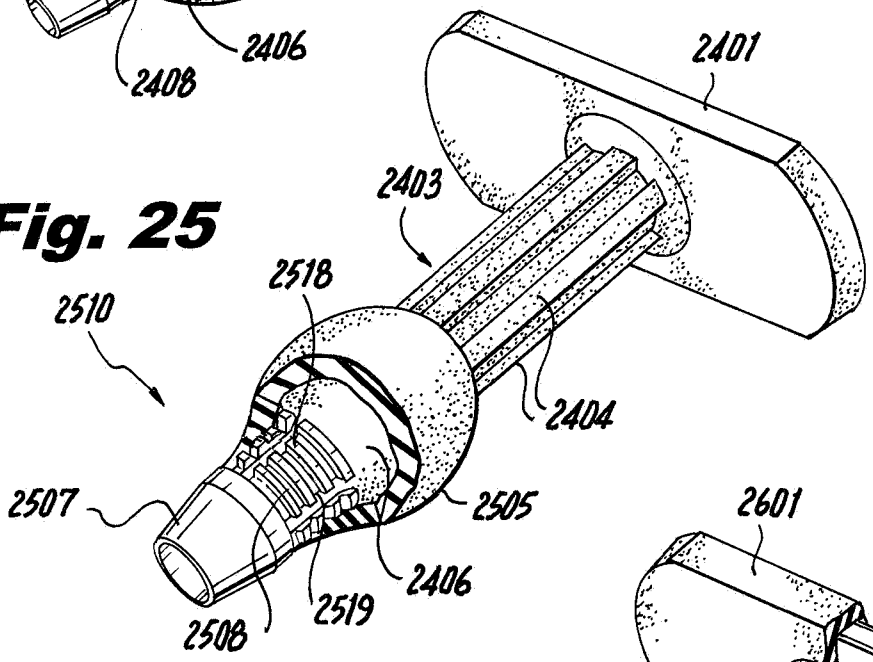

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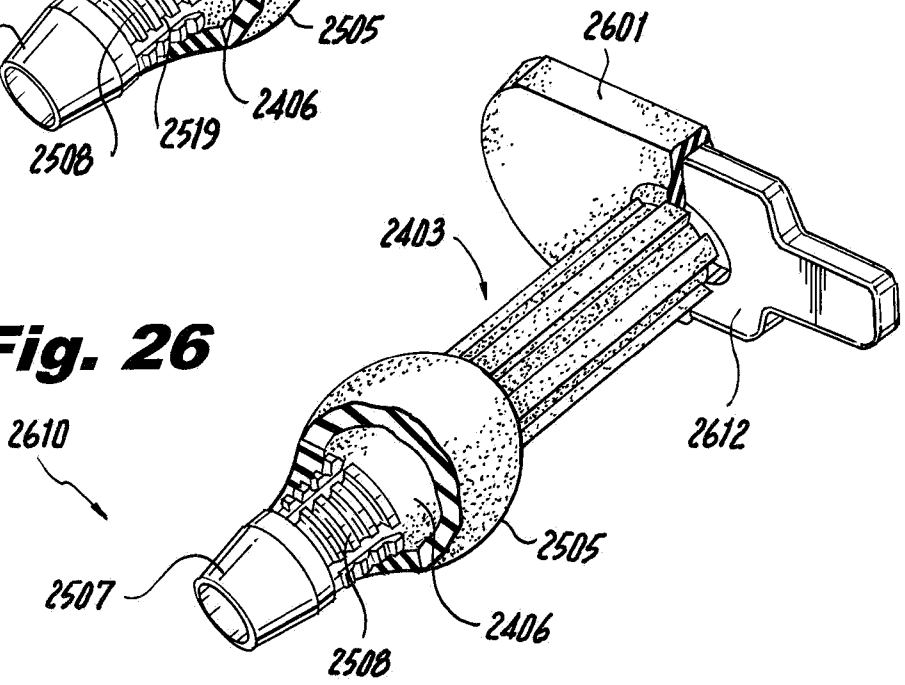

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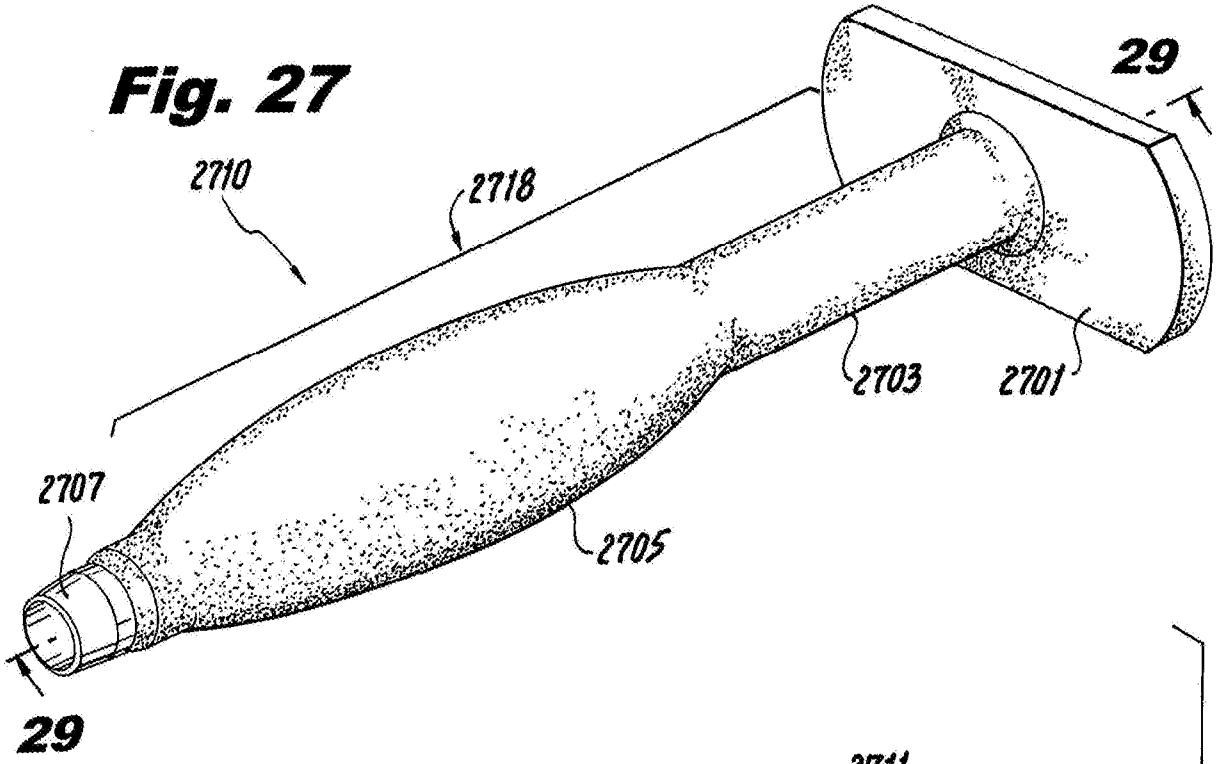
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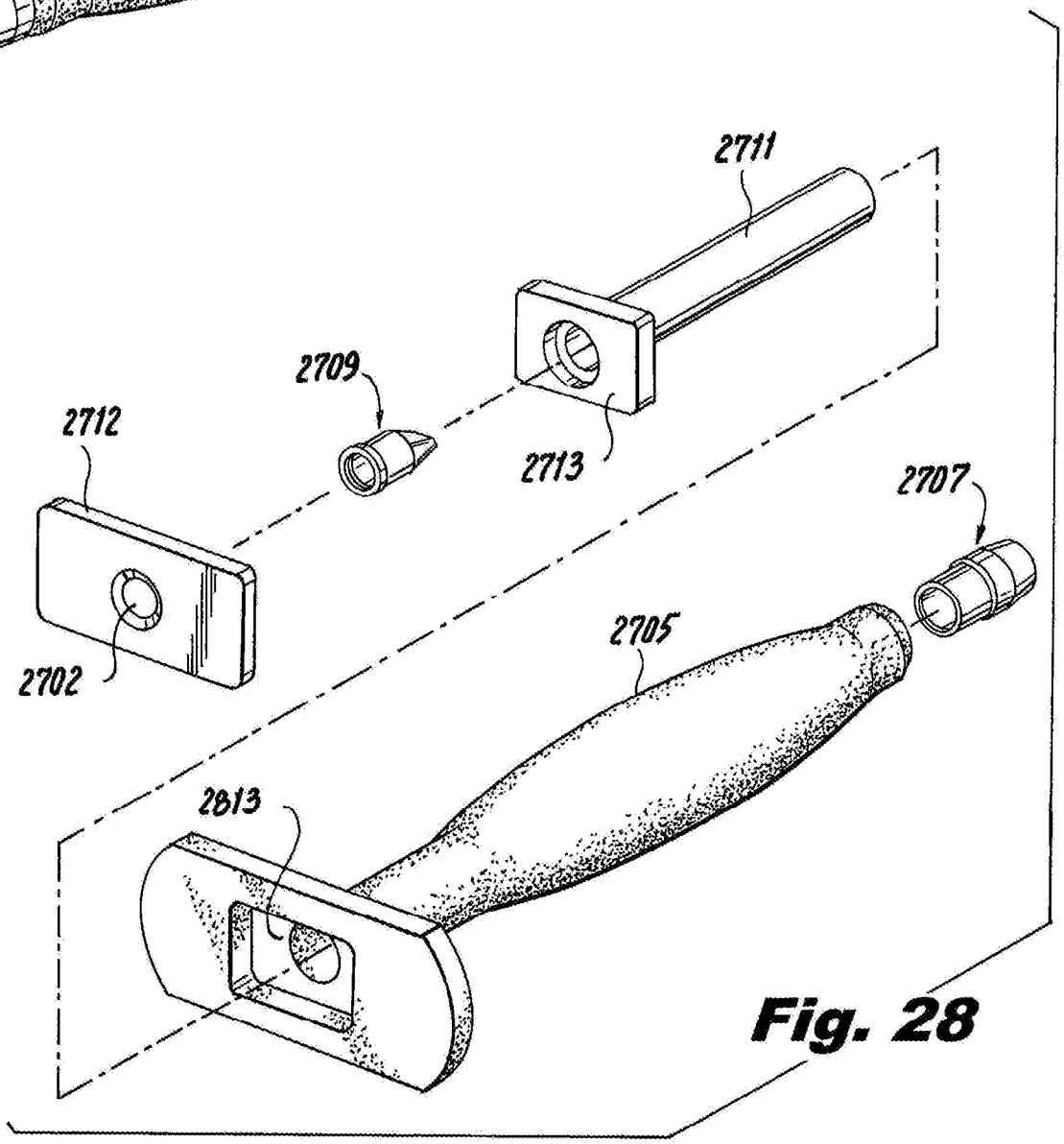
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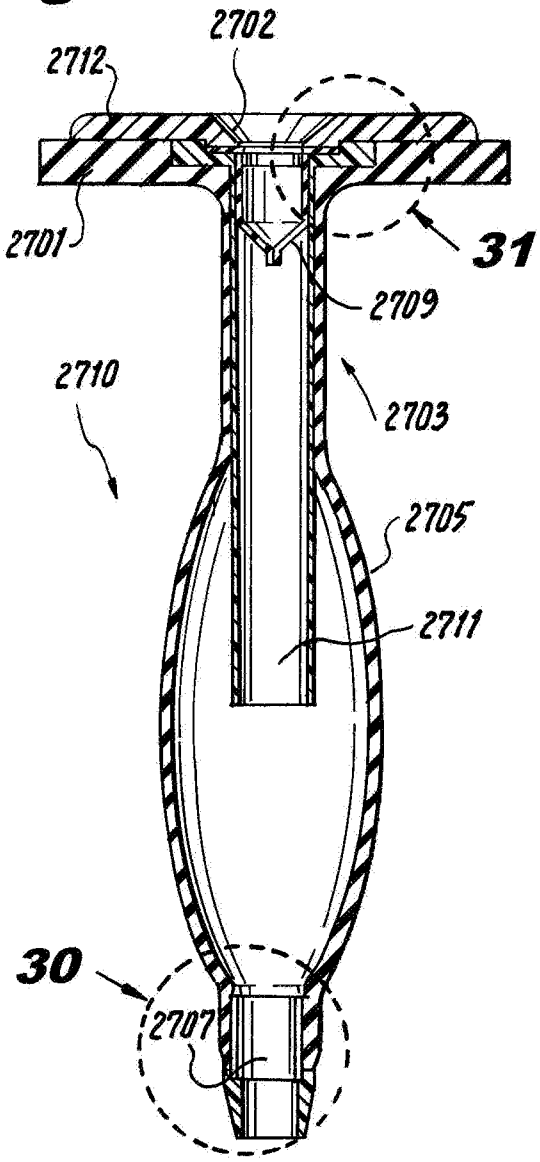
Fig. 28

Fig. 29



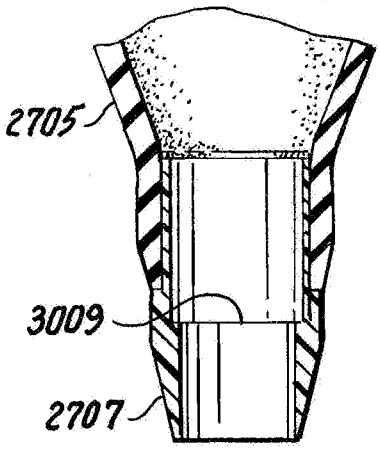
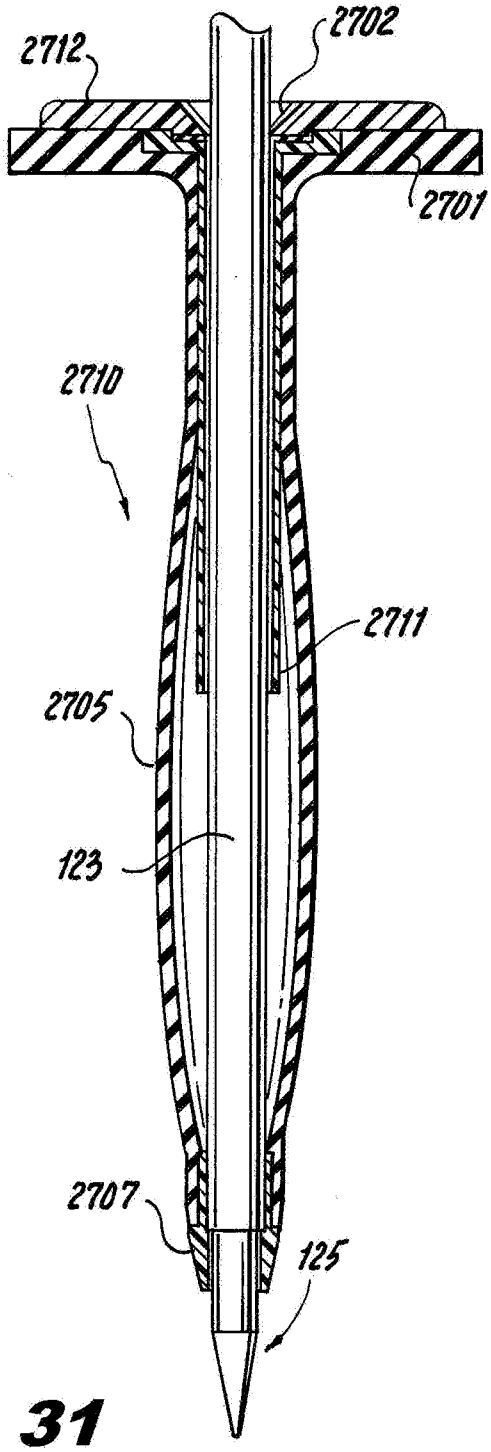


Fig. 30

Fig. 32



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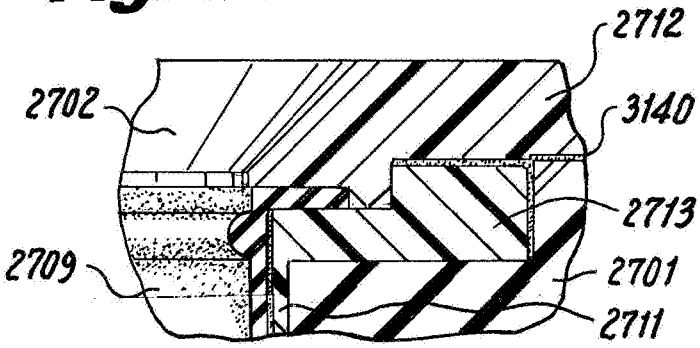

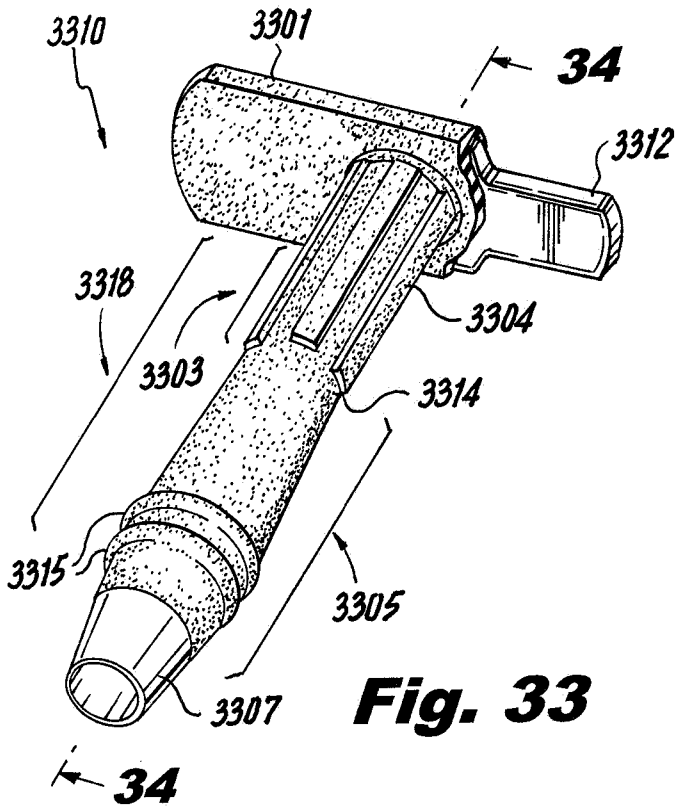

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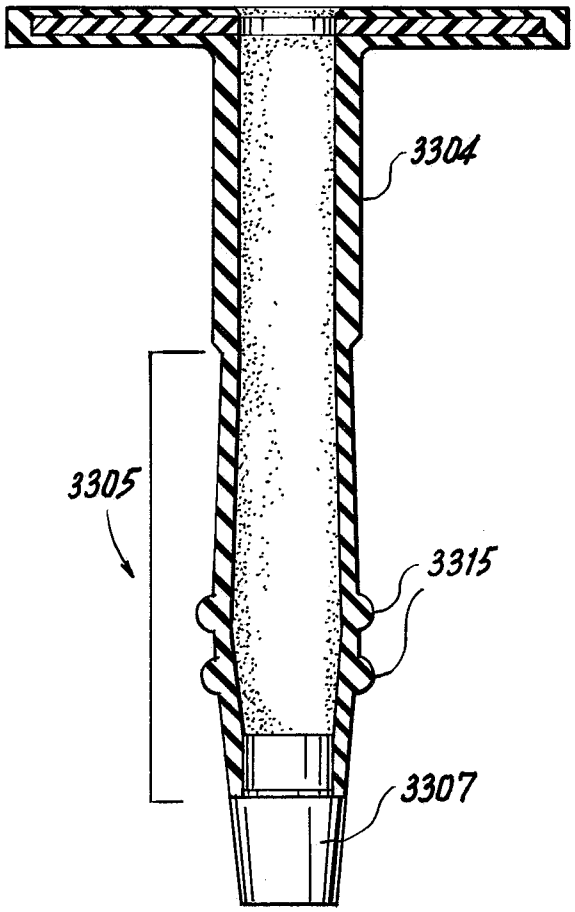

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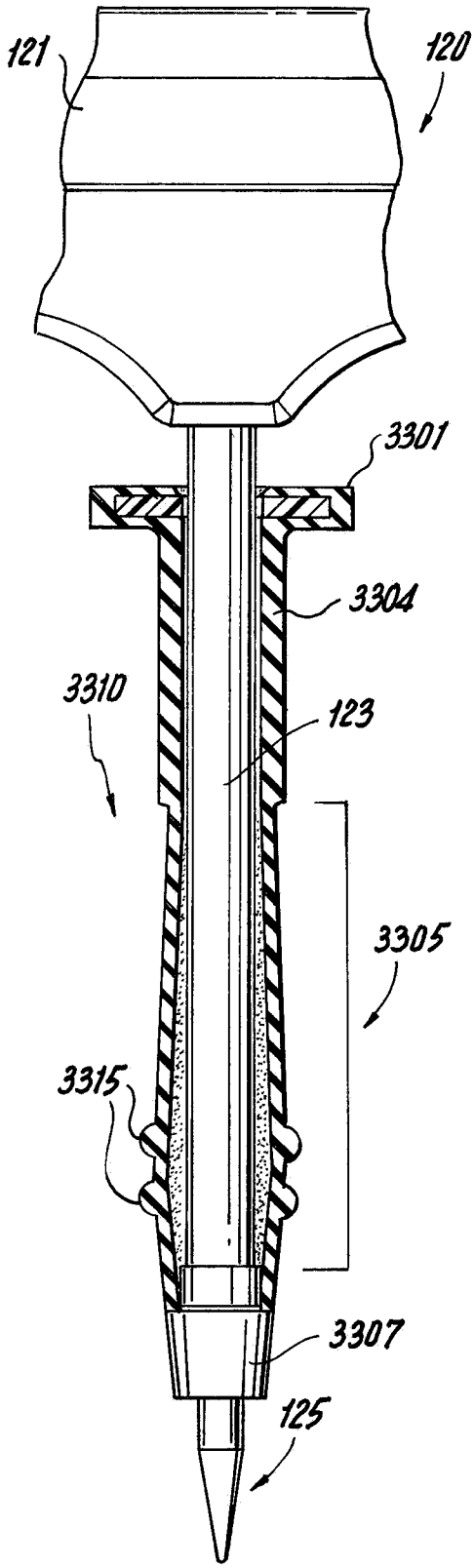

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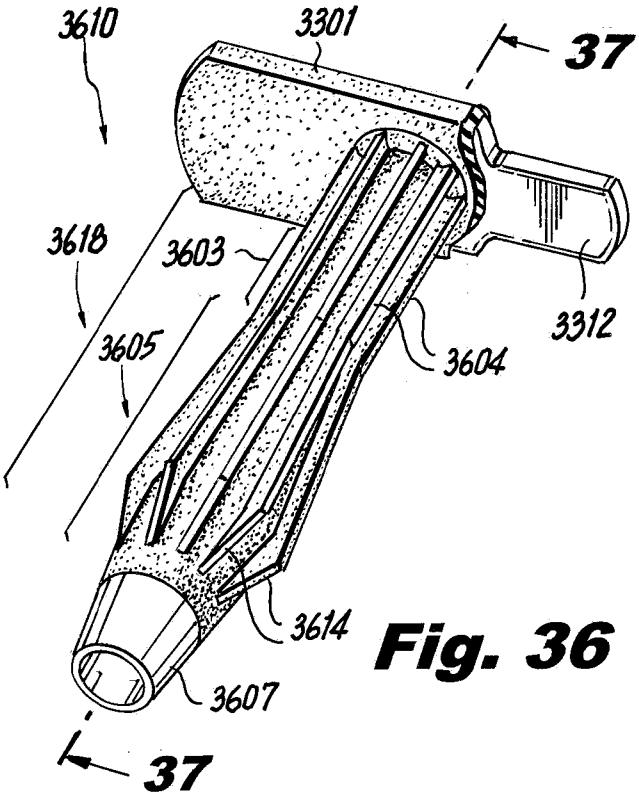

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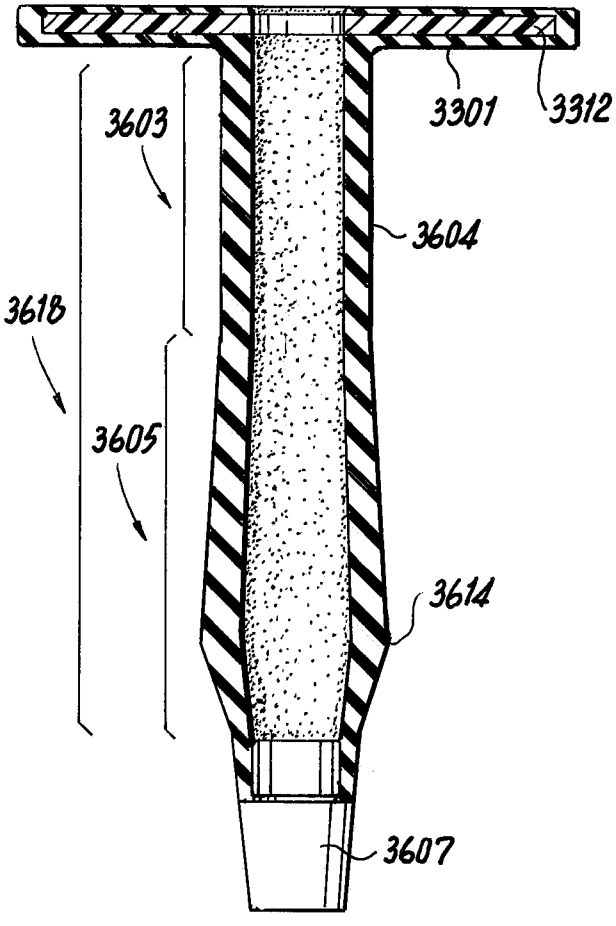

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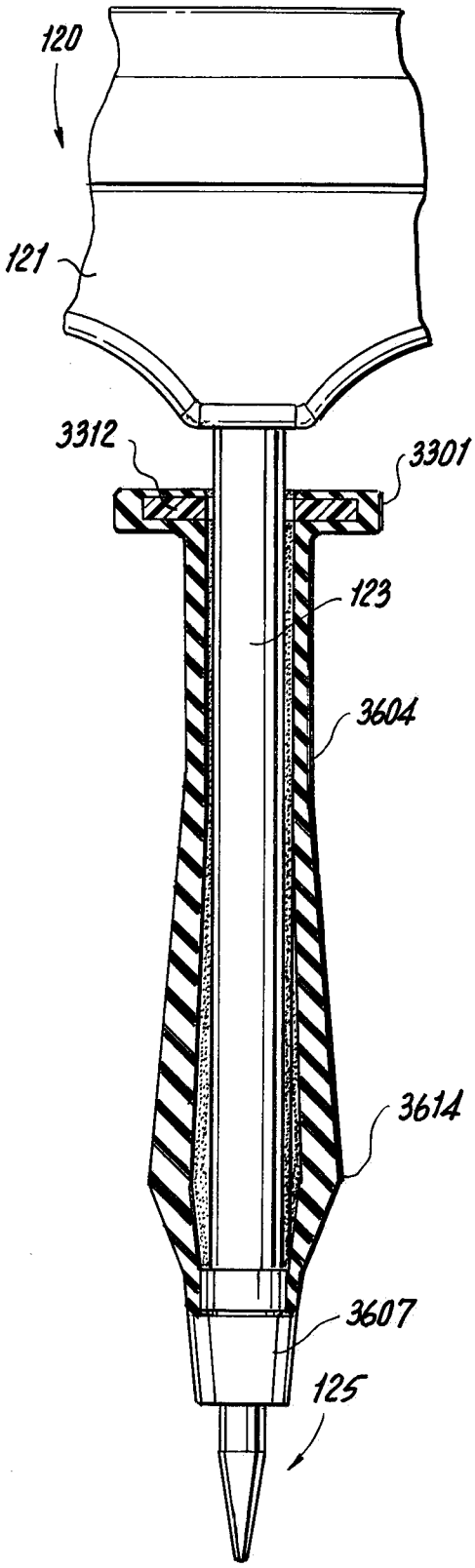

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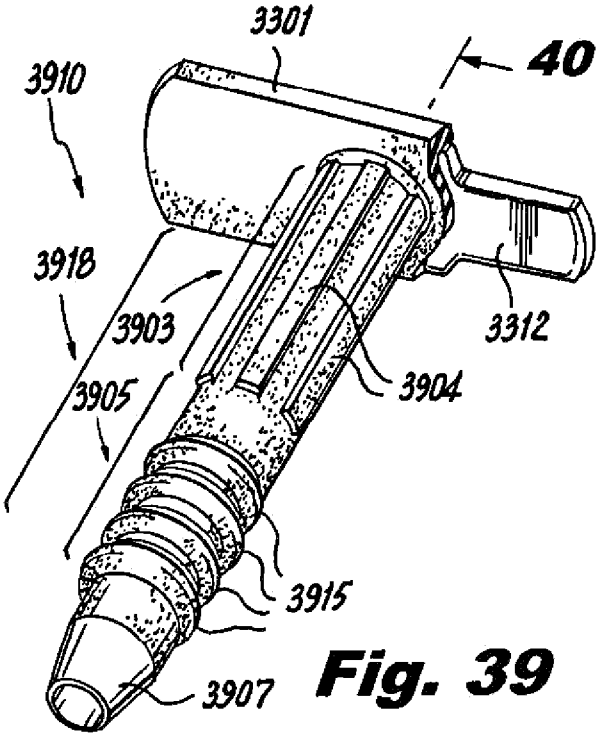

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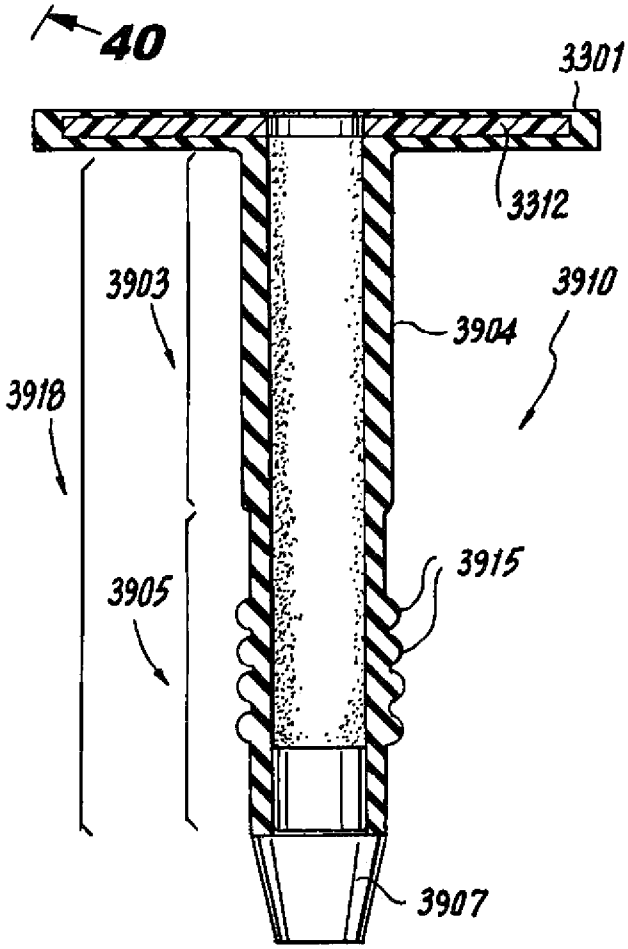

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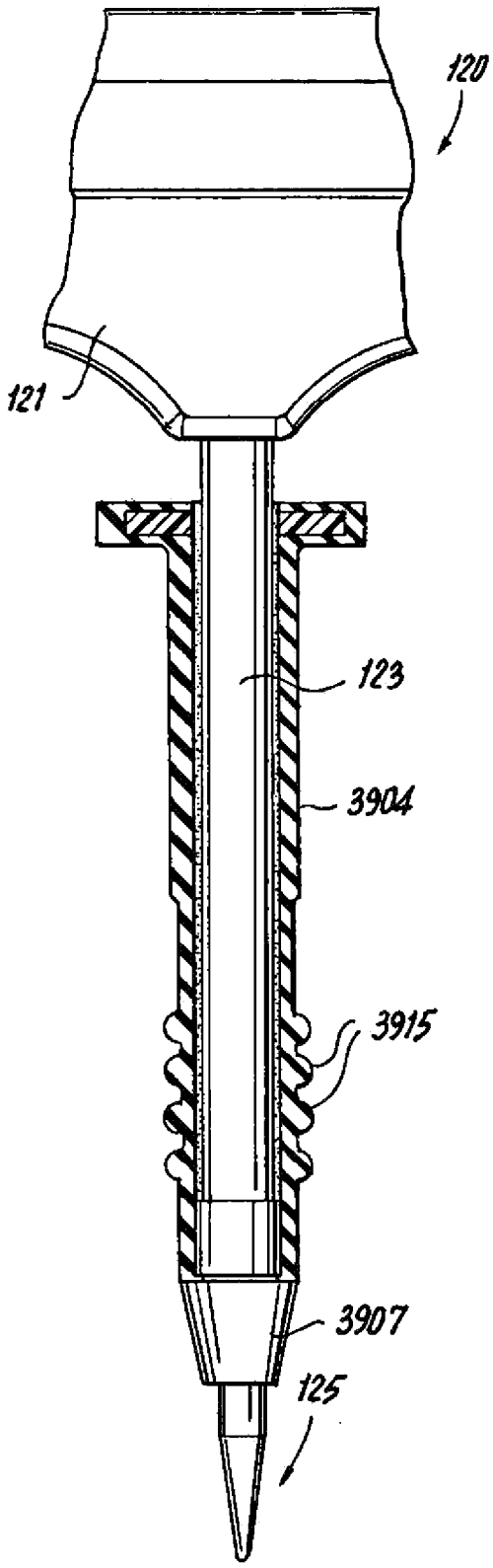
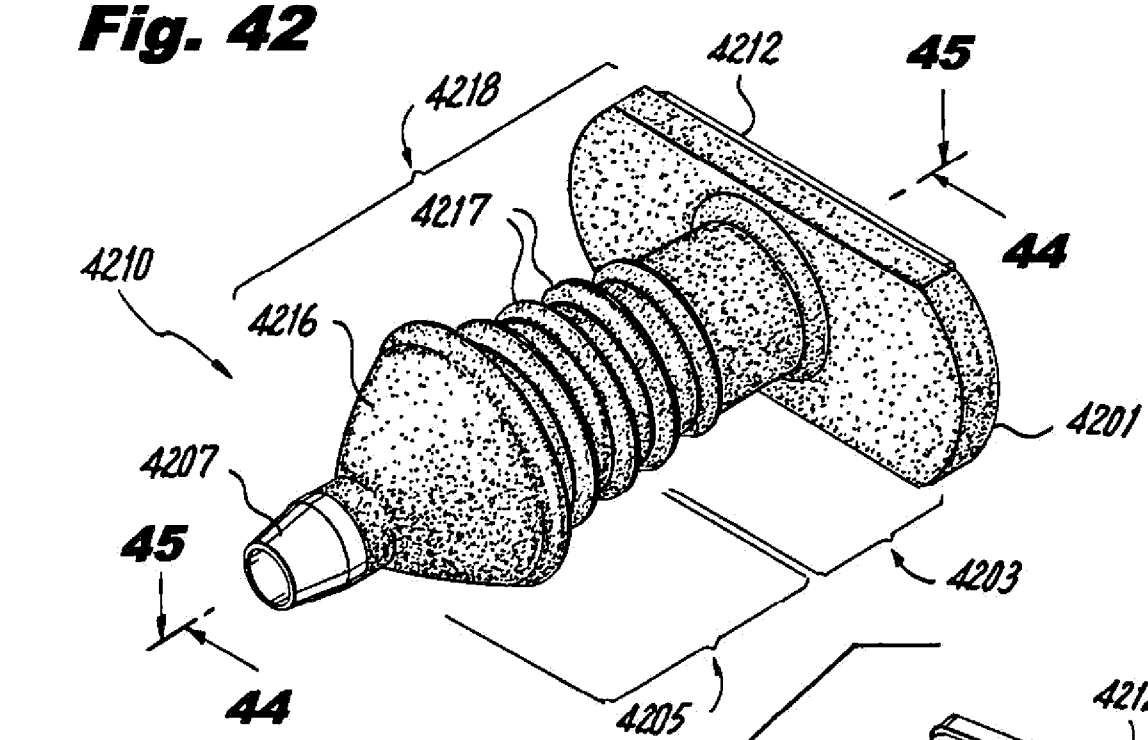


Fig. 41

Fig. 42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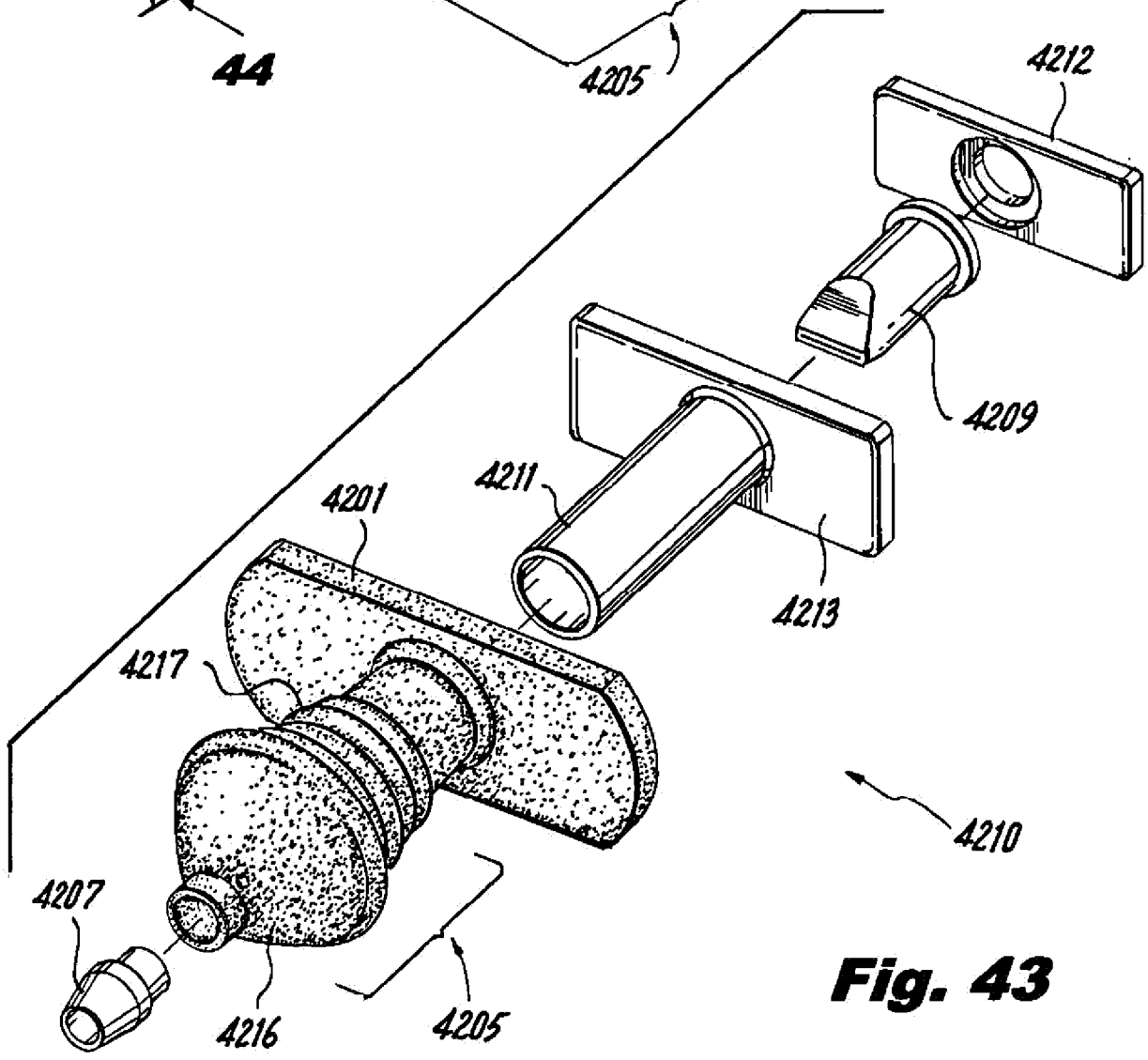
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Fig. 43

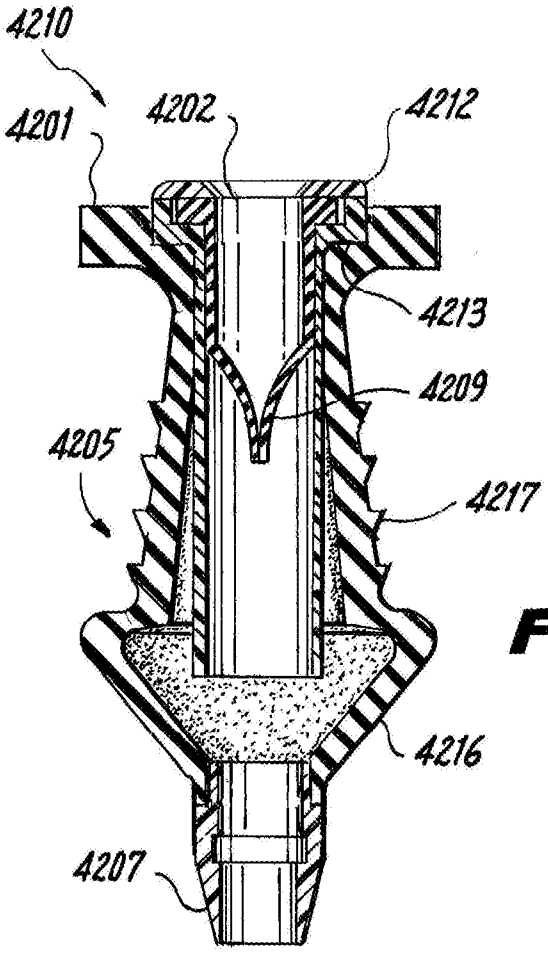
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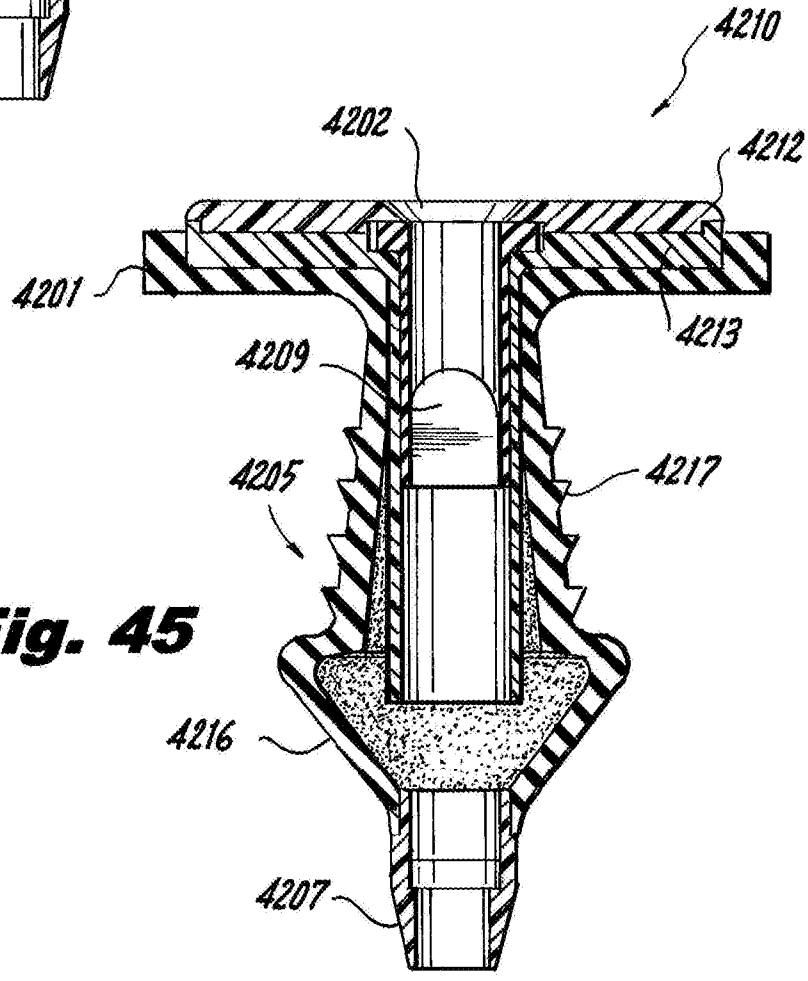
Fig. 44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4201
4213
4209
4205
4217
4216
4207

Fig. 45

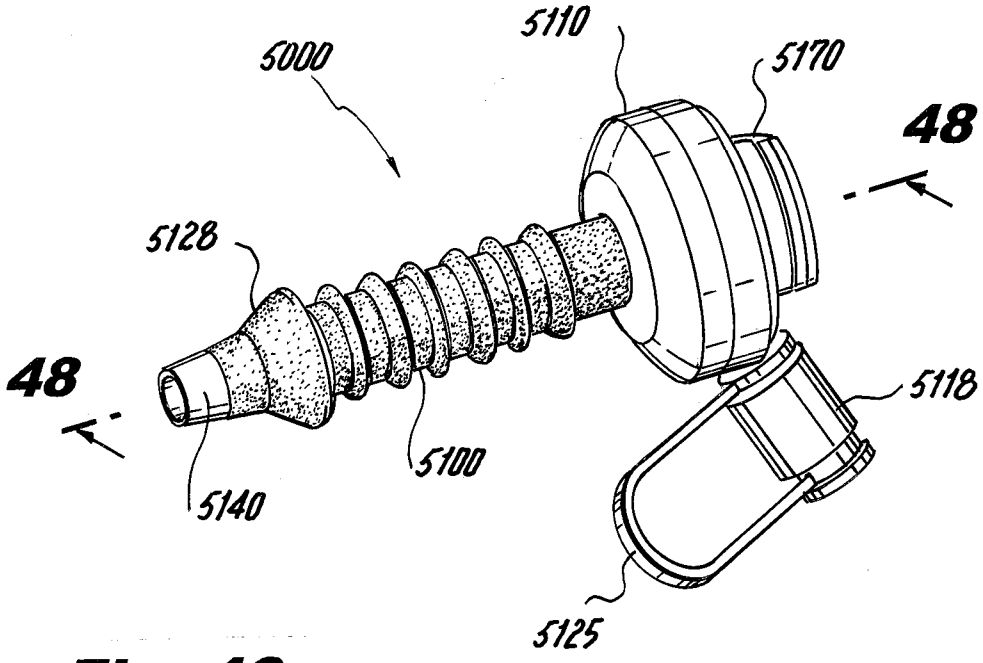
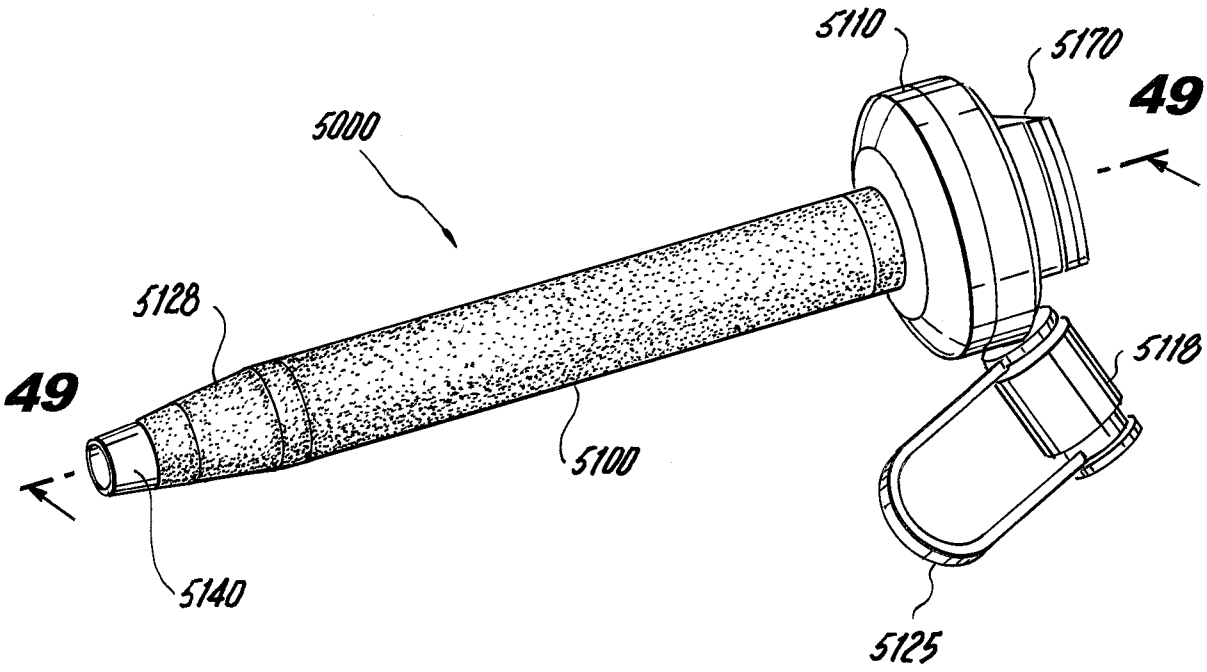

5000
5110
5170
48
5128
48
5118
5100
5140
5125

Fig. 46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5170
49
5000
5128
49
5118
5100
5140
5125

Fig. 47

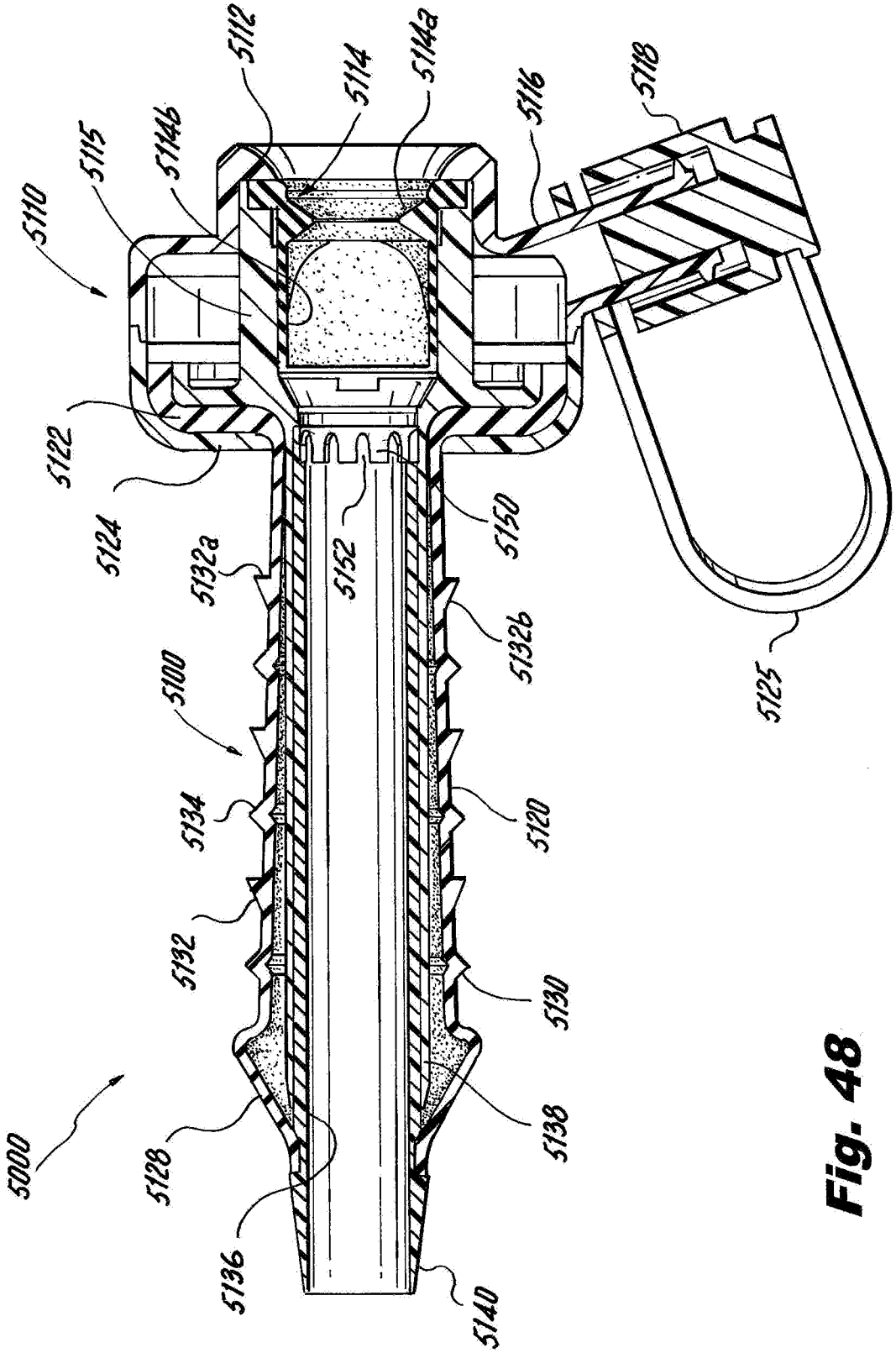
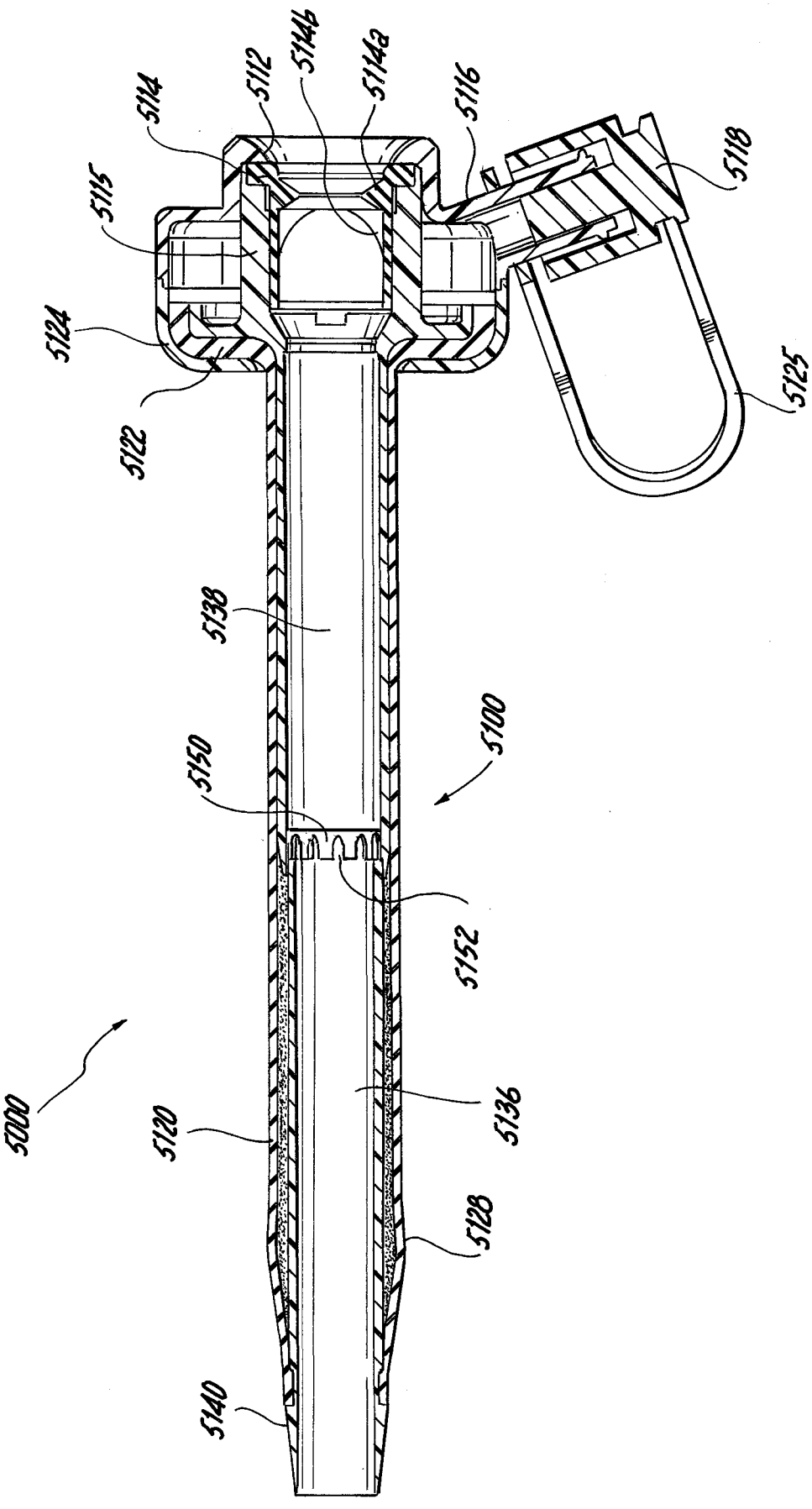

5112
5114
5114a
5116
5118
5115
5114b
5110
5122
5124
5132a
5152
5150
5126
5125
5100
5134
5120
5132
5130
5128
5138
5136
5140
5000

Fig. 48


5114
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5114b
5114a
5116
5118
5115
5124
5125
5122
5138
5100
5150
5152
5000
5120
5136
5128
5140

Fig. 49

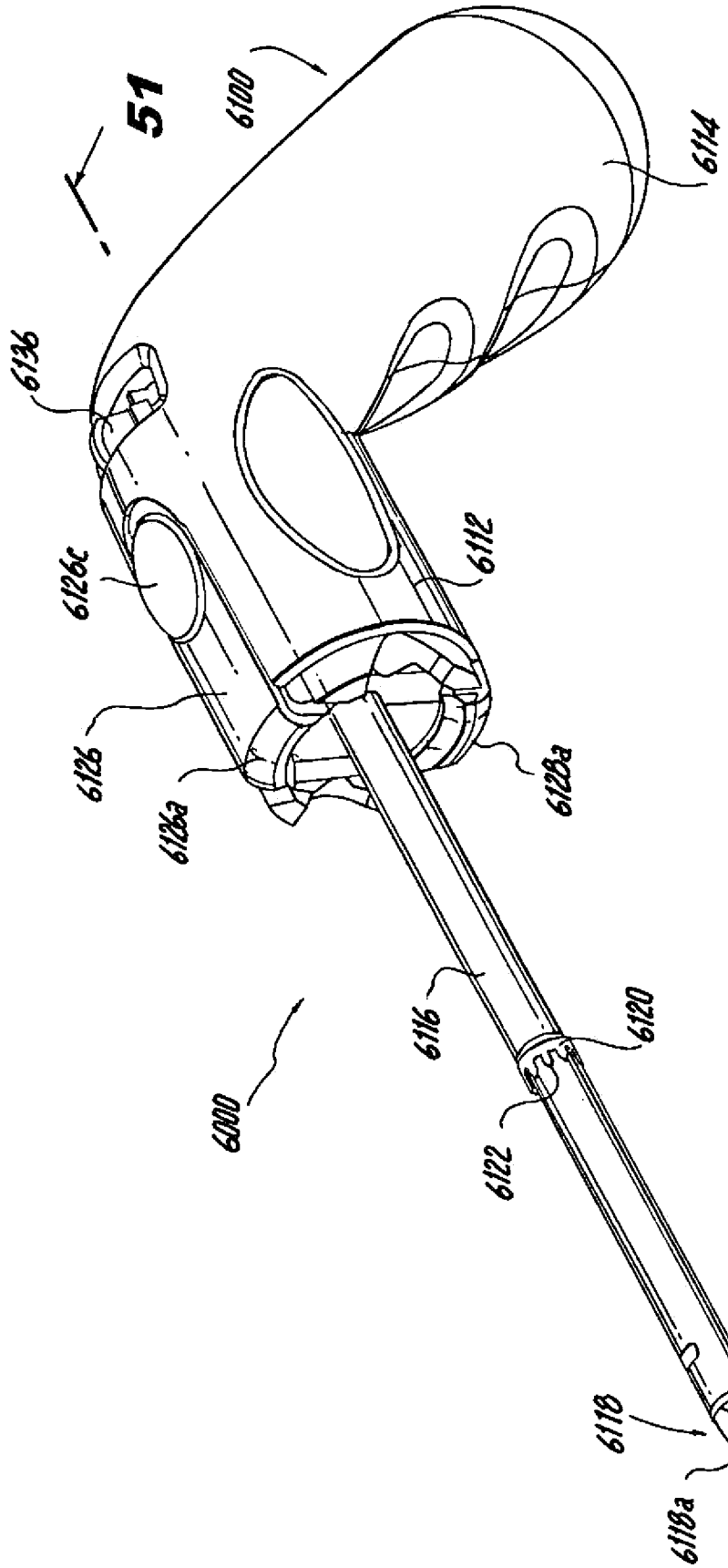
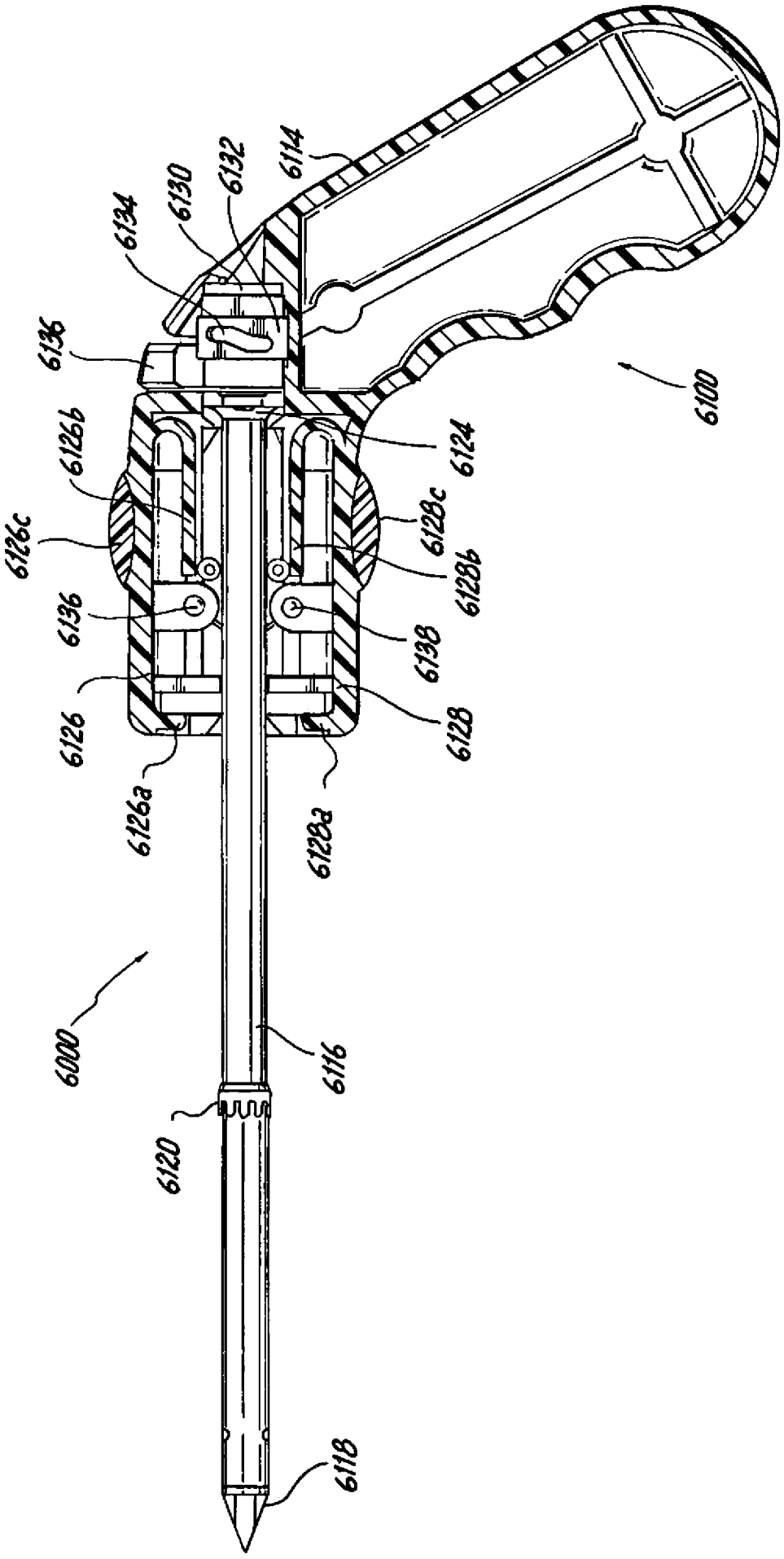

51
6100
6114
6136
6126c
6112
6126
6128a
6126a
6116
6120
6000
6122
6118b
6118
6118a
51

Fig. 50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6132
6130
6134
6136
6100
6124
6126b
6128c
6126c
6128b
6136
6138
6126
6128
6126a
6128a
6000
6116
6120
6118

Fig. 51

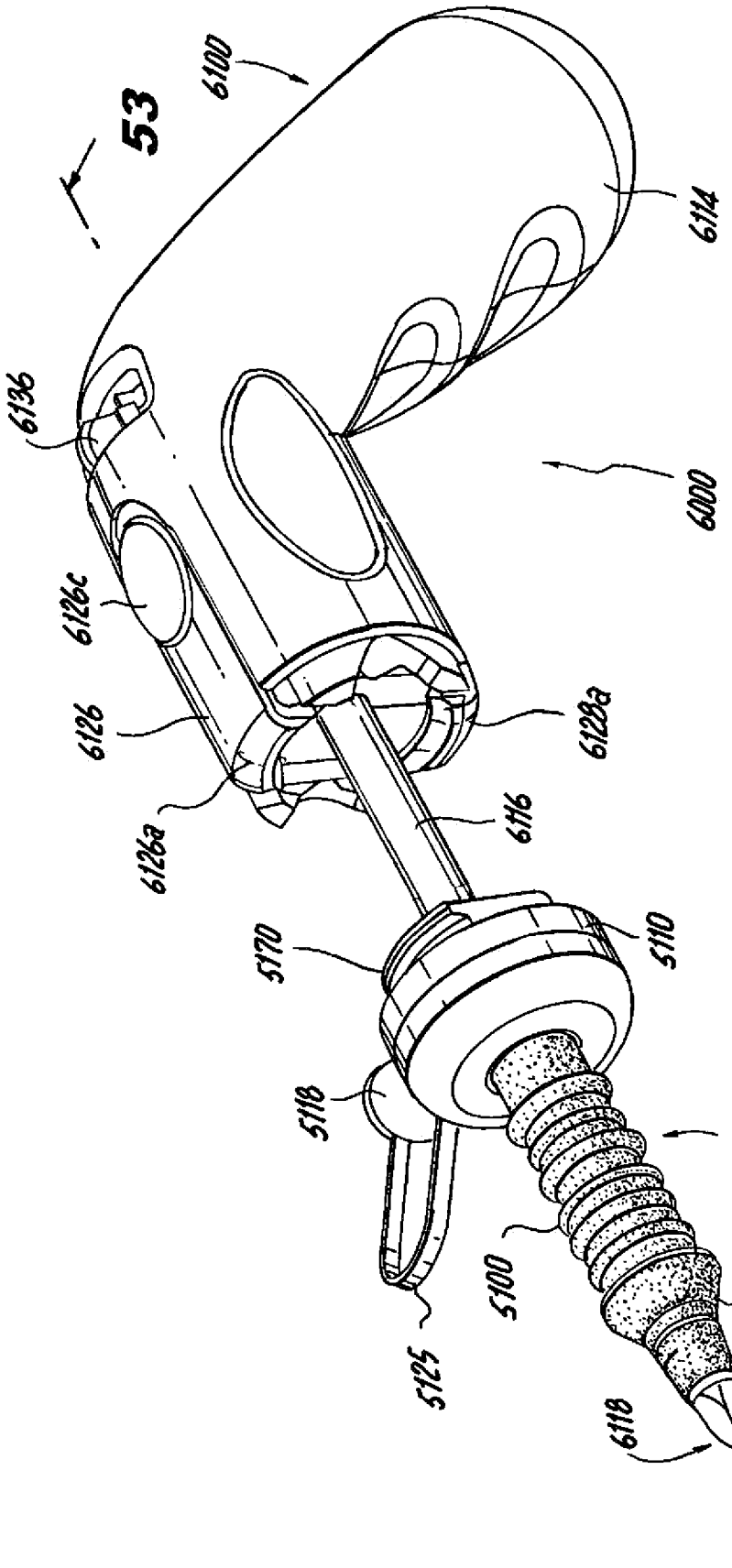
53
6100
6114
6136
6000
6126c
6126
6128a
6126a
6116
5170
5110
5118
5000
5100
5128
5125
6118
53

Fig. 52

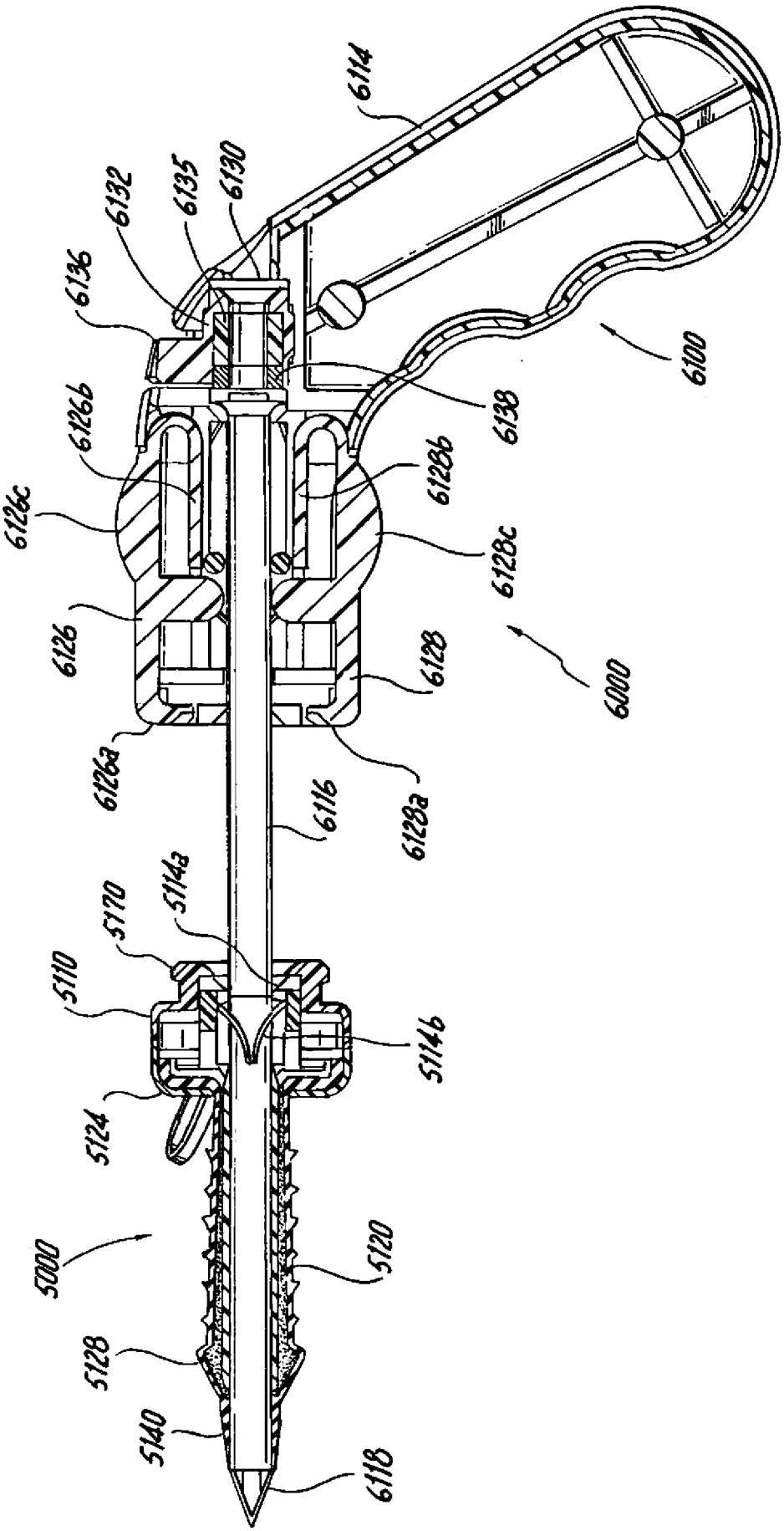
6114
6135
6130
6132
6136
6126b
6128b
6126c
6128c
6138
6100
6126
6128
6000
6126a
6128a
6116
5114a
5170
5110
5114b
5124
5000
5120
5128
5140
6118

Fig. 53

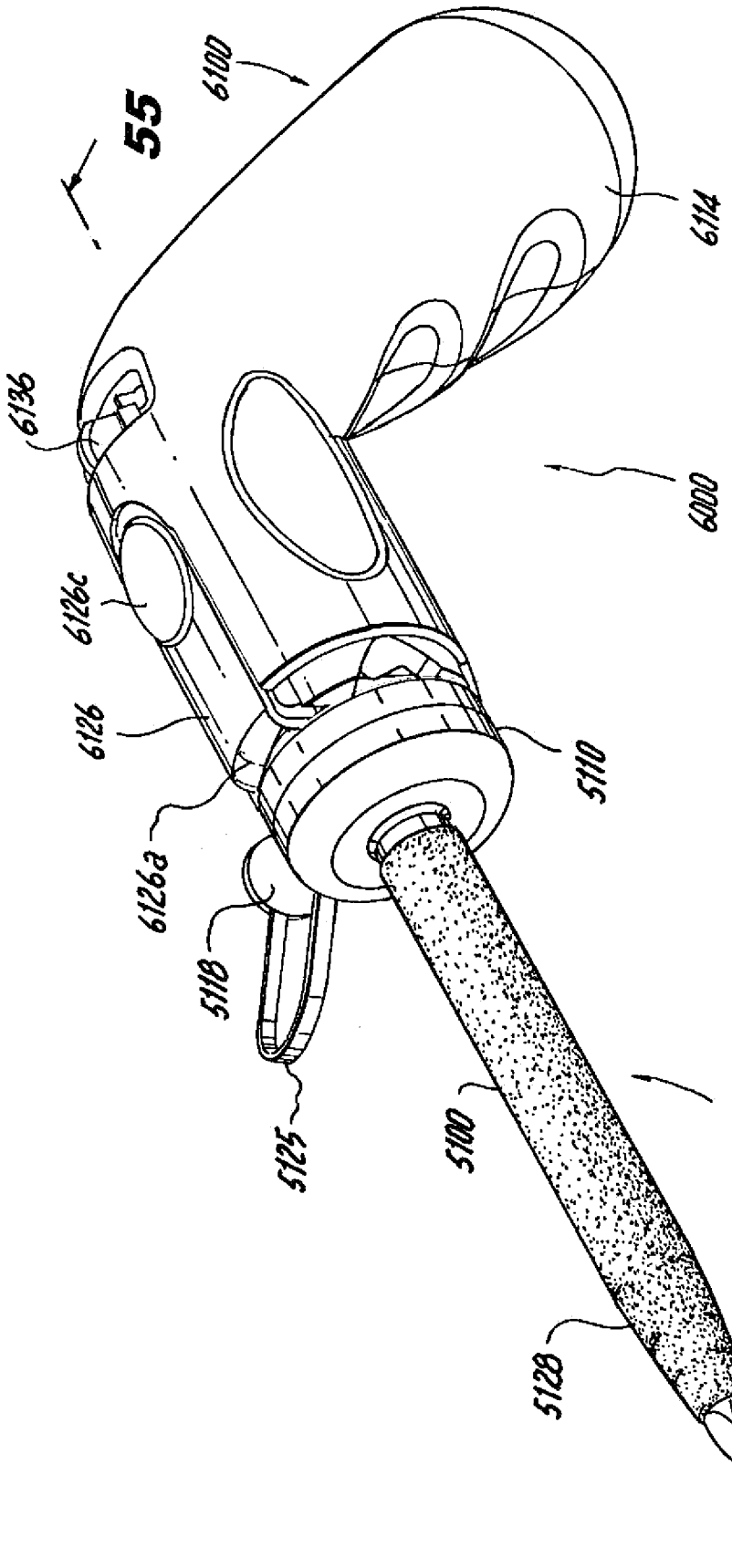
55
6100
6114
6136
6000
6126c
6126
5110
6126a
5118
5125
5100
5000
5128
6118
55

Fig. 54

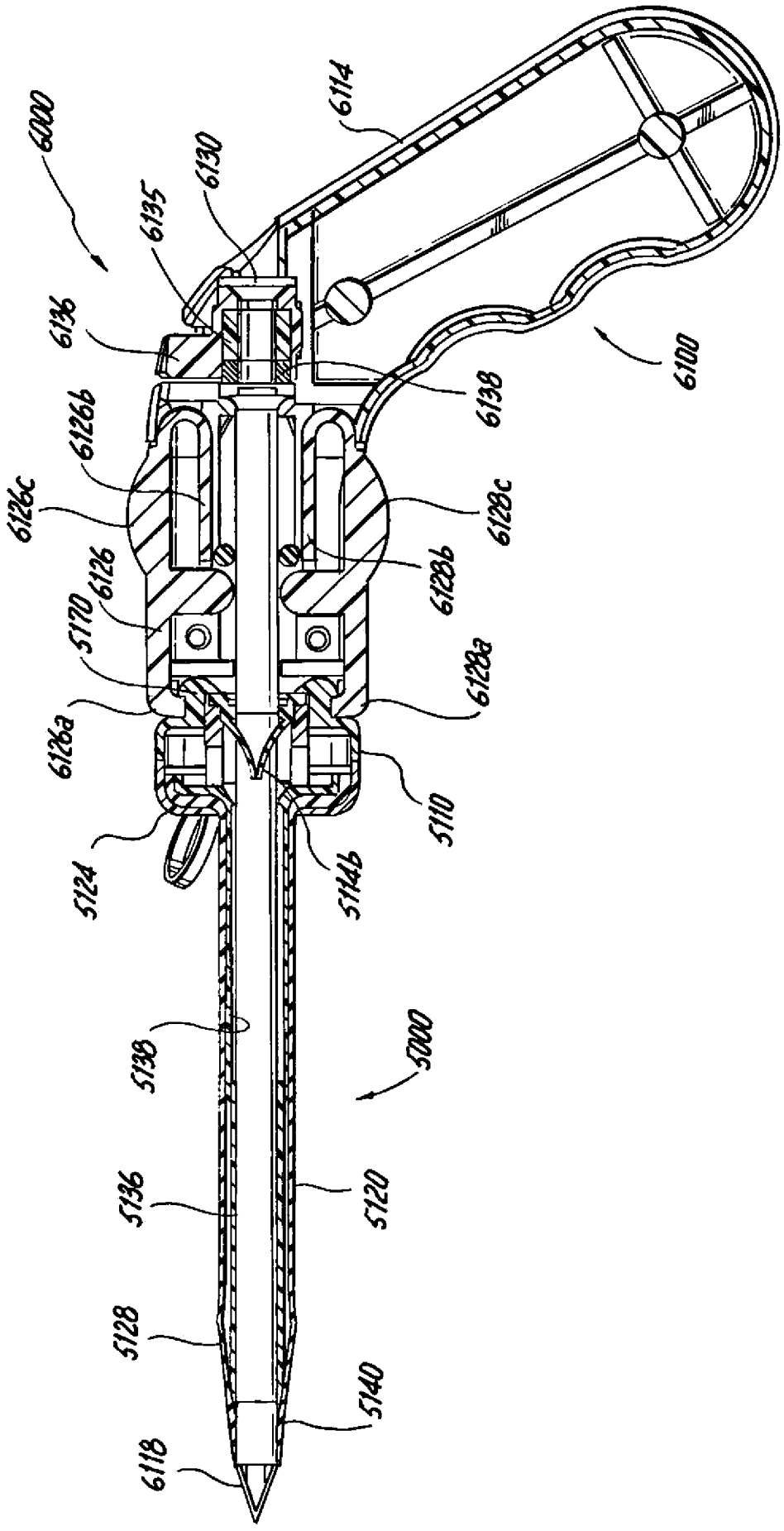
6000
6114
6130
6135
6136
6138
6100
6126b
6126c
6128c
6126
6128b
5170
6128a
6126a
5110
5124
5114b
5130
5000
5136
5120
5128
5140
6118

Fig. 55

专利名称(译)	可弹性变形的外科进入装置，具有伸缩式导管		
公开(公告)号	EP2136721A2	公开(公告)日	2009-12-30
申请号	EP2008733196	申请日	2008-04-13
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申请(专利权)人(译)	SURGIQUEST注册成立		
当前申请(专利权)人(译)	SURGIQUEST注册成立		
[标]发明人	MASTRI DOMINICK AZARBARZIN KURT		
发明人	MASTRI, DOMINICK AZARBARZIN, KURT		
IPC分类号	A61B17/34 A61B1/313 A61B17/00 A61B19/00		
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优先权	11/786832 2007-04-13 US		
其他公开文献	EP2136721B1		
外部链接	Espacenet		

摘要(译)

公开了一种外科进入装置，其包括具有细长主体的进入端口，所述细长主体具有相对的近端部分和远端部分并限定纵向轴线，所述主体具有延伸穿过其中心的中央内腔并且具有形成在近端和远端之间的弹性球部分。其中，弹性灯泡部分适于并构造成在灯泡部分具有第一直径和第一长度的第一条件和第二条件之间转换，其中灯泡部分具有小于第一直径的第二直径直径和第二长度大于第一长度，并且其中伸缩导管组件（5136,5138）设置在进入端口主体的中央腔内，用于容纳细长插入装置，其中导管组件适合于并且被配置为在对应于灯泡部分的第一条件的第一长度和第二长度之间转换对应于灯泡部分的第二状态。