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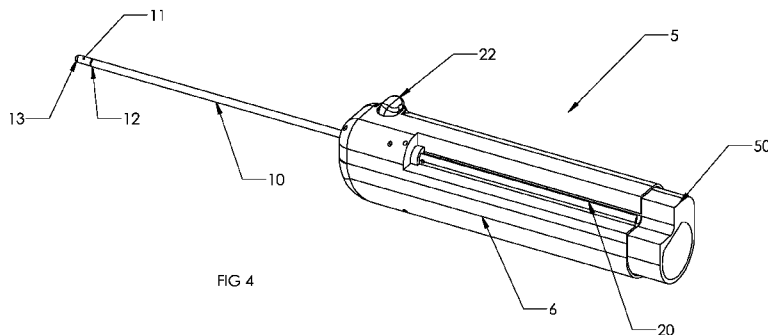
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(54) Title: TISSUE REMOVAL DEVICE AND METHOD OF USE



(57) Abstract: A biopsy device for acquiring a tissue sample is disclosed. The biopsy device comprises a tissue-engaging outer element, a handle and a trocar. Multiple tissue samples may be collected.

TITLE OF THE INVENTION

TISSUE REMOVAL DEVICE AND METHOD OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Nos. 62/169,888 filed on June 02, 2015 and 62/326,785 filed on April 26, 2016, which are both incorporated by reference herein in their entireties.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] This disclosure relates to medical instrumentation. More particularly, a tool used for acquiring tissue and a method for using the same are disclosed.

Description of the Prior Art

[0003] A number of medical procedures require the removal of tissue samples from a patient. These operations can range from the removal of suspicious tissue, as in the biopsy of a cancerous lesion, to cell harvesting, as in a bone marrow donation. A number of different biopsy tools are used for retrieving these tissue samples from patients. There are two main styles of core biopsy tools –side cutting and forward coring. One style of biopsy tool may be called forward coring. A forward coring biopsy tool may include a spinning cannula with a razor edge. As the device is advanced into a tissue mass, the cannula may core the tissue. The cored tissue sample must then be parted off from the remaining tissue mass. There are a number of methods for parting off the tissue sample, such as tearing or cutting.

SUMMARY OF THE INVENTION

[0004] A tool used to obtain tissue samples is disclosed herein. The partoff mechanism of the tool can be comprised of at least one tubular element. The tubular element may be spun along a central axis. The distal end of the tubular element may comprise a flexible partoff tab. The

angle of this partoff tab may be adjusted during use. For example, the partoff tab may be flush with the remainder of the tube wall while advancing the device into a mass of tissue & while coring a tissue sample; the partoff tab may be angled inwards to partoff the sample from the tissue mass. The tube may be spinning as the partoff tab is repositioned; if the tube is spinning, the partoff tab may cut the tissue mass as it is being repositioned. The partoff tab may remain positioned inwards to secure the samples within the tubular element (e.g. the partoff tab may prevent the samples from falling out of the terminal distal end of the tubular element).

[0005] A tool for acquiring tissue is disclosed. The tool can have a cutter tube comprising a tubular system and a partoff tab. The partoff tab may have a partoff tab first end and a partoff tab second end. The partoff tab first end can be secured to the tubular system. The partoff tab second end can be secured to the tubular system. The cutter tube can have a tubular longitudinal axis. The partoff tab can have a longitudinally expanded configuration and a longitudinally contracted configuration. The length of the partoff tab along the tubular longitudinal axis in the longitudinally expanded configuration may be longer than the length of the partoff tab in the longitudinally contracted configuration.

[0006] A tool for acquiring tissue may be comprised of a cutter tube, a partoff tab having a partoff tab first and second ends and an actuator. The partoff tab first end can be secured to the cutter tube. The partoff tab second end can be secured to the actuator. The length of the partoff tab along the tubular longitudinal axis in the longitudinally expanded configuration may be longer than the length of the partoff tab in the longitudinally contracted configuration.

[0007] A tool for acquiring tissue may comprise a cutter tube. The cutter tube may comprise the tubular system and the partoff tab. The length of the partoff tab along a tubular longitudinal axis in the longitudinally expanded configuration may be longer than the length of the partoff tab in the longitudinally contracted configuration. The partoff tab can have two flex points, when in the contracted configuration.

[0008] A tool for acquiring tissue may comprise a cutter tube. The cutter tube may comprise the tubular system and the partoff tab. The length of the partoff tab along a tubular longitudinal axis in the longitudinally expanded configuration may be longer than the length of the partoff tab in the longitudinally contracted configuration. The partoff tab can have one inflection point, when in the contracted configuration.

[0009] A tool for acquiring tissue may comprise a cutter tube, a partoff tube and an actuator. The partoff tab can have two flex points, when in the contracted configuration.

[0010] A tool for acquiring tissue may comprise a cutter tube, a partoff tube and an actuator. The partoff tab can have one inflection point, when in the contracted configuration.

[0011] A method for operating a mass removal device is disclosed. The mass removal device may comprise a cutter tube, comprising the tubular system and the partoff tab. The partoff tab can have a partoff tab first end and a partoff tab second end. The partoff tab first end can be secured to the tubular system. The partoff tab second end can be secured to the tubular system. The method can comprise actuating the partoff tab, wherein the actuating comprises extending the partoff tab radially inwardly or outwardly relative to the cutter tube.

[0012] A method for operating a mass removal device is disclosed. The mass removal device may comprise a cutter tube, an actuator and a partoff tab. The partoff tab can have a partoff tab first end and a partoff tab second end. The partoff tab first end can be secured to the cutter tube. The partoff tab second end can be secured to the actuator. The method can comprise actuating the partoff tab, wherein the actuating comprises extending the partoff tab radially inwardly or outwardly relative to the cutter tube.

[0013] A method for operating a mass removal device is disclosed. The mass removal device may comprise a cutter tube, an actuator and a partoff tab. The partoff tab can have a partoff tab first end and a partoff tab second end. The partoff tab first end can be secured to the cutter tube. The partoff tab second end can be secured to the actuator. The method can comprise actuating the partoff tab, wherein the actuating comprises extending the partoff tab radially inwardly or outwardly relative to the cutter tube. The cutter tube may rotate relative to the tissue mass. The mass removal device may acquire multiple samples with one single insertion into the tissue mass. The samples may stack up sequentially within the cutter tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is an isometric view of a variation of the tool.

[0015] **FIG. 2a** and **FIG. 2b** illustrate a cross-sectional view of the tool along a tubular longitudinal axis **8**. **FIG. 2a** illustrates the tool with the trocar out (insertion mode) and **FIG. 2b** illustrates the tool with the trocar back (sampling mode).

[0016] **FIG. 3** is a cross-sectional view of the distal section of the cutter tube with a tissue-engaging inner element.

[0017] **FIG. 4** is an illustrative isometric view of a variation of the tool

[0018] **FIG. 5** is a top view of a variation of the tool.

[0019] FIG. 6 is an illustrative isometric view of a variation of the reusable handle.

[0020] FIG. 7 is an illustrative isometric view of a trocar recessed with a trocar tube.

[0021] FIG. 8 is an illustrative isometric view of an inner tube extending distally past the cutter tube terminal distal end.

[0022] FIG. 9 is an illustrative isometric view of a handle with a slideable button.

DETAILED DESCRIPTION

[0023] FIG. 1 illustrates a tool 5 that can be sterilized. The tool 5 may have an ergonomic handle 6. The handle 6 can have a handle top portion joined together with a handle bottom portion. The tool 5 may have a handle left portion and a handle right portion. The handle top portion and the handle bottom portion may be injection molded. The handle 6 may contain a cutter tube 10. The cutter tube 10 can be rotatable about a tubular longitudinal axis 8 or rotationally-fixed with respect to the handle 6. The cutter tube 10 can be longitudinally fixed with respect to the handle 6. The cutter tube 10 can extend distally from the handle 6 and can have a cutter tube terminal distal end 12. The handle 6 can have an electrical connection which can connect to an external power supply. The tool 5 could instead, or in combination with an external power supply, be powered with internal batteries, mechanically, hydraulically or pneumatically. A cover may enclose the samples in a collection chamber. The cover may be removed or adjusted to provide physical access to the samples stored in the collection chamber. The cover can be transparent, translucent, or opaque. The rotation of the cutter tube 10 may be controlled by actuating a first button 22. A second button 7 may actuate a partoff mechanism 31. The second button 7 and the first button 22 may be the same button; for example, a button could have multiple positions and depending on the position may actuate the partoff mechanism 31 and/or rotate the cutter tube 10. The first button 22 and/or the second button 7 could be used to rotate the cutter tube 10 in different directions (e.g., clockwise and counter-clockwise). The first button 22 and/or the second button 7 could be used to control the position of a trocar 11. The trocar 11 could have a sharp point; for example, the trocar 11 could be formed by three facets; the three facets could form a trocar point 13 at the distal terminal end of the trocar 11. The trocar point 13 could be soft and/or atraumatic. The trocar point 13 could be rounded, chamfered, square and/or beveled. The trocar 11 could be rigid and/or flexible. The trocar 11 could be made from one solid piece of material (e.g., stainless steel or plastic). The trocar 11 could be made from two or more components; for example a portion of the trocar 11 could have different properties than the remainder. For example, one section of the trocar 11 could be rigid and another section could

be flexible. For example, the distal end of the trocar **11** could feature a sharp trocar point and be made from a rigid material such as stainless steel; for example, the proximal end of the trocar **11** could be made from a flexible material. For example, a flexible portion of the trocar **11** could be made from a soft polymer. The flexible portion of the trocar **11** could be made from a flexible assembly of rigid components, such as a chain and/or ball chain. One section of the trocar **11** could rotate with respect to another section of the trocar **11**. For example, the distal end of the trocar **11** could rotate with cutter tube **10**, while another section of the trocar **11** could be rotationally stationary with respect to the handle **6**. The trocar **11** could be positioned concentrically inside of the cutter tube **10**. The gap between the outside diameter of the trocar **11** and the inside diameter of the cutter tube **10** could be a clearance fit, such as between 0.001 to 0.006in (0.02 to 0.15mm). The trocar point **13** could extend past the cutter tube terminal distal end **12** to enable easier insertion into a tissue. A coaxial introducer **54** may be secured to the handle **6**. The coaxial introducer **54** may be comprised of a tube and a luer fitting. The luer fitting of the coaxial introducer **54** may secure the coaxial introducer **54** to the handle **6**. The coaxial introducer **54** may be secured to the handle **6** using a latch mechanism and/or magnet. The coaxial introducer **54** may be secured to the handle **6** without rotating the coaxial introducer **54** with respect to the handle **6**. The tube of the coaxial introducer **54** may have a clearance fit with the cutter tube **10**. For example, the gap between the cutter tube **10** and the coaxial introducer **54** may be between 0.001 to 0.006in (0.02 to 0.15mm). The trocar **11**, the cutter tube **10** and/or the coaxial introducer **54** could use radiofrequency (RF) energy to assist in cutting. For example, the first button **22**, the second button **7** and/or a third button could be used to control the RF energy. RF energy could be turned on to assist during insertion of the probe into the tissue and/or during sampling/partoff of a tissue sample. The trocar **11** could spin relative to the handle **6** about the tubular longitudinal axis **8**. The trocar **11** could be rotationally fixed relative to the handle **6**. The cutter tube **10** and/or the coaxial introducer **54** could have a lubricious coating. For example, the outside diameter of the cutter tube **10** and/or the coaxial introducer **54** could be coated to adjust friction with Teflon, parylene, a hydrophilic coating, and/or a hydrophobic coating. The outside diameter of the cutter tube **10** and/or the coaxial introducer **54** could be engineered to adjust friction, such as being polished, having microscaffolds, and/or plasma activation. outside diameter of the cutter tube **10** and/or the coaxial introducer **54** could be modified to reduce the friction to less than about 0.1, or more narrowly, less than about 0.05. The coaxial introducer **54** could be longitudinally fixed and/or rotationally fixed to the handle **6**. The coaxial introducer **54** could translate and/or rotate with respect to the handle **6**.

Depressing a button, such as the first button **22** and/or the second button **7**, could move the coaxial introducer **54** and/or the cutter tube **10**. For example, when coring tissue, the coaxial introducer **54** could retract relative to the cutter tube **10** (or the cutter tube **10** could advance relative to the coaxial introducer **54**), thereby exposing the cutter tube terminal distal end **12**. After coring, the cutter tube terminal distal end **12** could be recessed underneath a distal end of the coaxial introducer **54**. For example, during tissue partoff and/or tissue transport, the cutter tube terminal distal end **12** could be recessed to allow the cutter tube **10** to spin without risking coring and/or cutting additional tissue.

[0024] During insertion of the tool **5** into the tissue and/or while obtaining a tissue sample, the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could spin about the tubular longitudinal axis **8**. Spinning the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could result in a lower and/or more consistent resistance to advancing the tool. For example, even if the resistance is not lower, it may be made more consistent by minimizing the stick-slip friction phenomenon. The rotational velocity of the spinning the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could be variable; for example, the velocity could be dependent on the tissue type, the rate of advancement of the tool, the state of the tool (e.g., insertion, coring and/or partoff), and/or the temperature. The rotational velocities of the spinning the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could all be different and/or the same as each other. The rotational velocities of the spinning the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could be controlled with separate motors. The rotational velocities of the spinning the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could be linked together, for example, with gears and/or pulleys. The rotational velocities of the spinning the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could be passively linked together, for example friction between the cutter tube **10** and the coaxial introducer **54** could urge the coaxial introducer **54** to spin with the cutter tube **10**.

[0025] The cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could have a helical feature on their surface. For example, the coaxial introducer **54** could comprise a rifled surface **14**. The rifled surface **14** could be embossed and/or debossed on the surface the coaxial introducer **54**. The rifled surface **14** could be on the inside and/or the outside of the coaxial introducer **54**. The rifled surface **14** could be clockwise and/or counter-clockwise. The rifled surface **14** could urge the tool **5** distally or proximally as the coaxial introducer **54** is rotated. For example, rotating the coaxial introducer **54** during insertion and/or coring could allow the rifled surface **14** to interact with the tissue and thereby urge the tool distally.

Urging, pulling, pushing and/or forcing the tool longitudinally (e.g., distally and/or proximally) could provide the operator with more control while positioning the tool **5**, similar to how power-steering provides a vehicle driver with superior handling. The rifled surface **14** could be formed on the surface of the coaxial introducer **54**, for example by stamping and/or machining the surface, and/or be a separate material secured to the coaxial introducer **54** (for example by welding, soldering, brazing and/or friction) The rifled surface **14** could be present on the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11**.

[0026] The cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could pulse distally/proximally in the direction of tubular longitudinal axis **8**. For example, during insertion, sampling and/or partoff the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could oscillate to reduce resistance and/or provide superior cutting. The cutter tube **10**, the coaxial introducer **54** and/or the trocar **11** could oscillate at an ultrasonic frequency.

[0027] A trocar tab **19** may indicate the longitudinal position of the trocar **11** with respect to the cutter tube **10** and/or the handle **6**. The trocar tab **19** may be visible in a trocar tab slot **20**. The trocar tab slot **20** may be located in the handle **6**. The trocar tab slot **20** may be open and/or covered. For example, the trocar tab slot **20** may be a transparent section in the handle **6**. The trocar tab slot **20** may have visual and/or tactile position indicators. The indicators on the trocar tab slot **20** may have visual and/or tactile position indicators may be metric and/or English units, for example every 1cm. The indicators on the trocar tab slot **20** may have visual and/or tactile position indicators may mark approximate sample length. The trocar tab **19** may be adjusted by the operator to control the position of the trocar **11**. The trocar tab **19** may be longitudinally and/or rotationally fixed with respect to the trocar **11**. The trocar **11** may be secured to the trocar tab **19** and/or they may be separate elements. The length of the trocar **11** extending proximally out of the cutter tube **10** may be an indicator length, such as a first indicator length, that may correspond to the length and/or volume of the tissue in the cutter tube **10**.

[0028] FIG. 2a illustrates that the cutter tube **10** may have a round cross-section. The cutter tube **10** may be manufactured from stainless steel hypodermic tubing (i.e., hypotube). For example, the cutter tube **10** may be manufactured from full hard 304SS hypotube. The hypotube may be welded and drawn. The hypotube may be ground (e.g., centerless ground and/or plugged and ground).

[0029] FIG. 2a illustrates that the trocar **11** may be secured to a trocar support **16**. The trocar support **16** may be the trocar tab **19**. The trocar support **16** may have different properties than the trocar **11**. The trocar **11** and/or the trocar support **16** may be made from hardened 300 or

400 series stainless steel, plastic (e.g., plastic, such as abs, delrin, glass-filled abs, glass filled delrin, ryton, polycarbonate). The trocar support **16** may be secured to the trocar **11** via friction, welding, brazing, soldering, overmolding, snap-fit, adhesive and/or solvent bonding. The trocar support **16** may be made injection molded. The trocar support **16** may be flexible. The outside diameter of the trocar support **16** may be threaded. For example, the position of the trocar support **16** may be controlled by spinning the trocar support **16** with respect to a threaded nut **17**. The threaded nut **17** may be secured to the cutter tube **10**, the coaxial introducer **54** and/or the trocar **11**. For example, rotating the cutter tube **10** clockwise may urge the trocar support **16** and the trocar **11** proximally. For example, rotating the cutter tube **10** counter-clockwise may urge the trocar support **16** and the trocar **11** distally. A portion of the trocar support **16** could be threaded. For example, the distal end of the trocar support **16** could be unthreaded so that when the trocar support **16** is fully proximal, the threads on the trocar support **16** do not engage with the threaded nut **17**. The threaded nut **17** could be expandable. The threaded nut **17** could be a split and/or a partial nut. The threaded nut **17** could be moved to control if it is engaged with the trocar support **16**.

[0030] FIG. 2b illustrates that the trocar **11** may be positioned proximally to the cutter tube terminal distal end **12**, thereby creating a tissue sample space **18**. The trocar point **13** may extend past the cutter tube terminal distal end **12**, such as a first trocar position. The trocar point **13** may be constrained to never extend past the cutter tube terminal distal end **12** and/or the partoff mechanism **31**. The tissue sample space **18** may be filled with zero, one or multiple tissue samples. The tissue sample space **18** may be bounded by the trocar **11** on the proximal end. The tissue sample space **18** may be surrounded by the cutter tube **10**. The distal end of the tissue sample space **18** may be open or closed; for example, by the partoff mechanism **31**. The volume of the tissue sample space **18** may be adjusted. During insertion, the tissue sample space **18** may be non-existent, if the trocar **11** extends distally past the cutter tube terminal distal end **12**. During coring, the tissue sample space **18** may be empty, partially filled with tissue and/or completely filled with tissue. For example, the trocar **11** could be urged and/or pushed back by tissue and/or tissue samples, thereby the tissue sample space **18** may expand as necessary to accommodate more tissue samples. The trocar tab **19** and/or the trocar **11** may provide a visual and/or tactile representation of how many tissue samples are located in the cutter tube **10**. The trocar tab **19** could disable the first button **22** and/or the second button **7** when it has reached a certain position. When the trocar **11** is fully proximal, the trocar tab **19** could be fully proximal. When the trocar **11** is fully proximal, such as a second trocar position, a portion of the trocar **11** could remain within the cutter tube

10 and/or the trocar **11** could fully exit from the cutter tube **10**. For example, when the trocar **11** is fully proximal the tissue samples may exit from the proximal end of the cutter tube **10** into the handle and/or a collection chamber. The trocar **11** could be removed from the cutter tube **10** and/or the handle **6** to allow the operator to access the lumen of the cutter tube **10**, for example to use a tissue transport mechanism and/or aspiration and/or a marker. A proximal terminal end of the trocar **11** may always be distal to a proximal terminal end of the handle **6**. The trocar **11** and/or the trocar tab **19** could engage or disable the first button **22** and/or the second button **7** based on the position of the trocar **11** and/or the trocar tab **19** with respect to the handle **6** and/or the cutter tube **10**. The trocar **11** could be positioned fully proximally during coring, thereby expanding the tissue sample space **18** to the maximum possible volume; the tissue samples could fill the tissue sample space **18** as necessary. The proximal end of the tissue sample space **18** could be open. For example, the trocar **11** could fully exit the cutter tube **10**; thereby, allowing the operator to obtain more tissue samples than could fit inside of the cutter tube **10** at one time. The trocar **11** could be advanced distally to push out any samples from the tissue sample space **18**. For example, the tool **5** could be removed from the tissue and the tissue samples could exit from cutter tube terminal distal end **12**. After the trocar **11** has pushed out tissue samples from the tissue sample space **18**, the trocar **11** could be positioned distal to the cutter tube terminal distal end **12** (as shown in **FIG. 2a**) and the tool **5** could be in the insertion state; the operator could then insert the tool into the tissue and obtain additional tissue samples.

[0031] FIG. 2b illustrates that the tool **5** can be manually advanced into the tissue. The operator may press the first button **22** and/or the second button **7** to place the tool **5** in a coring state. In the coring state, the cutter tube **10** may be spinning. The cutter tube terminal distal end **12** may cut through the tissue as the cutter tube **10** is advanced. The terminal distal end **12** may be sharpened. A tissue sample or tissue samples may enter into the tissue sample space **18**. The operator may manually advance the tool **5** through the tissue while the cutter tube **10** is spinning. The operator may control the rate of advancement and total deflection of the cutter tube **10** and/or the tool **5**. For example, the the operator may be able to obtain different tissue sample lengths. For example, the operator may advance the tool slowly for safety reasons and/or depending on the tissue type (e.g., hard and/or dense tissues).

[0032] FIG. 3 illustrates that a partoff tab **30** may obstruct tissue samples **101d** and **101e** from exiting the cutter tube **10**. The partoff tab **30** may be a component in the partoff mechanism **31**. The partoff mechanism **31** may be used to sever a tissue sample from a tissue site; for example after the tissue sample has been cored (but may still be attached to the tissue

site). The partoff mechanism **31** may be a passive and/or active system. For example, the partoff mechanism **31** may be deployable tab, a multi-bar linkage or a passive, spring-loaded tab. The partoff mechanism **31** may be deployed while the spinning about the tubular longitudinal axis **8**. The partoff mechanism **31** may be at least one tab that may allow the tissue to move proximally and/or distally along the tubular longitudinal axis **8**. The coaxial introducer **54** may control the deployment of the partoff mechanism **31**; for example, the axial position of the coaxial introducer **54** and/or the tissue-engaging inner element **100** relative to the cutter tube **10** may control the position of the partoff mechanism **31**. A tissue-engaging inner element **100** may be located inside of the cutter tube **10**. For example, the tissue-engaging inner element **100** may be helically shaped. The tissue-engaging inner element **100** may be made from stainless steel. The tissue-engaging inner element **100** may be rotationally stationary/fixed or spin with respect to the cutter tube **10**. The tissue-engaging inner element **100** may be rotationally stationary and/or rotate with respect to the handle **5**. The tissue-engaging inner element **100** may be longitudinally fixed and/or move relative to the handle **5** and/or the cutter tube **10**. The tissue samples **101d** and **101e** may contact the tissue-engaging inner element **100** and/or the cutter tube **10**. For example, the cutter tube **10** may urge tissue samples **101d** and **101e** to spin. For example, the tissue samples **101d** and **101e** may spin relative to the tissue-engaging inner element **100**. The relative rotation between the tissue samples **101d** and/or **101e** and the tissue-engaging inner element **100** may urge the tissue samples proximally and/or distally relative to the handle **5**. For example, while advancing the tool **5** into the tissue, the cutter tube **10** may be spinning (e.g., spinning relative to the handle **5** and/or the tissue) and may be coring tissue samples **101d** and/or **101e** and may be positioning them inside of the tissue sample space **18**. The relative rotation between the tissue sample(s) **101d** and/or **101e** and the tissue-engaging inner element **100** may urge/pull/force the tissue further into the cutter tube **10**; for example, creating a mechanical suction force to obtain larger tissue sample(s) **101d** and/or **101e**. Transporting the tissue samples **101d** and/or **101e** proximally inside of the cutter tube **10** may create a vacuum, thereby drawing more tissue into the cutter tube **10**. A vacuum may be applied while sampling and/or advancing the tool to urge tissue into the cutter tube **10**. For example, the handle **6** and/or the cutter tube **10** may be longitudinally stationary while a vacuum is applied to the proximal end of the cutter tube **10**. The vacuum may urge tissue into the cutter tube **10**, which may be cored and/or cut while the cutter tube **10** is spinning.

[0033] FIG. 3 illustrates that the tissue sample **101d** may be acquired first (e.g., coring into the tissue mass and then parting off the tissue sample from the tissue mass). The subsequent

tissue sample **101e** may be acquired from the same tissue mass or a different tissue mass. As the tissue sample **101e** is cored, it may push the first tissue sample **101d** proximally towards the handle. The samples may be stored sequentially/chronologically in the order they were acquired. The samples may be removed by pushing them out with a rod. The samples may be removed by hydraulic, pneumatic pressure and/or vacuum. The partoff tab **30** may be left in the actuated position to prevent the tissue samples **101** from exiting from the distal end **12**.

[0034] FIG. 3 illustrates that the tissue-engaging inner element **100** may be located within the cutter tube **10**. The tissue transport system **100** may comprise an elongated coil. The tissue-engaging inner element **100** may be rotationally stationary relative to the handle **6**. The tissue-engaging inner element **100** may terminate proximal to the partoff tab **30**. The tissue-engaging inner element **100** may terminate approximately 2 - 3cm proximal to the partoff tab **30**. The tissue-engaging inner element **100** may engage with tissue sample **101d** after a second tissue sample **101e** pushes the tissue sample **101d** into contact with the tissue-engaging inner element **100**. For example, the operator may first acquire a tissue sample **101d**. The operator may then acquire the second tissue sample **101e**, which subsequently pushes the tissue sample **101d** proximally and into contact with the tissue-engaging inner element **100**. Once the tissue sample **101d** is engaged with the tissue-engaging inner element **100**, the tissue sample **101d** may be transported proximally into the handle **6**. For example, if the tissue sample **101d** is rotating relative to the tissue-engaging inner element **100**, it may be urged proximally (e.g., a corkscrew effect). The tissue-engaging inner element **100** may extend fully to the partoff tab **30** such that the tissue sample **101d** is immediately in contact with the tissue-engaging inner element **100** without requiring the second tissue sample **101e** to push the tissue sample **101d** proximally. The tissue-engaging inner element **100** may translate relative to the cutter tube **10**; for example, the transport system **100** may oscillate proximally/distally by 0.5 to 1 mm.

[0035] FIG. 4 and **FIG. 5** illustrate that the handle **6** could feature a reusable handle **50**. The reusable handle **50** and/or the handle **6** could include at least one of a motor, switch, power jack, battery, LED, PCB, resistor, circuit, capacitor, nitinol actuator, shape memory actuator, muscle wire, spring and/or string. The trocar **11** and/or the trocar tab **19** could be visible in the handle **6**. The trocar **11** and/or the trocar tab **19** could be controlled using the first button **22** or another button (not shown). The trocar **11** could be pushed proximally by a tissue sample **101**. The trocar **11** could be pushed and/or pulled manually, automatically or semi-automatically. For example, the operator could push the trocar **11** and/or the trocar tab **19** distally. The operator could turn a wheel and/or a thumb wheel which could engage the trocar

11 and/or the trocar tab **19**; for example, the thumb wheel could contact the trocar **11** and/or the trocar tab **19** with friction or a rack/pinion mechanism. The thumb wheel could be geared to ensure optimize the level of torque and/or manipulation required. The tissue indicator could be straight, the trocar tab slot **20** is shown or it could be a different shape and/or mechanism. For example, the trocar tab slot **20** could be round and/or spiral. The tissue indicator could be a dial indicator that could be driven by the trocar **11** and/or the trocar tab **19**. For example, a string or wire could be connected between the trocar tab **19** and/or the proximal end of the trocar **11** and/or an indicator (e.g., a dial indicator and/or the trocar tab slot **20**). A string or wire could be connected between the trocar tab **19** and/or the trocar **11** and a rotary and/or linear actuator. For example, a string or wire could be connected to both a pulley and the trocar tab **19** and/or the trocar **11**; rotating the pulley could pull on the string and therefore force the trocar point **13** distally; the pulley could be driven manually and/or using an actuator, such as a motor. A second motor (in addition to the motor used to spin the cutter tube **10**) could be used to actuate the trocar tab **19** and/or the trocar **11**. Forcing the trocar **11** distally could push tissue samples out of the cutter tube terminal distal end **12**. The trocar **11** and/or the trocar tab **19** could be manipulated using various actuators, including a brushed motor, a brushless motor, a spring, and/or a shape memory actuator. The handle **6** could contain two buttons: one button could be used for coring the tissue and the other button could be used for advancing the position of the trocar **11**. During coring, the trocar **11** could be pushed back by tissue samples or using an actuator built into the tool **5**. The trocar **11** and/or the trocar point **13** can spin with the cutter tube **10** to minimize trauma to any tissue samples.

[0036] FIG. 6 illustrates that the reusable handle **50** could be battery and/or wall-powered (e.g., tethered). The reusable handle could be sealed from the patient and patient tissue/fluids to prevent cross-contamination. For example, seals and/or magnets (e.g., non-contact actuation) can be used to prevent the reusable handle from engaging with patient tissue directly or indirectly. The reusable handle may contain a first hub **51** and a second hub **52**. The first hub **51** and/or the second hub **52** may engage with interlocking hubs on the disposable handle. The first hub **51** and/or the second hub **52** may be driven using the same actuator or different actuators. The first hub **51** and/or the second hub **52** may use one-way clutches so that the first hub **51** and/or the second hub **52** may be driven in only one direction. For example, spinning a motor clockwise may drive only the first hub **51** while driving the motor counter-clockwise may drive only the second hub **52** (or vice-versa). Alternatively, one hub may always be driven, whereas the other hub may be only driven in one direction. A

speed reducer and/or gear head may be used to adjust the speed and/or torque of one hub versus the other hub.

[0037] The coaxial introducer **54** and/or the cutter tube **10** may be longitudinally fixed with respect to the handle **6**. The coaxial introducer **54** and/or the cutter tube **10** may be partially longitudinally fixed with respect to the handle **6**. For example, during tissue coring, the coaxial introducer **54** and/or the cutter tube **10** may be advanced or retracted between 0.01in (0.25mm) and 1in (2.5 cm), for example 0.06in (1.5mm) and remain longitudinally fixed with respect to the handle **6** while the tool is manually advanced into the tissue. Upon completion of coring, the coaxial introducer **54** and/or the cutter tube **10** may be retracted or advanced. The cutter tube **10** may continue to spin after the first button **22** and/or another button is released; for example the cutter tube **10** may continue to spin 0.01 to 30 seconds, such as approximately 0.5 or 1 second. Depressing the first button **22** may adjust the partoff mechanism **31** to the coring state and then spin the cutter tube **10**. Releasing the cutter tube **10** may adjust the partoff mechanism **31** into the partoff state, keep the cutter tube spinning for a pre-determined or user-dependent time period such as 0.5 seconds to complete tissue partoff/severing/cutting and then stop the cutter tube **10** from spinning. Manipulating the axial position of the coaxial introducer **54** and the cutter tube **10** with respect to each other may allow the cutter tube **10** to continue spinning while preventing the cutter tube terminal distal end **12** from coring additional tissue. For example, after coring a tissue sample, the cutter tube **10** may continue to spin to partoff the tissue sample from the tissue mass and/or transport the tissue sample (e.g., using a helical transport element); adjusting the linear position of the cutter tube **10** with respect to the coaxial introducer **54** may hide the cutter tube terminal distal end **12** within the coaxial introducer **54** to ensure that no additional tissue is cored and/or traumatized. The coaxial introducer **54** may be rotationally fixed with respect to the handle **6** and/or the tissue. The coaxial introducer **54** may rotate with or with respect to the cutter tube **10**.

[0038] FIG. 7 illustrates that a trocar tube **120** may be positioned concentrically over the trocar **11**. The trocar tube **120** may be a clearance fit with the trocar **11**, for example with a gap of less than 0.01 in, approximately, 0.005 inches. The trocar **11** may be longitudinally moveable and/or fixed with respect to the trocar tube **120**. The trocar **11** may be rotationally moveable and/or fixed with respect to the trocar tube **120**. During insertion of the tool **5** into the tissue, the trocar point **13** may extend distal to a trocar tube distal end **121**. During tissue acquisition, the trocar point **13** may be recessed proximally to the trocar tube distal end **121**; thereby protecting the trocar point **13** and minimizing trauma to the tissue samples that could

be created by the trocar point **13**. A flexible and/or a slit seal could be placed on the distal end of the trocar tube to minimize contact between the trocar point **13** and tissue samples. The trocar tube distal end **121** could be in contact with the tissue samples **101** during tissue acquisition and when pushing the tissue samples **101** out of the cutter tube **10**.

[0039] FIG. 8 illustrates that an inner tube **125** may be located concentrically within the cutter tube **10**. The inner tube **125** may have a dull or a sharp end. The inner tube **125** may be rotationally and/or longitudinally fixed with respect to the cutter tube **10**. The inner tube **125** may rotate or move with respect to the cutter tube **10**. The inner tube **125** may have a clearance fit with the cutter tube **10**, with a gap of less than 0.02 inches between the walls, for example 0.003 inches. The inner tube **125** may be proximal to the cutter tube terminal distal end **12** during coring and distal to the coring tube distal end **12** when the tool **5** is not coring. The tool **5** can be used with different imaging systems, including ultrasound, stereotactic, MRI, x-ray tomography and/or tomosynthesis. The tool **5** can be advanced manually, automatically or semi-automatically. The tool **5** can be used to capture tissue samples of variable lengths. When used manually (e.g., under ultrasound guidance), the operator may visualize the tool **5** cutting through the tissue and obtain the ideal length of tissue required. When used manually (e.g., under ultrasound guidance), the operator may visualize the tool **5** cutting through the tissue and ensure that the tool **5** does not cause unnecessary patient trauma; for example, if the operator realizes that the tool **5** is about to enter an undesired tissue, the operator can release a button on the tool **5** and/or stop advancing the tool **5**. The first button **22** can be depressed and/or moved axially, thereby allowing additional functionality with a single button. For example, depressing the first button **22** may control the rotation of the cutter tube **10** and pushing the first button **22** forward and/or backward may control the partoff mechanism **31**. Manipulating the first button **22** to the left and/or right may control the position of the trocar **11**. Depressing the first button **22** may control the rotation of the cutter tube **10** and pulling the first button **22** backward may control the partoff mechanism **31** and pushing the first button **22** forward may control the position of the trocar **11**. A knob and/or button may be used to control the position of the cutter tube **10** with respect to the handle **6**. For example, spinning a knob may advance the cutter tube **10** distally while holding the handle **6** stationary, thereby offering precise control of the cutter tube terminal distal end **12** without having to manipulate the handle **6** with respect to the tissue. Depressing the first button **22** may cause the cutter tube **10** to be advanced distally at a pre-determined rate (such as 0 – 2cm per second, approximately 1 cm /sec) and/or distance (such as 1, 2 or 3cm) and releasing the first button **22** may cause the cutter tube **10** to retract into the handle **6**. In the

default, standby position the cutter tube terminal distal end **12** may be proximal to a distal end of the coaxial introducer **54** or the inner tube **125**, thereby sheathing the sharp end of the cutter tube terminal distal end **12**. During coring and as the cutter tube **10** is spinning, the cutter tube terminal distal end **12** may be positioned distal to a distal end of the coaxial introducer **54** or the inner tube **125**, thereby allowing the cutter tube terminal distal end **12** to be in contact with the tissue. Sheathing and unsheathing the cutter tube terminal distal end **12** may protect both the cutter tube terminal distal end **12** and the patient from unnecessary and/or unintended trauma. A light, such as an LED or electroluminescent material may be used in the tool **5**. The light may be used to illuminate the tissue, the buttons, the trocar **11** and/or the trocar tab **19**. A digital indicator may be used to indicate the position of the trocar point **13**. The distance and/or angular position between the trocar point **13** and the trocar tab **19** may be fixed or variable. For example, the trocar point **13** and the trocar tab **19** could be made from the same material (e.g., an injection molded component). The trocar tab **19** could be a separate component that can be used to push the trocar point **13** distally but not be able to apply proximal force to the trocar point **13**. The proximal end of the trocar **11** may be used to indicate the position of the trocar point **13** instead of the trocar tab **19**.

[0040] FIG. 9 illustrates that the second button **7** could be slideable within a button track **201**. The button track **201** could extend for the entire length of the handle **6** or a portion of the handle **6**. The second button **7** can slide within the button track **201**, for example between a first button track position **202a** and a second button track position **202b**. The second button **7** may engage directly and/or indirectly with the trocar **11**. For example, the button **7** could feature a one-way clutch mechanism. Many versions of one-way clutch mechanisms exist, including those found in ratchets, clamps, speed clamps and one-way bearings. An example of a one-way clutch mechanism could be a piece of sheet metal, for example between 0.005in (0.13mm) to 0.060in (1.5mm) thick, such as ~0.02in thick (0.5mm) with a hole and/or slot cut into the strip that the trocar **11** may slide through; the angle of the sheet metal strip may be such that the sheet metal may bind with the trocar **11** in one direction but be unbound in a second direction. For example, the sheet metal strip may be at an angle of 5 – 60 degrees with respect to a front plane, such as 15 and/or 20 degrees. The front plane may be perpendicular to the tubular longitudinal axis **8**. Another one-way clutch mechanism may include two ball bearings on opposite sides of the trocar **11** that are housed within a ramped slot(s), such that the ball bearings squeeze against the trocar **11** and bind the trocar **11** when it slides in one direction, but disengage when the trocar **11** moves in the other direction. Sliding the second button **7** between the first button track position **202a** and the second button track position

202b may push the trocar **11** distally. The second button **7** may be slid repeatedly between button track positions **202a** and **202b** to move the trocar **11** distally until it exits the cutter tube terminal distal end **12**. A third button track position **202c** may allow the second button **7** to engage with an unlocking post **200**. The unlocking post **200** may disable the one-way clutch in the second button **7**, thereby allowing the trocar **11** to slide freely proximally, distally and/or rotationally. For example, when coring and/or obtaining tissue, the second button **7** may be in the third button track position **202c**, thereby engaging with the unlocking post **200** and allowing tissue samples **101** to push proximally on the trocar **11** and therefore translate the trocar **11** proximally. The trocar **11** may be visible through the button track **201** and/or the handle **6**, thereby providing an indication of how much tissue is located within the cutter tube **10**. The operator may then remove the device from the tissue site and remove the tissue samples **101** from the cutter tube **10** by sliding the second button **7** back and forth between button track positions **202a** and **202b**. A button locking feature may be present to limit the motion of the second button **7** between the button track positions **202a** and **202b**; the button locking feature may be disengaged by depressing the first button **22**. The button locking feature may be used to ensure that the second button **7** does not contact the unlocking post **200**. During insertion of the tool **5** into the tissue site, the button locking feature may be used to ensure that the second button **7** is binding the trocar **11** such that it does not slip proximally into the cutter tube **10**. The button locking feature may lock the second button **7** and/or the trocar **11**, such as the terminal proximal end of the trocar **11**. The button locking feature may use the trocar **11** as a guide, such that the button locking feature locks the second button **7** and/or the trocar **11** once the trocar **11** has reached a certain position, such as when the trocar point **13** is extending past the cutter tube terminal distal end **12**. The second button **7** may include a button ramp **205** which may engage directly and/or indirectly with the first button **22** and/or the partoff mechanism **31**. For example, when advancing the trocar **11** distally, the button ramp **205** may force the first button **22** into a position where the partoff mechanism **31** is hidden and/or retracted (e.g., in the coring state and/or configuration), thereby allowing tissue samples **101** to exit from the cutter tube **10**. For example, the button ramp **205** could prevent the first button **22** from being fully depressed and therefore spinning the cutter tube **10**. The trocar **11** could be removed entirely from the handle **6**. One or more springs may be used, for example to bias the second button **7** proximally. If the trocar **11** is removed from the handle **6** or is moved proximally such that it does not engage with the cutter tube **10**, tissue samples **101** may enter a sample collection space **210**. The sample collection space **210** may be a collection chamber. The proximal end of the trocar **11** may

have a larger diameter and/or a lip. For example, the proximal 0.02in (0.5mm) – 0.8in (2mm) of the trocar **11**, such as 0.1in (2.5mm) in length may have a larger major diameter than the remainder of the trocar. The proximal lip of the trocar **11** may be formed by deforming the trocar **11**, for example by clamping, crimping and/or swaging. The proximal lip of the trocar **11** may be formed by securing another component to the trocar **11** such as a thin-walled tube, which could be glued, crimped, press-fit, brazed, welded, soldered or mechanically fastened to the trocar **11**. The proximal lip of the trocar **11** may engage with the cutter tube **10**, the handle **6** and/or the second button **7** to prevent the trocar **11** from advancing to far distally. The proximal lip of the trocar **11** may allow the trocar **11** to spin freely with respect to the handle **6**. The trocar **11** could be transported using a cable, thread, wire, electromechanically, electromagnetically, magnetically, pneumatically, hydraulically, with a vacuum, with a spring and/or manually (e.g., by manually pushing and/or pulling on the trocar). The sheet metal strip may be formed by stamping, laser-cutting, metal injection molding, water-jet cutting, machining, plasma cutting, etching and/or cutting. The button track **201** may be the trocar tab slot **20**.

[0041] The tissue samples can be transported using a helical transport system (e.g., a stationary coil) and/or with additional systems. For example, a second tube can be located concentrically within the cutter tube **10** and be pulled proximally. The second tube can have adjustable and/or one-way locking features to engage or secure the tissue samples **101**. The second tube may be the same as the inner tube **125**. One-way locking features may include tabs that are bent inwards and allow the tissue samples **101** to move proximally, but not distally. The coil may be moved proximally with or without tissue samples **101**. A vacuum may be used to pull tissue samples **101** proximally. The trocar **11** may be flexible. The trocar **11** may wrap around a pulley, which may be turned to advance and/or retract the trocar **11**; the angular position of the pulley may be used to indicate the position of the trocar point **13**. The trocar **11** may be flexible and be located within a contoured guide within the handle **6** or an empty space within the handle **6**. The trocar **11** may extend past the handle **6**, for example proximal to the handle **6** and/or trocar tab slot **20**. A compression, tension, torsion, clock and/or power spring may be used to bias the trocar **11** in a distal and/or proximal direction. A ratchet mechanism may be used to advance or retract the trocar **11**. For example, a button and/or knob may be pushed forward from the default position 0.1 to 3 inches, for example 0.75in to advance the trocar **11** and then retract to the default position with a spring; adjusting the position of the trocar **11** during the manual pushing step but without adjusting the position of the trocar **11** during the retracting step.

[0042] The internal diameter of the cutter tube **10** may be larger than about 0.04in (1.0mm), yet more narrowly larger than about 0.06in (1.5mm), yet more narrowly larger than about 0.08in (2.0mm), yet more narrowly larger than about 0.1in (2.5mm), yet more narrowly larger than about 0.12in (3.0mm), yet more narrowly larger than about 0.14in (3.5mm) or yet more narrowly larger than about 0.16in (4.0mm). The internal diameter of the cutter tube **10** may be less than about 0.16in (4.0mm), or yet more narrowly smaller than about 0.14in (3.5mm), or yet more narrowly smaller than about 0.12in (3.0mm), or yet more narrowly smaller than about 0.10in (2.5mm), or yet more narrowly smaller than about 0.08in (2.0mm), or yet more narrowly smaller than about 0.06in (1.5mm) or yet more narrowly smaller than about 0.04in (1.0mm).

[0043] The wall thickness of the cutter tube **10** may be larger than about 0.002in (0.05mm), or yet more narrowly larger than about 0.004in (0.10mm) or yet more narrowly larger than about 0.006in (0.15mm). The wall thickness of the cutter tube **10** may be smaller than about 0.006in (0.15mm), or yet more narrowly smaller than about 0.004in (0.10mm) or yet more narrowly smaller than about 0.002in (0.05mm). The wall thickness of the cutter tube **10** may vary. For example, the partoff tab **30** may have a different wall thickness than the actuator **32**.

[0044] The cutter tube **10** or any or all elements of the tool and/or other tools or apparatuses described herein can be made from or coated with, for example, single or multiple stainless steel alloys, steel, spring steel, nickel titanium alloys (e.g., Nitinol), cobalt-chrome alloys (e.g., ELGILOY® from Elgin Specialty Metals, Elgin, IL; CONICHRROME® from Carpenter Metals Corp., Wyomissing, PA), nickel-cobalt alloys (e.g., MP35N® from Magellan Industrial Trading Company, Inc., Westport, CT), molybdenum alloys (e.g., molybdenum TZM alloy), tungsten-rhenium alloys, polymers such as polyethylene terephthalate (PET), polyester (e.g., DACRON® from E. I. Du Pont de Nemours and Company, Wilmington, DE), polypropylene, aromatic polyesters, such as liquid crystal polymers (e.g., Vectran, from Kuraray Co., Ltd., Tokyo, Japan), ultra high molecular weight polyethylene (i.e., extended chain, high-modulus or high-performance polyethylene) fiber and/or yarn (e.g., SPECTRA® Fiber and SPECTRA® Guard, from Honeywell International, Inc., Morris Township, NJ, or DYNEMA® from Royal DSM N.V., Heerlen, the Netherlands), polytetrafluoroethylene (PTFE), Parylene poly(p-xylylene) polymers, Parylene N, Parylene C, Parylene D, expanded PTFE (ePTFE), polyether ketone (PEK), polyether ether ketone (PEEK), polycarbonate (PC), Acrylonitrile Butadiene Styrene (ABS), poly ether ketone ketone (PEKK) (also poly aryl ether ketone ketone), nylon, polyether-block co-polyamide polymers (e.g., PEBAX® from ATOFINA, Paris, France), aliphatic polyether polyurethanes (e.g., TECOFLEX® from

Thermedics Polymer Products, Wilmington, MA), polyvinyl chloride (PVC), Nylon, Vinyl, polyurethane, thermoplastic, fluorinated ethylene propylene (FEP), absorbable or resorbable polymers such as polyglycolic acid (PGA), poly-L-glycolic acid (PLGA), polylactic acid (PLA), poly-L-lactic acid (PLLA), polycaprolactone (PCL), polyethyl acrylate (PEA), polydioxanone (PDS), and pseudo-polyamino tyrosine-based acids, extruded collagen, silicone, zinc, echogenic, radioactive, radiopaque materials, a biomaterial (e.g., cadaver tissue, collagen, allograft, autograft, xenograft, bone cement, morselized bone, osteogenic powder, beads of bone), a material with high strength (60 ksi) and biocompatibility, any of the other materials listed herein or combinations thereof. Examples of radiopaque materials are barium sulfate, zinc oxide, titanium, stainless steel, nickel-titanium alloys, tantalum and gold. The device can be made from substantially 100% PEEK, braided nylon, braid reinforce nylon, braid reinforced polyimide, braid reinforced tubing, substantially 100% titanium or titanium alloy, or combinations thereof.

[0045] The cutter tube **10** may spin or rotate at a velocity relative to the handle **6** of greater than about 100 rpm, yet more narrowly larger than about 1,000 rpm, yet more narrowly larger than about 2,500 rpm, yet more narrowly larger than about 3,000 rpm, yet more narrowly larger than about 4,000 rpm, yet more narrowly larger than about 5,000 rpm, yet more narrowly larger than about 7,500 rpm, yet more narrowly larger than about 10,000 rpm. The cutter tube **10** may spin or rotate at a velocity relative to the handle **6** of less than about 10,000 rpm, yet more narrowly less than about 7,500 rpm, yet more narrowly less than about 5,000 rpm, yet more narrowly less than about 4,000 rpm, yet more narrowly less than about 3,000 rpm, yet more narrowly less than about 2,500 rpm, yet more narrowly less than about 1,000 rpm, yet more narrowly less than about 100 rpm.

[0046] The internal diameter of the cutter tube **10** may be larger than about 0.5 mm (0.02 in), more narrowly larger than about 1 mm (0.04 in), yet more narrowly larger than about 1.5 mm (0.06 in), yet more narrowly larger than about 2 mm (0.08 in), yet more narrowly than about 2.5 mm (0.10 in), yet more narrowly larger than about 3 mm (0.12 in), yet more narrowly larger than about 3.5 mm (0.14 in), yet more narrowly larger than about 4 mm (0.18 in), yet more narrowly larger than about 4.5 mm (0.18 in), yet more narrowly larger than about 5 mm (0.20 in), yet more narrowly larger than about 6 mm (0.24 in), yet more narrowly larger than about 7 mm (0.28 in), or yet more narrowly larger than about 10 mm (0.39 in). The internal diameter of the cutter tube **10** may be less than about 10 mm (0.39 in), more narrowly less than about 7 mm (0.28 in), yet more narrowly less than about 6 mm (0.24 in), yet more narrowly less than about 5 mm (0.20 in), yet more narrowly less than about 4.5 mm (0.18in),

yet more narrowly less than about 4 mm (0.18 in), yet more narrowly less than about 3.5 mm (0.14 in), yet more narrowly less than about 3 mm (0.12 in), yet more narrowly less than about 2.5 mm (0.10 in), yet more narrowly less than about 2 mm (0.08 in), yet more narrowly less than about 1.5 mm (0.06 in), yet more narrowly less than about 1 mm (0.04 in), or yet more narrowly less than about 0.5 mm (0.02 in).

[0047] The wall thickness of the cutter tube **10** may be larger than about 0.05 mm (0.002 in), more narrowly larger than about 0.10 mm (0.004 in), yet more narrowly larger than about 0.15 mm (0.006 in), yet more narrowly larger than about 0.20 mm (0.008 in), yet more narrowly larger than about 0.30 mm (0.012 in), yet more narrowly larger than about 0.50 mm (0.020 in), yet more narrowly larger than about 0.70 mm (0.028 in), or yet more narrowly larger than about 1.00 mm (0.039 in). The wall thickness of the cutter tube **10** may be less than about 1.00 mm (0.039 in), yet more narrowly less than about 0.70 mm (0.028 in), yet more narrowly less than about 0.50 mm (0.020 in), yet more narrowly less than about 0.43 mm (0.017 in), yet more narrowly less than about 0.30 mm (0.012 in), yet more narrowly less than about 0.20 mm (0.008 in), yet more narrowly less than about 0.15 mm (0.006 in), yet more narrowly less than about 0.10 mm (0.004 in), or yet more narrowly less than about 0.05 mm (0.002 in).

[0048] Multiple tissue samples can be collected and/or obtained and/or parted-off without removing the tool from the mass of tissue (i.e., tissue mass). The tubular longitudinal axis **8** can pass through the cutter tube **10**, the transport system **100** and/or the handle **6**. The cutter tube terminal distal end **12** may be sharpened mechanically, electro-chemically and/or chemically. The trocar **11** may slide in the cutter tube **10** and/or the handle **6**. The first button **22** and/or the second button **7** may contact the trocar **11** and/or the trocar tab **19**. There may be sufficient friction between the trocar **11** and another component in the tool **5** (such as the cutter tube **10**, the first button **22**, the handle **6** and/or the second button **7**) to prevent the trocar **11** from moving relative to the handle **6** because of gravity; however, the friction may be low enough to allow the tissue samples **101** to urge the trocar **11** proximally. The frictional force may be adjustable; for example, the friction between the trocar **11** and another component in the tool **5** (such as the cutter tube **10**, the first button **22**, the handle **6** and/or the second button **7**) may be lower when the first button **22** and/or the second button **7** are depressed than when no buttons are depressed. The frictional force between the trocar **11** and another component in the tool **5** (such as the cutter tube **10**, the first button **22**, the handle **6** and/or the second button **7**) may be between 0.01 and 2 Newtons.

[0049] The trocar **11** may be slidably positioned inside of the cutter tube **10**. The handle may be longitudinally fixed with respect to the cutter tube **10**. The cutter tube **10** may be a coring element. The trocar **11** may be an indicator. For example, the trocar **11** may be string, a liquid and/or some other material that may be displaced by the tissue samples **101** in the cutter tube **10**.

[0050] PCT/US 2014/052,431 filed August 26, 2014; US Application 14/517,873 filed October 19, 2014; PCT/US11/061,089 filed November 16, 2011; U.S. Patent 8,317,727 filed on April 21, 2012; U.S Provisional Application Nos. 61/872,678, filed August 31, 2013; 62/086,523, filed on December 02, 2014; 61/872,674, filed August 31, 2013 are all incorporated by reference herein in their entireties.

[0051] It is apparent to one skilled in the art that various changes and modifications can be made to this disclosure, and equivalents employed, or combinations of any of the disclosed elements, characteristics, features, devices, tools, steps, or methods without departing from the spirit and scope of the invention. Any of the disclosed elements, characteristics, features, devices, tools, steps, or methods can be present as a singular or as a plurality regardless of whether the elements, characteristics, features, devices, steps, or methods are explicitly disclosed herein as being singular or as a plurality. Elements shown with any variation are exemplary for the specific variation and can be used on other variation within this disclosure.

CLAIMS

I claim:

1. A tool for acquiring a tissue comprising:
 - a cutter tube for receiving the tissue;
 - a partoff mechanism at least partially inside of the cutter tube;
 - a trocar slidably positioned inside of the cutter tube;
 - a handle having a tubular longitudinal axis, wherein the handle is longitudinally fixed to the cutter tube;wherein the trocar has a first trocar position and a second trocar position, wherein in the first trocar position the trocar is in a distal-most position in the cutter tube, and wherein in the second trocar position, the trocar is proximal to the first trocar position, and the tissue is in the cutter tube, and the tissue is in contact with a distal terminal end of the trocar, and wherein the proximal end of the trocar extends into the handle, and wherein the proximal end of the trocar is distal to the proximal terminal end of the handle.
2. The tool of claim 1, wherein the cutter tube is configured to rotate about the tubular longitudinal axis with respect to the handle.
3. A method for acquiring tissue comprising:
 - receiving the tissue in the distal end of a cutter tube, wherein a trocar is slidably positioned in the cutter tube, and wherein receiving the tissue comprises pressing the tissue against the distal end of the trocar, and wherein the pressing comprises sliding the trocar proximally.
4. The method of claim 3, further comprising inserting the cutter tube into a tissue site.
5. The method of claim 3, further comprising ejecting the tissue from the distal end of the cutter tube.
6. The method of claim 5, wherein ejecting comprises sliding the trocar distally in the cutter tube.
7. A tool for acquiring a tissue comprising:
 - a cutter tube for receiving the tissue; and
 - an indicator configured to indicate the amount of tissue in the cutter tube.
8. The tool of claim 7, wherein the indicator comprises a first indicator length extending out of the cutter tube, and wherein the first indicator length corresponds to the length of the tissue in the cutter tube.
9. The tool of claim 7, wherein the indicator comprises a trocar.

10. The tool of claim 7, wherein a partoff mechanism is located adjacent to the cutter tube.
11. The tool of claim 10, wherein the partoff mechanism is configured to sever the tissue.
12. The tool of claim 7, further comprising a handle having a tubular longitudinal axis, wherein the cutter tube is configured to rotate about the tubular longitudinal axis with respect to the handle.
13. The tool of claim 12, wherein the indicator is configured to rotate with respect to the handle.
14. The tool of claim 12, wherein the indicator is configured to be rotationally fixed with respect to the handle.
15. The tool of claim 7, wherein the cutter tube is longitudinally fixed with respect to the handle.
16. The tool of claim 7, wherein the indicator is configured to eject the tissue from the cutter tube.

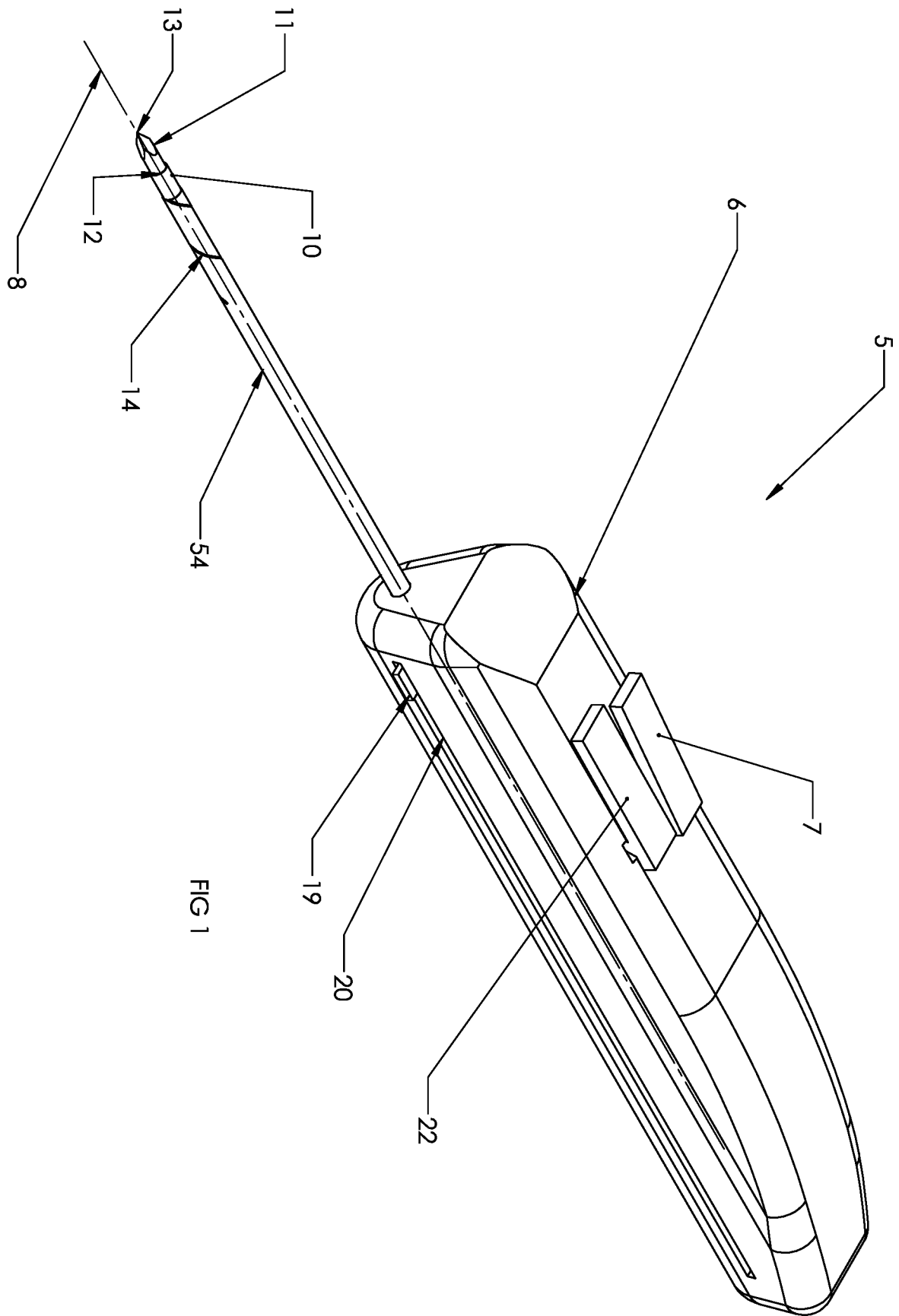
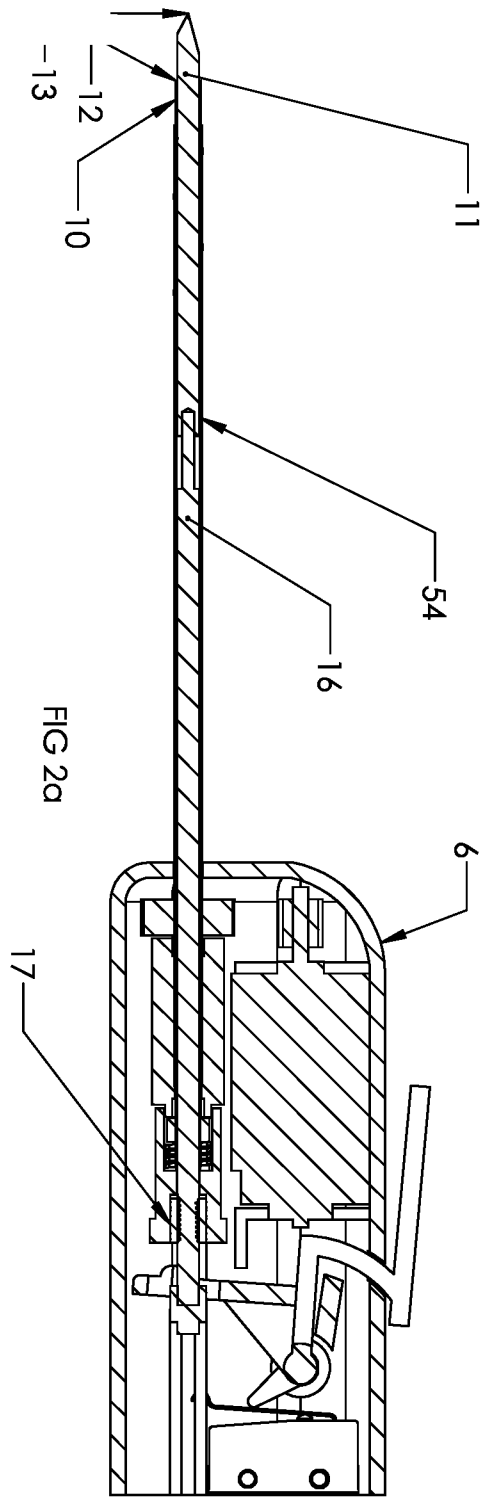
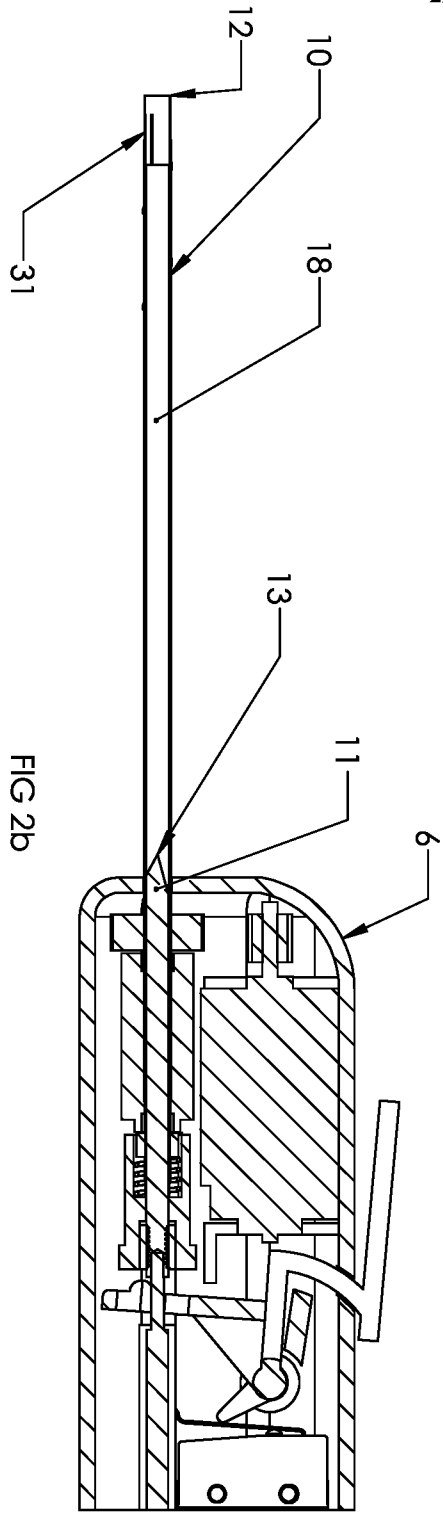


FIG 1



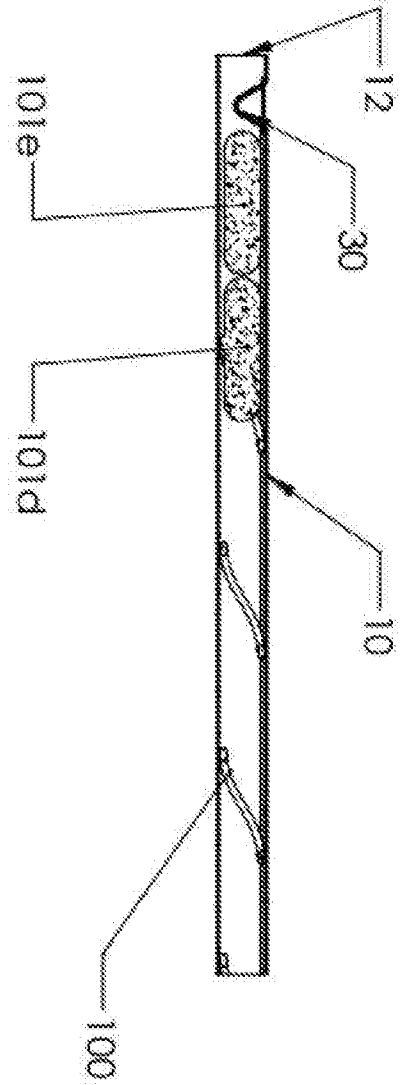
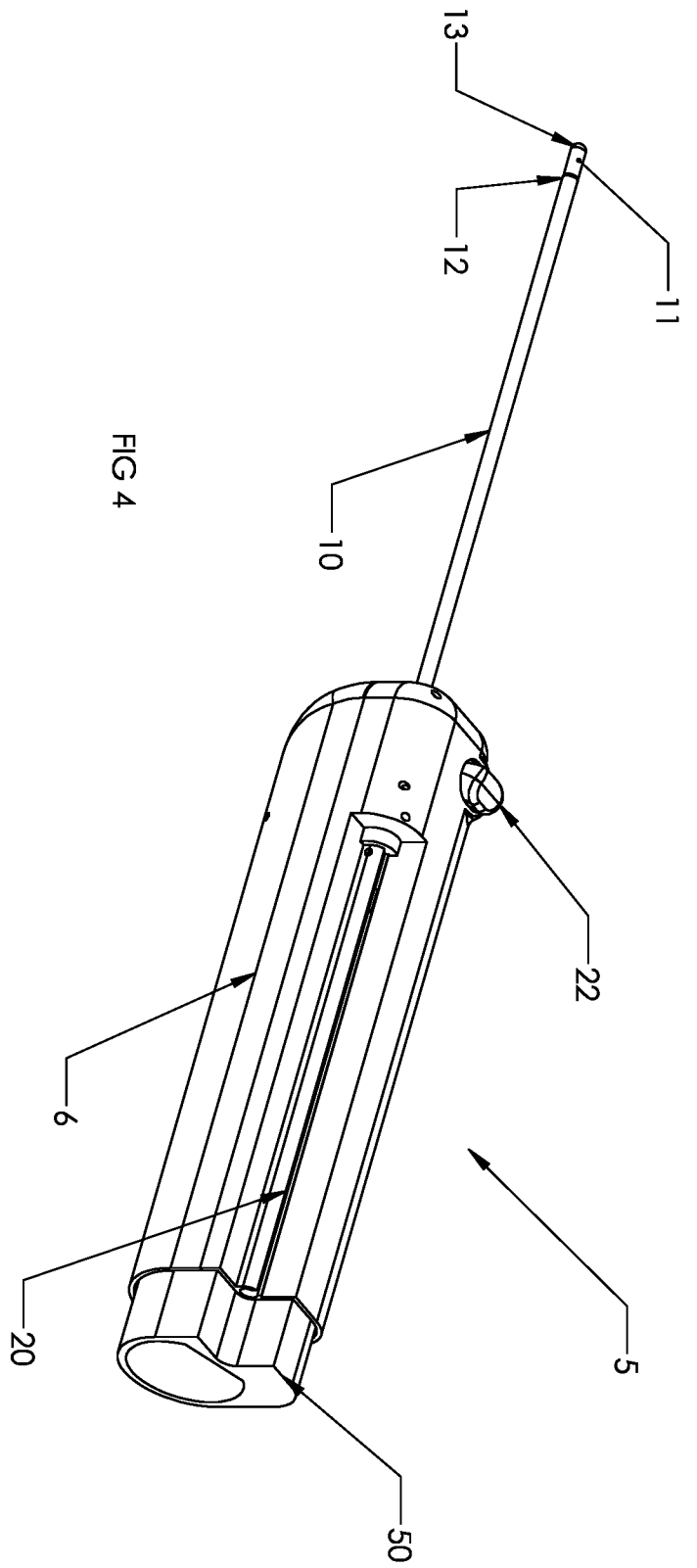
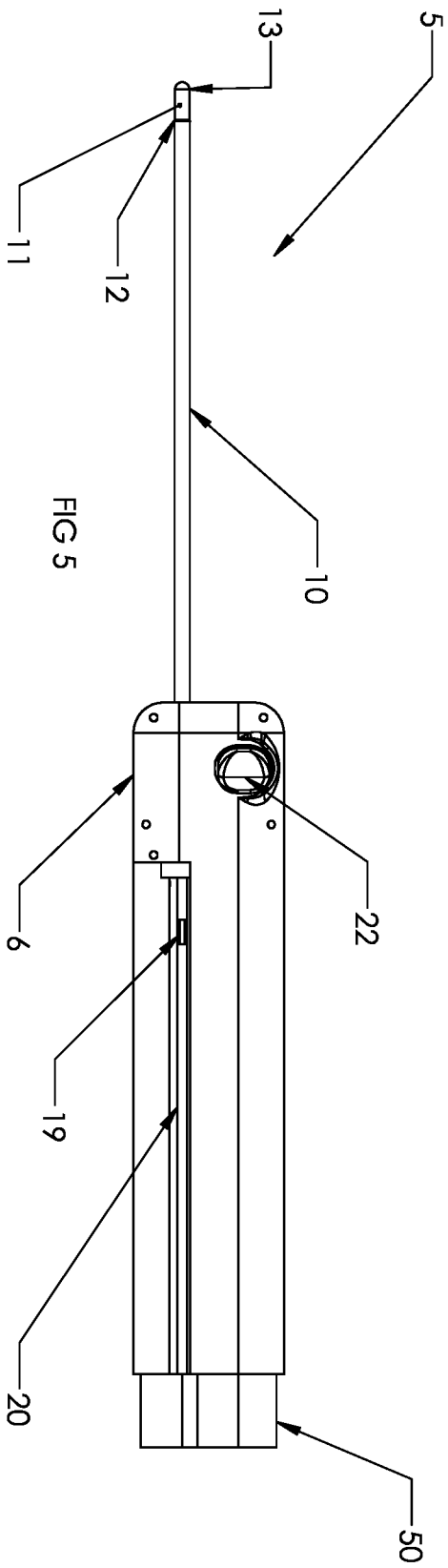
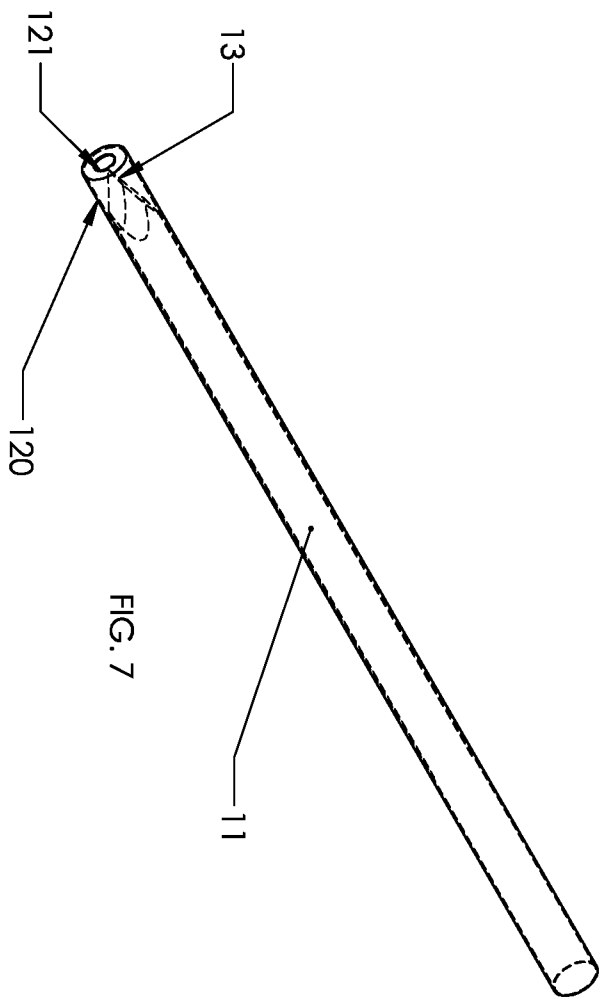
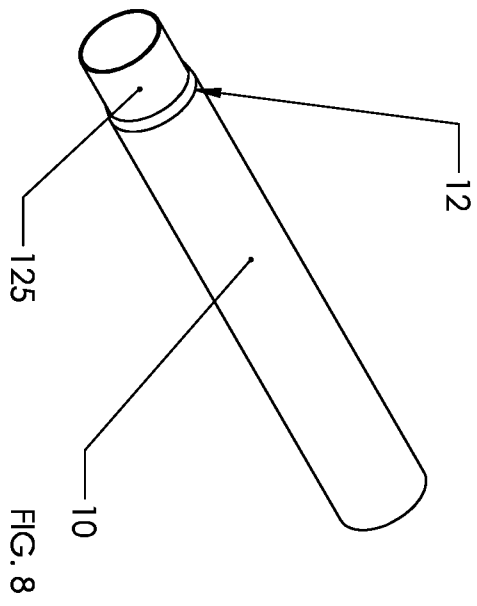
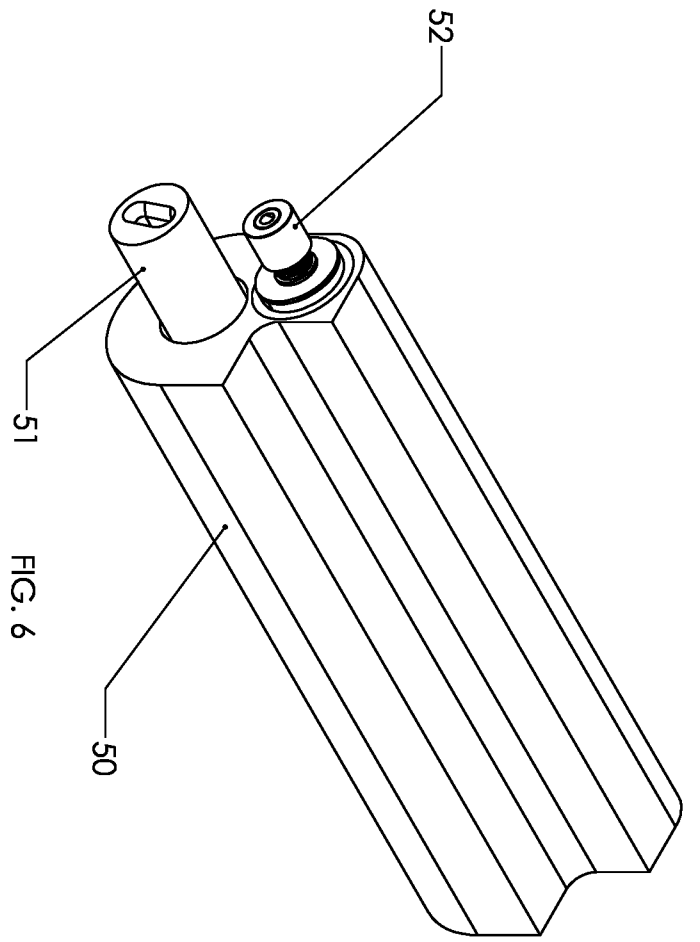
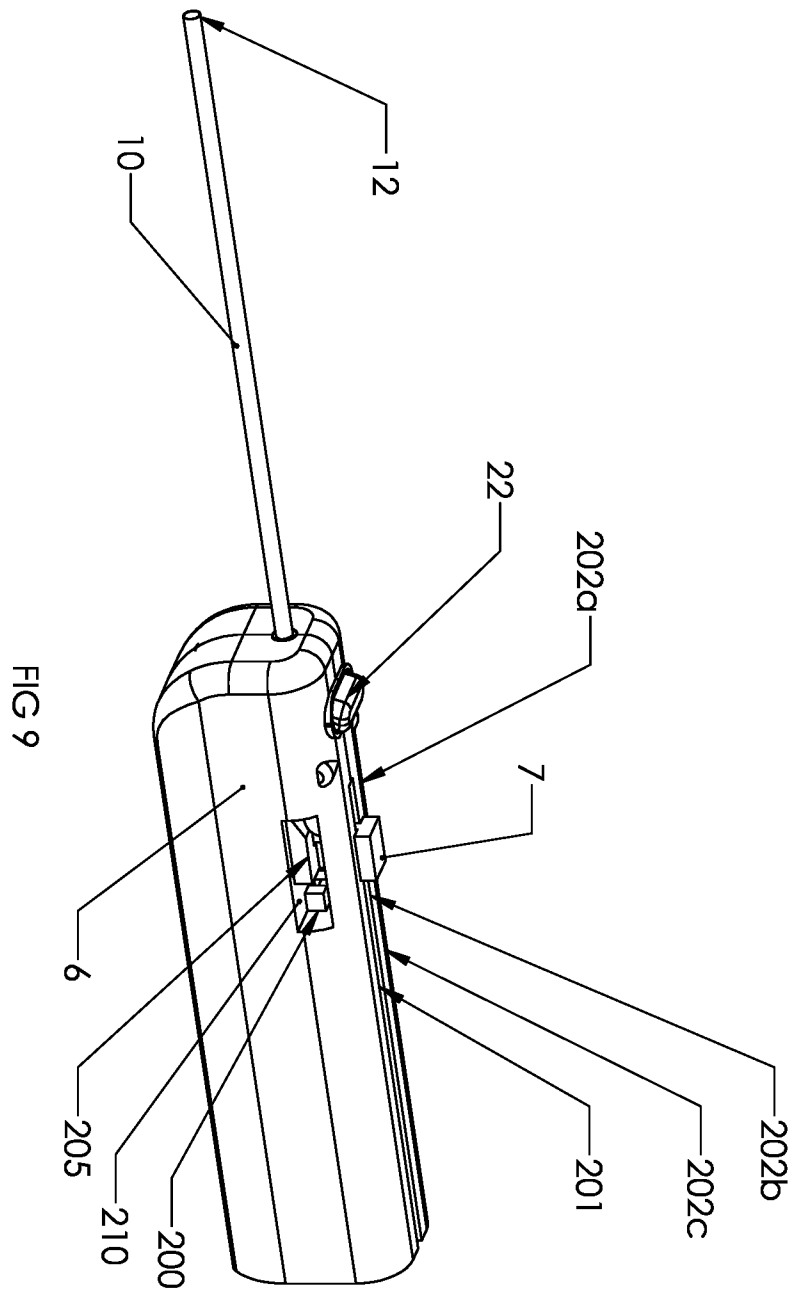


FIG 3







INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 16/35138

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - A61B 10/02 (2016.01)
 CPC - A61B 10/0266, 2017/320064
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
 IPC(8) : A61B 10/02 (2016.01)
 CPC : A61B 10/0266, 2017/320064

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 IPC(8) : A61B 10/00, 10/04, 10/06, 17/00, 17/32, 17/3205, 17/34 (2016.01)
 CPC: A61B 10/00, 10/04, 10/06, 10/0233, 2010/0208, 2010/0225, 17/00, 17/32, 17/3205, 17/34, 17/32053

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 Patbase, Google Patent, Google Scholar: biopsy, sample, tube, cannula, needle, trocar, stylet, probe, rod, coaxial, central, center, inside, slide, translate, move, retract, displace, depth, deep, penetration, number, indicate, gauge, display, push, rear, back, distal, rotate, spin, rotary, cutter, edge, blade, core, contact, touch

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y --- A	US 5,324,300 A (ELIAS et al) 28 June 1984 (28.06.1984) see especially col 5, ln 9-39, col 5, ln 66 to col 6, ln 9, col 6, ln 22-26, col 6, ln 39-46, fig 1-3, 5, 6	3-4, 7-9, 12-13, 15 ----- 1-2, 5-6, 10-11, 16 ----- 14
X	US 6,440,086 B1 (HOHENBERG) 27 August 2002 (27.08.2002) see especially col 3, ln 61 to col 4, ln 56, col 5, ln 6-10, col 5, ln 16-35, fig 1-3	3-4
Y	US 2015/0065912 A1 (PELIKS) 03 May 2015 (03.05.2015) see especially para [0025], [0027]-[0030], fig 1, 2B-E	1-2, 10-11
Y	US 2013/0331734 A1 (KEAST et al) 12 December 2013 (12.12.2013) see especially para [0074]	5-6, 16
A	US 6,086,543 A (ANDERSON et al) 11 June 2000 (11.06.2000) see whole document	1-16
A	US 5,713,368 A (LEIGH) 03 February 1998 (03.02.1998) see whole document	1-16
A	US 5,392,790 A (KANNER et al) 28 February 1995 (28.02.1995) see whole document	1-16
A	US 4,817,631 A (SCHNEPP-PESCH et al) 04 April 1989 (04.04.1989) see whole document	1-16

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 22 July 2016	Date of mailing of the international search report 31 AUG 2016
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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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