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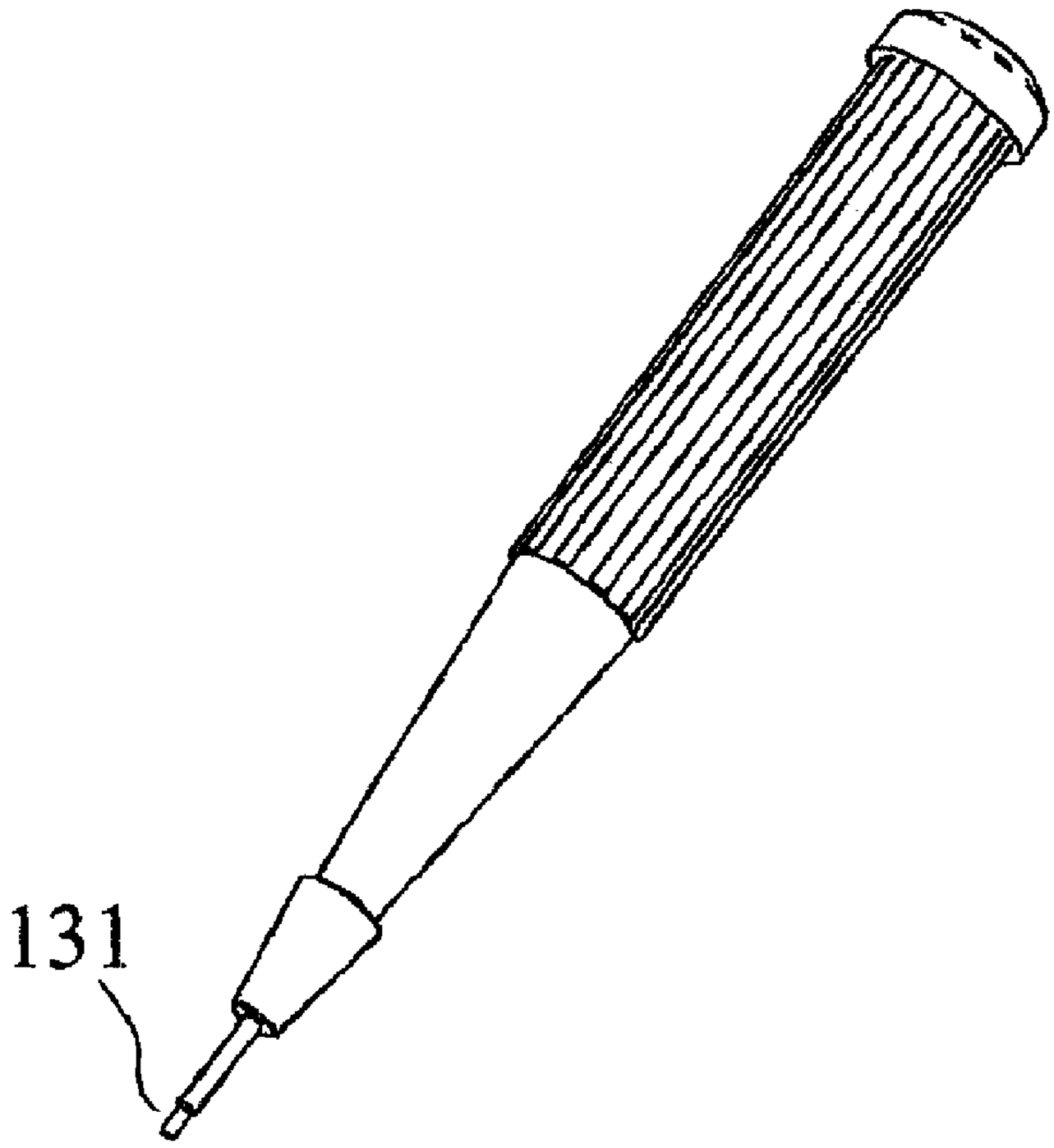

(57) Abrégé/Abstract:
An apparatus to collect a sample of material has a handle with a tubular sample sleeve extending from an end of the handle. The end of the sleeve distal from the handle forms a cutting edge circumscribing a circular sampling region. A plunger slides reciprocally

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(57) Abrégé(suite)/Abstract(continued):
within the tubular sample sleeve between a retracted position and an expulsion position. A user cuts a sample from a source material by engaging contact between the cutting edge of the tubular sample sleeve and the source material. The sample cut from the source is lodged within the tubular sample sleeve. Actuation of the plunger from the retracted position toward the expulsion position displacing the sample from the sleeve.

ABSTRACT OF THE DISCLOSURE

SAMPLING APPARATUS FOR MATERIAL COLLECTION

An apparatus to collect a sample of material has a handle with a tubular sample sleeve extending from an end of the handle. The end of the sleeve distal from the handle forms a cutting edge circumscribing a circular sampling region. A plunger slides reciprocally within the tubular sample sleeve between a retracted position and an expulsion position. A user cuts a sample from a source material by engaging contact between the cutting edge of the tubular sample sleeve and the source material. The sample cut from the source is lodged within the tubular sample sleeve. Actuation of the plunger from the retracted position toward the expulsion position displacing the sample from the sleeve.

SAMPLING APPARATUS FOR MATERIAL COLLECTION

Background of the Invention

Sampling devices are conventionally used to extract samples from materials such as paper, cloth, wood, tissues and the like. In one arrangement, a sampling device has a tubular sleeve forming a cutting edge at one end. A sample is obtained by advancing the sleeve into the sample source. The sleeve may then be gently rocked to separate the sample from the source, thereby retaining the sample in the cutting sleeve. The sample is then removed from the cutting sleeve using a second tool in the form of a pick or probe. In one prior art arrangement, the cutting sleeve provides an auxiliary opening extending along the length of the sleeve to facilitate removal of the sample. The extracted sample may then be placed in a receptacle, or may be mounted on a support.

Removal of sample from the cutting sleeve in either method as described above, presents a number of problems that may affect the integrity of the sample. Moreover, sample handling may present potential health hazards to the technician working with the sample. The process of picking a sample from the cutting sleeve is inefficient and time consuming. The conventional methods described above expose technicians to unnecessary health risks through the handling of sharp cutting instruments to extricate the retained sample material from the cutting sleeve. The sample material can also be partially lost, dropped or contaminated consequently requiring further sampling or the inability to do further sampling.

Summary of the Invention

The present invention is a sample collection apparatus comprising an elongate handle, a tubular sample sleeve extending from one end of the handle having a cutting edge at an end of the tubular sample sleeve distal from the handle. The sampling device has a plunger reciprocally operable to displace a sample from the tubular sample sleeve. In one embodiment, an end of the plunger is linked to an actuator that axially displaces the plunger within the handle of the apparatus. The actuator controls the movement of the plunger through a linkage joining the plunger to the actuator. A sample is cut from a source by the cutting edge of the tubular sample sleeve. A sample is collected from a source by excision from the source as the tubular sample sleeve is urged into contact with the source. The sample is received within

the lumen of the tubular sample sleeve. Once removed from the source, the sampling device can be used to transport the sample that is thereby lodged within the lumen of the tubular sample sleeve. The sample is expelled from the tubular sample sleeve by the plunger which is displaceable axially through the lumen of the tubular sample sleeve. The plunger can expel the entire sample at once, or incrementally to permit sectioning the sample into smaller portions as it is partially expelled from the sleeve. Another embodiment for actuating the plunger is comprised of a spring cover that biases the plunger in the retracted position until actuation for expulsion of a sample.

The present invention allows the user to withdraw a sample from a source and retain it within the tubular sample sleeve until needed. Suitable sample sources for this invention include soft materials such as cloth, paper, wood, films, gels, plant, animal and human tissues, and other sources capable of being cut by a surgical steel cutting edge. Ejection of the sample in increments allows for small portions of the sample to be segmented from the whole of the sample without removal of the entire sample from the cutting sleeve. Using this technique reduces likelihood for inadvertent or accidental cutting and repeated extraction from the cutting sleeve. The plunger eliminates the need for direct handling of the sample and reduces the likelihood of potential contamination that may require re-sampling of the source. This reduces the amount of manipulation to be performed by the technician who collects the sample, and reduces potential risks for contamination of the sample or contact between the user and the sample.

In this invention, the cutting sleeve serves as a cutting tool and as a storage receptacle to retain the sample. The plunger enables quick, safe and clean removal of the sample from the cutting sleeve.

Preferably, the sampling device is made from materials that are stable to heat of sterilization. The device can also be used as a disposable tool. The sampling device is particularly suited to be readily transported either alone or as part of a kit for the collection and transportation of samples.

Brief Description of the Drawings

Figure 1 is an elevation view showing a preferred embodiment of a sample collection apparatus constructed in accordance with the principles of the invention shown with the sample plunger in the expulsion position.

Figure 1A is an elevation view of Figure 1 along section axis 2-2.

Figure 2 is a cross-sectional view of the apparatus of Figure 1A taken along section line 2-2 of Figure 1A in the expulsion position.

Figure 2A is an exploded view of the removable cap and plunger in the expulsion position on Figure 2.

Figure 3 is an elevation view showing the apparatus in Figure 1 in the retracted position.

Figure 4 is a cross-sectional view of the apparatus taken along section line 4-4 of Figure 3 in the retracted position.

Figure 5 shows an enlarged, partial cross section of the apparatus bounded by circle 5 shown in Figure 4.

Figure 6 shows a perspective view of the sample collection apparatus of Figure 1 being operated to collect a sample from a source on a self-healing, inert mat.

Figure 7 shows a perspective view of the sample collection apparatus of Figure 1 in use to collect a sample from a piece of blotting paper, on a self-healing, inert mat.

Figure 8 is an enlarged cross-sectional view of the sample cutting and collection portion of the apparatus defined by circle 5 in Figure 4 where the apparatus is being used to take a sample of a substrate as is shown in Figure 6.

Figure 9 shows a perspective view of the sample collection apparatus of Figure 1, where a sample is being ejected into a receptacle.

Figure 10 is an elevation view of another preferred embodiment of an sample collection apparatus constructed in accordance with the principles of the invention shown with the plunger in the retracted position.

Figure 10A is an elevation view of Figure 10 along section axis 11-11.

Figure 11 is a cross section taken along section line 11-11 of Figure 10A.

Figure 12 shows an enlarged partial cross section of the apparatus comprising the area encompassed in Figure 11 by circle 12.

Figure 13 shows a perspective view of the apparatus on Figure 11 where a sample is being ejected into a receptacle, the plunger being in the expulsion position.

Figure 14 shows an elevation view of another embodiment of a sampling device constructed in accordance with the principles of the invention, having a slide actuator for expelling a sample from within the device, the plunger being in the retracted position.

Figure 15 shows a longitudinal cross-sectional view of the sampling device taken along cutting line 15-15 of Figure 14, shown with the plunger in the retracted position.

Figure 16 shows a plan view of the embodiment of the sampling and collecting device of Figure 14, where the device has been rotated about its longitudinal axis by 90 degrees, and with the plunger and the slide actuator shown in the expulsion position.

Figure 17 is an enlarged view of the portion of the Figure 15 defined by circle 17.

Detailed Description of the Preferred Embodiments

Referring to Figures **1** and **1A**, a preferred embodiment of a sample collection device constructed in accordance with the principles of the invention is shown. A handle **110** has a tubular sample sleeve **120** extending from one end of the hand **110** indicated by **113**. The exterior surface of the handle may include a plurality of ridges **111** to provide a better gripping surface for the user. There is a plunger **131** shown here in an expulsion position, where the plunger **131** extends past cutting edge **150** of tubular sample sleeve **120**.

Figure 2 and shows a longitudinal cross-section of the device taken along cutting line 2-2 of Figure 1A. A linkage **130** connects plunger **131** to an actuator, shown here as cover **220**, which axially reciprocates plunger **131** through the lumen of sleeve **120** between an expulsion position, as shown in Figures 1, 1A and 2, and a retracted position as shown in Figures 3 and 4. The retracted position has plunger **131** positioned within the apparatus and preferably within tubular sample sleeve **120**, whereas the expulsion position has plunger **131** positioned outside of tubular sample sleeve **120**, extended past cutting edge **150**.

The cover **220** can have an inner diameter that is equal to or slightly larger than the outer diameter of the first end **112** of the handle **110**. The cover **220** is used to activate the plunger **131** and can form a seal with the first end **112** of the handle **110** when not in use. The plunger **131** can be attached to the cover by various means, such as by linkage **130** within a flange **223** as shown in Figure 2.

Figure 2A is an exploded view of the cover 220 and cover assembly to linkage 130 in Figure 2.

In a preferred embodiment, a grommet 121 and stopper assembly can be used for retaining the cover **220**, linkage **130** and plunger **131** attached to handle **110**, and particularly for setting the retracted position for plunger **131** within tubular sample sleeve **120**. A grommet **121** can be disposed at the upper interior portion of the handle **112,** opposite the end from which sleeve **120** extends. Grommet **121** is preferably made from a material that can be compressed for insertion within the handle but which retains its elasticity and returns to its original size. For example, grommet **121** can be made from soft rubber. A stopper **122** can be attached to linkage **130**. When cover **220** is removed from handle **110**, plunger **131** slides with tubular sample sleeve **120** until stopper **122** contacts grommet **121**, thus defining the range of reciprocal motion of plunger **131** in the retracted position.

Referring to Figures 3, 4, and 5, the cover **220** mounts onto handle **110** detachably, allowing plunger **131** to slide within the length of the tubular sample sleeve **120**. The plunger **131** is moved between the retracted and expulsion positions by movement of cover **220** and linkage **130**, which communicates the axial displacement to plunger **131**. When cover **220** is fitted on handle **110**, plunger **131** extends outwardly through tubular sample sleeve **120** and past cutting edge **150** to the expulsion position. As

cover **220** is removed from handle **110**, plunger **131** withdraws into tubular sample sleeve **120** to the retracted position.

As shown in Figures 2 and 4, linkage **130** is mounted to the inside of cover **220** and is held in place by flanges **223.** Linkage **130** slides freely within grommet **121** through aperture **125** of grommet **121**. Stopper **122** is held in place as shown in this embodiment with a hexagonal screw **124**. When cover **220** is removed from handle **110,** linage **130** and plunger **131** can be slid axially through handle **110** away from cutting edge **150** of sleeve **120.** When stopper **122** contacts grommet **121**, cover **220** can no longer be displaced from handle **110**, and plunger **131** can no longer move further away from cutting edge **150.** Figure 4 shows cover **220** raised from first end **112** so that plunger **131** is located within tubular sample sleeve **120** for removing a sample from a source. Stopper **122** is preferably positioned so as to prevent plunger **131** from being dislodged from within tubular sample sleeve **120**.

As shown in Figure 4, 5 and 8, when plunger **131** is in the retracted position, there is a chamber **160** created within tubular sample sleeve **120** so as to permit entry of a sample **40** cut by cutting edge **150** into tubular sample sleeve **120** from a sample source **70**.

Figure 5 shows a longitudinal cross-sectional view of the area in Figure 4 bounded by circle 5. Plunger **131** is shown retracted within tubular sample sleeve **120** creating a chamber **160** within the tubular sample sleeve **120** that will be filled by a sample that is to be removed from a source.

Figure 6 shows use of the coring device in association with source **70**, which is being cut using self-healing inert support **50**. Tubular sample sleeve **120** has perforated source **70** at its surface. The user is holding handle **110**, and has displaced cover **220,** so as to withdraw plunger **131** into the barrel of tubular sample sleeve **120**. Grommet **121** and stopper **122** are not shown in this embodiment. Cutting of a sample **40** using inert support **50** is preferred where the source **70** being cut is the material to be analyzed, for example, cloth, wood, or tissue.

Figure 7 shows a similar configuration as in Figure 6, except the source **70** is absorbed on blotting paper **30** or other absorptive material that has the sample absorbed on its surface and within the micro-structure

of the absorptive material, for example, blood blotted on paper.

Figure 8 shows the same view as Figure 5 except cutting edge **150** and tubular sample sleeve **120** have penetrated surface **80** of source **70**. Cutting edge **150** is located within source **70**, while plunger **130** is retracted from surface **80** of source **70.** Chamber **160** is practically filled by sample **40** from source **70**.

Figure 9 shows the ejection of sampled material **40** into vial collecting receptacle **90**. The user repositions cover **220** onto handle **110** which in turn slides plunger **131** through tubular sample sleeve **120** and past cutting edge **150**, forcing the expulsion of sample **40**.

In another preferred embodiment, as shown in Figures 10, 10A, 11, 12 and 13, a spring ejection cover **340** has a cap **334** that engages the first end **112** of handle **110**, and a spring and shaft assembly that is mounted to spring ejection cover **340** within cap **334.** The spring ejection cover **340** is comprised of an actuator **331**, a spring **337** and an enclosure **338** for the spring **337**, a shaft **336** and the plunger **131.** The shaft **336** is mounted to the actuator **331** at one end, and is buttressed against spring **337** at the other. The linkage **130** is mounted on the end of the shaft **336** that is buttressed against spring **337**. Linkage **130** can lie within the coils of spring **337 as** shown by these drawings. As actuator **331** is pressed into cover **330** by shaft **336,** which also compresses spring **337** and displaces plunger **130** axially. The spring **337** is also buttressed against the enclosure **338** that holds the spring and shaft assembly against flange **333**. When the actuator **331** is no longer pressed, the spring **337** returns the actuator **331** and the shaft **336** to the retracted position, moving plunger **130** back to its first position, within annular cutting sleeve **120**. Cap **334** can have an inside diameter that is slightly larger than the outside diameter of handle **110** and can be fitted onto the handle **110** accordingly.

The present embodiments of the invention allow the sample **40** to be ejected from cutting sleeve **120** in its entirety or in increments. One can also eject sample **40** into a collection vial **90** without working sample **40** free of tubular sample sleeve **120**. The controlled ejection of sample **40** from the tubular sample sleeve **120** allows for small portions of sample **40** to be cut away from the whole sample by way of scalpel without removing all of sample **40** from tubular sample sleeve **120**.

The device can also be sued to sample source **70** resting on an inert support **50**, such as a self-healing cutting mat. Because the device is rotated with downward pressure, it cuts the source **70** with the cutting edge **150** of tubular sample sleeve **120**, into inert support **50**, so that inert support **50** forces sample **40** into tubular sample sleeve **120**. The collected sample **40** is then retained in the tubular sample sleeve **120** until such time when it is displaced therefrom by actuation of the plunger **131**.

Figure 11 shows actuator **331** mounted within cover **330**, which in turn is mounted on handle **110**. Figure 12 shows a magnified view of the cross section of spring ejection cover **340**. Attached to actuator **331** is shaft **336**, which is mounted to actuator **331** at flange **335**. When actuator **331** is pressed by the user, flange **335** contacts opposing flange **333** within the cover, thus limiting the motion of actuator **331**. As actuator **331** is pressed, shaft **336** slides within opposing flange **333** and spring **337** contracts against enclosure **338**. As shaft **336** moves axially within handle **110**, linkage **130** is similarly engaged and also moves axially through handle **110**. When actuator **331** is pressed inward onto cap **334**, shaft **336** moves axially towards tubular sample sleeve **120**, and in turn forces linkage **130** to move plunger **131** through tubular sample sleeve **120** towards cutting edge **150**. When actuator **331** is moved through its complete range of motion, and spring **337** is at its most compressed point, linkage **130** should extend past cutting tip **150** outside of tubular sample sleeve **120** in the expulsion position.

Figure 13 shows sample **40** being ejected into collecting vial 90 by the pressing of actuator **331**. This embodiment of the invention can be used as shown in Figures 6 and 7, for example.

Referring to Figures 14, 15, 16 and 17, an embodiment of the invention is shown where plunger **131** is movable between a first position where plunger **131** is within the apparatus (the retracted position) and where plunger **131** extends past tubular sample sleeve **120** and cutting edge **150** (the expulsion position). The plunger **131** is moved between these two positions using sliding arm **441**, the actuator in this embodiment, which attached to stopper **442** on linkage **130**, sliding arm **441** extending through opening **445** on handle **110.** Opening **445** is preferably located at a position approximately central among plurality of ridges **111** used for gripping the apparatus, and has a length in the axial direction of handle **110** that is sufficient to allow sliding arm **441** to move plunger **131** between the retracted and expulsion positions. Stopper **442** is mounted to linkage **130** along its length, preferably at the end of linkage **130**

opposite the plunger **131**. Sliding arm **44** moves between a first position and a second position within opening **445**, the first position of the sliding arm **441** corresponding to the retracted position of plunger **131**, and the second position of the sliding arm **441** corresponding to the expulsion position of plunger **131**.

Referring more particularly to Figures 15 and 17, sliding arm **441** is mounted to a stopper **442**, which in turn is mounted to linkage **130**. Biased against stopper **442** is spring **443**, which is mounted between tubular sample sleeve **120** and stopper **442**, around linkage **130**. Spring **443** biases plunger **131** and sliding arm **441** in the retracted position until moved into the expulsion position by a user seeking to expel a sample. Spring **443** also keeps plunger **131** in alignment with tubular sample sleeve **120**. The plunger **131** can be moved to positions between the first and second position for gradual expulsion of a sample from within the tubular sample sleeve **120**.

I CLAIM:

1. An apparatus to collect a sample comprising:

a handle;

a tubular sample sleeve depending from the handle forming a cutting edge at an end remote from the handle;

a plunger slidably disposed within a lumen of said tubular sample sleeve reciprocally movable between a retracted position and an expulsion position;

a linkage that joins the plunger to an actuator means so that the actuator means can translocate the plunger using the linkage; and

actuator means operable to actuate said plunger between the retracted position and the expulsion position.

2. The apparatus of claim 1 wherein said actuator means comprises a cover affixed to the said linkage.
3. The apparatus of claim 1 further including biasing means to bias said plunger into said retracted position.
4. The apparatus of claim 2 where the actuator means is a sliding arm located along the axial length of the handle coupled to said plunger.
5. The apparatus of claim 1 having a grommet inserted within a first end of the handle through which the plunger passes, and a stopper mounted to the plunger such that the stopper contacts the grommet when the plunger is located in the retracted position, preventing removal of the plunger from a hollow body of the handle.
6. The apparatus of claim 2 having a grommet inserted within a first end of the handle, through which the plunger passes, and a stopper mounted to the plunger such that the stopper contacts the grommet when the plunger is located in the retracted position, preventing removal of the plunger from a hollow body of the handle.
7. The device of claim 5 having a grommet inserted within the first end of the handle, through which the plunger passes, and a stopper mounted to the plunger such that the stopper contacts the grommet when the plunger is located in the retracted position, preventing removal of the plunger from the hollow body of the handle.
8. The device of claim 4 having a grommet inserted within a first end of the handle, through which the plunger passes, and a stopper mounted to the plunger such that the stopper contacts the grommet when the plunger is located in the retracted position, preventing

removal of the plunger from a hollow body of the handle.

9. A sampling device comprising:

a handle and a spring ejection cover depending from the handle, the handle having:

a hollow body;

a first end that engages a spring ejection cover; and

a terminal end into which is mounted one end of a tubular sample sleeve having a cutting blade at an opposite end to that mounted to the terminal end of the handle;

and the spring ejection cover having:

a cap that engages the first end of the said handle;

a spring and shaft assembly having an actuator, a shaft, a spring and an enclosure, said actuator moving from a released position to a compressed position, the actuator connecting to the shaft at a first end of the shaft, the shaft engaging the spring at a second end of the shaft, and the shaft connecting to a linkage at the second end of the shaft;

the linkage connecting to a plunger at the end of the linkage that is not connected to the shaft;

the spring ejection cover moving the plunger between a first position and a second position, whereby the actuator is moved from a position where the spring is extended against the shaft to a position where the actuator moves within the sleeve of the spring ejection cover, the actuator moving the shaft to compress the spring against the enclosure and the shaft moving the plunger to the second position, and upon release of the actuator, the spring forces the shaft and the actuator to their original positions by extending to its original shape, moving the plunger with the shaft to the first position, the first position being a retracted position located where the plunger does not pass through the length of the tubular sample sleeve past the cutting blade, and the second position being an expulsion position where the plunger is forced through the tubular sample sleeve and past the cutting blade.

10. Any of the devices of claims 1 through 9 where the movement of the plunger can be effected in small increments.

11. A method of extracting a sample from a soft source using a sampling device where the source is cut by a cutting blade of a tubular sample sleeve, the tubular sample sleeve being mounted to a terminal end of a handle, the tubular sample sleeve holding the

sample until a plunger is actuated to expel the sample from the tubular sample sleeve, the plunger being contained within the sampling device and being actuated from a first end of the handle opposite the terminal end of the handle, the plunger moving from a first position to a second position, the first position being where the plunger is predominantly or entirely contained within the handle, and the second position being where the plunger passes through the tubular sample sleeve and past the cutting blade, expelling the sample.

12. The method of claim 11 where the plunger is actuated by removal and replacement of a cover at the first end of the handle, the plunger being fitted to the cover.
13. The method of claim 11 where the plunger is actuated by a spring ejection cover comprising:

    a sleeve that engages the first end of the handle;

    a spring and shaft assembly having an actuator, a shaft, a spring and an enclosure, said actuator moving from a released position to a compressed position, the actuator connecting to the shaft at a first end of the shaft, the shaft engaging the spring at a second end of the shaft, and the shaft connecting to the plunger at the second end of the shaft through a linkage;

    the spring ejection cover moving the plunger between the first position and the second position, whereby the actuator is moved from a position where the spring is extended against the shaft to a position where the actuator moves within the sleeve of the spring ejection cover, the actuator moving the shaft to compress the spring against the enclosure and the shaft moving the linkage which in turn moves the plunger to the second position, and upon release of the actuator, the spring forcing the shaft and the actuator to their positions by extending to its original shape, moving the plunger with the shaft to the first position.
14. The method of claim 11 where the plunger is actuated using a sliding arm mounted to a linkage which is connected to the plunger, the sliding arm extending at its free end through an opening on the handle, the plunger being biased in a retracted position by a spring abutting against a stopper mounted to the linkage on one side of the spring, and abutting against an internal surface of the terminal end of the handle on an other side of the spring.
15. The method of any of claims 11 through 14 where the movement of the plunger can be effected in small increments.

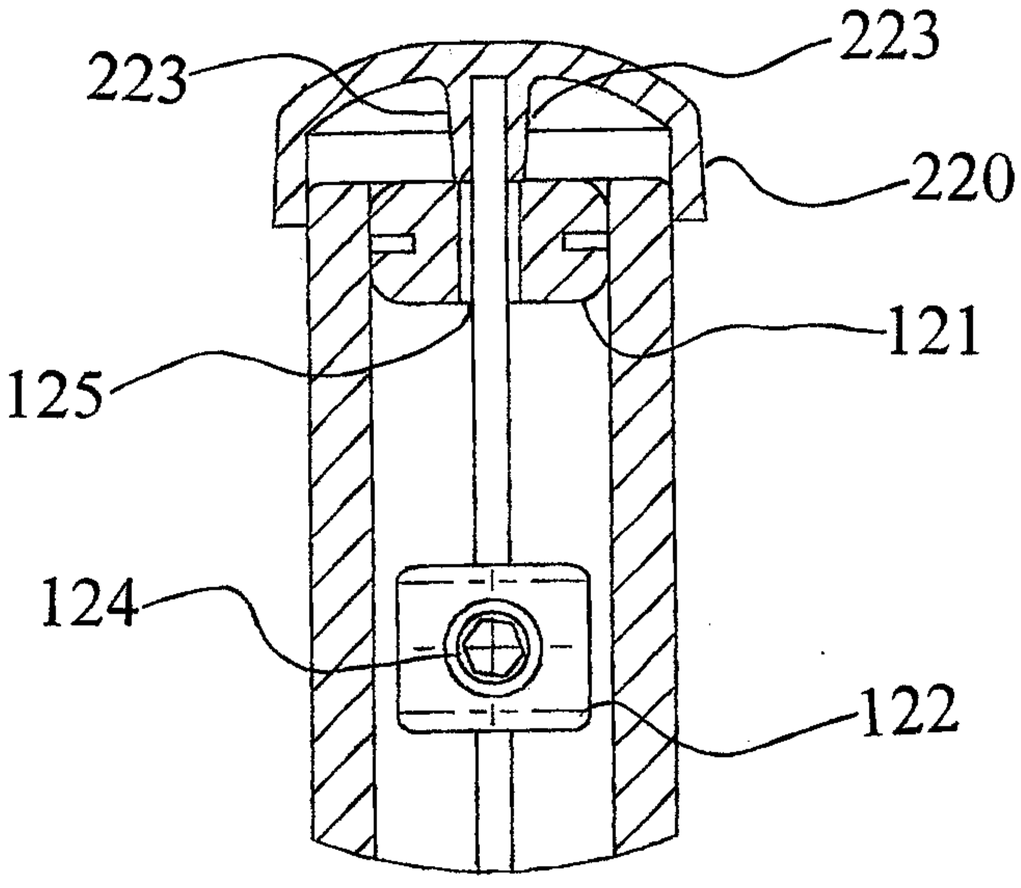


Figure 2A

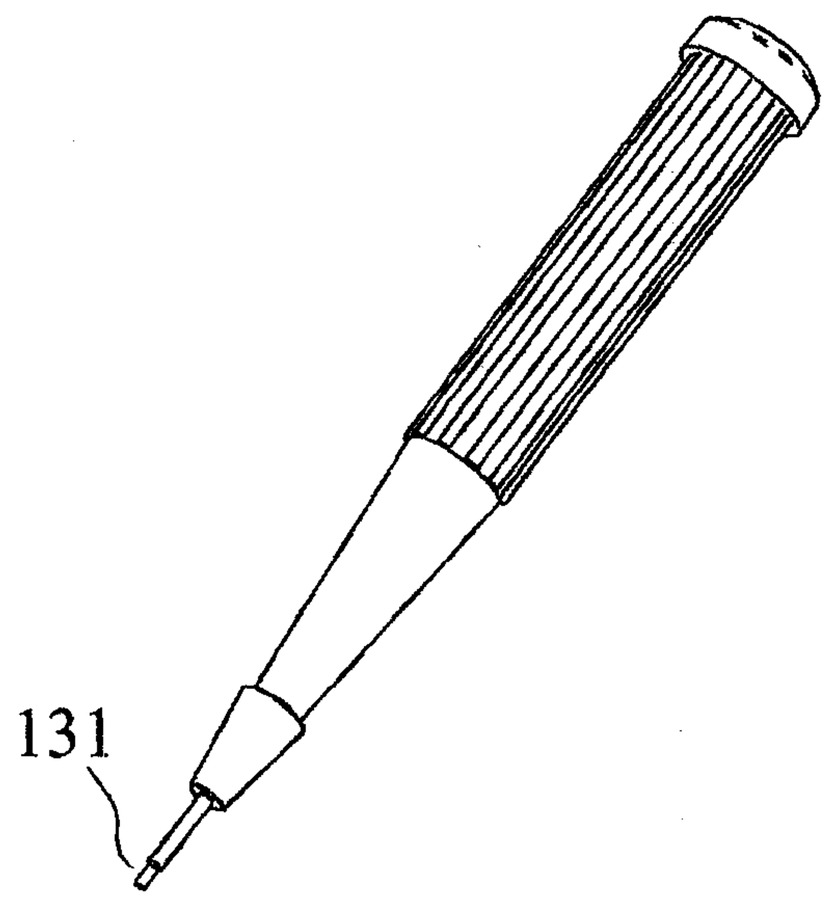


Figure 1

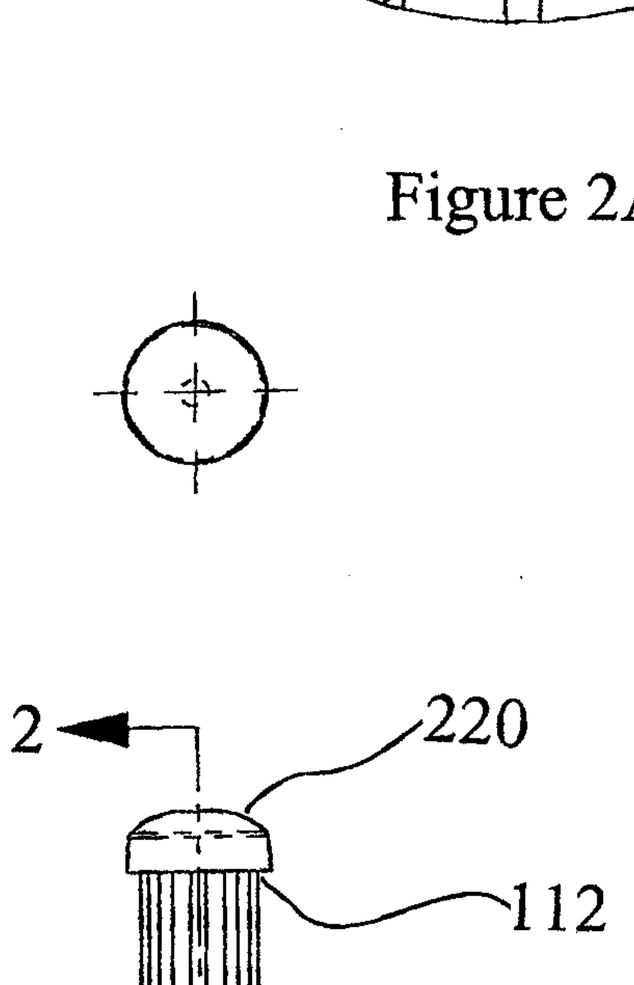


Figure 1A

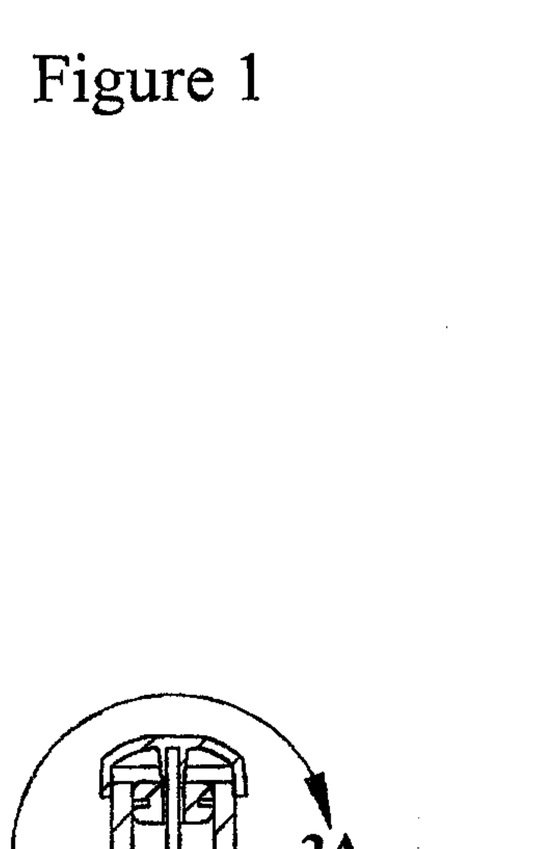


Figure 2

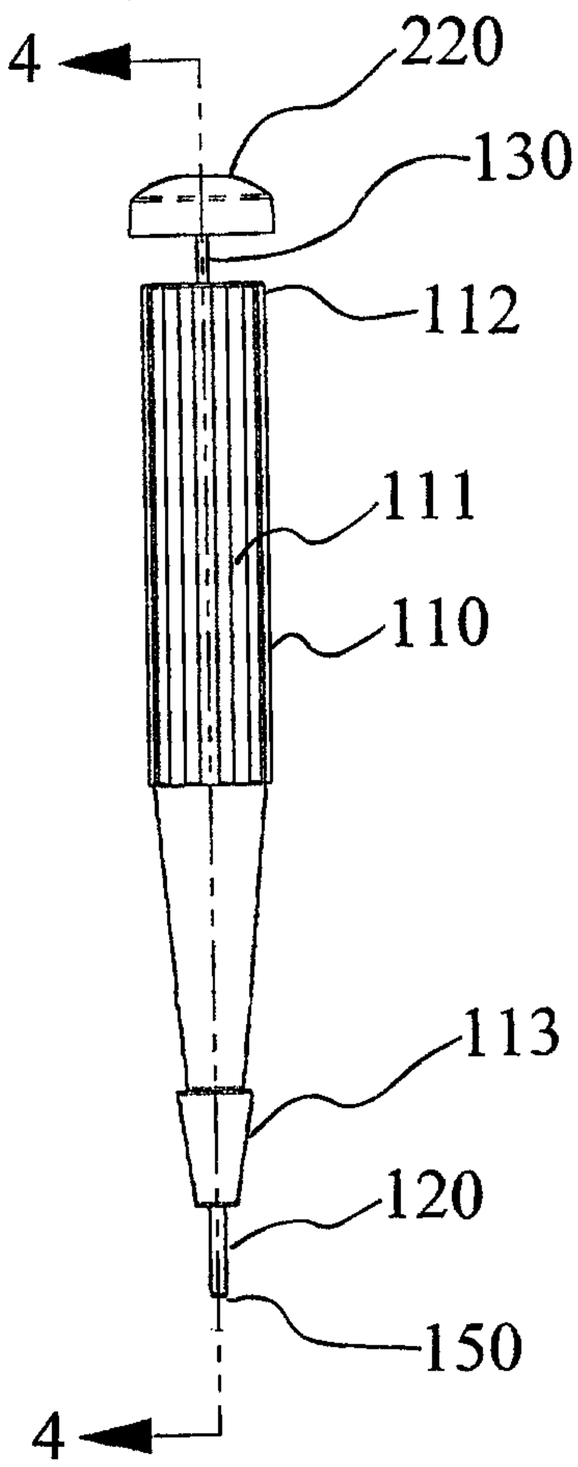


Figure 3

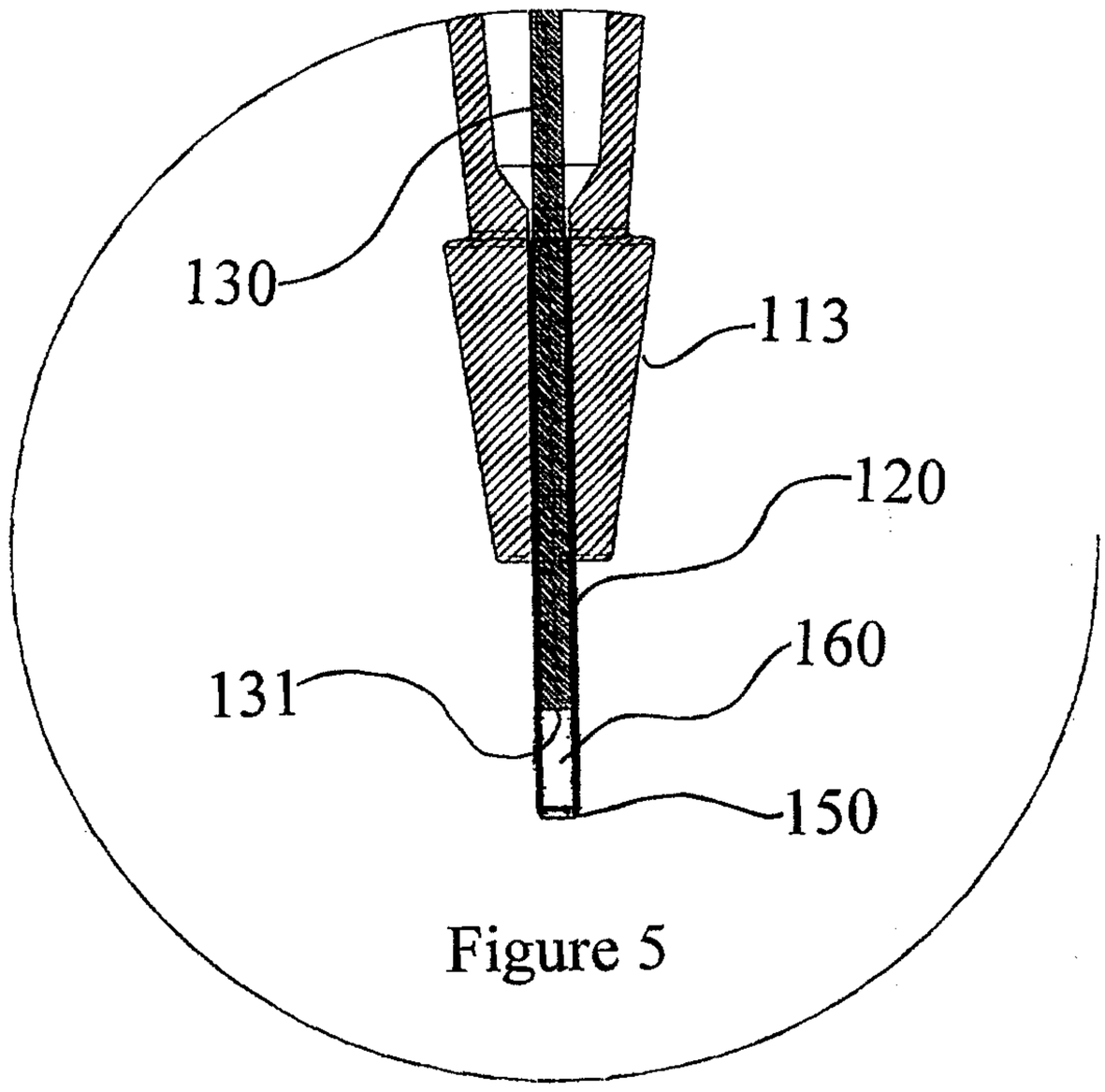


Figure 5

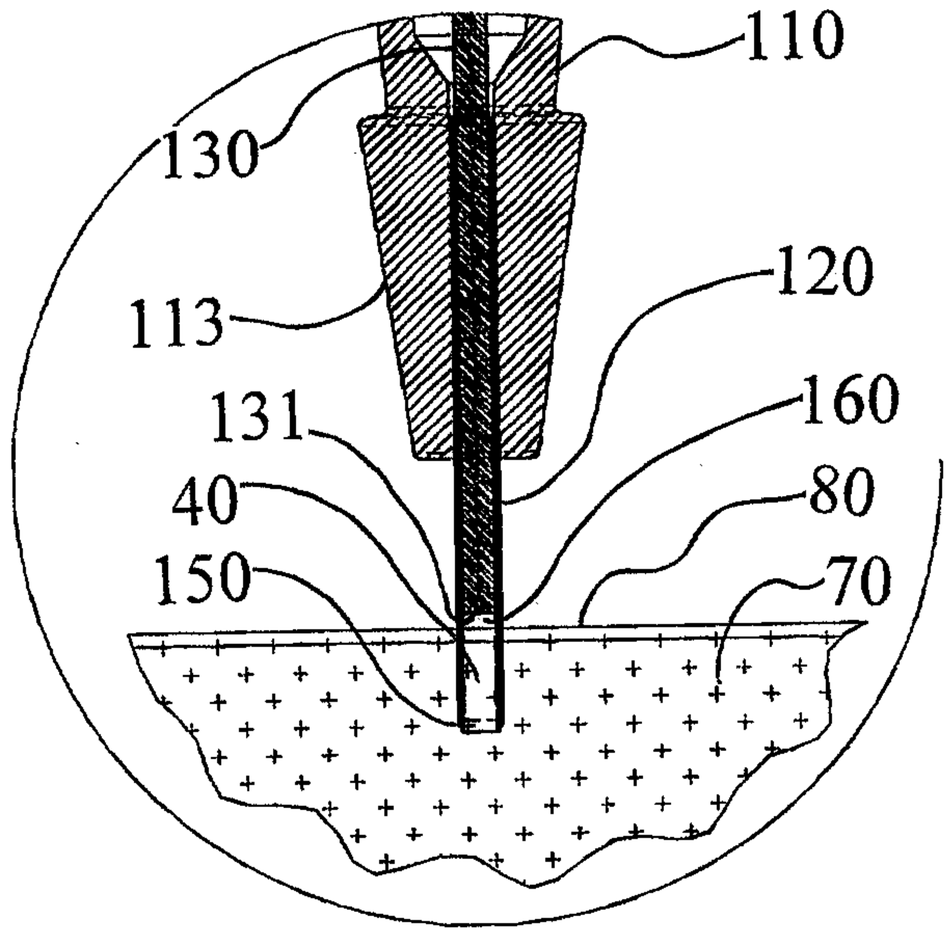


Figure 8

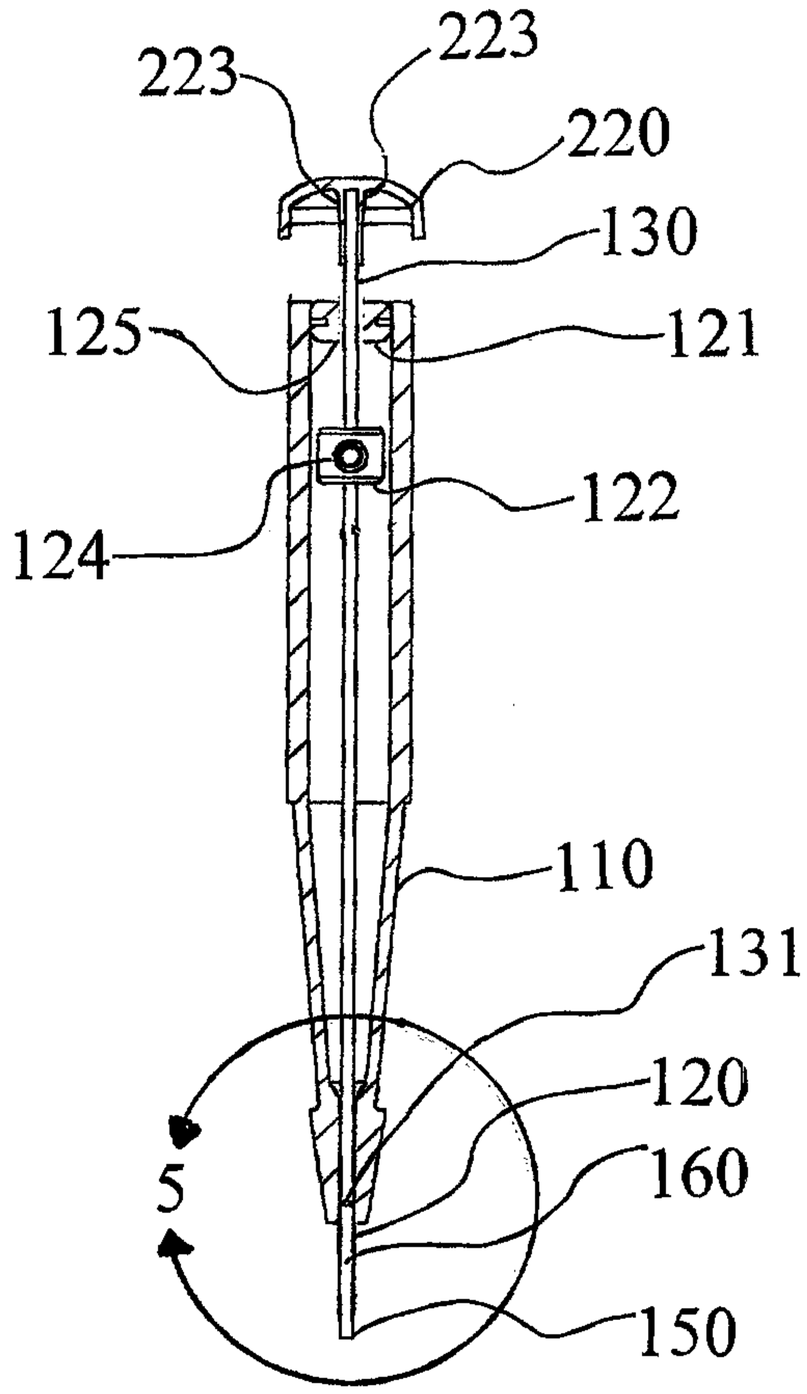


Figure 4

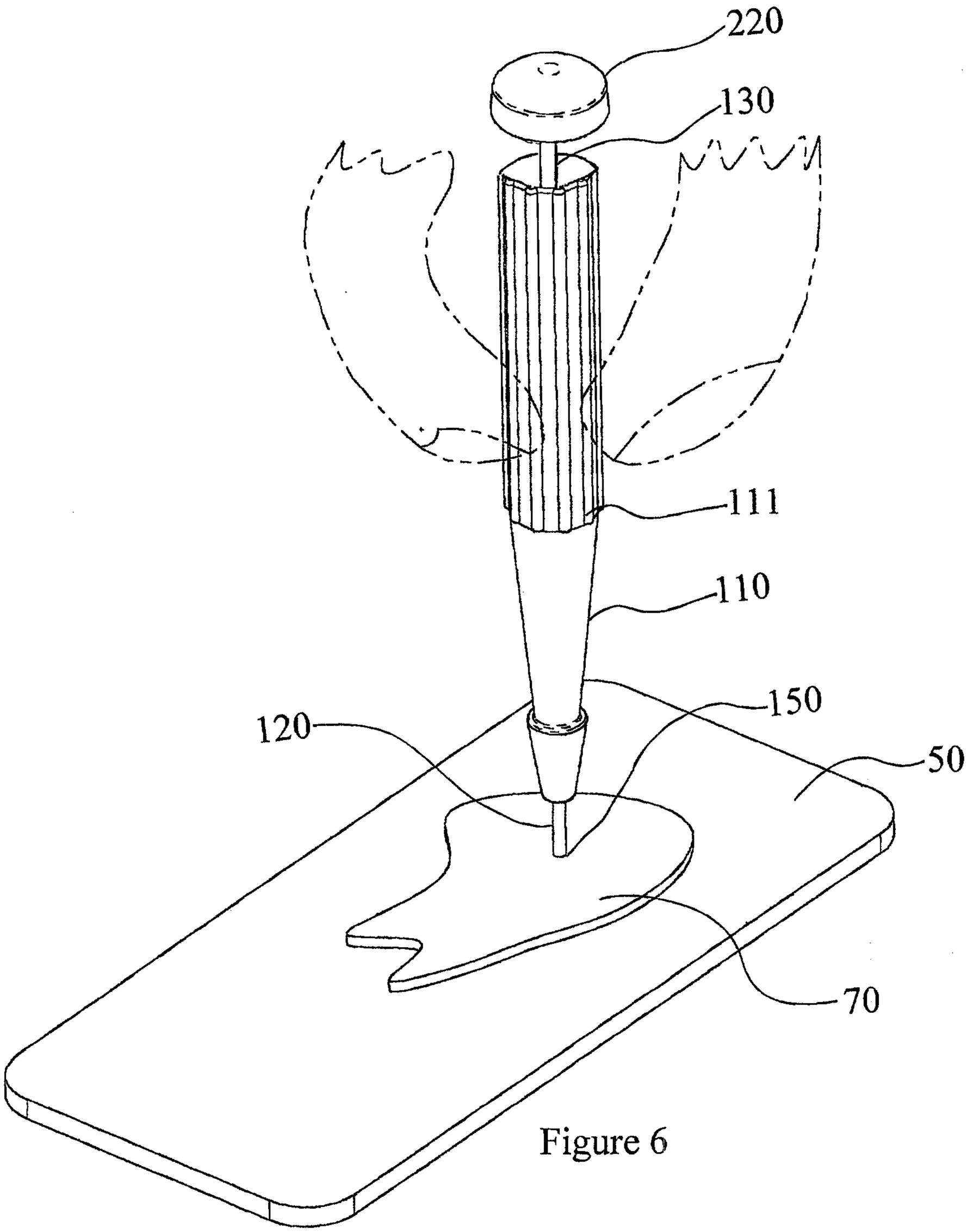


Figure 6

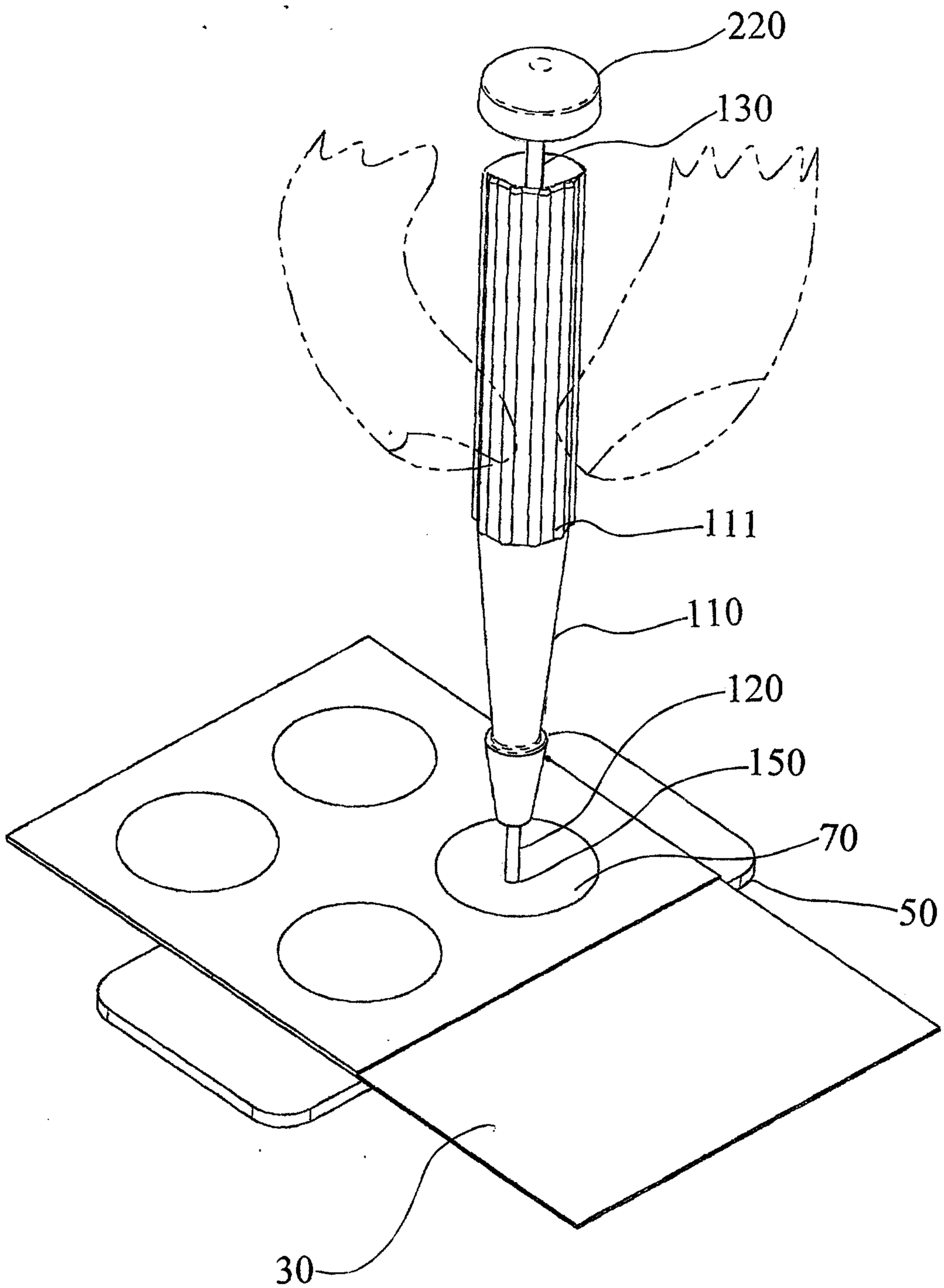


Figure 7

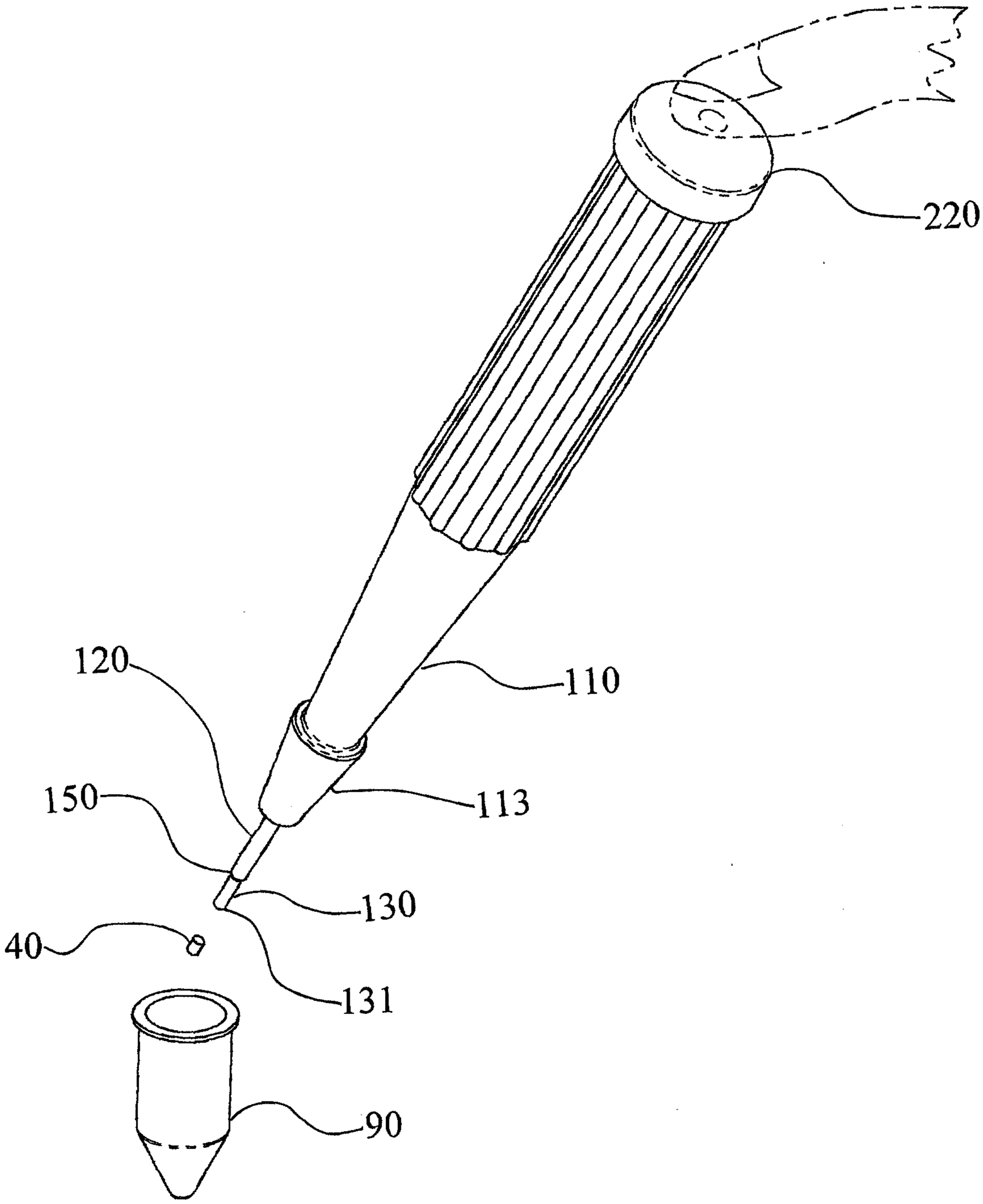


Figure 9

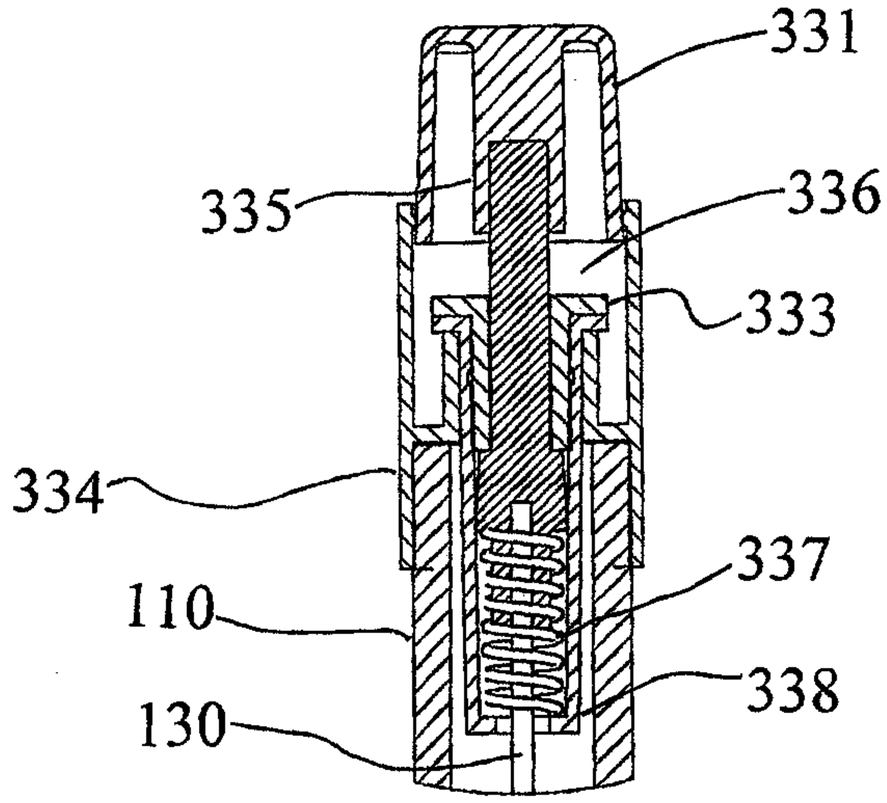


Figure 12

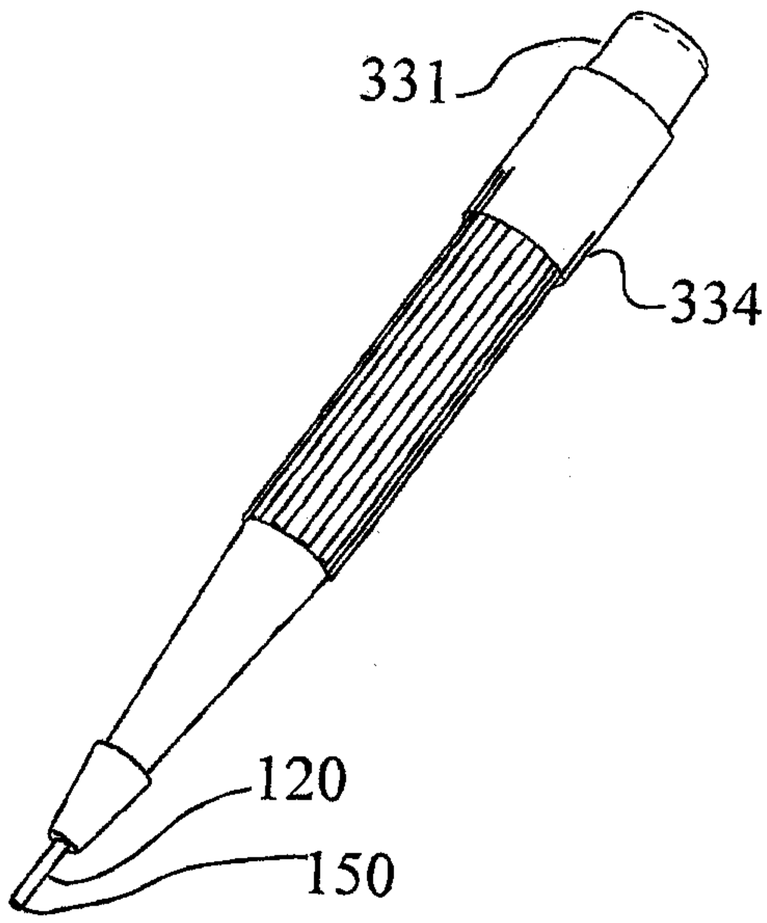
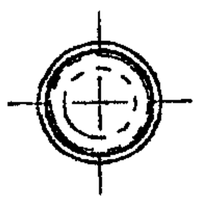


Figure 10



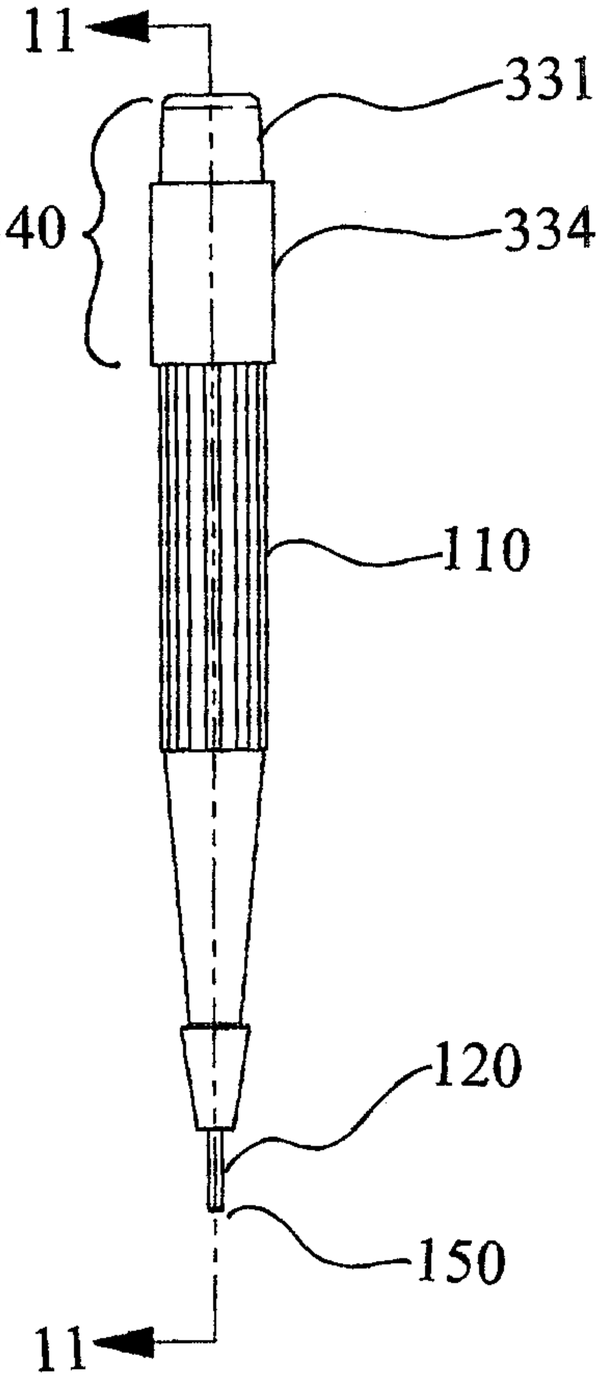


Figure 10A

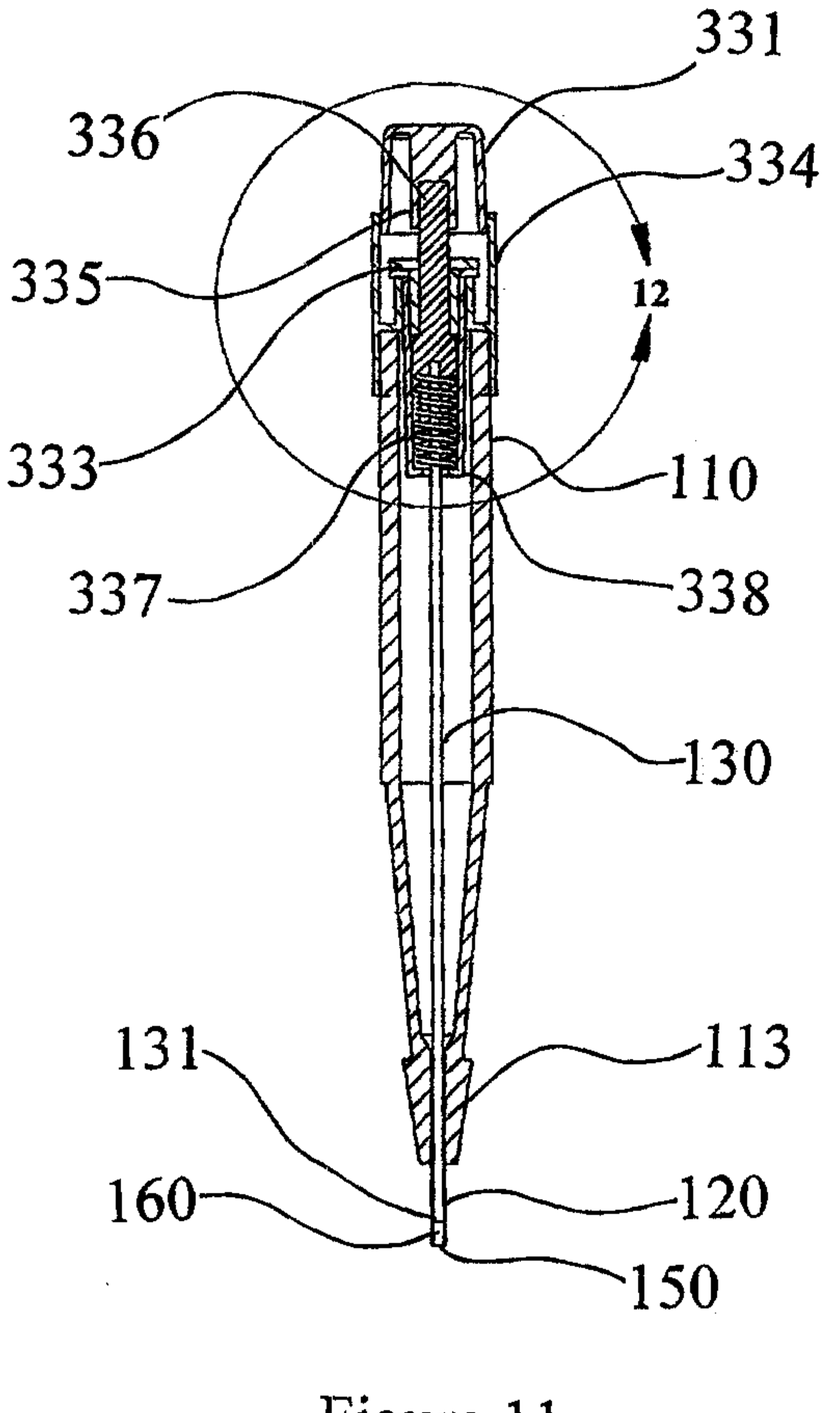


Figure 11

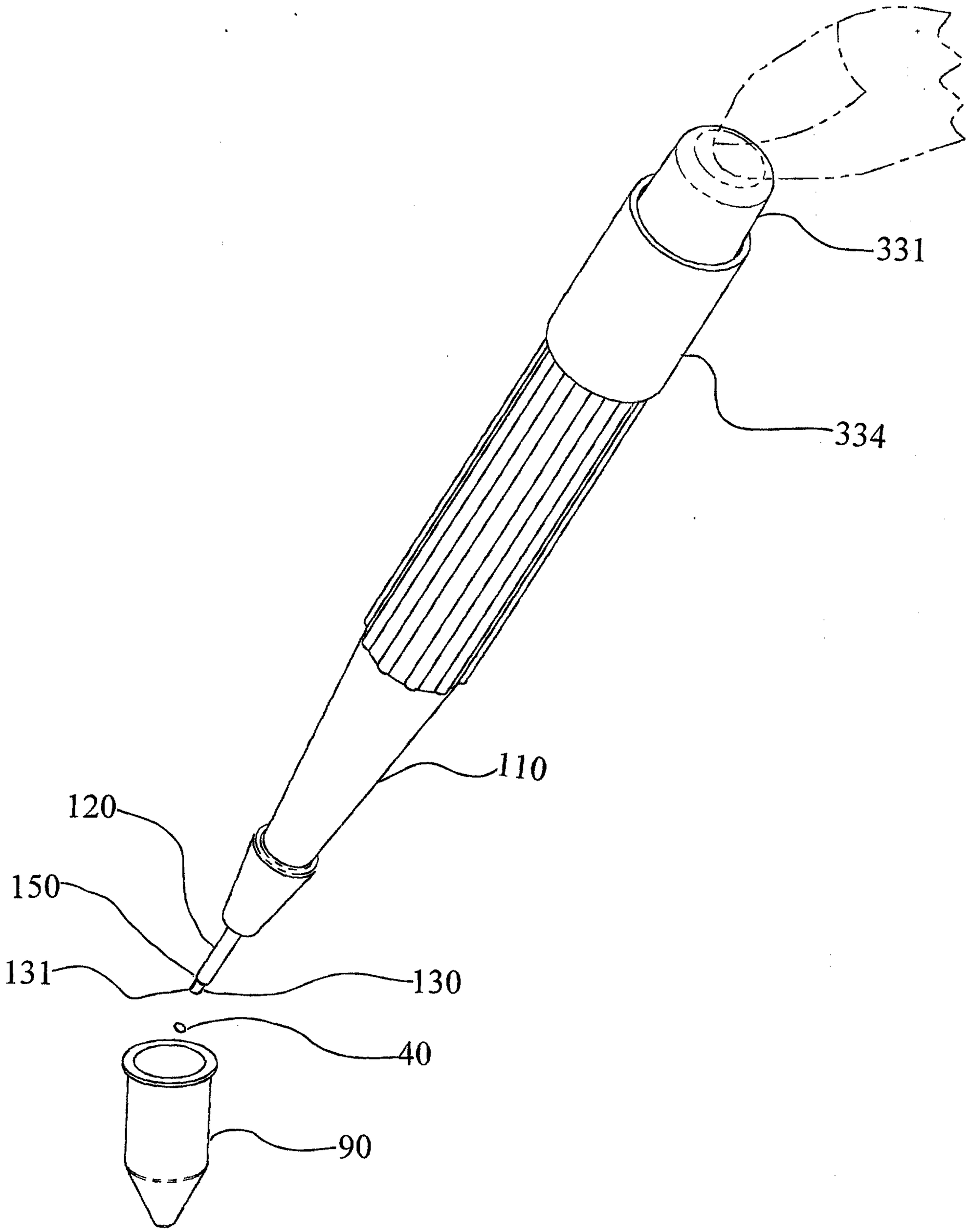


Figure 13

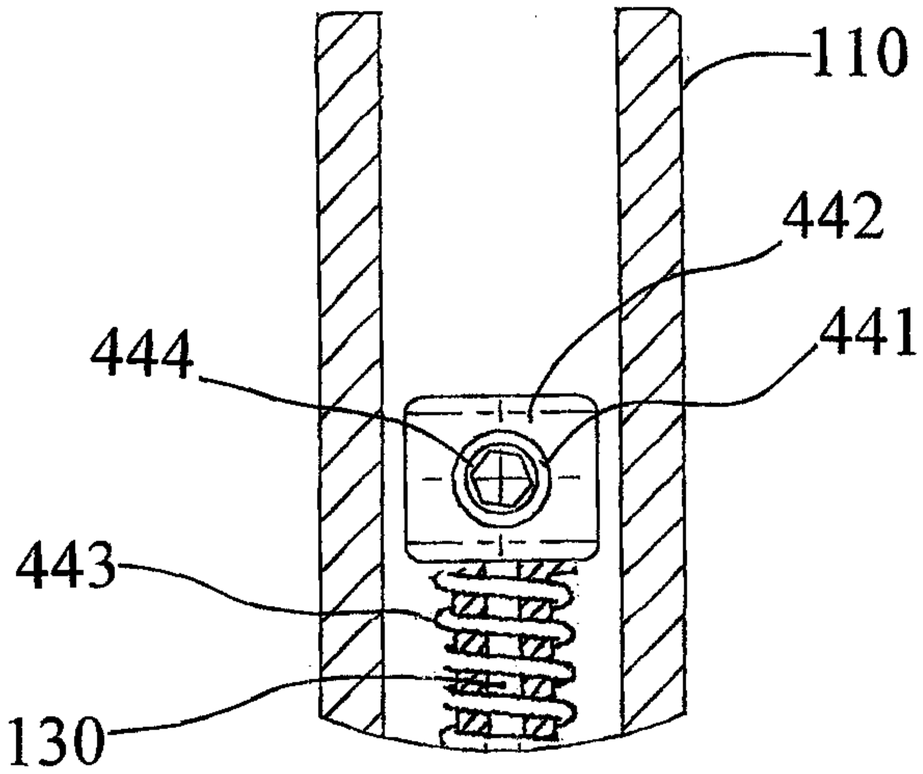


Figure 17

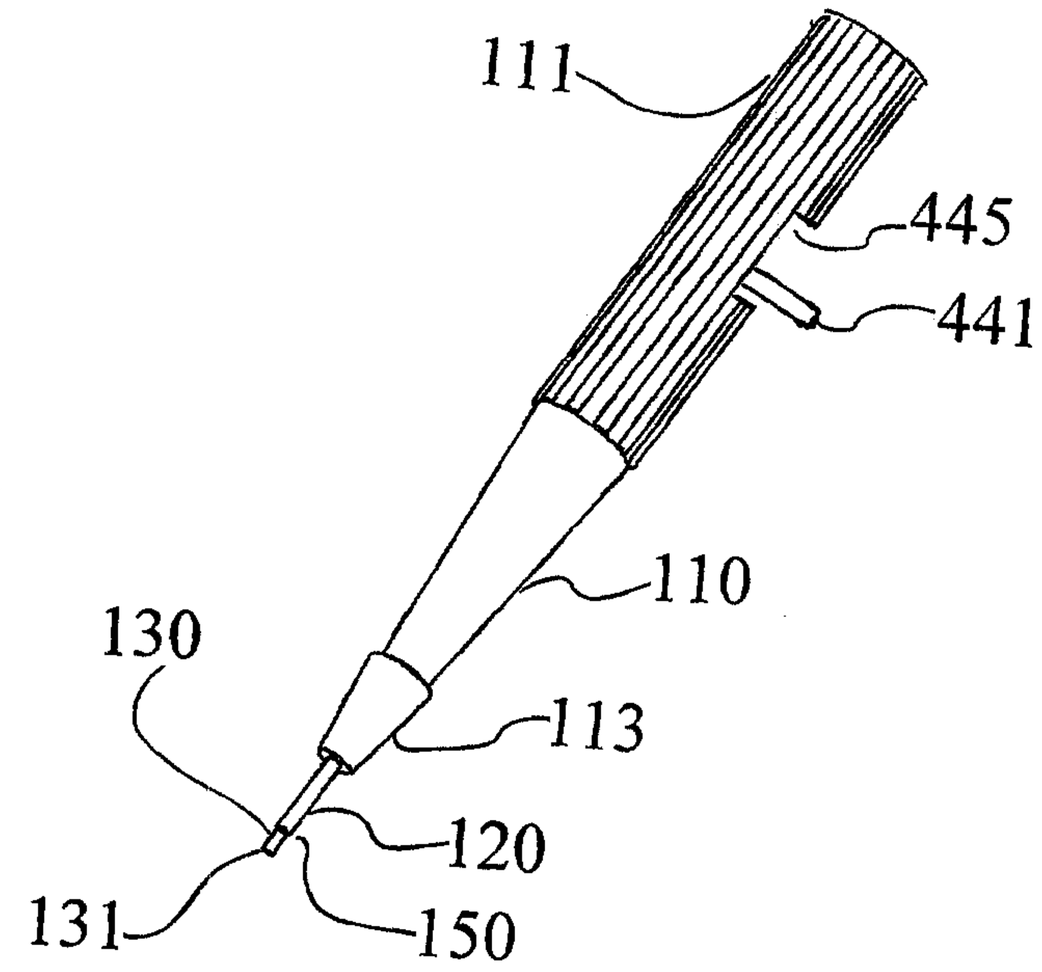


Figure 16

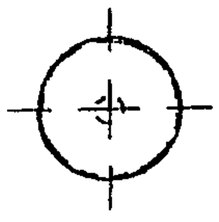


Figure 14

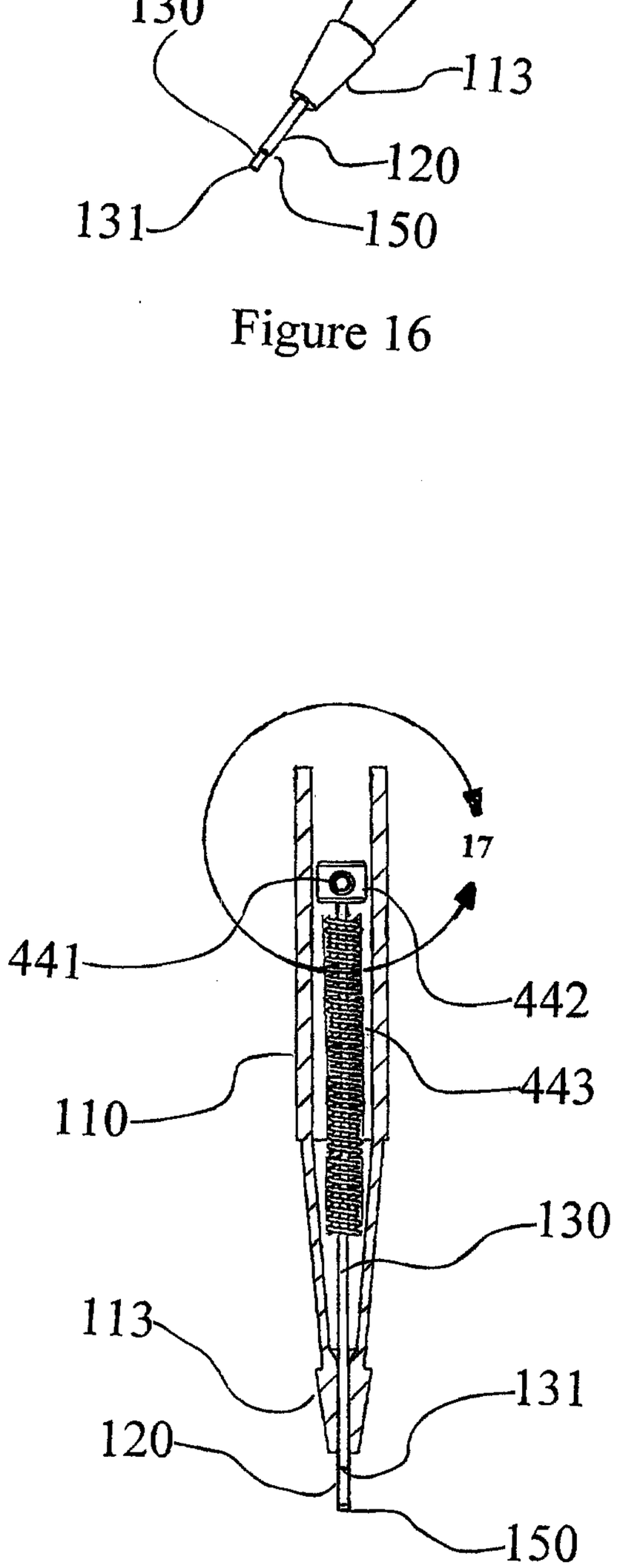
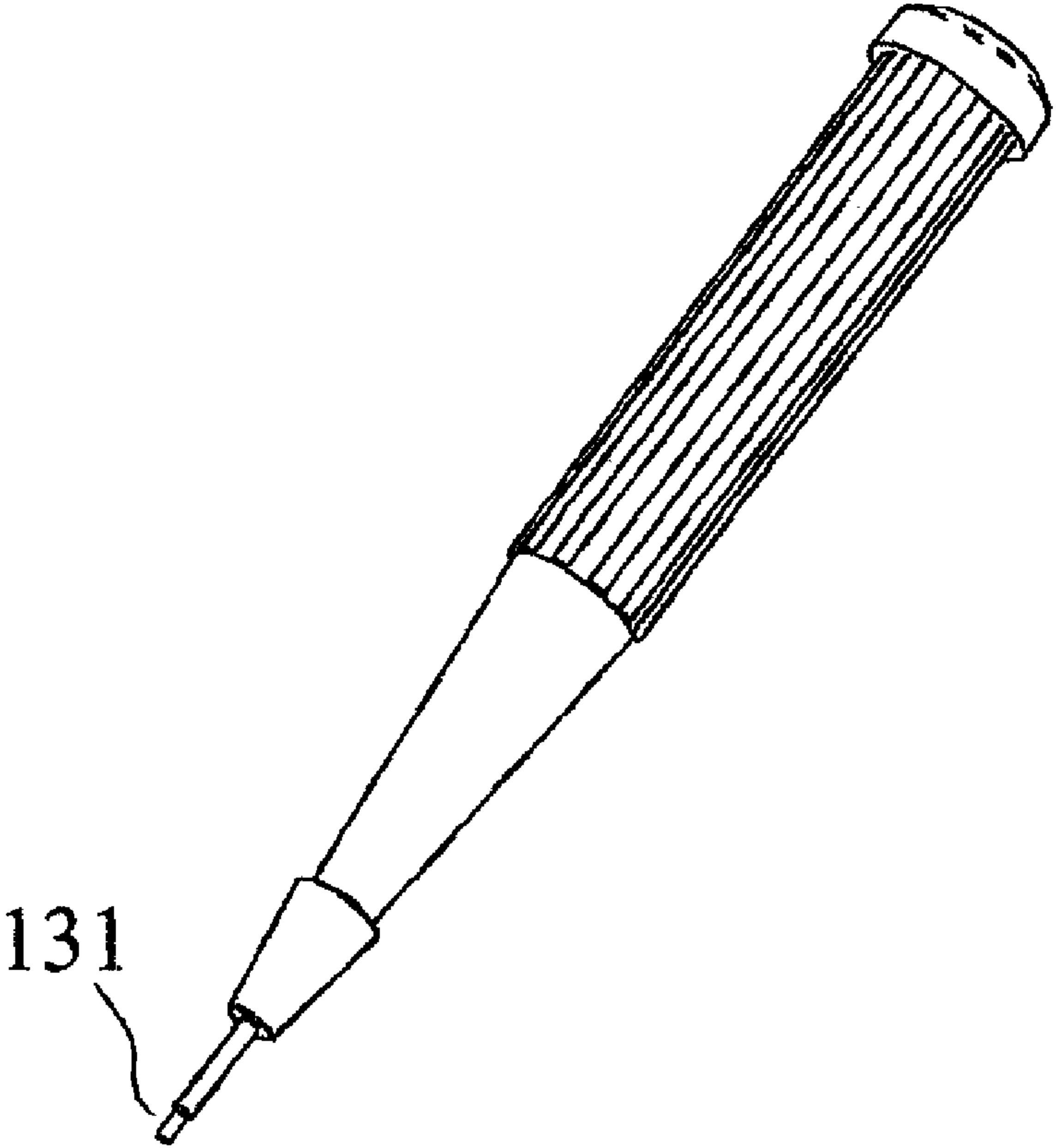


Figure 15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