June 7, 1955 J. K. CROMER ET AL 2,710,000

CUTTING INSTRUMENT

Filed Feb. 19, 1952 3 Sheets-Sheet 1

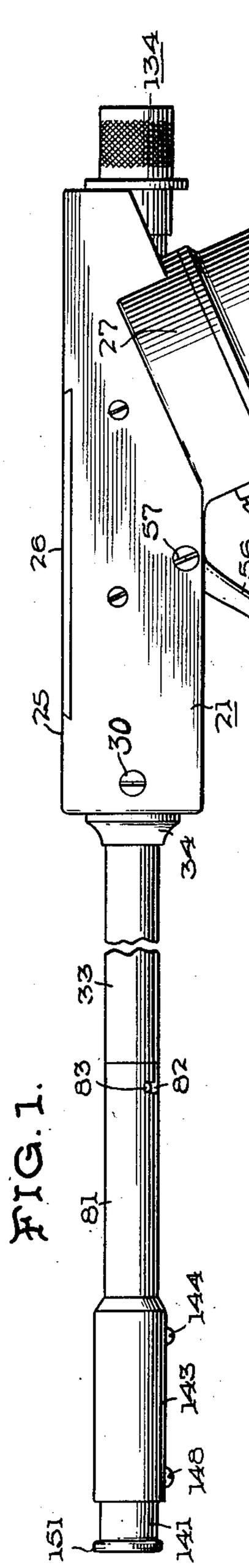

FIG. 1.

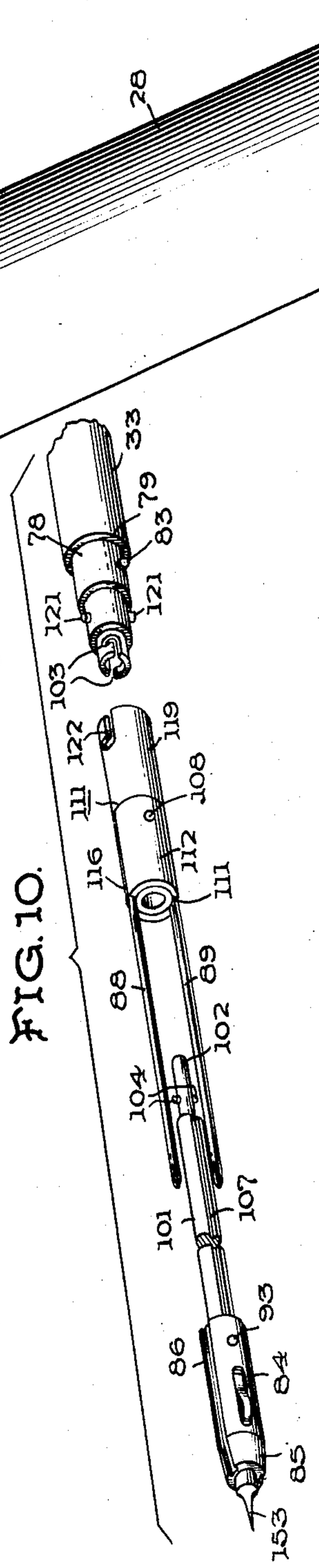

FIG. 10.

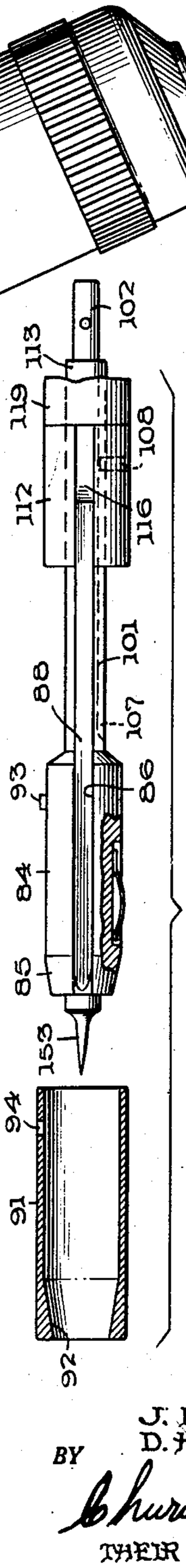

FIG. 11.

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CUTTING INSTRUMENT

Filed Feb. 19, 1952 3 Sheets-Sheet 2

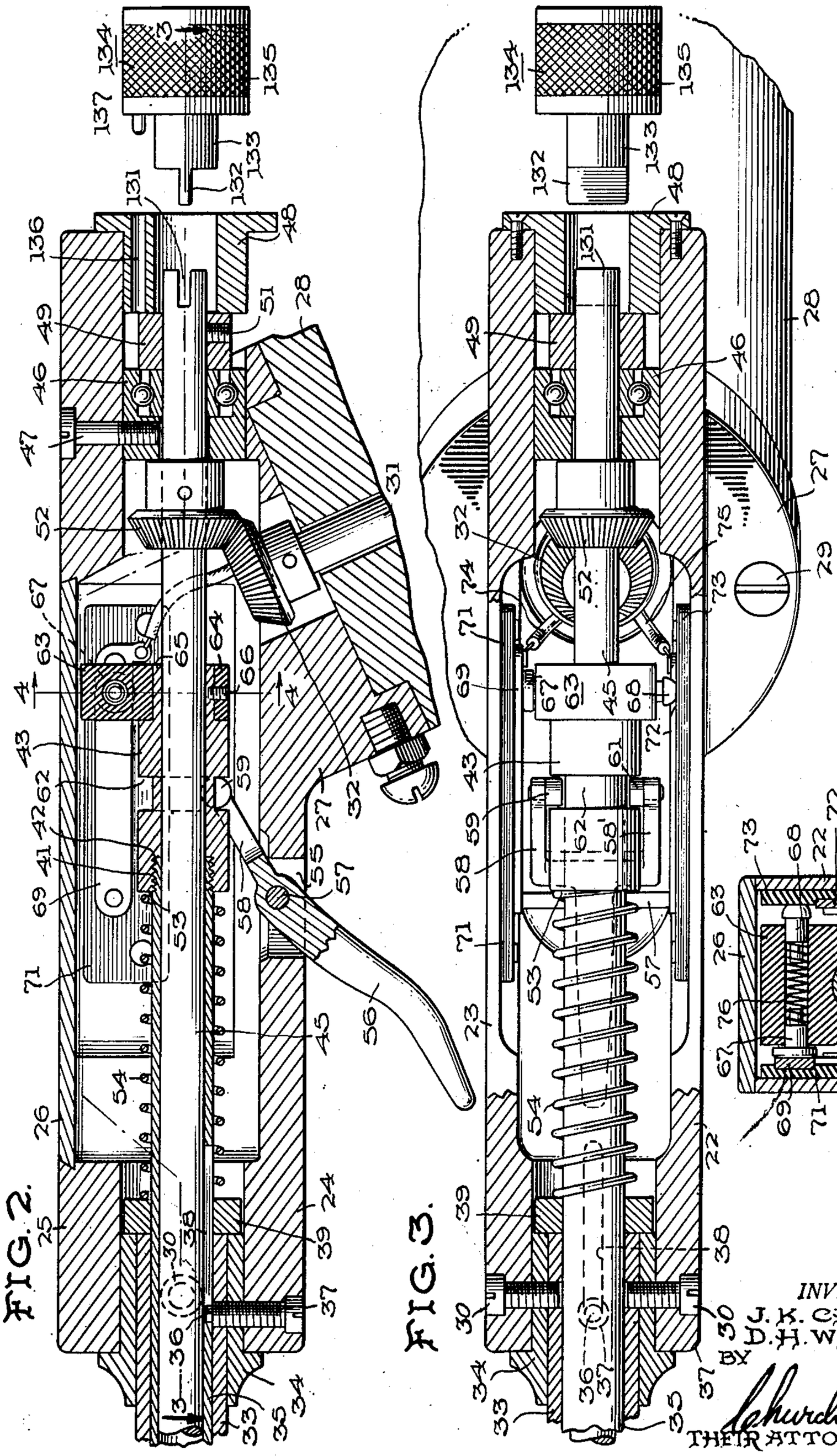

FIG. 2.

FIG. 3.

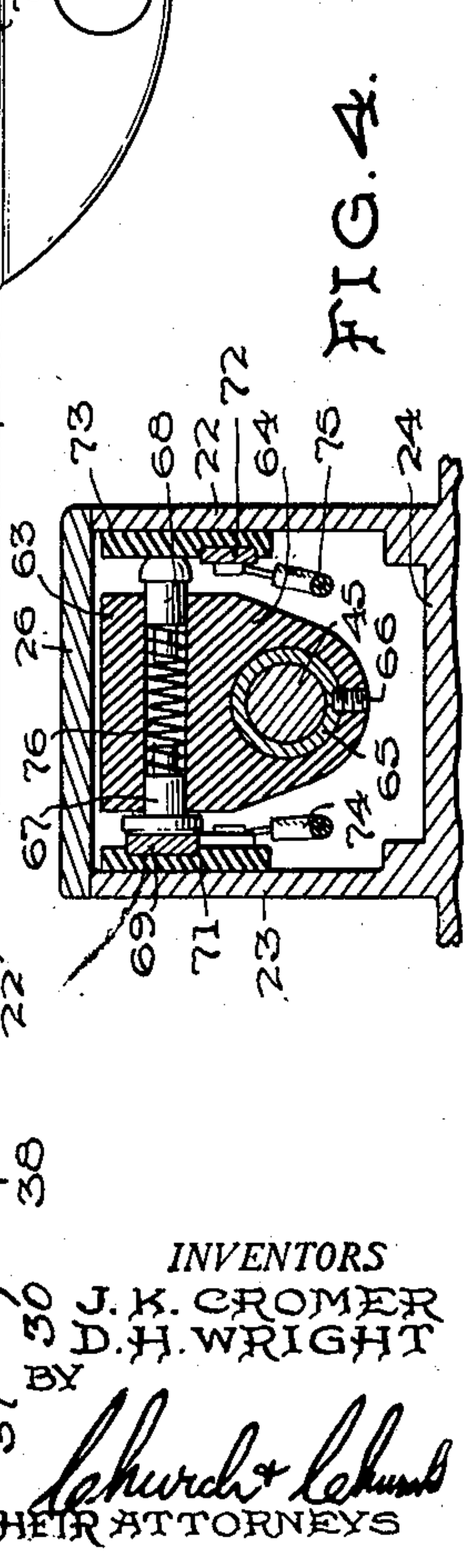

FIG. 4.

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CUTTING INSTRUMENT

Filed Feb. 19, 1952 3 Sheets-Sheet 3

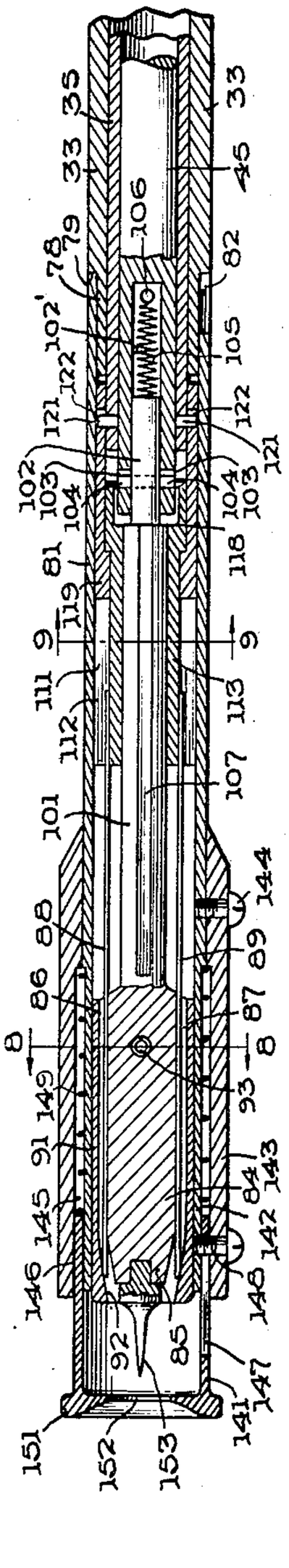

FIG. 5.

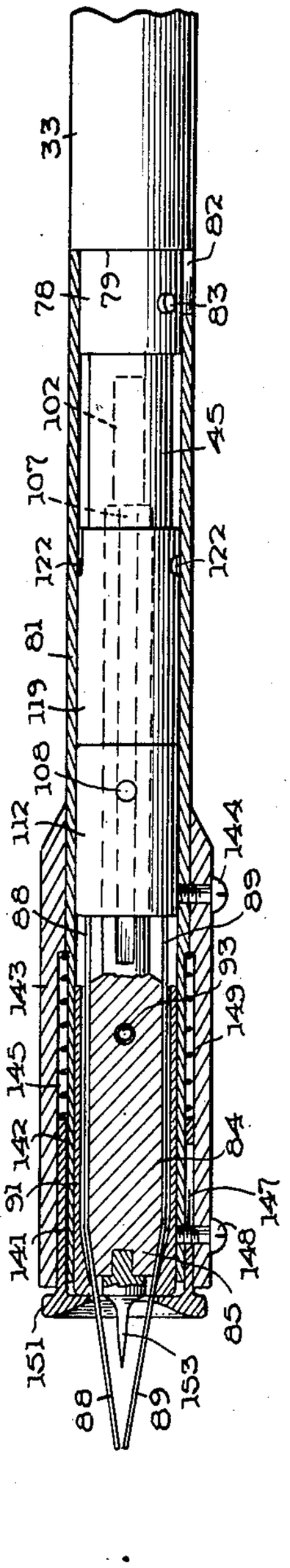

FIG. 6.

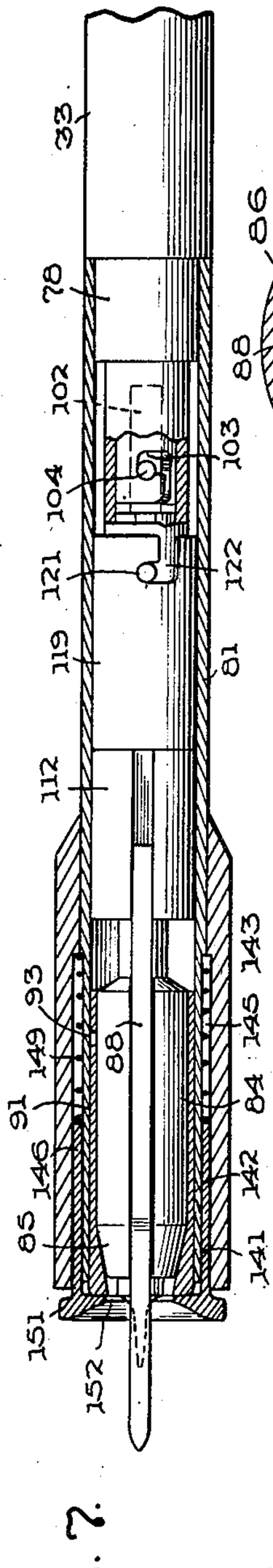

FIG. 7.

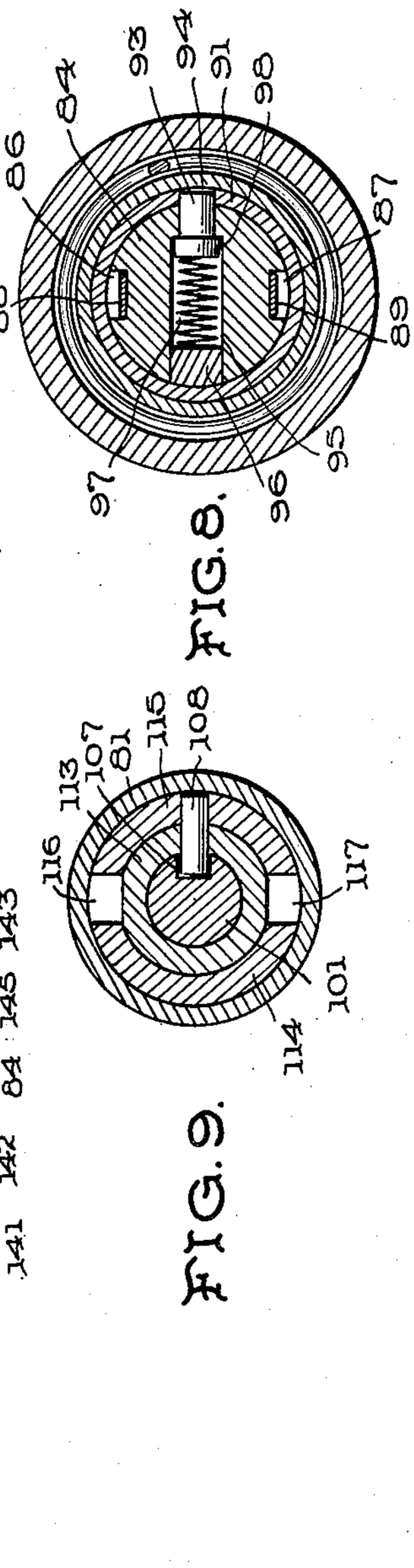

FIG. 8.

FIG. 9.

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United States Patent Office

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2,710,000

CUTTING INSTRUMENT

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Application February 19, 1952, Serial No. 272,344

28 Claims. (Cl. 128—2)

This invention relates to an instrument for cutting and removing a sample from material and particularly concerns a surgical instrument for removing a conically shaped biopsy specimen from the cervix.

Early detection of cancer of the cervix is desirable as the chances of curing the disease are accordingly increased. In addition to examining vagina smear or a cervical scraping, it is desirable to remove a biopsy specimen from the cervix.

A major object of this invention is to provide a cutting instrument with a power driven blade for cutting and removing a sample from material. More particularly, an object of the invention is to provide a cutting instrument for cutting a conically shaped sample from material.

Specifically, an object of the invention is to provide a surgical instrument which may be inserted through the vagina to cut and remove a conically shaped biopsy specimen from the cervix.

In the attainment of these objects, one important feature of the invention resides in the provision of a blade driven to rotate about an axis and arranged to be translated axially while being rotated. At the same time, the blade may be guided toward its axis of rotation so, when inserted into solid matter, it will cut a conical sample from the matter.

Another feature of the invention resides in the arrangement of a housing with a shaft extending longitudinally and rotatable about a longitudinal axis in the housing to rotate a cutting blade supported near one end of the housing and arranged to be translated longitudinally of the shaft during rotation of the blade so the blade extends beyond the end of the housing and is progressively inserted into the matter being sampled. Guidance of the blade toward its axis as it emerges from the end of the housing causes it to cut a conically shaped sample from the matter. In accordance with another feature of the invention, the end of the housing is provided with a longitudinally slidable cup having a rim at its outer end for engaging the matter to be sampled.

A further feature of the invention concerns the arrangement of a drive shaft with a cutter head rotated by the shaft and having one or more cutter blades slidable axially of the head by translation of a sleeve surrounding the shaft. A still further feature of the invention resides in the arrangement of couplings for the shaft, the cutter head and a housing extension so these parts may be removed from the main housing for sterilization purposes.

Other features and objects of the invention will become apparent from the following specification taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a side elevational view of a surgical instrument embodying the invention in its preferred form, the housing being foreshortened to illustrate the device on an adequate scale;

Fig. 2 is a partial vertical sectional view of the instrument shown in Fig. 1;

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is a longitudinal sectional view through the outer end of the instrument shown in Fig. 1, the cup at the end of the instrument being shown in its projected position and the cutter blades being shown in their retracted positions;

Fig. 6 is a view similar to Fig. 5 but showing the cup in its retracted position and the blades in their extended positions;

Fig. 7 is a view similar to Fig. 6 but taken on the plane normal to the section plane of Fig. 6;

Fig. 8 is a transverse sectional view taken on the line 8—8 of Fig. 5;

Fig. 9 is a transverse sectional view taken on the line 9—9 of Fig. 5;

Fig. 10 is an exploded perspective view showing parts of the instrument in disassembled relation; and

Fig. 11 is a side elevational view of the cutter head with the cap removed.

In accordance with the preferred form of the invention, a housing has a main portion depending from which is a motor. A shaft extends longitudinally of the main portion of the housing through a bell-like forwardly extending portion of the housing. This shaft is rotatably mounted and connected by gearing to a motor in the handle of the housing. Surrounding the shaft and extending longitudinally of it is a sleeve. One or more cutter blades are rotated by the shaft and moved axially thereof by reciprocation of the sleeve.

A cutter head has guideways for directing the blade or blades toward the axis of rotation as they are moved longitudinally forwardly. The cutter head may be connected by a coupling to the shaft and has a rotatable but axially slidable connection to a collar to which the cutter blades are attached. The cutter blades rest in guideways extending longitudinally of the cutter head, and the cutter head may have a frusto-conical forward portion. Snugly fitting around this cutter head is a sleeve of cylindrical shape but having a tapered inner periphery at one end for cooperating with the frusto-conical end of the cutter head. Thus, the guideways are enclosed and the blades, upon being translated longitudinally, are directed by the frusto-conical portion of the head and the tapered portion of the sleeve toward the axis of rotation.

The collar for rotating the blades is rotatably connected to a coupling which may be connected to the translatable sleeve. Thus, translation of the sleeve effects translation of the cutter blades with respect to the cutter head during rotation of the cutter head and blades. A housing extension surrounds the cutter head and may be detachably connected to the forwardly extending part of the main housing. Translation of the sleeve may be effected by a trigger supported in the main part of the housing. This trigger may also actuate a switch for energizing the motor to rotate the shaft upon translation of the sleeve.

At the end of the shaft, and projecting beyond the end of the housing extension, there is arranged a cusp which enters the material being sampled at the axis of the cone of the specimen to be removed. Slidable on the end of the housing extension is a cup having a rim for engaging the material being sampled and normally extending beyond the point of the cusp. Upon application of the tool to the matter to be sampled, the cup is moved to its retracted position exposing the cusp and forming a base which may be placed against the material being sampled.

After the conically shaped specimen has been cut by rotation and translation of the cutter blades, the housing is moved away from the material being cut so the cusp

withdraws the specimen and the cup surrounds the specimen as it is withdrawn, thereby preventing the specimen from being dislodged.

For a more detailed description of the invention, reference may be had to the drawings where the cutting instrument shown in Fig. 1 has a main housing 21 of rectangular cross-section (Fig. 4) with sides 22 and 23, a bottom 24, and a top 25. The top is provided with an opening which may be closed by a sliding cover 26, the edges of which are angularly cut to diverge downwardly and cooperate with downwardly diverging shoulders at the ends of the opening. Integrally formed with the bottom 24 of the main housing 21 is a circular base 27 to the bottom of which is secured a motor in a cylindrical housing 28. The motor may be secured to the base 27 as by bolts such as the bolt 29 shown in Fig. 3 extending downwardly through the base.

Driven by the motor in housing 28 is a drive shaft 31 to the upper end of which is fixed a bevel gear 32.

Extending forwardly from housing 21 is a cylindrical housing part 33 secured in grommet 34 mounted in the forward end of main housing 21 as by bolts 30, 30. Slidable within the cylindrical housing 33 is a cylindrical sleeve 35, guided for longitudinal sliding movement, but prevented from rotation by engagement of reduced end 36 on bolt 37 with a slot 38 formed in the under side of the sleeve in the area of the grommet 34. Bolt 37 extends through the main housing, the grommet 34 and the cylindrical housing 33 into the slot 38. Housing 33 may be secured to a collar 39 surrounding the sleeve 35 and abutting the inner end of the grommet 34.

Sleeve 35 has a rearwardly extending portion disposed within the main housing 21 and having a threaded end 41 engaged with a threaded socket 42 in a cylindrical sleeve operating member 43. Rotatably supported by sleeve 35 is a shaft 45 extending longitudinally of the sleeve, through the sleeve operating member 43, and rearwardly through a bearing 46 mounted in the rear part of main housing 21 and secured thereto as by a bolt 47 extending downwardly through the top of the housing. Arranged between the bearing 46 and a bushing 48 extending into the back of the housing is a collar 49 secured to the shaft by a set screw 51 for the purpose of preventing longitudinal movement of the shaft with respect to the housing. Keyed to the shaft 45 and meshing with bevel gear 32 is a bevel gear 52 for rotating the shaft 45 upon rotation of the drive shaft 31 of the motor.

Disposed between collar 39 and forward edge 53 of the sleeve operating member 43 is a coiled compression spring 54 normally urging the sleeve rearwardly of the housing so the bolt end 36 engages the forward part of slot 38. Pivoted in an opening 55 in the bottom 24 of the housing 21 is a trigger 56 on pivot pin 57 having a bifurcated upper end formed by arms 58 and 58' carrying rollers 59 and 61 arranged in an annular groove 62 formed in the body of the sleeve operating member 43. Using the motor housing 28 as a handle or a hand grip, the trigger 56 may be pulled toward the hand grip to move sleeve operating member 43 forwardly against the compression of spring 54 and slide sleeve 35 forwardly with respect to the cylindrical housing 33 and the shaft 45.

Carried by the upper portion of the rearward end of the sleeve operating member 43 is an insulating block 63 mounted on a bracket 64 surrounding the reduced rear end 65 of the sleeve operating member 43 and secured thereto as by a set screw 66. Insulating block 63 is provided with a transverse bore (Fig. 4) in the ends of which are disposed a pair of brushes 67 and 68. Brush 67 is arranged to engage a conducting bar 69 mounted on an insulating strip 71 on the side 23 of the housing 21. Brush 67 may at all times be in engagement with the conducting bar 69. On the other hand, brush 68 is arranged to engage a similar conducting bar 72 mounted on an insulating strip 73 on the opposite side

22 of the housing 21. Conducting bar 72 is not as long as the bar 69 and is of such length that the brush 68 will be disengaged from the conducting bar 72 when the sleeve 35 is in its retracted position and the trigger 56 is in its released position as illustrated in Figs. 2 and 3 of the drawings. Conducting bars 69 and 72 are respectively connected to leads 74 and 75 which are in series with one of the power leads for the motor. Thus, the motor is normally deenergized, but upon pulling the trigger 56 to slide sleeve operating member 43 forwardly, contact 68 engages conducting bar 72 to complete the circuit for energizing the motor. Contacts 67 and 68 are normally urged toward their respective conducting bars by a spring 76 disposed within the transverse bore between the two contacts.

At its forward end, cylindrical housing 33 has a terminal portion 78 of reduced diameter providing a shoulder 79 between the terminal portion 78 and the cylindrical housing 33. Terminal portion 78 serves as a base for supporting a housing extension 81, also of cylindrical shape, and having an internal diameter corresponding to the external diameter of the terminal portion 78. Housing extension 81 is provided with a bayonet slot 82 cooperating with a pin 83 on the terminal portion 78 for the purpose of coupling the housing extension to the cylindrical housing 33 to form a continuous housing extending from the main housing 21 to the end of the instrument. The purpose of this detachable coupling is to permit removal of the housing extension for purposes to be discussed below.

Rotatable within the housing extension 81 is a rotary cutter assembly which includes a cutting head 84 of cylindrical shape having its forward end 85 longitudinally tapered to provide a frusto-conical shape and formed with a pair of diametrically opposed longitudinally extending channels 86 and 87 for accommodating rotary cutting blades 88 and 89, respectively. Surrounding cutting head 84 and forming a part of the rotary cutter assembly is a sleeve 91 having an internal diameter corresponding to the external diameter of the cutting head 84 and having an external diameter corresponding to the internal diameter of the housing extension 81. At its forward end, the internal surface of sleeve 91 is tapered longitudinally to provide an internal frusto-conical surface 92 corresponding to the frusto-conical surface 85 on the cutting head 84. Inasmuch as the channels 86 and 87 extend longitudinally of the cutting head 84 and converge toward each other along the frusto-conical surface 85, the sleeve 91 cooperates with the channels 86 and 87 to provide enclosed guideways in which the blades 88 and 89 may slide axially of the housing and the cutting head. Sleeve 91 is retained on the cutting head 84 by a stud 93 slidable in a transverse bore in the cutting head into a hole 94 in the sleeve 91. Stud 93 is inserted through an enlarged transverse bore 95 in the cutting head 84 which is closed by a plug 96. A spring 97 interposed between the plug 96 and head 98 on the stud 93 normally urges the stud into the hole 94 in the sleeve.

Extending rearwardly from the cutting head 84 is a shaft 101 connected to the cutting head and preferably integrally formed therewith. At its rear end, shaft 101 has a reduced terminal portion 102 of a diameter integrally received in axial bore 102' in the terminal end of shaft 45. The shaft 45 is provided with a bayonet slot coupling 103, 103 cooperating with pins 104, 104 on the reduced end 102 of shaft 101 providing a detachable coupling between the shaft 45 and shaft 101. Preferably, a compression spring 105 is anchored by a pin 106 in the axial bore 102' for engaging the end of the terminal portion 102 on shaft 101 thereby retaining the pins 104 in the bayonet slot 103 and preventing decoupling of the shafts. Shaft 101 has its surface formed with a longitudinally extending keyway 107 in which slides a pin 108 to provide a sliding connection between

the shaft **101** and a two-part collar **111** forming a part of the rotary cutter assembly.

Part **112** of the two-part collar **111**, which carries the pin **108**, is composed of a core member **113** having a sliding fit on shaft **101** and carrying a pair of substantially semi-cylindrical members **114** and **115** (Fig. 9) spaced apart by longitudinally extending channels **116** and **117** to accommodate the ends of cutter blades **88** and **89**, respectively. Cutter blades **88** and **89** may be secured as by brazing or welding to the core member **113** so the blades will rotate with the core **113** of the part **112** of two-part collar **111** and will also translate axially upon sliding movements of the two-part collar relative to the shaft **101**. Pin **108** extends through the core **113** and semi-cylindrical member **115** so part **112** operates as a unit.

At its rear end, core **113** of part **112** of the two-part collar has a terminal portion **118** of enlarged diameter disposed within the bore of part **119** of the two-part collar **111**. Cooperation of shoulders on the core **113** and the inner surface of part **119** retains the part **119** in abutting relationship with part **112** so parts **112** and **119** of the two-part collar **111** are relatively rotatable but move axially as a unit. Core **113** serves to retain the parts in their axial relationship but permits relative rotation thereof by reason of the rotatable connection between the part **119** and the enlarged terminal **118** of the core **113**. Near its rear end, the internal diameter of part **119** corresponds to the external diameter of sleeve **35** and is arranged to overlap that sleeve and be coupled thereto by cooperation of pins **121, 121** on the sleeve **35** with bayonet slots **122, 122** in the collar part **119**.

From the description, it will be apparent that translation of the sleeve **35** axially with respect to shaft **45** will effect corresponding translation of the two-part collar **111** and the blades **88** and **89** while the shaft **45** is operating through shaft **101** to rotate the cutting head and the blades. Axial movement of the blades during rotation thereof causes the blades to converge toward their axis of rotation by reason of the frusto-conical shape at the end of the cutting head. In this fashion, the rotary blades make a conical cut to remove a specimen of the material being sampled.

To aid in assembling the parts of the cutting instrument, the shaft **45** has at its rear end a transverse slot **131** arranged to be engaged by a tooth **132** on head **133** of a key **134** having a large knurled knob **135**. Head **133** is arranged to enter the bore of bushing **48** and permit tooth **132** to engage notch **131**. The purpose of the key is to prevent rotation of the shaft **45** and to this end, bushing **48** is provided with an axial bore **136** transversely spaced with respect to the shaft **45** and arranged to receive a pin **137** on the knob **135**. Thus, with the tooth **132** engaging the notch **131** and the pin **137** disposed in bore **136**, the shaft **45** is locked against rotation with respect to the housing. Having thus locked the shaft, the rotary cutting head assembly may be easily attached to the cutting instrument. To accomplish this, terminal portion **102** of shaft **101** is inserted in bore **102'** formed in the end of drive shaft **45**. This compresses spring **105** until pins **104, 104** are received in bayonet slots **103, 103** formed in the terminal portion of the drive shaft **45**. Then, by rotating the shaft **101** with respect to the instrument, the pins may be locked in the bayonet slots where they are retained by the compressive force of spring **105**. Next, two-part collar **111** is moved axially with respect to the shaft **101** until bayonet slots **122, 122** are engaged by pins **121, 121** on the sleeve **35**. Then, relative rotation of the two-part collar with respect to the sleeve **35** locks inner part **119** to the sleeve. Finally, housing extension **81** is slipped over terminal portion **78** of housing **33** until pin **83** enters slot **82**. Then, the housing extension **81** may be locked to the housing **33** by relative rotation of those parts until the pin is secured in the slot.

When thus assembled, sleeve **35** is translatable axially within cylindrical housing **33** and shaft **45** rotates within the sleeve **35**. Housing extension **81** cooperates with cylindrical housing **33** to provide a continuous cylindrical housing. Within the housing extension **81**, the cutting head assembly is rotatable and two-part collar **111** is slidable axially. The forwardmost end of the housing extension **81** provides a rotary bearing for the cutting head and particularly for sleeve **91** of the cutting head. Thus, when power is applied to shaft **45**, it drives through shaft **101** to rotate the cutting head **84**, and the cutting blades **88** and **89** carried thereby. Translation of the sleeve **35** effects translation of the two-part collar **111** thereby axially moving the cutting blades **88** and **89** relative to the cutting head **84**. This axial movement through the converging portions of the channels **86** and **87** causes the cutting blades **88** and **89** to converge as they move out of the end of the cutting head.

To provide a guide for the end of the cutting head and also to provide a cup for retaining the specimen cut by the cutting blades **88** and **89**, a cup **141** is slidably mounted on the end of the instrument. For this purpose, the outermost end of housing extension **81** has its external surface provided with a reduced diameter portion **142**. An end cover **143** of cylindrical formation is secured by a bolt **144** to the end of the housing extension **81**. The inner surface of the cover **143** has an outer portion of enlarged diameter to accommodate cup **141** and an inner portion of reduced diameter corresponding to the outer end portion of the housing extension **81**. Thus, these parts have their portions snugly fitting to secure the cover on the housing extension and provide between their walls an annular recess **145** in which the annular inner end **146** of the cup **141** is slidably mounted. Cup **141** is provided with an axial slot **147** engaged by a set screw **148** mounted in the cover **143** and extending through the slot **147**. This set screw **148** cooperates with slot **147** to retain the cup mounted on the end of the instrument but permit axial movement between the cup and the end of the housing. A light compression spring **149** is coiled around the end of the housing extension and disposed within the recess **145** to engage the inner end of the cup **141** and normally urge it outwardly beyond the end of the instrument.

At its outer end, cup **141** is provided with an annular rim **151** which has an opening **152** of smaller diameter than the internal diameter of the cylindrical inner surface of the cup. Through this opening, a cusp **153** mounted in the outer end of cutting head **84**, may project during operation of the instrument as may the converging cutting blades **88** and **89**.

In operation, the instrument is held using the motor housing **28** as a hand grip and with one finger on the trigger **56**. Then, the rounded rim **151** of the cup **141** is placed against the surface of the material to be sampled. Next, the instrument is moved toward the material to be sampled, thereby moving the end of the instrument with respect to the rim of the cup and causing cusp **153** to project through opening **152** and enter the surface of the material to be sampled. When the instrument has been moved until the outer end of the cup abuts the outer end of the sleeve **91**, as shown in Fig. 6, the operator presses the trigger which first closes contacts **68** and **69** to energize the motor and rotate motor shaft **31**, drive shaft **45**, shaft **101**, and the cutter head **84** as well as part **112** of the two-part collar **111**. This latter rotation is effected through the key pin **108** which is in engagement with the axial slot **107** in the shaft **101**. Rotation of part **112** of the two-part collar **111** and the cutter head **84** causes rotation of the two cutting blades **88** and **89** about the longitudinal axis of the instrument. Preferably, each of these cutting blades is made of spring steel and has a sharpened edge extending along one side longitudinally

of the instrument, the cutting blades themselves being of elongated formation so they are effective to cut during translation of the blades.

Depression of the trigger **56** starts rotation of the blades and causes translation of sleeve **35** with respect to housing **33** and shaft **45**. This translation is effective through coupling **121** and **122** to translate part **119** of two-part collar **111** with respect to housing extension **81** and cutting head shaft **101**. Hence, with continued rotation of the cutting head **84** and the cutting blades **88** and **89**, translation of the two-part collar **111** causes axial movement of the cutting blades **88** and **89** with respect to the cutting head. As the ends of the cutting blades **88** and **89** move through the portions of channels **86** and **87** in the tapered end portion of the cutting head, the blades are bent toward the axis of rotation, and the ends of the blades **88** and **89** converge axially thereby moving in a conical path with their axis of rotation as a center. This is continued until the blades reach the position shown in Figs. 6 and 7 where they are fully extended and have cut a conically shaped specimen from the material being sampled. The sample is confined between the blades **88** and **89** and is secured by cusp **153** on the end of the cutting head. At this point, the trigger **56** may be released thereby withdrawing the cutting blades **88** and **89** and stopping the motor to arrest rotary movement of the blades. After this, the instrument may be withdrawn from the surface of the material being sampled. During this withdrawal, rim **151** remains in engagement with the surface of the material being sampled in an annular area surrounding the cut sample. Withdrawal of the instrument itself withdraws the cusp **153** so the sample is drawn within the cup **141**. Then, the instrument may be removed, during which time the specimen on the cusp **153** is protected by the cup **141**.

In the particular application for which this preferred form of the instrument was designed, the end of the instrument is inserted in the vagina until the rim **151** engages the cervix following which the insertion of the instrument is continued until cusp **153** enters the specimen to be removed. Then the trigger is operated to rotate and simultaneously translate the cutting blades so they move toward their axis of rotation to effect a conical cut. Subsequent withdrawal of the instrument withdraws the conically shaped specimen within the cup **141** where it is protected while the instrument is removed.

The particular arrangement of the removable housing extension **81** and the removable cutting head assembly permits these parts of the instrument to be sterilized after which the parts may be assembled as previously described and the instrument used to remove a conically shaped specimen.

In this preferred embodiment of the invention, the cutting and removal of a conically shaped specimen is effected by rotation of an elongated blade about an axis while simultaneously moving the blade axially with respect to its axis of rotation and also moving the blade toward its axis of rotation during such axial movement. This is accomplished by the arrangement of the blades in a rotating cutting head provided with a guideway through which they may slide and be moved toward its axis of rotation while it is being rotated. While the preferred embodiment of the invention utilizes a pair of diametrically disposed blades, the same result may be accomplished by a single blade operated in the same manner.

While the foregoing specification describes and the accompanying drawings illustrate a preferred embodiment of the invention, it is contemplated that many changes may be made in the construction of the instrument and its method of operation without departing from the scope of the invention. Therefore, this specification and the drawings are intended to be illustrative and are not to be construed in a limiting sense.

What is claimed is:

1. A cutting instrument comprising an elongate blade having a cutting edge extending along one side, means for rotating said blade about an axis, a guideway in which the rotating blade is slidable lengthwise, said guideway being arranged to guide the blade in a path extending axially of and toward said axis, and means for translating the rotating blade along said guideway, whereby said blade cuts a conical specimen from material into which it is inserted while being rotated.

2. A cutting instrument comprising a pair of elongate blades having cutting edges extending longitudinally along their sides, guideways for said blades, means for rotating said blades and said guideways about a common axis, and means for translating the rotating blades axially in paths intersecting said axis.

3. A cutting instrument comprising a flexible blade, means for rotating said blade about an axis, and means for translating said blade lengthwise of said axis and simultaneously bending said blade toward said axis during rotation of the blade.

4. A cutting instrument comprising a blade having a cutting edge along one side, means for rotating said blade about an axis, means for translating said blade lengthwise during rotation of the blade, and means for guiding said blade toward said axis during lengthwise movements of the blade.

5. A cutting instrument comprising a housing, a flexible blade in said housing, means for rotating said blade about an axis extending longitudinally of said housing, and means for translating said blade longitudinally of said housing and simultaneously bending said blade toward said axis during rotation of the blade.

6. A cutting instrument comprising a pair of flexible cutting blades, means for rotating said blades about a common axis, and means for translating said blades longitudinally of said axis and simultaneously bending said blades toward said axis during rotation of the blades.

7. A cutting instrument comprising a pair of blades, means for rotating said blades about a common axis, means for translating said blades longitudinally of said axis during rotation of the blades, and means for guiding said blades toward said axis during longitudinal movement of the blades.

8. A cutting instrument comprising a housing, a motor carried by said housing, a shaft driven by said motor, a knife connected to said shaft for rotation therewith, said knife being translatable longitudinally of said housing with respect to said shaft, a trigger carried by said housing and coupled to said knife for translating said knife with respect to said shaft, and a switch operated by initial movement of said trigger, for energizing said motor whereby operation of said trigger starts the motor and translates the knife with respect to said shaft.

9. In a cutting instrument, a cutting head rotatable about an axis, a guideway in said head extending in an axial direction toward said axis, and a cutting blade slidably arranged in said guideway for rotation with said head about said axis.

10. In a cutting instrument, a cutting head rotatable about an axis, a pair of guideways in said head extending in an axial direction and converging toward said axis, and a pair of cutting blades slidably arranged in said guideways for rotation with said head about said axis.

11. In a cutting instrument, a cylindrical cutting head having a tapered end of frusto-conical shape, an axial channel in the outer surface of said head extending along said tapered end in a direction toward said axis, a sleeve surrounding said head and covering said channel to form therewith an enclosed guideway, and a cutting blade slidably arranged in said guideway for rotation with said head about said axis.

12. In a cutting instrument, a cylindrical head having a tapered end of frusto-conical shape, said cylindrical head and tapered end being formed with a pair of axial channels angularly spaced about the outer surface of said head, a sleeve covering said head and cooperating with said

channels to form a pair of guideways extending axially of said head and converging along said tapered end toward said axis, and a pair of blades in said guideways.

13. In a cutting instrument, a cutting head rotatable about an axis, said head being of cylindrical shape with a tapered end and formed with an axial channel in its outer surface extending along said end, a sleeve surrounding said cutting head and being formed with an internally tapered bore cooperating with the tapered end of said cutting head and covering said channel to form an enclosed guideway along which a cutting blade may slide axially of said cutting head and converge toward said axis, and a cutting blade in said guideway slidable therealong and rotatable with said head about said axis.

14. In a cutting instrument, a shaft, means for rotating said shaft, a cutting head at one end of said shaft, said cutting head being formed with a guideway extending axially of said shaft and toward the axis of rotation thereof, a cutting blade disposed in said guideway and slidable therealong, a collar keyed to said shaft and spaced from said cutting head, said collar being slidable relative to said shaft and connected to said cutting blade, and means for moving said collar axially of said shaft during rotation thereof to translate said blade in said guideway.

15. A cutting instrument comprising a housing, a shaft rotatably supported in said housing, means for rotating said shaft, a cutting head on one end of said shaft formed with a guideway extending axially toward said shaft, a cutting blade disposed in said guideway, a two-part collar surrounding and slidable along said shaft, one part of said collar being slidably keyed to said shaft and connected to said cutting blade, the other part of said collar being connected to the first part in a manner permitting relative rotation of said parts, and a trigger supported on said housing and coupled to said other part of said collar for translating said collar axially of said shaft during rotation thereof to translate said knife along said guideway.

16. In a cutting instrument, a housing, a rotary knife carried within said housing and movable axially beyond one end of said housing, a cylindrical cup on said one end of said housing having an annular rim at its outer end for engaging the material to be cut, said cup being slidable axially of said housing between a projected position with said rim spaced beyond said one end of said housing and a retracted position with said rim adjacent said one end of said housing.

17. In a cutting instrument, a housing, a rotary knife supported within said housing and movable axially beyond one end of said housing, a cylindrical cup on said one end of said housing having an annular rim at its outer end for engaging the material to be cut, said cup being slidable axially of said housing between a projected position with said rim spaced beyond said one end of said housing and a retracted position with said rim adjacent said one end of said housing, and spring means interposed between said housing and the inner end of said cup normally urging said cup toward its projected position.

18. In a cutting instrument, a housing, a shaft extending longitudinally of said housing, a rotary knife driven by said shaft and movable axially beyond one end of said housing, a cusp on a head at the end of said shaft projecting beyond said one end of said housing, a cylindrical cup on said one end of said housing having an annular rim at its outer end for engaging the material to be cut, said cup being slidable axially of said housing between a projected position surrounding said cusp with said rim spaced beyond said one end of said housing and a retracted position with said rim adjacent said one end of said housing thereby exposing said cusp.

19. In a cutting instrument, a housing, a shaft extending longitudinally of said housing, a rotary knife driven by said shaft and movable axially thereof and axially of said housing beyond one end of said housing, and an axially aligned cusp on a head at the end of said shaft normally extending beyond the end of said rotary knife.

20. A cutting instrument comprising a housing, a shaft rotatably mounted and extending longitudinally in said housing, a sleeve surrounding said shaft and slidable relative to said shaft and said housing, a cutter blade connected to said shaft to be rotatably driven thereby, said blade being connected to said sleeve and slidable therewith, and means for translating said sleeve axially of said housing and said shaft for moving said blade longitudinally of said housing during rotation of said blade by said shaft.

21. A cutting instrument comprising a housing, a shaft rotatable in said housing about a longitudinal axis, a sleeve surrounding said shaft and slidable axially thereof within said housing, a cutter blade connected to said shaft to be rotated thereby and connected to said sleeve to slide therewith, and a trigger on said housing coupled to said sleeve for translating said sleeve longitudinally of said housing and said shaft to move said blade axially of said shaft beyond said housing during rotation of said blade.

22. A cutting instrument comprising a housing, a shaft mounted in said housing for rotation about a longitudinal axis, a sleeve surrounding said shaft and slidable longitudinally relative to said shaft and said housing, a collar connected to said shaft for rotation thereby and connected to said sleeve for translation thereby, a cutter blade connected to said collar for movement therewith, and means for translating said sleeve during rotation of said shaft for projecting said blade beyond said housing during rotation of the blade.

23. A cutting instrument comprising a housing, a drive shaft rotatable in said housing and extending longitudinally thereof, a cutting head, a shaft extending rearwardly from said cutting head, a coupling connecting said shafts for rotation together, a sleeve surrounding said drive shaft and translatable longitudinally thereof, a cutter blade slidably carried by said cutting head and connected to the shaft thereof to be rotated by said drive shaft, said blade being connected to said sleeve for translation therewith, and means for translating said sleeve longitudinally of said housing to move said cutter blade axially along said cutting head beyond the end of said housing during rotation of the blade.

24. A cutting instrument comprising a housing, a shaft rotatably mounted in said housing and extending longitudinally thereof, a sleeve surrounding said shaft and slidable in said housing longitudinally of said shaft, a cutting head rotatable in said housing and having a shaft extending rearwardly therefrom, coupling means connecting said shafts for rotation together, a collar surrounding the shaft on said cutting head, means connecting said collar for rotating said shaft on said cutting head for rotation therewith and permitting relative longitudinal movement of said collar with respect to said cutting head, a blade connected to said collar and extending through said cutting head, a coupling connected to said collar for rotation relative thereto and detachably connected to said sleeve for translating said collar upon translation of said sleeve, and means for translating said sleeve during rotation of said shaft to move said blade longitudinally of said cutting head beyond the end of said housing during rotation of the blade.

25. A cutting instrument comprising a housing, a shaft rotatably mounted in said housing and extending longitudinally thereof, a sleeve surrounding said shaft and slidable axially thereof within said housing, a cutting head extending beyond said housing and having a shaft coupled to said drive shaft, a collar connected to said shaft on said cutting head for rotation therewith and slidable axially thereof, a blade connected to said collar and projecting along said cutting head, means connecting said collar to said sleeve in a manner permitting relative rotation of said collar and said sleeve, a housing extension surrounding said cutting head and said collar, coupling

means connecting said housing extension to the end of said housing, and means in said housing for translating said sleeve axially of said shaft to move said collar and said blade relative to said cutting head to protect said blade beyond said housing extension during rotation of the blade.

26. A cutting instrument comprising a housing, a shaft rotatably mounted in said housing and extending axially beyond one end thereof, a sleeve surrounding said shaft and translatable axially thereof relative to said housing, a blade connected to said shaft for rotation thereby and connected to said sleeve for translation therewith, said blade extending beyond the end of said housing, a housing extension surrounding said shaft and said blade, means for coupling said housing extension to said housing to provide a unitary casing for said shaft and said blade, and means for translating said sleeve to slide said blade relative to said shaft beyond the end of said housing extension during rotation of the blade.

27. A cutting instrument comprising a housing, a shaft rotatable in said housing and extending longitudinally thereof, a cutting blade connected to said shaft for rotation therewith and slidable axially thereof, a sleeve slidable in said housing axially of said shaft, means coupling said blade to said sleeve permitting rotation of said blade relative to said sleeve, and means for translating said sleeve axially of said housing to slide said blade beyond the end of said housing during rotation of the blade.

28. A cutting instrument comprising a housing, a shaft rotatable in said housing and extending longitudinally thereof, a motor carried by said housing and operatively coupled to said shaft, a sleeve surrounding said shaft and slidable axially thereof in said housing, a cutter blade connected to said shaft for rotation therewith and connected to said sleeve for translation therewith, and a trigger carried by said housing for translating said sleeve to move said blade longitudinally beyond the end of said housing during rotation of said blade by said motor.

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