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(21) International Application Number: PCT/US92/02743 (22) International Filing Date: 3 April 1992 (03.04.92) (30) Priority data: 680,389 4 April 1991 (04.04.91) US (71) Applicant: SYMBIOSIS CORPORATION [US/US]; 8600 N.W. 41st. Street, Miami, FL 33166 (US). (72) Inventor: BALES, Thomas, O. ; 3661 Bougainvillea Road, Miami, FL 33133 (US). (74) Agent: GORDON, David, P.; 65 Woods End Road, Stamford, CT 06905 (US). (81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent).		Published <i>Without international search report and to be republished upon receipt of that report.</i>
(54) Title: INSULATING FERRULE FOR ENDOSCOPIC SURGICAL INSTRUMENT (57) Abstract A ferrule for a laparoscopic surgical instrument is disclosed. The ferrule is an integral plastic piece which shields a peripheral uncovered portion of a metal tube of the surgical instrument which is intermediate a shrink wrap covered portion of the metal tube and an actuator housing which closely surrounds an extended portion of the metal tube. The ferrule has first and second end portions and a middle portion, with a cylindrical bore in the first end which closely contacts the shrink wrap covered portion of the metal tube, a first outwardly flaring frusto-conical bore in the middle portion and adjacent the cylindrical bore which surroundingly covers the uncovered portion of the metal tube, and a second outwardly flaring frusto-conical bore in the second end adjacent the first outwardly flaring bore. The second outwardly flaring frusto-conical bore has a smaller inner diameter than the adjoining portion of the first frusto-conical bore to provide an inwardly depending projection which closely, matingly engages a peripheral channel in the housing surrounding the extended portion of the metal tube. The ferrule is color coded to signify the type of surgical instrument of which it is part.		

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INSULATING FERRULE FOR ENDOSCOPIC SURGICAL INSTRUMENT

BACKGROUND OF THE INVENTION

The present invention broadly relates to endoscopic surgical instruments. More particularly, the invention relates to surgical instruments which include end effectors such as cutters, graspers, and dissectors which are useful in endoscopy and laparoscopy procedures and which may be disposed of after a single use.

The endoscopy and laparoscopy procedures have recently become widely practiced surgical procedures. The endoscopy and laparoscopy procedures involve incising through body walls (e.g., such as the abdominal wall) for examining, viewing and/or operating on the ovaries, uterus, gall bladder, bowels, appendix, etc. or for general abdominal surgery. Typically, trocars are utilized for creating the incisions. Trocar tubes are left in place in the abdominal wall so that the endoscopic or laparoscopic surgical tools may be inserted through the tube. A camera or magnifying lens is often inserted through the largest diameter trocar tube (e.g. 10mm diameter) which for the laparoscopy procedure is generally located at the navel incision, while a cutter, dissector, or other surgical instrument is inserted through a smaller diameter trocar tube (e.g. 5 mm diameter) for purposes of manipulating and/or cutting the internal organ. Sometimes it is desirable to have several trocar tubes in place at once in order to receive several surgical instruments. In this manner, organ or tissue may be grasped with one surgical instrument, and simultaneously may be cut or stitched with another surgical instrument; all under view of the surgeon via the camera in place in the navel trocar tube.

The endoscopic and laparoscopic tools of the prior art are primarily reusable stainless steel tools. Between each use of a stainless steel tool, the tool must be soaked, scrubbed, and disinfected. The usual procedure is then to dry the tool, wrap it, and put it in a steam autoclave. The tool is kept sterile until just prior to use when it is removed from the autoclave and unwrapped in the locale of the sterile field of use.

While reusable laparoscopic tools have functioned well for their intended purpose, the process of sterilizing the tool is problematic. Small pieces of tissue or organ often become lodged in the end effectors, and much labor is required to ensure that complete sterility is obtained and maintained. In addition, over time, sharp laparoscopic instruments such as a scissors get dull and must be discarded. However, prior to use of a particular instrument, the surgeon is not able to discern the state of the instrument and whether the instrument will satisfy the surgeon's requirements.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide disposable endoscopic and laparoscopic surgical instruments.

It is another object of the invention to provide surgical instruments of improved design with smooth transitions from an insulating shrink wrap to the end effectors and to the handle of such instruments.

In accord with the objects of the invention, a disposable surgical instrument generally includes, a tube, a push rod which extends through the tube, an actuating means engaging the tube and the push rod for imparting reciprocal axial motion to the push rod, end effector means coupled to the push rod by linkage means which are also coupled to the push rod, and a clevis coupled to the tube at its proximal end and to the end effector means at its distal end, wherein axial movement of the push rod effects movement of the end effector means in a plane parallel to the longitudinal axis of the push rod. Plastic shrink wrap is preferably utilized to electrically insulate the disposable instrument and extends over the aluminum tube and over at least an adjacent portion of the clevis. The tube and push rod are preferably made of aluminum, the clevis is preferably made of a high-strength aluminum alloy, the actuating means is preferably made of plastic and aluminum, and the end effector means is preferably made of investment cast bronze.

The clevis of the invention is preferably a separately formed clevis having a knurled rod-like proximal end for mating with the end of the aluminum tube, and a post-supporting U-shaped distal portion for holding the end effector means. The post in the distal portion is perpendicular to the legs of the U-shaped distal portion and is arranged to extend through hole(s) in the end effector means. In this manner, the blades or prongs of the end effector means are held by, but can rotate around the post. Each leg of the U-shaped distal portion of the clevis also preferably includes a notch which serves as a terminating location for the shrink-wrap.

The other end of the shrink-wrap terminates on the other end of the aluminum tube adjacent the actuating handles. The ferrule of the invention is snapped onto the handle ridge for

guaranteeing continuity of insulation from the tube to the handles. Preferably, the ferrule is formed of plastic and is color coded so that a different color is used for each instrument or class of instruments to distinguish therebetween.

The end effector means of the invention can take any of many forms, such as, e.g., a scissors, a dissector, or a grasper. Additionally, the end effector means can be double acting or single acting. Regardless of the type of end effector utilized, the end effector is arranged with a hole to accept the post of the clevis so that the end effector can rotate around the post.

According to one aspect of the invention the push rod is flattened on its distal end, and the linkage means which couples the push rod and the end effector is a staple which extends through a hole in the flattened end of the push rod as well as another hole in the proximal end of the end effector. Because the outer tube is positioned at a fixed distance from the rotation hole in the end effector (due to the clevis), when the push rod is moved axially relative to the tube, the end effector cannot move axially. However, because the push rod is also a fixed distance away from another hole in the proximal end of the end effector (due to the staple), movement of the push rod relative to the tube causes rotation of the end effector in a plane. In other words, movement of the push rod relative to the tube causes the hole through the end effector through which the staple extends to rotate along an arc centered at the rotation hole in the end effector through which the post of the clevis extends. Movement in this manner typically effects a cutting, dissecting or grasping action.

A better understanding of the surgical instruments of the invention, and additional advantages and objects of the invention will become apparent to those skilled in the art

upon reference to the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevation view, partly in section, of a disposable endoscopic instrument prior to insertion into a trocar tube, and, in partial phantom format, after insertion into a trocar tube;

Figure 2a is a side elevation view, partly in section, of the clevis of the invention in conjunction with the distal end of the tube and shrink wrap of the invention;

Figure 2b is a cross-section view of the device of Figure 2a;

Figure 3a is a partially broken-away side elevation view of the actuating handle of the disposable laparoscopic instrument of the invention;

Figure 3b is a rear elevation view of the device of Figure 3a;

Figure 4a is a side elevation view, partly in section, of a double acting dissector in conjunction with the clevis and the distal ends of the rod and tube of the disposable laparoscopic instrument of the invention, with the staple linkage means shown in perspective and broken out views;

Figure 4b is a plan view of the device of Figure 4a;

Figure 5a is a side elevation view in section of a ferrule shielding device of the present invention engaged with the shrink wrapped aluminum tube and handle of the invention; and

Figure 5b is a cross-section view of the device of Figure 5a.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Figure 1, a disposable endoscopic surgical instrument is indicated at 10. The disposable instrument 10 broadly comprises an aluminum tube 15 surrounded by a peripheral insulating shrink wrap layer of plastic 20, a clevis means 30, end effectors 40, actuating means 50, and a push rod 60. The clevis means 30 is advantageously a separately formed aluminum piece which fixedly engages aluminum tube 15 as described in more detail hereinafter. The clevis 30 also engages the end effectors 40 which are pivotally engaged to clevis 30 at pivot pin 45. The end effectors 40 are preferably formed of investment cast bronze.

The push rod 60, which is also formed of aluminum, is engaged at its distal end 65 to the end effectors 40, as hereinafter more fully described, and is connected at 70, at its proximal end to a manually operable actuating means 50. For purposes herein, the "distal end" of the instrument 10 or any part thereof, is the end closest to the surgical site and distant from the surgeon, while the "proximal end" of the instrument 10 or any part thereof, is the end most proximate the surgeon and distant the surgical site.

In use, the endoscopic/laparoscopic instrument 10 is inserted with the blades or graspers 90, 92 of the end effector 40 in the closed position, into trocar tube 80, as indicated at the arrow 85 of Figure 1. The distal portion of the instrument 10 passes through the trocar tube 80 into body incision 100. Upon the distal portion of the instrument 10 exiting the trocar tube 80, the blades 90, 92 can be opened and closed as indicated at 105 by reciprocal motion of push rod 60 which results from operation of the manual actuating means 50. As is discussed more fully hereinafter, the clevis effectively translates the reciprocal motion of the push rod 60 into the end effector means action indicated at 105.

Turning to Figures 2a and 2b, a preferred configuration of the clevis 30 of the present invention is seen. The clevis has a knurled rod-like proximal portion 34 for mating with the end of the aluminum tube 15, and a post-supporting U-shaped distal portion 32 for holding the end effector means. The outer diameter of the distal portion 32 of the clevis is larger than the outer diameter of the proximal portion 34; shoulder 39 being formed therebetween. The proximal portion 34 of the clevis is preferably hollow, as indicated at 33, to permit the push rod 60 to extend therethrough. The distal portion 32 of the clevis 30 is provided with legs 36 and a post or pivot pin 45. The post 45 is generally perpendicular,

i.e. transverse, to the legs 36 of the clevis and is arranged to extend through hole(s) 39 in the end effector means 40. In this manner, the blades or prongs of the end effector means 40 are held by, but can rotate around, i.e. are rotatably engaged with the post 45.

As seen in Figure 2a, a recess or notch 380 is provided which extends across each leg 36 of the clevis 30. Consequently, a peripherally applied electrically insulating plastic wrap 20 can be end-cut at recess 380 and a smooth transition from the end effector means 40 via the clevis 30 to tube 15 can be achieved. Even if slight outward flaring of wrap 20 occurs at the end-cut, as is common, this flaring can be tolerated as it will be within the envelope of the normal outer surface indicated at 43.

Clevis 30 is preferably made from a high strength aluminum base alloy (e.g. 2024 alloy of Alcoa) which is preferably harder than the aluminum base alloy (e.,g. 6061 or 6063 alloys of Alcoa) from which tube 15 is fabricated. The post portion of the clevis may be made out of the identical alloy or, for added strength, out of a stainless steel nail. In assembly of the laparoscopy surgical instrument 10, serrated or knurled portion 34 of clevis 10 is fit snugly into tube 15 such that the walls of tube 15 abut the peripheral shoulder 39 of clevis 30, with the outer surface of tube 15 and the adjacent outer surface of clevis 30 having essentially the same diameter. Mechanical pressure is then applied to tube 15 peripherally at the location of knurled portion 34, thereby crimping the end portion of tube 15 onto the knurled portion 34. Mechanical pressure causes the projections of the knurls to bite into and firmly engage tube 15 as indicated at 37 due to the higher hardness of the clevis material. Once the clevis 30 and tube 15 have been properly joined, the

plastic shrink wrap 20 can be applied over the tube 15 and an adjacent portion of the clevis 30 and end-cut at recess 380.

With reference to Figures 3a and 3b, manually operable actuating means are indicated at 50 which includes an electrically insulating housing 914 having a fixed handle portion 410 integral therewith and a lever portion 420 pivotally engaged to housing 914 at pivot pin 430. Push rod 60 passes through aluminum tube 15 (covered by shrink wrap 20) and engages cross pin 440 at 454; set screw 441 being used to extend into cross pin 440 and set push rod 60 in the cross pin 440. The cross pin 440 is fixedly positioned in lever member 420. Upon pivotal motion of lever arm 420, as indicated at 450, using a conventional hand grip as indicated at 455 to apply pressure to extended handle element 456 of lever member 420, push rod 60 will move linearly as indicated at 460 to actuate an end-effector (not shown in Figure 3a) coupled thereto as hereinabove described. There may be occasions, in the course of certain procedures, that certain surgeons will prefer to hold the actuating means 50 in the manner indicated at 465 with fingers grasping housing 914 and the thumb 467 adjacent a portion 470 of lever member 420 which is positioned on the opposite side of cross-pin 440 from extended handle element 456. Thus, in accord with one aspect of the invention, a roughened knurled or serrated surface 480 is provided integral with portion 470 of lever member 420 to enable a frictional engagement with thumb 467. Utilizing serrated surface 480, when thumb motion as indicated at 490 is initiated, pivotal motion of lever arm 420 is accomplished, as indicated at 450, as is the linear motion of push rod 60 as indicated at 460.

Also seen in Fig. 3a is an insulating ferrule 910 which is designed to extend over and bridge the shrink wrap tubing 20 and the housing 914 so as to guarantee that all portions of

the tube 15 is insulated. The ferrule 910 permits a cautery procedure to be accomplished (see cautery terminal 999) without concern of shock to the surgeon. Additional details of the ferrule 910 are discussed hereinafter with reference to Figs. 5a and 5b.

With reference to Figures 4a-4b, details are seen of an end effector 40 and the linkage means for linking the end effector 40 to the push rod 60. In particular, in Figs. 4a-4b, a double acting dissector is shown with blades 90', 92' which are respectively rotatably mounted on pivot pin 45 of clevis 30'. Each blade 90', 92' of the dissector has a forwardly extending manipulating portion 94, and a rearwardly extending planar base portion 96 with a through-hole 98. Each of the through-holes 98 of planar base portions 96 is separately engaged by a separate connecting or linkage means 110, 112.

As shown in Fig. 4a, according to one preferred embodiment, each linkage means 110, 112 is in the form of a thin metal member generally in the shape of an outwardly flared staple. Each linkage means may be generally described as having a U-shaped section 114 with a base 111 perpendicular to and bridging the arms 118 of the U, and two generally parallel spaced apart outwardly extending side or tab elements 113 which are generally parallel to base 111. Each of the linkage means 110, 112 has one of its tab elements 113 engaged in a through-hole 98 of a planar base 96, with the U-shaped section of the linkage means extending respectively in opposite directions as illustrated. The other tab element 113 of the linkage means 110, 112 engage through-holes 120 formed in a flattened plate-like terminal portion 122 of push rod 60 (as seen more clearly in Figs. 4d-4f). As can be seen from Fig. 4a, movement of push rod 60 in the direction indicated at 124 will cause blades 90', 92' to move in the direction

indicated at 127 to the position 129 without interference between the oppositely positioned staple-like linkage means 110, 112.

That manipulators (blades) 90' and 92' open and close in response to the axial movement of push rod 60 may be understood by understanding the relationship of the clevis 30' and linkage means 110, 112 to the blades 90', 92', the push rod 60, and the tube 15. In particular, due to the fact that the clevis 30' is rigidly attached to the tube 15 (as described above with reference to Fig. 2a), the tube 15 is a fixed distance from the rotation pin 45 of the clevis, and hence to the holes in the blades 90' and 92' through which rotation pin 45 extends. Thus, when the push rod 60 is moved axially relative to the tube 15 (the tube being fixed in place), the blades of the end effector cannot move axially with the push rod. However, because the push rod 60 is also a fixed distance away from holes 98 in the base portion of the end effector blades (due to staple linkage means 110, 112), movement of the push rod relative to the tube must cause movement of the holes 98 in the end effector blades. Because one part each blade is fixed, but another part must move when the push rod 60 is moved relative to the tube 15, end effector blades 110 and 112 rotate along an arc centered at the fixed rotation hole in the end effector through which the post 45 of the clevis 30' extends. Movement in this manner typically effects a cutting or grasping action.

Turning to Figures 5a and 5b, a ferrule type connecting means 910 is shown. Ferrule 910 provides a secure electrically insulating connection which peripherally bridges the exposed peripheral, electrically conductive, lateral portion 912 of aluminum tube 20 located between electrically insulating plastic shrink wrap 20 and the electrically insulating housing 914 of manually operable actuating means 50

which closely surrounds the aluminum tube 15. The portion of electrically insulating housing 914 adjacent the terminal portion 916 of electrically insulating shrink wrap 20 is provided with a flat-surfaced peripheral ridge 920. Ridge 920 has a substantially perpendicular wall 922 in the direction away from the shrink wrap 20. Wall 922 forms one side of a frusto-conical peripheral groove 921 which slopes upwardly away from perpendicular wall 922 until it terminates at wall 923. Ridge 920 further has a substantially frusto-conical surface 924 which slopes toward and is closely adjacent but slightly spaced from the shrink wrap 20 as indicated at 926.

Ferrule means 910 has a generally conical outer surface 929. The inner surface of ferrule means 910 is provided with a cylindrical passage 930 which is adapted to be closely adjacent to and surround a portion of shrink wrap 20, and is slidable with respect thereto. Contiguous to cylindrical passage 930, and coaxial therewith, is an outwardly flaring frusto-conical passage 932 which bridges and is spaced from the peripheral electrically conductive portion 912 of aluminum tube 20. Outwardly flaring frusto-conical passage 932 is bounded at its wider flared end by a flat peripheral rim of extension 934 which is adapted to abut the flat surfaced peripheral ridge 920 of the portion 914 of the electrically insulating housing 50. An axially inwardly depending perpendicular peripheral wall 936 of the outwardly flaring frusto-conical projection 938 abuts the peripheral wall 922 of the electrically insulating housing 914 of actuating means 50. Projection 938 is matingly seated in the extended frusto-conical peripheral groove 940 of the housing 914 and causes the ferrule connecting means 910 to be secured to the housing 914 while shielding the electrically conductive peripheral portion 912 of aluminum tube 20.

Ferrule connecting means 910 is suitably made of a strong, resilient, electrically insulating plastic material such as polypropylene or polycarbonate. In a preferred embodiment, the ferrule is a colored plastic, with the color utilized to identify the type of instrument of which it is a part. For example, a blue ferrule might identify a Maryland dissector, while a red ferrule might identify a single acting scissors. Regardless of color, the ferrule is installed by being moved slidably along shrink wrap 20 in the direction indicated at 945. When the ferrule means 910 is moved in the direction indicated, at some point, the portion of the frusto-conical projection 938 located adjacent wall 936 resiliently deforms outwardly to pass over rim 934 of rigid plastic housing 914. After wall 936 passes wall 922, the frusto-conical projection 938 snaps back into a mating engagement with groove 940 of the rigid plastic housing 914. In this mated position, the electrically insulating ferrule connecting means 910 overlaps peripheral electrical conductive portion 912 of aluminum tube 20 as well as substantial portions of the electrically insulating shrink wrap 20 and the electrically insulating housing 914. In this manner, the ferrule connecting means 910 ensures that the possibility of short circuiting and electrical disruption is eliminated.

The preferred endoscopic instruments of the invention are preferably assembled in the following fashion. The knurled portion 34 of the clevis 30 of the invention is inserted into the aluminum tube 15 which had been previously insert molded in the fixed handle portion 914, 410 of the actuating means 50. The aluminum tube 15 is crimped over the knurls 37 to effect mating. Shrink wrap 20 is then applied over the aluminum tube 15 and end-cut at grooves 380 in the arms 36 of the clevis 30. Ferrule 910 is slid over the distal end of the aluminum tube 15, up over the end of the housing 914, and snapped into place, thereby providing complete insulation. The rod 60, staples 110, 112, and end effectors (e.g. 90, 92)

are assembled, with the staples coupling the rod to the end effectors. The rod is slid through the clevis and down the aluminum tube, until the end effectors are located between the arms of the clevis. When the holes in the proximal end of the end effectors (e.g. 96, 98) are lined up with the through-holes 39 in the arms of the clevis, the rotation post 45, which may either be integral with the clevis, or a separate post or nail, is inserted through the holes in the end effectors, and secured in the holes of the clevis arms such as by tapping. At this point, all that remains to be assembled is the actuating means 50. To assemble the actuating means, a cross pin 440 is inserted in handle 420. Handle 420 is then arranged such that the push rod 60 which extends out of the fixed handle portion will extend through the cross pin 440. With rod 60 in the cross pin 440, handle 420 is lined up with handle 410 such that the handle rotation pivot pin 430 can be inserted. With pivot pin 430 in place, and with the end effectors in the closed position, set screw 441 is tightened into the cross pin until it bites into rod 60, thereby holding rod 60 in place relative to cross pin 440.

There has been described and illustrated herein a disposable laparoscopic instrument. While particular embodiments of the invention have been described, it is not intended that the invention be limited exactly thereto, as it is intended that the invention be as broad in scope as the art will permit. Thus, while particular end effectors were disclosed, it will be appreciated that other end effectors such as, e.g., duck-bill graspers, duck-bill dissectors, atraumatic graspers, and traumatic (rat-tooth) graspers, could be utilized. Also, while various materials were described as being preferred for various parts, it will be appreciated that other materials could be utilized. Therefore, it will be apparent to those skilled in the art that other changes and modifications may be made to the invention as described in the

specification without departing from the spirit and scope of the invention as so claimed.

What is claimed is:

1. In a surgical instrument for insertion through a trocar tube comprising a metal tube having proximal and distal ends, an electrically insulating shrink wrap covering a portion of said metal tube other than said proximal end of said metal tube, one of grasping, cutting, clamping, dissecting, and extracting end effector means, and actuating means coupled to said end effector means, said actuating means having a housing closely surrounding and covering said proximal end of said metal tube, wherein said metal tube is exposed intermediate said shrink wrap covered portion of the metal tube and said housing, an improvement comprising:

a peripheral channel in said housing adjacent said proximal end of said metal tube; and

an integral electrically insulating ferrule means having distal and proximal end portions and a middle portion, said ferrule means having

a cylindrical bore in said distal end of said ferrule means closely contacting a portion of said shrink wrap covered portion of the metal tube,

a first outwardly flaring frusto-conical bore in its middle portion and adjacent said cylindrical bore, said first outwardly flaring frusto-conical bore surroundingly covering said exposed portion of said metal tube, and

a second bore in said second end of said ferrule means adjacent said first outwardly flaring frusto-conical bore, said second bore having a smaller inner diameter than an adjacent portion of said first frusto-conical bore at said adjacent portion of said second bore, thereby providing an inwardly depending projection which closely, matingly engages said peripheral channel in said housing.

2. In a surgical instrument according to claim 1, wherein:

said inwardly depending projection comprises a flat peripheral rim.

3. In a surgical instrument according to claim 1, wherein:
said ferrule means is in the form of an integral, resilient, plastic body.

4. In a surgical instrument according to claim 1, wherein:
said proximal end portion of said ferrule means has an end which terminates said ferrule means, and
said ferrule means has a smoothly tapered outer peripheral surface with an outer diameter at said terminating end which is substantially equal to the outer diameter of said housing adjacent said peripheral channel.

5. In a surgical instrument according to claim 1, wherein:
said metal tube is comprised of aluminum,
said ferrule means is in the form of an integral, resilient plastic body,
said second bore comprises a second frusto-conical bore,
said first frusto-conical bore and said second frusto-conical bore are separated by a flat peripheral rim, and
said ferrule means has a smoothly tapered outer peripheral surface with an outer diameter at said terminating end which is substantially equal to the outer diameter of said housing adjacent said peripheral channel.

6. In a surgical instrument according to claim 1, wherein:
said ferrule means is in the form of an integral, resilient, colored, plastic body, and

the color of said ferrule means is chosen to signify the type of laparoscopic surgical instrument of which said ferrule means is part.

7. The combination of said ferrule means in accordance with claim 1, and said metal tube and said housing.

8. In a surgical instrument according to claim 1, wherein:
said housing is comprised of plastic, and said housing is insert molded with said metal tube therein.

9. In a surgical instrument according to claim 8, wherein:
said housing has a first end with a cylindrical bore which closely surrounds said proximal end of said metal tube, the outer surface of said first end having
a first ramp which increases in diameter as it extends away from said first end, and
said peripheral channel having a first end and a second end, said first end being adjacent said first ramp, with said peripheral channel having an outer diameter adjacent said first ramp which is smaller than the outer diameter of said first ramp adjacent said peripheral channel, said outer diameter of said peripheral channel increasing as it extends away from said first ramp.

10. In a surgical instrument according to claim 9, wherein:
said second bore comprises a second outwardly flaring frusto-conical bore, and
the outer surface of said first end further includes a second ramp which starts at said second end of said peripheral channel and increases as it extends away from said peripheral

channel, the outer diameter of said second ramp adjacent said peripheral channel being larger than the outer diameter of said peripheral channel adjacent said second ramp and substantially similar the largest outer diameter of said second outwardly flaring frusto-conical bore of said ferrule means.

11. In a surgical instrument according to claim 9, wherein:
said first ramp terminates in a shoulder of relatively constant diameter between said first ramp and said peripheral channel, and said first outwardly flaring frusto-conical bore terminates with a flat peripheral rim between said first outwardly flaring frusto-conical bore and said second outwardly flaring frusto-conical bore, said shoulder and said flat peripheral rim in contact with each other.

12. In a surgical instrument according to claim 10, wherein:
said first ramp terminates in a shoulder of relatively constant diameter between said first ramp and said peripheral channel, and said first outwardly flaring frusto-conical bore terminates with a relatively constant diameter seat between said first outwardly flaring frusto-conical bore and said second outwardly flaring frusto-conical bore, said shoulder and seat in contact with each other.

13. In a surgical instrument according to claim 1, wherein:
said housing has a first end with a cylindrical bore which closely surrounds said proximal end of said metal tube, the outer surface of said first end having
a first ramp which increases in diameter as it extends away from said first end, and

said peripheral channel having a first end and a second end, said first end being adjacent said first ramp, with said peripheral channel having an outer diameter adjacent said first ramp which is smaller than the outer diameter of said first ramp adjacent said peripheral channel, said outer diameter of said peripheral channel increasing as it extends away from said first ramp, and

said ferrule means is in the form of an integral resilient plastic body.

14. In a surgical instrument according to claim 8, wherein:

said ferrule means is in the form of an integral, resilient, colored, plastic body, and

the color of said ferrule means is chosen to signify the type of laparoscopic surgical instrument of which said ferrule means is part.

15. In a surgical instrument according to claim 12, wherein:

said ferrule means is in the form of an integral, resilient, colored, plastic body, and

the color of said ferrule means is chosen to signify the type of laparoscopic surgical instrument of which said ferrule means is part.

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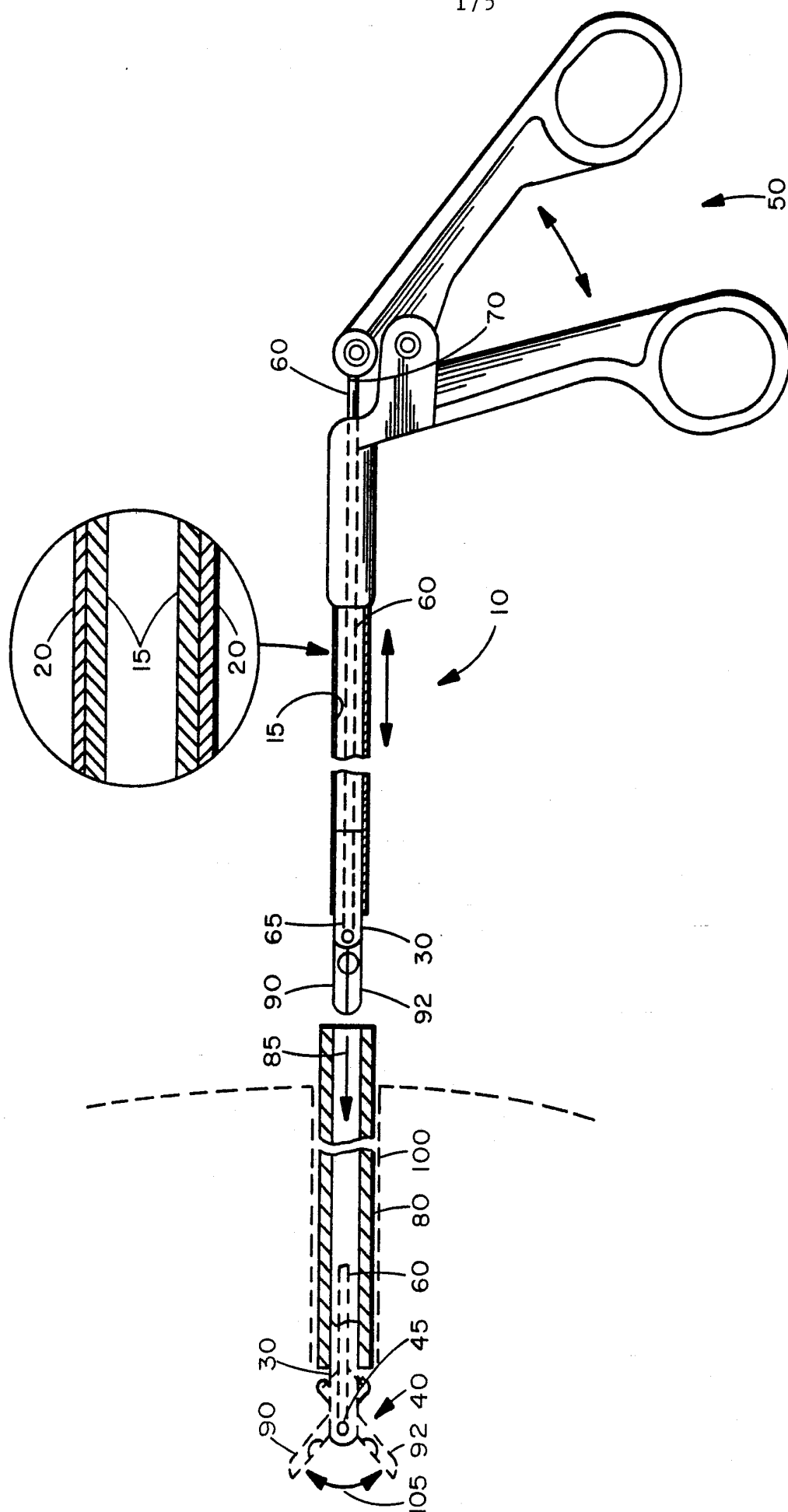


FIG. 1

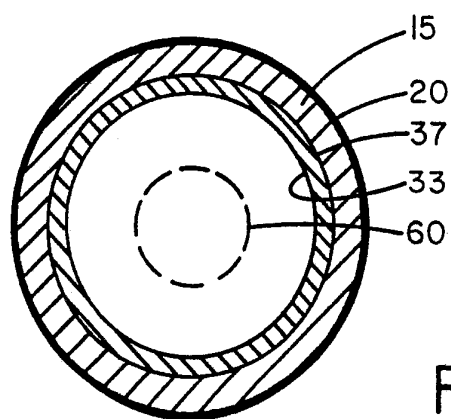


FIG. 2b

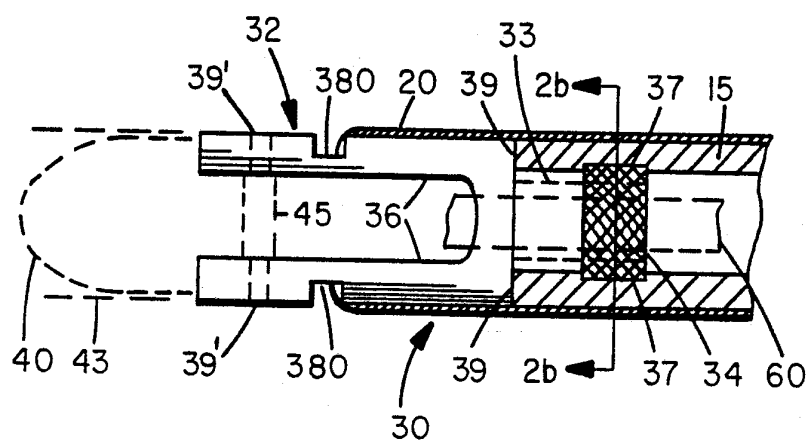


FIG. 2a

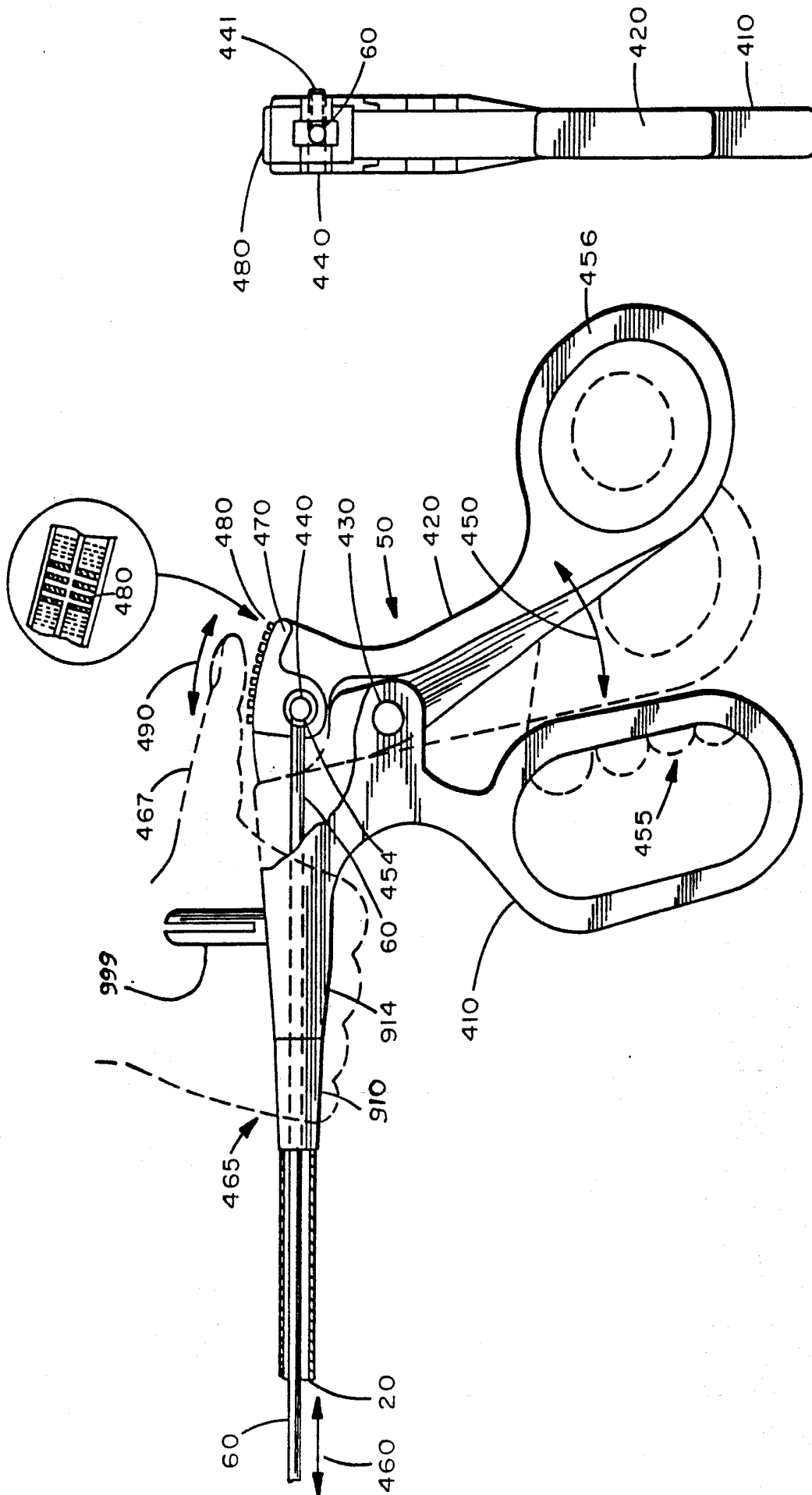


FIG. 3b

FIG. 3a

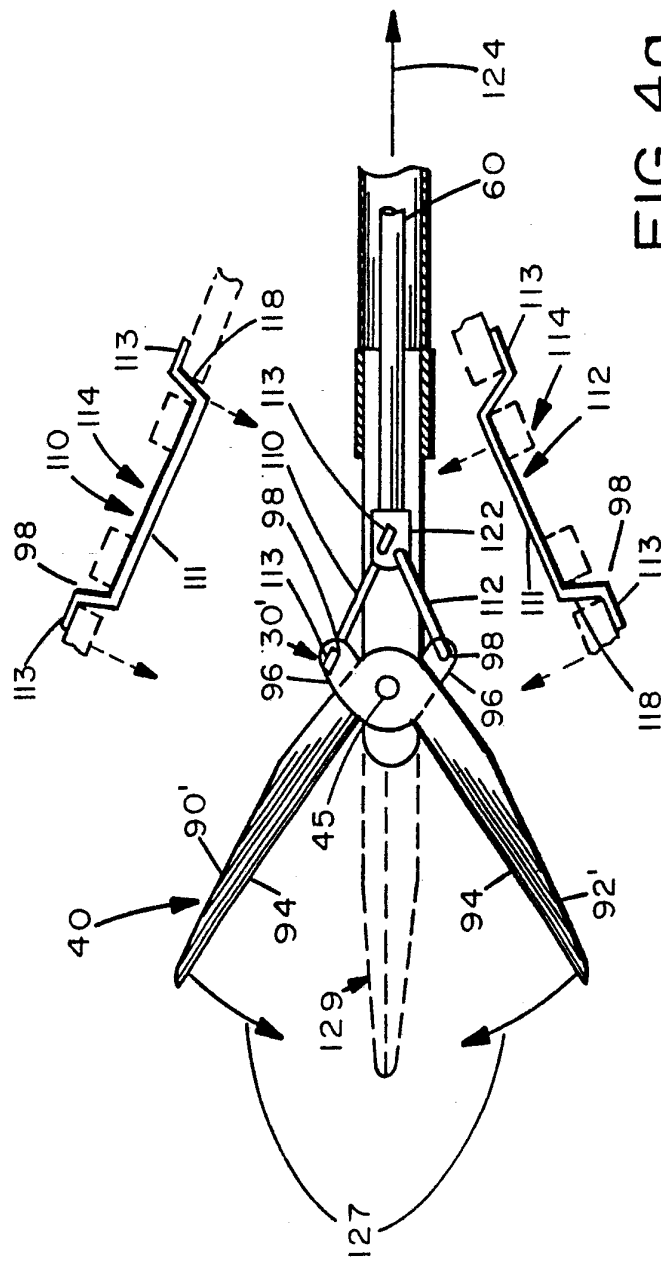


FIG. 4a

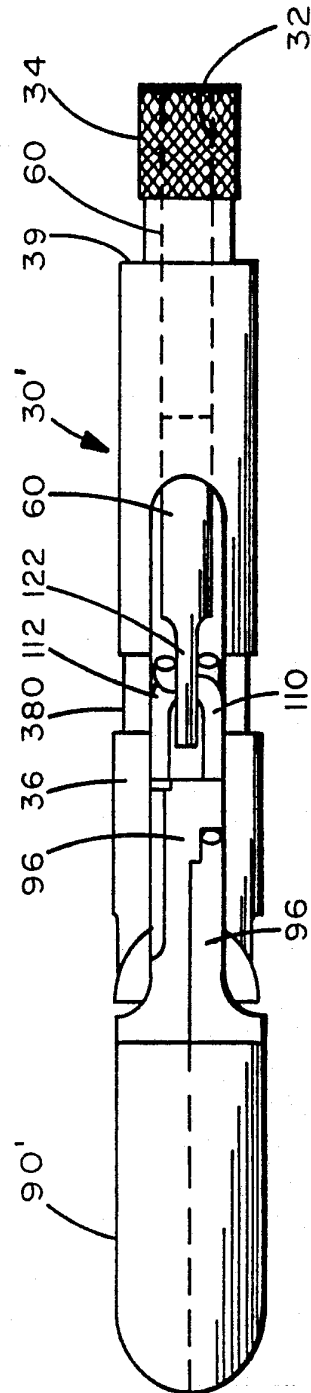


FIG. 4b

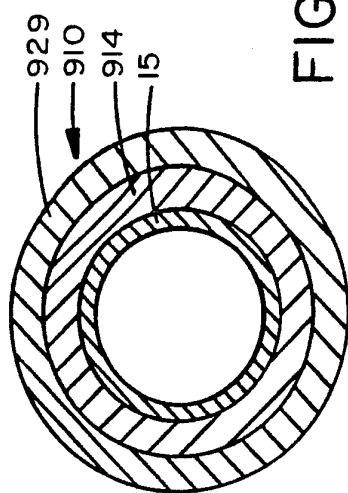


FIG. 5b

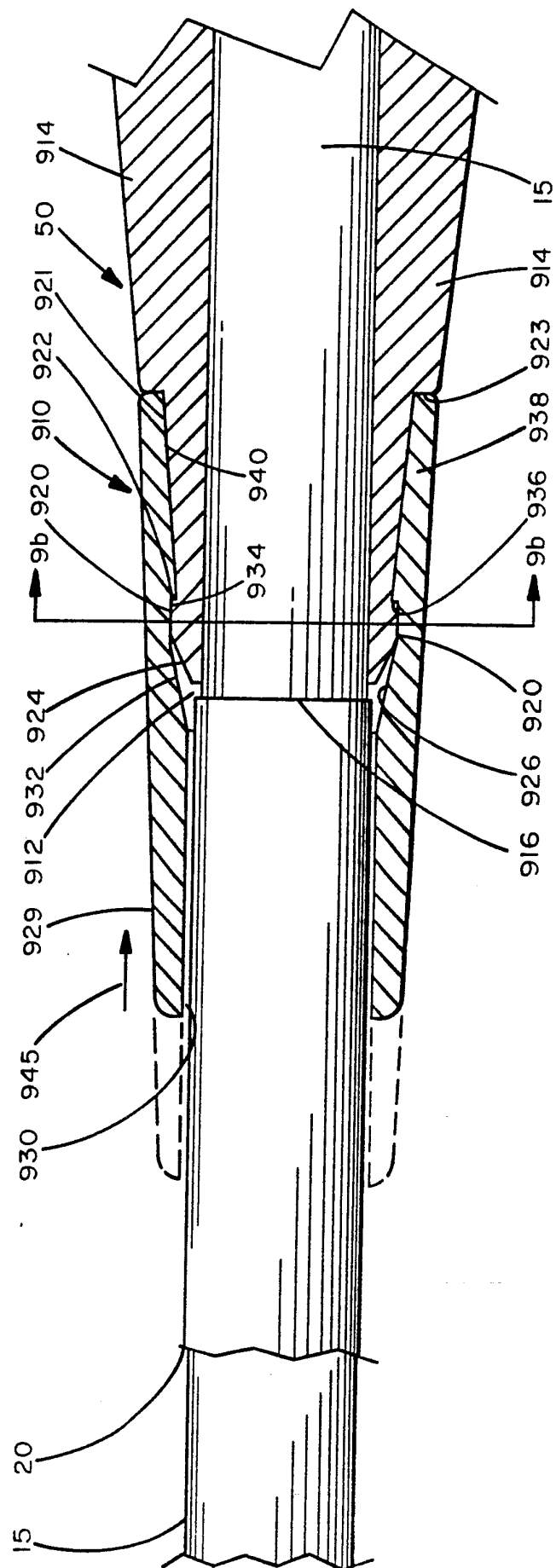


FIG. 5a