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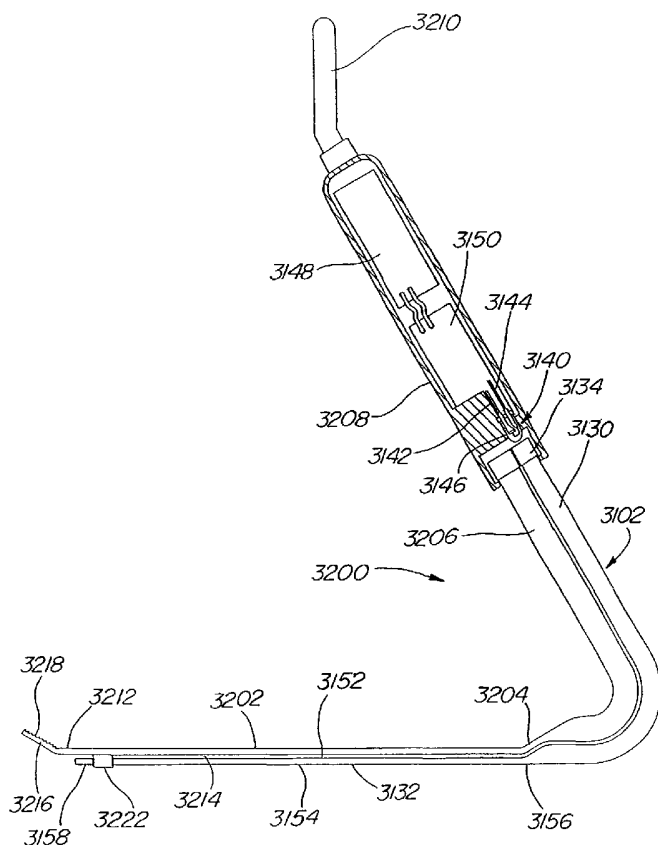
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(54) Title: ILLUMINATED SURGICAL RETRACTOR



(57) Abstract: Illuminated surgical retractors (3100) include at least one retractor blade (3202) and a light delivery system (3120). In some embodiments of the invention, the light delivery system (3120) includes a light emitter in the form of an elongated light emitting blade portion extending along the length of the retractor blade. The light emitter may be coupled to a light source integral with the retractor for illuminating all or a portion of the length of the light emitter or retractor blade. In other embodiments of the invention, the light delivery system (3102) may include an array of lights which may be attached directly to the retractor blade or to a support in the shape of an elongated blade that extends along the length of the retractor blade for illuminating all or a portion of the length of the retractor blade.

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TITLE: ILLUMINATED SURGICAL RETRACTOR

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FIELD OF INVENTION

The present invention relates generally to a surgical instrument that includes a light delivery system for providing illumination for the instrument.

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BACKGROUND OF THE INVENTION

While light delivery systems are generally known, prior art light delivery systems are not easily adapted for use in connection with functional instruments such as surgical instruments of various types. In this respect, current light
15 delivery systems do not provide optimal illumination for a variety of desired lighting conditions. Moreover, current light delivery systems are costly to replace, and are thus not well suited for conditions which necessitate that the light delivery system be disposable, such as where sterilization is desired.

The present invention overcomes these and other disadvantages of prior
20 art light delivery systems.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a surgical instrument including particularly a retractor having a light delivery system for providing
25 illumination for the retractor.

In accordance with one aspect of the invention, the light delivery system is adapted for attachment to a surgical instrument.

In accordance with another aspect of the invention, the light delivery system is adapted for integration with a surgical instrument.

30 In accordance with another aspect of the invention, the light delivery system is disposable or reusable.

In accordance with another aspect of the invention, the light delivery system is suitably configured in numerous shapes and sizes.

35 In accordance with another aspect of the invention, the light delivery system is quickly and easily attached to and detached from an associated surgical instrument.

In accordance with another aspect of the invention, the light delivery system may include a light emitter that locally varies the intensity of emitted light and provides directional control of the emitted light.

5 In accordance with another aspect of the invention, the light delivery system may include an array of lights attached to a retractor blade or to a support in the shape of an elongated blade that extends along the length of the retractor blade for illuminating the retractor blade along all or a portion of the length thereof.

10 Still other aspects and advantages of the invention will become apparent to those skilled in the art upon the reading and understanding of the following detailed description, accompanying drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

15 In the annexed drawings:

Fig. 1 is an enlarged perspective view of a portion of the light emitter shown in Fig. 4A;

Fig. 2 is an enlarged transverse section through the light emitter shown in Fig. 1;

20 Fig. 3A is an enlarged plan view of a portion of a light emitter, showing one form of pattern of light extracting deformities on the light emitter;

Figs. 3B-3D are enlarged schematic perspective views of a portion of a light emitter showing other forms of light extracting deformities formed in or on the light emitter;

25 Fig. 4A is a perspective view of a light delivery system, wherein the light delivery system is attachable to a suction/blower device;

Fig. 4B is a perspective view of the light delivery system shown in Fig. 4A, as attached to the suction/blower device;

30 Fig. 4C is a perspective view of an alternative embodiment of the attachment means for the light delivery system;

Fig. 5A is a perspective view of a suction/blower device having an integrated light delivery system;

Fig. 5B is an enlarged cross-sectional view taken along line 5B-5B of Fig. 5A;

Fig. 5C is an alternative embodiment of the cross-sectional view taken along line 5B-5B of Fig. 5A;

Fig. 6 is a perspective view of another type of suction/blower device having an integrated light delivery system;

5 Fig. 7 is a perspective view of yet another type of suction/blower device having an integrated light delivery system;

Fig. 8 is a perspective view of an electrosurgical pencil including the light delivery system of the present invention;

10 Fig. 9A is a perspective view of a transillumination tray including the light delivery system of the present invention;

Fig. 9B is a cross-sectional view taken along line 9B-9B of Fig. 9A, with a vein/artery located in the transillumination tray;

Fig. 10A is a perspective view of a stabilizer including an integrated light delivery system;

15 Fig. 10B is a side view of the stabilizer shown in Fig. 10A;

Fig. 11 is a perspective view of a plurality of retractors including a light delivery system;

Fig. 12 is a top view of a forceps including an integrated light delivery system;

20 Fig. 13 is a perspective view of a multi-purpose lighting device including a light delivery system;

Fig. 14 is a sectional view of the multi-purpose lighting device taken along line 14-14 of Fig. 13;

25 Fig. 15A is a perspective view of a lighting device including a light delivery system;

Fig. 15B is a sectional view of the lighting device taken along line 15-15 of Fig. 15A.

Fig. 16A is a perspective view of a "rope" lighting device;

30 Fig. 16B is a cross-sectional view of the lighting device taken along line 16-16 of Fig. 16A;

Fig. 17 is a top view of a trans-illuminating forceps including an attachable light delivery system;

Fig. 18 is a perspective view of a trans-illuminating retractor including an attachable light delivery system;

Fig. 19A is a perspective view of a spring-formed "rope" lighting device;

Fig. 19B is a cross-sectional view of the lighting device taken along line 19-19 of Fig. 19A;

Fig. 20A is a perspective view of a smoke evacuation tube having an integrated light delivery system;

Fig. 20B is a cross-sectional view of the smoke evacuation tube taken along line 20-20 of Fig. 20A;

Fig. 21A is a perspective view of a suction tube having an integrated light delivery system;

Fig. 21B is a cross-sectional view of the suction tube taken along line 21-21 of Fig. 21A;

Fig. 22A is a perspective view of a suction tube having an attachable light delivery system;

Fig. 22B is a cross-sectional view of the suction tube taken along line 22-22 of Fig. 22A;

Fig. 23A is a perspective view of a ring-shaped "rope" lighting device;

Fig. 23B is a cross-sectional view of the lighting device taken along line 23-23 of Fig. 23A;

Fig. 24A is a perspective view of a protective cover applied to a light distributor, in accordance with one embodiment of the present invention;

Fig. 24B is a cross-sectional view of the protective cover, taken along line 24B-24B of Fig. 24A;

Fig. 24C is an end view of the protective cover shown in Fig. 24A;

Fig. 24D is a cross-sectional view of the protective cover, taken along line 24D-24D of Fig. 24C;

Fig. 25A is a perspective view of a protective cover applied to a light distributor, in accordance with another embodiment of the present invention;

Fig. 25B is a cross-sectional view of the protective cover, taken along line 25B-25B of Fig. 25A;

Fig. 25C is an end view of the protective cover shown in Fig. 25A;

Fig. 25D is a cross-sectional view of the protective cover, taken along line 25D-25D of Fig. 25C;

Fig. 26A is a perspective view of a protective cover applied to a light distributor, in accordance with yet another embodiment of the present invention;

Fig. 26B is a cross-sectional view of the protective cover, taken along line 26B-26B of Fig. 26A;

Fig. 26C is an end view of the protective cover shown in Fig. 26A;

5 Fig. 26D is a cross-sectional view of the protective cover, taken along line 26D-26D of Fig. 26;

Fig. 27A is a cut-away view of a protective cover according to another embodiment of the present invention as applied to a light rod;

Fig. 27B is a cross-sectional view of the protective cover taken along line 27B-27B of Fig. 27A;

10 Fig. 28A is a cut-away view of a protective cover as applied to a light rod with attached retractor blade;

Fig. 28B is a cross-sectional view of the protective cover taken along line 28B-28B of Fig. 28A;

15 Fig. 29A is a cut-away view of a protective cover according to another embodiment of the present invention as applied to a rope light;

Fig. 29B is a cross-sectional view of the protective cover taken along line 29B-29B of Fig. 29A;

Fig. 30A is a cut-away view of a protective cover according to another embodiment of the present invention as applied to a ring light;

20 Fig. 30B is a cross-sectional view of the protective cover taken along line 30B-30B of Fig. 30A;

Fig. 31 is a plan view, partly in section, of a retractor including an attachable light delivery system;

25 Fig. 32 is a side elevation view, partly in section, of a retractor including an attachable light delivery system;

Fig. 33 is a side elevation view, partly in section, of a retractor including an attachable light delivery system;

Fig. 34 is a perspective view of a retractor including an attachable light delivery system;

30 Fig. 35 is a plan view, partly in section, of a retractor including an attachable light delivery system;

Fig. 36 is a side elevation view, partly in section, of a retractor including an attachable light delivery system; and

Fig. 37 is a side elevation view, partly in section, of a retractor including an attachable light delivery system.

DETAILED DESCRIPTION OF THE INVENTION

5 Referring now to the drawings wherein the showings are for the purposes of illustrating exemplary embodiments of the invention only and not for purposes of limiting same, Figs. 4A and 4B illustrate a suction/blower device 100 having an externally mounted light delivery system 2. Fig. 4A shows a light delivery system 2 detached from suction/blower device 100, while Fig. 4B shows light delivery
10 system 2 attached to suction/blower device 100. It should be appreciated that device 100 can take many forms including a surgical instrument or a conventional hand tool, as will be illustrated below.

Light delivery system 2 is generally comprised of a light emitter 10, a light distributor 60, and an attachment means 80. Light emitter 10 focuses light of
15 varying intensity in a predetermined direction or pattern. As a result, an associated viewing field is illuminated with a predetermined light characteristic. Light distributor 60 (e.g., optic light pipe) transmits light from a light source 90 to light emitter 10. Attachment means 80 provides a support structure for coupling light delivery system 2 to device 100. In this regard, attachment means 80 may
20 include tabs, hooks or the like.

Light emitter 10 is comprised of a transparent or translucent light emitting material of any suitable type, including acrylic, polycarbonate, glass, epoxy, resins or the like. Emitter 10 may be substantially flat, suitably curved, may be formed of single or multiple layers, and may have different thicknesses and
25 shapes. Moreover, emitter 10 may be flexible, or rigid, and may be made out of a variety of compounds. It should also be appreciated that emitter 10 may be hollow, filled with liquid, air, or be solid, and may have holes or ridges formed therein.

Means for directing light in desired directions and patterns, and providing
30 various light intensity levels will now be described with reference to Figs. 1 and 2, which show a section B of light emitter 10. Light extracting formations including deformities, disruptions, coatings, patterns or lenses, may be provided on one or more selected light surface areas 20 on one or more sides 21 or edges 23 of emitter 10. As used herein, the term light extracting formation is to mean any

change in the shape or geometry of the surface and/or coating or surface treatment that causes a portion of the light to be emitted. Fig. 3A schematically shows one such light surface area 20 on which a pattern of light extracting deformities or disruptions 22 is provided. The pattern of light extracting deformities or disruptions 22 shown in Fig. 3A includes a variable pattern which breaks up the light rays such that the internal angle of reflection of a portion of the light rays will be great enough to cause the light rays either to be emitted out of emitter 10 through the side or sides on which the light extracting deformities or disruptions 22 are provided or reflected back through the emitter 10 and emitted out the other side thereof.

Light extracting formations can be produced in a variety of manners, for example, by providing a painted pattern, an etched pattern, a machined pattern, a printed pattern, a hot stamped pattern, a molded pattern, a curved surface (i.e., lens), a diffraction grating, a prismatic surface or the like on selected light surface areas 20 of emitter 10. An ink or printed pattern may be applied for example by pad printing, silk screening, ink jet, heat transfer film process or the like. The deformities or disruptions may also be printed on a sheet or film which is used to apply the deformities or disruptions to light surface area 20. This sheet or film may become a permanent part of emitter 10 for example by attaching or otherwise positioning the sheet or film against one or both sides of the emitter light surface area similar to the sheet or film 24 shown in Figs. 1 and 2 in order to produce a desired effect.

By varying the density, opaqueness or translucence, shape, depth, color, area, index of refraction, diffraction grating, or type of light extracting formations, the light output of emitter 10 can be controlled. The light extracting formations may be used to control the direction and/or percent of light emitted from any area of emitter 10. For instance, less and/or smaller size deformities 22 may be placed on emitter 10 in areas where less light output is wanted. Conversely, a greater percentage of and/or larger deformities 22 may be placed on emitter 10 in areas where greater light output is desired.

Varying the percentages and/or size of deformities 22 in different areas of emitter 10 is necessary in order to provide a uniform light output distribution. For example, the amount of light traveling through light emitter 10 will ordinarily be greater in areas closer to the light source than in other areas further removed

from the light source. A pattern of light extracting deformities 22 may be used to adjust the light variances within the emitter, for example, by providing a denser concentration of light extracting deformities with increased distance from the light source thereby resulting in a more uniform light output distribution from light
5 emitter 10. The deformities 22 may also be used to control the output ray angle distribution of the emitted light to suit a particular application.

It should be appreciated that other light extracting formations are suitably provided in addition to or in lieu of the patterns of light extracting deformities 22 shown in Fig. 3A. As indicated above, other light extracting formations including
10 lenses, prismatic surfaces, depressions or raised surfaces of various shapes using more complex shapes in a mold pattern may be molded, etched, stamped, thermoformed, hot stamped or the like into or on one or more surface areas (e.g., sides and edges) of the light emitter. Lenses (e.g., pillow lenses) can be used to provide diffuse light (by spreading light rays) and directional light (by focusing
15 light rays). Figs. 3B and 3C show areas 26 on which prismatic surfaces 28 or depressions 30 are formed in the emitter surface area, whereas Fig. 3D shows prismatic or other reflective or refractive surfaces 32 formed on the exterior of the emitter surface area. The prismatic surfaces, depressions or raised surfaces will cause a portion of the light rays contacted thereby to be emitted from the light
20 emitter. Also, the angles of the prisms, depressions or other surfaces may be varied to direct the light in different directions to produce a desired light output distribution or effect, or to project a spot image or pattern of light to a specific area or region. Moreover, the reflective or refractive surfaces may have shapes or a pattern with no specific angles to reduce moiré or other interference effects.
25 In addition, the light rays emitted from the emitter may provide generally shadowless or homogenous light. In this regard, the emitter may simultaneously illuminate a 3-D object from a plurality of sides.

As best seen in the cross-sectional view of Fig. 2, a back reflector 34 (including trans reflectors) may be attached or positioned against one side of the
30 panel member 14 of Fig. 1 using a suitable adhesive 36 or other method in order to improve light output efficiency of light emitter 10 by reflecting the light emitted from that side back through the panel for emission through the opposite side. Additionally, a pattern of light extracting deformities 22, 28, 30 and/or 32 may be provided on one or both sides of the light emitter in order to change the path of

the light so that the internal critical angle is exceeded and a portion of the light is emitted from one or both sides of the light emitter. Moreover, a transparent film, sheet or plate member 24 may be attached or positioned against the side or sides of the emitter from which light is emitted using a suitable adhesive 36 or
5 other method in order to produce a desired effect.

Member 24 may be used to further improve the uniformity of the light output distribution. For example, member 24 may be a colored film, a diffuser, or a label or display, a portion of which may be a transparent overlay that may be colored and/or have text or an image thereon.

10 If adhesive 36 is used to adhere the back reflector 34 and/or film 24 to the emitter, the adhesive is preferably applied only along the side edges of the emitter, and if desired the end edge opposite light transition areas, but not over the entire surface area or areas of the emitter because of the difficulty in consistently applying a uniform coating of adhesive to the panel. Also, the
15 adhesive changes the internal critical angle of the light in a less controllable manner than the air gaps 40 (see Fig. 2) which are formed between the respective surfaces of the emitter and the back reflector 34 and/or member 24 when only adhered along the peripheral edges. Additionally, longer emitters are achievable when air gaps 40 are used. If adhesive were to be used over the
20 entire surface, the pattern of deformities could be adjusted to account for the additional attenuation in the light caused by the adhesive.

The light emitter disclosed herein may be used for a great many different applications including for example LCD back lighting or lighting in general, decorative and display lighting, automotive lighting, dental lighting, phototherapy,
25 photodynamic therapy, or other medical lighting, membrane switch lighting, and sporting goods and apparel lighting or the like. Also the emitter may be formed such that the deformities are transparent without a back reflector. This allows the emitter to be used such that the application is viewed through the transparent emitter.

30 The light that is transmitted by light distributor 60 to light emitter 10 may be emitted along the entire length of light emitter 10 or from one or more light output areas along the length of the panel as desired to produce a desired light output distribution to fit a particular application.

Light distributor 60 is a formed light conduit adapted to propagate light therethrough via internal reflection. In the embodiment illustrated in Fig. 4A and 4B, light distributor 60 takes the form of an optic light pipe. Light distributor 60 includes an interface 64 and a connecting member 62. Interface 64 interfaces
5 light distributor 60 with light emitter 10. Connecting member 62 facilitates connection of light distributor 60 with light source 90 (described below). It should be appreciated that light distributor 60, light emitter 64, and light source 90 may be formed as one unitary member without interface 64 and connecting member 62.

10 Light source 90 may take many forms as will be discussed below. In the embodiment of the present invention shown in Figs. 4A and 4B, light source 90 is generally comprised of a generator 92 and a cable 94. Generator 92 may be, for example, a 300 Watt Xenon light source. Cable 94 includes a connecting member 96, which mates with connecting member 62 of light distributor 60.

15 It should be appreciated that light source 90 illustrated in Figs. 4A and 4B is shown solely for the purpose of illustrating an embodiment of the present invention. In this respect, light source 90 may also be of other suitable types including, an arc lamp, an incandescent bulb (which also may be colored, filtered or painted), a lens end bulb, a line light, a halogen lamp, a light emitting diode
20 (LED), a chip from an LED, a neon bulb, a fluorescent tube, a laser or laser diode, or any other suitable light source. For example, light source 90 may take the form of any of the types disclosed in U. S. Patent Nos. 4,897,771 and 5,005,108, the entire disclosures of which are incorporated herein by reference. Additionally, the light source may be a multiple colored LED, or a combination of
25 multiple colored radiation sources in order to provide a desired colored or white light output distribution. For example, a plurality of colored lights such as LEDs of different colors (red, blue, green) or a single LED emitting a selected spectrum may be employed to create white light or any other colored light output distribution by varying the intensities of each individual colored light.

30 Attachment means 80 is suitably molded as an integral part of light distributor 60 (Fig. 4A), attaches to both the light distributor and the associated device (Fig. 4C), or forms a part of device 100. In the embodiment shown in Fig. 4A and 4B, attachment means 80 is fixed to light distributor 60, wherein gripping means 84 are provided for attaching light delivery system 2 to device 100.

Attachment means 80 allows light delivery system 2 to be easily and conveniently attached to and detached from suction/blower device 100. As a result, light delivery system 2 is easily replaced where sterilization is required.

In the embodiment shown in Fig. 4C, one form of attachment means 80 includes engagement means 82 and 84 for fixing light delivery system 2 to a device. In this respect, engagement means 82 are engageable with light distributor 60, while engagement means 84 are engageable with a portion of the device. It should be appreciated that engagement means 82 and/or engagement means 84 are suitably integral with light distributor 60 and the device, respectively. However, in the case where convenient replacement of light delivery system 2 is desired (e.g., when sterilization is required) engagement means 82 and/or engagement means 84 will preferably provide for convenient removal of light delivery system 2 from the device. For instance, in the embodiment shown in Figs. 4A and 4B, engagement means 84 takes the form of a clamp, which allows for simple attachment and detachment of light delivery system 2 from device 100. It should be appreciated that engagement means 82 and 84 may take the form of other suitable fastening members including cables, snaps, clips, tabs, adhesives, and the like.

Device 100 includes a tube 70 having a tip portion 76. Tip portion 76 is comprised of a plurality of openings 78, which are in communication with tube 70. Light emitter 10 is suitably dimensioned to receive tip portion 76, when light delivery system 2 is attached to device 100 (Fig. 4B). It should be noted that light emitter 10 is suitably formed to provide diffuse light in directions transverse to the longitudinal axis of device tip portion 76, and to provide direct light in a direction generally parallel to the longitudinal axis of tip portion 76. As indicated above, the direct light provides maximum illumination on the material being suctioned or blown. At the same time, the diffuse light provides sufficient, but not over bright, illumination of the area surrounding the material being suctioned or blown. As a result, the user's vision of the material being suctioned or blown is not impaired.

Other embodiments of the present invention will now be described with reference to Figs. 5-22, which illustrate a variety of different surgical instruments and hand tools which are used in conjunction with the light delivery system of the present invention.

Referring now to Fig. 5A, there is shown a suction/blower device 101A. Device 101A is a surgical instrument typically used to remove material (e.g., fluid or tissue) from a surgeon's field of view. In this respect, device 101A suctions or blows the obscuring material. Device 101A is generally comprised of a light emitter 110, a light distributor 160 and air passageway(s) 170. Light distributor 160 includes a connecting member 162 dimensioned to receive a mating connecting member 196 from cable 194. Cable 194 is connected to a light source (not shown).

It is important to note that light distributor 160 not only carries light to light emitter 110, but also provides a support structure for suction/blower device 101A. In this respect, light distributor 160 includes a light distribution member 161, which is constructed of a rigid material and formed into a suitable shape for a user to conveniently hold device 101A. Light distribution member 161 transmits light and defines passageway(s) 170. Passageway(s) 170 are generally tubular hollow channels formed along the length of light distributor 160. Figs. 5B and 5C illustrate two different embodiments for light distributor 160. Passageway(s) 170 provides a conduit for air, or other gas or fluid. Light distributor 160 also includes an outer layer 163. Outer layer 163 may take the form of a heat-shrunked film, coating or tubing. Outer layer 163 provides a protective layer for light distribution member 161. Similarly, an inner layer (not shown) may line the inner surface of light distribution member 161. The outer and inner layers protect the internal light propagation from impairment (e.g., blood or other materials that can cause light loss). It should be appreciated that light distributor 160 may be constructed of a plurality of walls of varying thickness. The walls may take the form of a film, coating or tubing. Moreover, the film, coating or tubing may extend along the full length of light distributor 160, or only along a portion thereof.

A connector 172 is provided to receive a mating connector from a hose 174. Hose 174 is connected to a vacuum generating means (not shown), where device 101A is used for suction, or is connected to a blower means (not shown), where device 101A is used for blowing. Light emitter 110 is located at the tip end of device 101A, and surrounds passageway(s) 170. Light emitter 110 is suitably formed to provide diffuse light in directions transverse to the longitudinal axis of device 101A, and to provide direct light in a direction generally parallel to the longitudinal axis of device 101A. In this way, the direct light provides maximum

illumination on the material being suctioned or blown. At the same time, the diffuse light provides sufficient, but not over bright, illumination of the area surrounding the material being suctioned or blown. As a result, the user's vision of the material being suctioned or blown is not impaired.

5 It should be appreciated that light distributor 160 and light emitter 110 form an integral part of the suction/blowing device 101A, and thus eliminate the need for an external lighting device mounted to the suction/blowing device, a lighting device mounted elsewhere in an operating room, or a hand held lighting device.

Fig. 6 illustrates an alternative embodiment of suction/blower device 101A.
10 Suction/blower device 101B is similar in many respects to suction/blower device 101A; however, light emitter 110 and light distributor 160 are disposable in this embodiment. In this respect, suction/blower 101B is generally comprised of a light emitter 110, a rigid body member 150, a light distributor 160 having a fixed portion 160A and a detachable portion 160B, and a tube 170. Body member 150
15 is constructed of a rigid material (e.g., plastic) and formed into a suitable shape for a user to conveniently hold device 101B. Body member 150 surrounds fixed portion 160A of light distributor 160. Fixed portion 160A includes a connecting member 162. Fixed portion 160A and detachable portion 160B are connected at interface 166. A hollow channel is formed along the length of portions 160A and
20 160B to provide tube 170. Light emitter 110 is optionally detachable from light distributor 160 at interface 166.

It should be appreciated that suction/blower device 101B has the advantage of having a detachable light emitter 110 and light distributor 160. This allows for convenient replacement of the portions of device 101B which may
25 require sterilization. As a result, only an inexpensive and small portion of device 101B is disposed, thus saving the expense of replacing the entire suction/blower device 101B.

Fig. 7 illustrates another suction/blower device 102. Device 102 is generally comprised of a light emitter 310, a light distributor 360 and a tube 370.
30 Light distributor 360 has a connecting member 362 dimensioned to receive a mating connecting member 396 from cable 394. Cable 394 is connected to a light source (not shown). It is important to note that light distributor 360 not only carries light to light emitter 310, but also provides a support structure for suction/blower device 102. In this respect, light distributor 360 is constructed of a

rigid material and formed into a suitable shape for a user to conveniently hold device 102. In addition, a hollow channel is formed along the length of light distributor 360 to provide tube 370. Light distributor 360 is preferably formed of an inexpensive plastic material. Tube 370 includes a connector 372,
5 dimensioned to receive a mating connector from a hose 374. Hose 374 is connected to a vacuum generating means (not shown), where device 102 is used for suction, or is connected to a blower means (not shown), where device 102 is used for blowing. Light emitter 310 is located at tip 368 of light distributor 360, and surrounds tube 370. Light emitter 310 is suitably formed to provide diffuse
10 light in directions transverse to the longitudinal axis of tip 368, and to provide direct light in a direction generally parallel to the longitudinal axis of tip 368. In this way, the direct light provides maximum illumination on the material being suctioned or blown. At the same time, the diffuse light provides sufficient, but not over bright, illumination of the area surrounding the material being suctioned or
15 blown. As a result, the user's vision of the material being suctioned or blown is not impaired.

It should be appreciated that light distributor 360 is easily and conveniently attached to and detached from cable 394 and hose 374. As a result, light delivery system 202 is easily replaced where sterilization is required.

20 Fig. 8 illustrates an electrosurgical pencil device 103. Electrosurgical pencil device 103 is used to destroy tissue by burning the tissue with a cauterizing tip. Device 103 is generally comprised of a light emitter 410, a light distributor 460 and a cauterizing tip 470. Light distributor 460 has a connecting member 462 dimensioned to receive a mating connecting member 496 from a
25 cable 494. Cable 494 is connected to a light source (not shown). It is important to note that light distributor 460 not only conducts light to light emitter 410, but also provides a support structure for device 103. In this respect, light distributor 460 is constructed of a rigid material and formed into a suitable shape for a user to conveniently hold device 103. In addition, a channel is formed along the length
30 of light distributor 460 to provide a passageway for electrical conductor 474. Electrical conductor 474 connects to cauterizing tip 470, to provide power thereto. Light emitter 410 is suitably formed to provide diffuse light in directions transverse to the longitudinal axis of tip 470, and to provide direct light in a direction generally parallel to the longitudinal axis of tip 470. In this way, the direct light

provides maximum illumination on the material being cauterized. At the same time, the diffuse light provides sufficient, but not over bright, illumination of the area surrounding the material being cauterized. As a result, the user's vision of the material being cauterized is not impaired.

5 Referring now to Fig. 9A, there is shown a transillumination tray 104 for illuminating a bodily structure (e.g., vein, artery, finger, or small organ). Tray 104 is generally comprised of a light distributor 560 and a light emitter 510. Light distributor 560 includes a connecting member 562 dimensioned to receive a mating connecting member 596 from a cable 594. Cable 594 is connected to a
10 light source (not shown). It is important to note that light distributor 560 not only conducts light to light emitter 510, but also provides a support base for tray 104. In this respect, light distributor 560 is constructed of a rigid material and formed into a suitable shape for receiving a generally U-shaped light emitter 510. Light emitter 510 is shaped to receive a bodily structure, and thoroughly illuminate it.
15 In this respect, light is emitted in all directions from the surface of light emitter 510. Fig. 9B illustrates a cross-sectional view of tray 104 with a vein/artery 570 located on tray 104 for examination. Light emitter 510 illuminates an obstruction 572 in vein/artery 570.

Figs. 10A and 10B show a stabilizer device 105 including the light delivery
20 system of the present invention. Stabilizer device 105 is generally comprised of light emitters 610A, 610B and 610C, and a light distributor 660. Light distributor 660 includes a central portion 670, arm portions 672, and connecting member 662. Connecting member 662 is dimensioned to receive a mating connecting member 696 from a cable 694 (such as a light pipe). Cable 694 is connected to a
25 light source (not shown). It is important to note that light distributor 660 not only carries light to light emitters 610A, 610B and 610C, but also provides a support structure for stabilizer device 105. In this respect, light distributor 660 is constructed of a rigid material and formed into a suitable shape for a user to conveniently hold device 102. Light emitters 610A, 610B and 610C provide
30 different lighting conditions. In this respect, light emitter 610A may include a lens 611 for providing direct focused light on incision work area I. Light emitter 610B is formed along the periphery defined by central portion 670 and arm portions 672. Light emitter 610B provides indirect diffuse light for incision work area I. Light emitter 610C is formed along the lower edge (i.e., bottom) of central portion

670 and arm portions 672. Light emitter 610C may provide indirect diffuse light or glowing light for transillumination of a bodily structure.

It should be appreciated that in an alternative embodiment, stabilizer device 105 may be suitably arranged to attach (e.g., using a clip or other attachment means) to a metal stabilizer having the same general shape as stabilizer device 105. In this regard, the strength of the material forming stabilizer device 105 may not be sufficient for a particular application. Accordingly, the metal stabilizer provides the desired strength.

Referring now to Fig. 11, there is shown retractor devices 106A, 106B and 106C for retracting body structure T (which may include, bodily tissue, bone, organs or the like). Retractor device 106A is comprised of a retractor member 770A and a light delivery system 702A. Retractor member 770A includes a horizontal portion 772, a vertical portion 774, and a support member 776. Support member 776 is arranged between horizontal portion 772 and a rigid mount (not shown). Light delivery system 702A is mounted to the front face of vertical portion 774, and includes a light distributor 760A and a light emitter 710A. Light distributor 760A bends to follow the general shape of retractor member 770A, and receives light from a light source (not shown). A suitable adhesive may be used to attach light delivery system 702A to vertical portion 774. Light emitter 710A provides diffuse or directional light into the work area.

Retractor device 106B is generally comprised of a retractor member 770B and a light delivery system 702B. Retractor member 770B is a rake retractor having a plurality of prongs. Light delivery system 702B includes an attachment member 780B, light distributor 760B, and light emitter 710B. Attachment member 780B has engagement means 784B for attaching light delivery system 702B to retractor member 770B. Light distributor 760B receives light from a light source (not shown). Light emitter 710B includes a top portion 711B and a side portion 713B. Light emitter 710B provides diffuse or directional light into the work area.

Retractor device 106C is a rake retractor formed of a translucent material (e.g., plastic). Retractor device 106C includes light distributor 760B and light emitter 710C. The light distributor 760B and light emitter 710C form the structural member of retractor device 106C.

Referring now to Fig. 12, there is shown an illuminated forceps 107 having an integrated light delivery system. Forceps 107 is generally comprised of light

distributors 860 and light emitters 810. Each light distributor 860 includes a pair of arms 870 and a pair of connecting members 862. Connecting members 862 connect to mating connecting members 896 of light source cables 894. Cables 894 connect to a light source (not shown). Light emitters 810 form the gripping surfaces of arms 870, and provide focused or diffuse light. It should be appreciated that light emitters 810 may provide light for inspection, as well as transillumination. In the case of inspection, the light is used to inspect a work area before proceeding with a further operation. With regard to transillumination, the light may be use to examine a bodily structure. For instance, a vein may be transilluminated to identify a blood clot before clamping and cutting.

Figs. 13 and 14 show a multi-purpose lighting device 108. Device 108 is generally comprised of a light delivery portion 902 and a handle portion 970. Light delivery portion 902 includes a light distributor 960 and a light emitter 910A. Handle portion 970 includes a central housing 972, a connecting member 974 and an endcap 976. As shown in Fig. 14, handle portion 970 houses a power source 950 (e.g., batteries), a light source 952 (e.g., light bulb), a reflector 954, a light filter 956 and a switch means 978. Reflector 954 reflects the light generated by light source 952. Light filter 956 filters the reflected light before it exits through the open end of connecting member 974. Light source 952 is turned on and off by switch means 978. It should be noted that endcap 976 may include a contact member for completing a circuit for powering light source 952.

It should be appreciated that connecting member 974 is dimensioned to receive a light distributor 960, as best seen in Fig. 14. Accordingly, a variety of different types of light delivery portions 902 can be used in combination with handle portion 970, wherein handle portion 970 provides a light source. For instance, light delivery portion 902 may include a light emitter 910A in the form of an illuminated ball (Fig. 13). The surface of the ball may be covered with cotton to form an illuminated cotton swab suitable for obtaining a culture. Alternatively, light delivery portion 970 may include a light emitter 901B in the form of an end light (Fig. 14), a light emitter 910C in the form of an illuminated tongue depressor (Fig. 14), and a light emitter 910D in the form of a transillumination tray (Fig. 14), similar to tray 104, described above. Through the use of a variety of attachable light delivery portions 902, device 108 serves a wide range of functions. The light

delivery portion or a sleeve fitting over the light delivery portion may be disposable for convenient reuse.

It should be appreciated that the light delivery portions shown in Fig. 13 and 14 are shown solely for the purpose of illustrating an embodiment of the present invention. In this respect, other types of light delivery portions, serving functions similar to those of the illustrated embodiments, are also contemplated. Moreover, it should be appreciated that the portable light source housed in the handle portion may be suitably replaced by a remote light source (e.g., see Fig. 4A), with a light pipe for conveying the light therefrom.

Referring now to Fig. 15A, there is shown a lighting device 109, which functions as a flexible and formable "trouble light". Lighting device 109 is generally comprised of a light delivery portion 1002 and a handle portion 1070. Light delivery portion 1002 includes a light distributor 1060 and a light emitter 1010. Light distributor 1060 includes a connecting member 1062 for connecting light distributor 1060 to handle portion 1070. It should be noted that in an embodiment of the present invention, light distributor 1060 is flexible. As seen in the cross-sectional view of Fig. 15B, light distributor 1060 is comprised of a light pipe member 1063, a translucent or colored outer sheath 1061 and a formable wire 1065. Formable wire 1065 allows light distributor 1060 to be bent or positioned in a suitable manner. Light emitter 1010 is detachable from light distributor 1060 to provide a variety of multi-purpose light emitters. In the embodiment shown in Fig. 15A, light emitter 1010 takes the form of a glowing tip, which is rotatable to alter the focus, size or light intensity of lighted area 1004.

Handle portion 1070 is similar to handle portion 970, described above. In this regard, handle portion 1070 includes a central housing 1072, connecting member 1074, endcap 1076, and a switch means 1078. Handle portion 1070 houses a light source and a power source. It should be appreciated that handle portion 1070 is suitably replaced by a light pipe 1090 of conventional light source. Light pipe 1090 includes a cable 1094 and a mating connecting member 1096, which mates with connecting member 1062.

Device 109 may optionally include a rigid support member 1050 to keep light distributor 1060 from changing positions. Support member 1050 includes an arm 1052 and clamp 1054. Clamp 1054 engages with light distributor 1060.

Referring now to Fig. 16A, there is shown a formable "rope" lighting device 1101, which is similar to the lighting device shown in Figs. 15A and 15B. Lighting device 1101 is generally comprised of a light distributor 1160 and light emitters 1110. Light distributor 1160 includes a connecting member 1162 for connecting
5 light distributor 1160 to a light source (not shown). It should be noted that in an embodiment of the present invention, light distributor 1160 is formed of a flexible optic light guide. As seen in the cross-sectional view of Fig. 16B, a protective outer sleeve 1170 covers light distributor 1160. Outer sleeve 1170 is preferably formed of a translucent or transparent material. An optional formable wire 1150 extends
10 between light distributor 1160 and outer sleeve 1170, to permit lighting device 1101 to hold its shape once bent to a suitable position. Light emitters 1110 provide diffuse light D along length L, in addition to a focused beam of light B at the free end of lighting device 1101. It should be noted that an optional lens may be provided at the free end of lighting device 1101 to focus light B from light emitters
15 1110 in a desired pattern.

Referring now to Fig. 17, there is shown a trans-illuminating pickup or forceps 1102 having an attachable light delivery system 1200. Arrows A illustrate the direction in which forceps 1102 is movable. Light delivery system 1200 is generally comprised of a light distributor 1260 and a light emitter 1210. Light
20 distributor 1260 includes connecting members (not shown) for connecting light delivery system 1200 to a light source (not shown). Light distributor 1260 preferably takes the form of an optic light guide cable, which may be either rigid or flexible. Attachment members 1280 connect light distributor 1260 to forceps 1102. In an embodiment of the present invention, attachment members take the
25 form of clips. An opening 1270 is formed at the tip end of one arm of forceps 1102. Opening 1270 is dimensioned to receive light emitter 1210. Light emitter 1210 provides light along length L. It should be appreciated that a second opening 1270 may be formed in the second arm of forceps 1102, in order to receive a second light emitter.

Referring now to Fig. 18, there is shown a trans-illuminating retractor 1103
30 having an attachable light delivery system 1300. Arrows A illustrate the directions in which retractor 1103 is movable. Light delivery system 1300 is generally comprised of a light distributor 1360 and a light emitter 1310. Light distributor 1360 includes connecting members (not shown) for connecting light

delivery system 1300 to a light source (not shown). Light distributor 1360 preferably takes the form of an optic light guide cable, which may be either rigid or flexible. A connector 1364 is provided to connect and interface light distributor 1360 with light emitter 1310. Attachment members 1380 and 1388 connect light
5 delivery system 1300 to forceps 1103. In an embodiment of the present invention, attachment member 1380 takes the form of a clip. Light emitter 1310 extends along the inner surface of the retractor arms.

The retractor 1103 shown in Fig. 18 includes a handle 1120 having opposite ends 1121 and 1122 and a gripping surface 1123 for contact with the
10 hand of a user.

A retractor arm 1125 is in the shape of an elongated blade having a planar lengthwise dimension and a generally curved cross-sectional shape as shown. The distal end 1126 of the retractor arm 1125 is connected to the handle end 1122. Extending between the distal end 1126 and the proximal end 1127 of the
15 retractor blade 1125 is a blade inner surface 128.

Light emitter 1310 is also in the shape of an elongated blade and extends along the length of the retractor blade 1125 for illuminating the retractor blade along all or a portion of the length thereof as shown. The retractor blade 1125 also acts as a back reflector for the light emitter blade 1310, which has inner and
20 outer surfaces 1129 and 1130 extending between its distal and proximal ends 1131 and 1132.

Both the retractor blade 1125 and light emitter blade 1310 extend at an angle with respect to the handle 1120. The distal end 1131 of the light emitter 1310 defines an illumination input end portion to which the connector 1364 is
25 coupled to optically couple the light emitter to a light source for emission of the light from the light emitter to illuminate the retractor blade along all or a portion of the length thereof as schematically shown in Fig. 18.

Figs. 19A and 19B illustrate a spring-formed "rope" lighting device 1104. Lighting device 1104 is generally comprised of a light distributor 1460 and a light
30 emitter 1410. Light distributor 1460 interfaces with a self-contained miniature light source unit 1490. Light source unit 1490 includes a light source (e.g., LED, incandescent light, laser diodes or the like) and a power source (e.g., a button battery cell or the like). The miniaturization and portability of light source unit 1490 allows lighting device 1104 to be arrangeable within a bodily structure, such

as a body cavity. Alternatively, a remote light source may substitute for self-contained light source unit 1490. It should be noted that in an embodiment of the present invention, light distributor 1460 is formed of a flexible optic light guide. As best seen in the cross-sectional view of Fig. 19B, a protective outer sleeve
5 1470 covers light distributor 1460. Outer sleeve 1470 is preferably formed of a translucent or transparent material. A spring 1450 extends between light distributor 1460 and outer sleeve 1470. Spring 1450 may be formed of a material which allows it to return to its original shape after being compressed. Accordingly, spring 1450 has a "memory", which allows for advantageous use of
10 lighting device 1104, as will be described below. Light emitter 1410 provides diffuse light D along length L.

It should be appreciated that while lighting device 1104 is shown with a generally round cross-sectional area, lighting device 1104 may have a cross-sectional area of other shapes, including a square and octagon.

15 Lighting device 1104 finds particularly advantageous use as a means for holding a cavity open during a surgical procedure. In this regard, lighting device 1104 is compressed (i.e., squeezed) and inserted through an opening into a cavity (e.g., a heart chamber). When the compressive force is removed from lighting device 1104, the "memory" of spring 1450 causes the device to return to
20 its original shape (i.e., spring open). As a result, the cavity opening is conveniently held open during further surgical procedures. It should be appreciated that spring 1450 may be suitably shaped to fit a particular application.

Figs. 20A and 20B illustrate a smoke evacuation tube 1105 having an
25 integrated light delivery system 1500. Light delivery system 1500 is generally comprised of a light distributor 1560 and light emitters 1510. Light distributor 1560 includes a connecting member 1562 for connecting light distributor 1560 to a light source (not shown). Light distributor 1560 is preferably formed of a flexible optic light guide. As best seen in the cross-sectional view of Fig. 20B, a
30 protective outer sleeve 1574 covers light distributor 1560. Outer sleeve 1574 is preferably formed of a translucent or transparent material. An optional formable wire 1550 extends between light distributor 1560 and outer sleeve 1574, to allow smoke evacuation tube 1105 to hold its shape once arranged in a desired position. Light emitters 1510 provide diffuse light D along length L, in addition to

a beam of light B. It should be noted that an optional lens may be provided at the free end of smoke evacuation tube 1105 to focus light B from light emitter 1510 in a desired pattern.

5 A hollow tube 1570 forms an evacuation chamber 1572 for removing smoke. As best seen in Fig. 20B, hollow tube 1570 surrounds and connects to outer sleeve 1574. Hollow tube 1570 is preferably formed of a translucent or transparent material. It should be appreciated that in an alternative embodiment, sleeve 1574 and tube 1570 are suitably arranged adjacent to each other.

10 Figs. 21A and 21B illustrate a suction tube 1106 having an integrated light delivery system 1600. Light delivery system 1600 is generally comprised of a light distributor 1660 and light emitters 1610. Light distributor 1660 includes a connecting member 1662 for connecting light distributor 1660 to a light source (not shown). Light distributor 1660 is preferably formed of a flexible optic light guide. As best seen in the cross-sectional view of Fig. 21B, a protective outer
15 sleeve 1674 covers light distributor 1660. Outer sleeve 1674 is preferably formed of a translucent or transparent material. An optional formable wire 1650 extends between light distributor 1660 and outer sleeve 1674, to permit suction tube 1106 to hold its shape once arranged in a desired position. Light emitters 1610 provide diffuse light D along length L, in addition to a focused beam of light B. It should
20 be noted that an optional lens may be provided at the free end of suction tube 1106 to focus light B from light emitter 1610 in a desired pattern. A hollow tube 1670 forms a suction chamber 1672 for suctioning smoke and other materials. A nozzle 1676 is formed at the free end of hollow tube 1670. As best seen in Fig. 21B, hollow tube 1670 is arranged adjacent and connected to outer sleeve 1674.
25 Hollow tube 1670 is preferably formed of a translucent or transparent material.

Figs. 22A and 22B illustrate a suction tube 1107 having an attachable light delivery system 1700. Light delivery system 1700 is generally comprised of a light distributor 1760 and light emitters 1710. Light distributor 1760 includes a connecting member 1762 for connecting light distributor 1660 to a light source
30 (not shown). Light distributor 1760 is preferably formed of a flexible optic light guide. As best seen in the cross-sectional view of Fig. 22B, a protective outer sleeve 1774 covers light distributor 1760. Outer sleeve 1774 is preferably formed of a translucent or transparent material. An optional formable wire 1750 extends between light distributor 1760 and outer sleeve 1774, to permit suction tube 1107

to hold its shape once arranged in a desired position. Light emitters 1710 provide diffuse light D along length L, in addition to a beam of light B. It should be noted that an optional lens may be provided at the free end of suction tube 1107 to focus light B from light emitter 1710 in a desired pattern.

5 A hollow tube 1770 forms a suction chamber 1772 for suctioning smoke and other materials. A nozzle 1776 is formed at the free end of hollow tube 1670. Hollow tube 1770 is preferably formed of a translucent or transparent material. Attachment members 1780 connect hollow tube 1770 to outer sleeve 1774. In one embodiment, attachment member 1780 takes the form of a clip having a pair
10 of gripping members respectively dimensioned to receive hollow tube 1770 and sleeve 1774 (Fig. 22A). However, it should be appreciated that attachment member 1780 may take other suitable forms.

Referring now to Fig. 23A, there is shown a ring-shaped "rope" lighting device 1108. Lighting device 1108 is generally comprised of a light distributor
15 1860 and light emitters 1810. Light distributor 1860 includes a connecting member 1862 for connecting light distributor 1860 to a light source (not shown). It should be noted that in an embodiment of the present invention, light distributor 1860 is formed of a flexible optic light guide. As seen in the cross-sectional view of Fig. 23B, a protective outer sleeve 1870 covers light distributor 1860. Outer
20 sleeve 1870 is preferably formed of a translucent or transparent material. A custom-formed spring temper wire 1850 extends between light distributor 1860 and outer sleeve 1870. Wire 1850 may be compressed and will return to its original shape. Light emitter 1810 provides light along length L. A fastener 1880 is provided to hold lighting device 1108 in a desired shape. Fastener 1880 may
25 take many suitable forms, including a mechanical fastener or adhesive (e.g., glue). A secondary wire 1852 is provided along a portion of light distributor 1860. Wire 1852 may be malleable or spring temper. Tabs 1882 hold lighting device 1108 in a desired location, and can also be used to retract tissue during a surgical procedure. In one embodiment, tabs 1882 take the form of adhesive
30 tape.

As indicated above, a protective outer sleeve may cover a light transmitting member (e.g., light distributor or light emitter). The purpose of this protective cover is to prevent (1) contaminants (such as blood, body tissue, dirt, oil, grease, paint, etc.); (2) other components (such as adhesive pads, labels,

hooks, etc.); or (3) any other material or structure that can cause attenuation, from directly contacting the light transmitting member and preventing proper operation thereof. In this regard, the protective cover allows light to pass through the light transmitting member with minimal disturbance to internal reflection of light traveling therethrough. When contaminants or components are in direct contact with the light transmitting member, they interfere with the proper internal reflection within the light transmitting member. In particular, the angle of reflection of light traveling through the light transmitting member is changed. In the case where there is no air gap, or virtually no air gap between the contaminant/components and the surface of the light transmitting member, optical energy of the light propagating through the light transmitting member (e.g., originating from a 300 Watt light source) is absorbed by the contaminant. As a result, the temperature of the contaminant will increase, possibly to an undesirable level.

It should be noted that the term "cover" as used herein refers to materials providing a film, skin, boundary layer, coating, and the like. Specific examples of suitable materials are discussed below.

Referring now to Figs. 24A-24D, there is shown a first exemplary embodiment of the protective cover. Protective cover 2400 surrounds a light transmitting member 2410 (e.g., a flexible or rigid light pipe). As best seen in Figs. 24B-24D, an air interface or gap 2408 is maintained between light transmitting member 2410 and cover 2400. It should be appreciated that the air interface or gap may be microscopic (e.g., a couple of microns) to avoid interference with internal reflection. In this regard, reflections occur at the interface of light transmitting member 2410 and air gap 2408. Cover 2400 may be applied to light transmitting member 2410 in a variety of suitable ways, including but not limited to molding, vacuum forming, heat shrinking, and the like.

Figs. 25A-25D illustrate another embodiment of the protective cover. Protective cover 2500 is generally comprised of a first cover portion 2500A and a second cover portion 2500B, which surround light transmitting member 2510. As best seen in Figs. 25B-25D, an air interface or gap 2508 is maintained between light transmitting member 2510 and cover 2500. Cover portions 2500A and 2500B are bonded together at interface 2502 to form a unitary protective cover

2500 (Fig. 25C). For instance, glue, a heat seal, or the like are suitable for bonding the cover portions 2500A, 2500B.

In the embodiment shown in Figs. 26A-26D, the cover takes the form of a coating 2600 that is applied to the surface of light transmitting member 2610.

- 5 Coating 2600 provides an appropriate index of refraction to maintain a desired internal reflection. The coating 2600 may take many suitable forms, including but not limited to optical coatings with an appropriate index of refraction, and Teflon[®]. It will be appreciated that in this embodiment there is no air interface or gap.

- The protective cover may be comprised of materials taking a number of suitable forms, including but not limited to glass, plastic, shrink film (e.g., Reynolon[®] shrink film packaging), thin-wall PVC heat shrinkable tubing, metal (e.g., aluminum), cardboard, and the like. The wall thickness of the shrinkable tubing is typically in the range of .0002 inches to .012 inches. Suitable shrinkable tubing is available from Advance Polymers, Incorporated and RJ International Corporation. Where a heat shrinkable tubing is used, the tubing is fit over the light transmitting member and heat is applied, to shrink the tubing around the light transmitting member.
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- It should be appreciated that the protective cover may be formed of a translucent, transparent, opaque, or reflective material, or combinations thereof. Thus, a lighting device may include a protective cover that allows some portions of the light transmitting member to emit light or "glow", while preventing other portions of the light transmitting member from emitting light or "glowing". For example, the protective cover may be suitably configured with an opaque section corresponding to one side of a light transmitting member, and with a transparent or translucent section corresponding to the other side of the light transmitting member. In addition, a reflective material may be used as a back-deflector to reflect light as it is traveling through the light transmitting member. Furthermore, it should be appreciated that the protective cover may be formed of a material which diffuses light passing therethrough. The protective covering may be formed of a material that is generally rigid or generally flexible. Some materials may have a "memory", so that when the protective cover is manually bent and then released, it does not retain its deformed state. Other materials may not have a "memory" and thus will not spring back to their original shape after deformation. It should be noted that materials lacking a memory can be
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effectively used as a means for positioning and supporting a generally flexible light transmitting member.

Referring now to Figs. 27A and 27B, there is shown a protective cover 2700 according to another embodiment of the present invention, as applied to a light transmitting member 2710. Protective cover 2700 has a generally tubular shape, and includes an outer surface 2702 and an inner surface 2704. In addition, protective cover 2700 has a closed end 2705 and an open end 2706, with a central body portion 2707 extending therebetween. Closed end 2705 covers the distal end of light transmitting member 2710. Open end 2706 is dimensioned to receive a connector member 2720, which is described below. An air interface or gap 2708 is maintained between protective cover 2700 and light transmitting member 2710.

In the embodiment shown in Figs. 27A and 27B, light transmitting member 2710 takes the form of a "light rod" which emits light at the distal end of the light transmitting member. In this respect, light emitters form a part of the light transmitting member 2710, along a portion of the distal end, to emit light in a manner appropriate for a particular application.

Connector member 2720 is attached to light transmitting member 2710, and provides an interface 2722 for attaching protective cover 2700. Interface 2722 includes a generally cylindrical engagement wall 2724 and a circular flange 2726. In an embodiment, the outer surface of engagement wall 2724 mates with inner surface 2704 of protective cover 2700. For instance, mating threads may be formed on the outer surface of engagement wall 2724 and inner surface 2704. Alternatively, the outer diameter of engagement wall 2724 may be dimensioned to press-fit within protective cover 2700. Circular flange 2726 acts as a stop to prevent over-tightening of connector member 2720 within protective cover 2700. In this respect, the front surface of circular flange 2726 engages with the front surface of open end 2706 of protective cover 2700.

Protective cover 2700, in cooperation with connector member 2720, seals a portion of light transmitting member 2710 from contact with contaminants. In an embodiment, the portion of the light transmitting member 2710 protected from contaminants will include a portion that emits light on a work area, and is the portion most likely to make contact with contaminants. Protective cover 2700, in

combination with connector member 2720, encloses a portion of light transmitting member 2710.

Figs. 28A and 28B show a protective cover 2800 that surrounds a light transmitting member 2810, and takes the same form as protective cover 2700. In this regard, protective cover 2800 has a generally tubular shape, and includes an outer surface 2802 and an inner surface 2804. In addition, protective cover 2800 has a closed end 2805 and an open end 2806, with a central body portion 2807 extending therebetween. Closed end 2805 covers the distal end of light transmitting member 2810. Open end 2806 is dimensioned to receive a connector member 2820, which is described below. An air interface or gap 2808 is maintained between protective cover 2800 and light transmitting member 2810.

In the embodiment shown in Figs. 28A and 28B, light transmitting member 2810 also takes the form of a "light rod" which emits light at a distal end thereof.

Connector member 2820 is attached to light transmitting member 2810, and provides an interface 2822 for attaching protective cover 2800. Interface 2822 includes a generally cylindrical engagement wall 2824 and a circular flange 2826. In an embodiment, the outer surface of engagement wall 2824 mates with inner surface 2804 of protective cover 2800. Circular flange 2826 acts as a stop to prevent over-tightening of connector member 2820 within protective cover 2800. In this respect, the front surface of circular flange 2826 engages with the front surface of open end 2806 of protective cover 2800.

In the embodiment shown in Figs. 28A and 28B, an attachment member 2850 attaches an accessory device 2860 to the lighting device. Attachment member 2850 can take a variety of suitable forms, including adhesive tape, Velcro fasteners, clips, hooks, tabs, clamps, snaps and the like. Moreover, it should be understood that attachment member 2850 may be an integral part of protective cover 2800. In this regard, protective cover 2850 may suitably include molded clips, hooks, tabs or the like, for attachment of an accessory device. Accessory device 2860 can also take a variety of suitable forms, including a medical instrument. In Figs. 28A and 28B, accessory device 2860 takes the form of a retractor blade.

Since attachment member 2850 is separated from light transmitting member 2810 by protective cover 2800 and air interface or gap 2808, it does not interfere (or minimizes interference) with the propagation of light through light

transmitting member 2810 via internal reflection. Consequently, attachment member 2850 does not cause the same problems that are caused by contaminants in direct contact with light transmitting member 2810.

5 Figs. 29A and 29B show a protective cover 2900 that is similar in many respects to protective covers 2700 and 2800, described above. Protective cover 2900 surrounds a light transmitting member 2910. In this regard, protective cover 2900 has a generally tubular shape, and includes an outer surface 2902 and an inner surface 2904. In addition, protective cover 2900 has a closed end 2905 and an open end 2906, with a central body portion 2907 extending therebetween.
10 Closed end 2905 covers the distal end of light transmitting member 2910, and includes an optional lens L for focusing the light emitted therethrough in a desired pattern. Open end 2906 is dimensioned to receive a connector member 2920, which is described below. An air interface or gap 2908 is maintained between protective cover 2900 and light transmitting member 2910.

15 In the embodiment shown in Figs. 29A and 29B, light transmitting member 2910 also takes the form of a formable rope light which emits light at the distal end thereof. Light transmitting member 2910 is generally flexible. Accordingly, a malleable wire W is provided to hold the shape of light transmitting member 2910 in a desired orientation. Since light transmitting member 2910 is generally
20 flexible, protective cover 2900 is also formed of a flexible material in this embodiment of the invention. For instance, protective cover 2900 may be formed of a flexible PVC material, which will flex along with light transmitting member 2910.

Connector member 2920 is bonded to light transmitting member 2910, and
25 provides an interface 2922 for attaching protective cover 2900. Interface 2922 includes a generally cylindrical engagement wall 2924 and a circular flange 2926. In an embodiment, the outer surface of engagement wall 2924 mates with inner surface 2904 of protective cover 2900. Circular flange 2926 acts as a stop to prevent over-tightening of connector member 2920 within protective cover 2900.
30 In this respect, the front surface of circular flange 2926 engages with the front surface of open end 2906 of protective cover 2900.

Referring now to Figs. 30A and 30B, there is shown a protective cover 3000 that surrounds a light transmitting member 3010, and takes a form similar to protective covers 2700, 2800 and 2900. In this regard, protective cover 3000

has a generally tubular shape, and includes an outer surface 3002 and an inner surface 3004. In addition, protective cover 3000 has a closed end 3005 and an open end 3006, with a central body portion 3007 extending therebetween.

Closed end 3005 covers the distal end of light transmitting member 3010. Open
5 end 3006 is dimensioned to receive a connector member 3020, which is described below. An air interface or gap 3008 is maintained between protective cover 3000 and light transmitting member 3010.

In the embodiment shown in Figs. 30A and 30B, light transmitting member
3010 takes the form of a generally rigid "ring light" which emits light at a distal
10 end thereof.

Connector member 3020 is attached to light transmitting member 3010, and provides an interface 3022 for attaching protective cover 3000. Interface 3022 includes a generally circular engagement wall 3024. In an embodiment, the inner surface of engagement wall 3024 mates with outer surface 3002 of
15 protective cover 3000.

Referring now to Fig. 31, there is shown an illuminated surgical retractor 3100 having an attachable light delivery system 3102. Retractor 3100 may include a pair of retractor arms 3104, 3106 pivotally connected together at their distal ends 3108, 3110. Attached to their distal ends are respective handle
20 portions 3112, 3114 which when moved toward one another, cause the retractor arms 3104, 3106 to move in the direction of the arrows A. Each handle portion may include a gripping surface 3116, 3118 intermediate its ends for gripping by the hand of a user.

Retractor arms 3104, 3106 may be in the shape of elongated blade
25 portions each having proximal ends 3120, 3122 remote from their distal ends and from their handle portions. Extending between the distal and proximal ends of each retractor blade is a blade inner surface 3124, 3126.

Light delivery system 3102 is generally comprised of a light distributor 3130 and a light emitter 3132. Light distributor 3130 may take the form of an
30 optical light guide cable.

The distal end 3134 of light distributor 3130 may be removably connected by connecting member 3136 to housing 3138 integral with one of the handle portions 3112, 3114. Housing 3138 may contain a light source 3140 which preferably comprises a solid-state light source (e.g., a light emitting diode (LED))

including an organic light emitting diode (OLED) and a polymer light emitting diode (PLED)) but may also comprise an incandescent lamp or halogen lamp if desired.

5 Housing 3138 may be made of metal or other suitable heat conductive material to provide a heat sink for light source 3140 which may be thermally coupled to the housing by providing contact between the housing and one of the light source leads 3142, 3144 and also with the body 3146 of the light source as schematically shown in Fig. 31.

10 A power source 3148, which may be a battery or fuel cell that is replaceable or rechargeable, may also be housed within housing 3138. The light source leads 3142, 3144 may be connected to a printed circuit board 3150 within housing 3138 which may act as an interface between light source 3140 and power source 3148.

15 Light emitter 3132 may either be a flexible or rigid transparent light guide, and may have a gradient pattern of printed dots or light extracting deformities on at least one surface thereof for causing light to be emitted from at least a portion of the light guide in the manner previously described in connection with other disclosed embodiments. Light emitter 3132 may also be in the shape of an elongated blade extending along the length of one of the retractor blades 3104
20 for illuminating the retractor blade 3104 along all or a portion of the length thereof. The light extracting deformities may also be arranged to direct light away from a user's eyes and toward a viewing area in proximity of the retractor blade 3104.

Both the retractor blade 3104 and light emitter blade 3132 may extend at
25 an angle with respect to the associated handle portion 3112. The connecting member 3136 of light distributor 3130 defines an illumination input end portion which may be optically coupled to light source 3140 for optically coupling the light emitter 3132 to the light source.

Retractor blade 3104 may also act as a back reflector for light emitter
30 blade 3132 which has inner and outer surfaces 3152, 3154 extending between its distal and proximal ends 3156 and 3158. A slot or opening 3160 may be provided in the proximal end 3162 of retractor blade 3104 for sliding receipt of the proximal end 3120 of light emitter 3132. It should be appreciated that a second

slot or opening may also be formed in the tip of the other retractor blade 3106 in order to receive a second light emitter if desired.

Figs. 32 and 33 show other illuminated surgical retractors 3200 having an attachable light delivery system 3102 similar to the light delivery system shown in Fig. 31. However, in these embodiments, the retractor 3200 only includes one elongated retractor blade 3202. Extending at an acute angle from the distal end 3204 of retractor blade 3202 is an end mount 3206. End mount 3206 may be used to removably attach retractor blade 3202 to a handle portion or other support 3208 which may have a mounting post 3210 protruding therefrom as shown in Fig. 32.

Extending between the distal and proximal ends 3204 and 3212 of retractor blade 3202 is a blade inner surface 3214. An angled or hooked tip 3216 may be provided at the proximal end 3212 of retractor blade 3202 for retaining or gripping tissue. Tip 3216 may also have serrations 3218 as shown.

Light delivery system 3102 is generally comprised of light distributor 3130 and light emitter 3132. Light distributor 3130 may take the form of an optical light guide cable having its distal end 3134 removably attached to one end of support 3208 which may house light source 3140 for directing light into the light distributor 3130 in the manner previously described. Support 3208 may also provide a heat sink for light source 3140 in a manner similar to that shown in Fig. 31, and may house a power source 3148 such as a battery or fuel cell that is replaceable or rechargeable. Alternatively light source 3140 may be powered by providing the retractor 3200 with a power cord 3220 as schematically shown in Fig. 33 for plugging into an electrical outlet (not shown). In either case, the leads 3142 and 3144 of light source 3140 may be connected to a printed circuit board 3150 within support 3208 which may act as an interface between the light source and the power source.

Connecting member 3136 of light distributor 3130 defines an illumination input end portion which may be optically coupled to light source 3140 for supplying light from the light source to light emitter 3132. Light emitter 3132 may also be in the shape of an elongated blade extending along the length of retractor blade 3202, and may either be a flexible or rigid transparent light guide. A gradient pattern of printed dots or light extracting deformities may be provided on at least one surface of light emitter 3132 for causing light to be emitted from at

least a portion thereof for illuminating retractor blade 3202 along all or a portion of the length thereof. Also the light extracting deformities may be arranged to direct light away from a user's eyes and toward a viewing area in proximity of the retractor blade.

5 Retractor blade 3202 may act as a back reflector for light emitter blade 3132 which has inner and outer surfaces 3152 and 3154 extending between its distal and proximal ends 3156 and 3158. Suitable attachment members such as clips 3222 may be used to removably attach light emitter blade 3132 to retractor blade 3202.

10 Fig. 34 shows another illuminated surgical retractor 3300 including a pair of opposed retractor blades 3302 and 3304 having a ratchet or other rod type connection 3306 therebetween for allowing the retractor blades to be moved in the direction of the arrows A upon turning a knob 3308 or the like. One or both retractor blades 3302 and 3304 may be illuminated by a light delivery system
15 3102 similar to the type previously described, including a light distributor 3130 having an illumination input end portion 3134 that is optically coupled to a light source 3140 and a light emitter 3132 that may either be a flexible or rigid transparent light guide and may have a gradient pattern of printed dots or light extracting deformities on at least one surface thereof for causing light to be
20 emitted from at least a portion of the length thereof. Light emitter 3132 may be in the shape of an elongated blade extending along the length of one of the retractor blades 3302 for illuminating retractor blade 3302 along all or a portion of the length thereof. Also the light extracting deformities may be arranged to direct light away from a user's eyes and toward a viewing area in proximity of the
25 retractor blade.

Light source 3140 may be contained within a metal housing 3310 that provides a heat sink for light source 3140 by providing contact between housing 3310 and one of the light source leads and with the body of the light source in the manner previously described. A power source 3148 such as a battery or fuel cell
30 that is replaceable or rechargeable may be provided for powering the light source.

Fig. 35 shows an illuminated surgical retractor 3100 similar to that shown in Fig. 31 having an attachable light delivery system 3400. Light delivery system 3400 differs from the light delivery systems shown in Figs. 31-34 in that it

comprises an array of lights 3140, preferably LEDs, attached to a support 3404 in the shape of an elongated blade that extends along the length of one of the retractor blades 3104 for illuminating retractor blade 3104 along all or a portion of the length thereof.

5 Light supporting blade 3404 may, for example, be a fiberglass printed circuit board (PCB) having a copper cladding that acts as a heat sink for lights 3140. A suitable attachment 3160 such as clips or a slot or opening may be provided at the proximal end 3120 of retractor blade 3104 for sliding receipt of the proximal end 3406 of light supporting blade 3404. It should be appreciated that a
10 second light supporting blade with its own array of lights (LEDs) may also be suitably attached to the other retractor blade 3106.

 A suitable power source 3148, which may be a battery or fuel cell that is replaceable or rechargeable, may be housed in a housing 3138 integral with one of the handle portions 3112, 3114 for powering the array of lights 3140 through a
15 suitable power cord 3408. One end of power cord 3408 may be connected to power source 3148 and the other end may be removably coupled to light supporting blade 3404 to permit light delivery system 3400 to be removed or replaced as desired.

 Figs. 36 and 37 show illuminated surgical retractors 3200 similar to those
20 shown in Figs. 32 and 33 having light delivery systems 3500 and 3600. Light delivery systems 3500 and 3600 comprise an array of lights 3140, preferably LEDs, which may be attached to a support 3504 in the shape of an elongated blade that extends along the length of retractor blade 3202 as shown in Fig. 36 or attached directly to the retractor blade 3202 as shown in Fig. 37 for illuminating
25 the retractor blade along all or a portion of the length thereof.

 The light supporting blade 3504 shown in Fig. 36 may, for example, be a fiberglass PCB having a copper cladding that acts as a heat sink for lights 3140. Also, suitable attachment members such as clips 3222 may be provided along the length of retractor blade 3202 for removably attaching light supporting blade
30 3504 to retractor blade 3202. Where the lights 3140 are attached directly to retractor blade 3202 as shown in Fig. 37, the retractor blade itself may act as a heat sink for the lights.

 In either case, the lights 3140 may be oriented along light supporting blade 3504 or retractor blade 3202 in any desired direction for directing the light away

from the user's eyes and toward a viewing area in proximity to retractor blade 3202.

5 A suitable power source 3148, which may be a battery or fuel cell that is replaceable or rechargeable, may be housed in handle portion or other support 3208 of retractor 3200 for powering the array of lights 3140 through a power cord 3408 suitably coupled to the light supporting blade 3504 of Fig. 36 or to a wire harness (not shown) inside the retractor blade 3202 of Fig. 37.

10 The invention has been described with reference to certain embodiments. Various modifications and alterations will occur to others upon a reading and understanding of this specification. In this regard, it should be appreciated that the present application discloses numerous exemplary embodiments of the present invention for the purpose of illustrating the present invention. It is contemplated that the various features shown in each embodiment may be combined in a plurality of ways to form further embodiments of the present invention. It is intended that all such modifications and alterations be included
15 insofar as they come within the scope of the appended claims or the equivalents thereof.

WHAT IS CLAIMED IS:

1. An illuminated surgical retractor comprising a support, an elongated first blade portion having one end connected to said support and another end
5 remote from said support, an elongated second blade portion extending along a length of said first blade portion, a connector for coupling said second blade portion to a light source integral with said retractor for illuminating at least a portion of at least one of said first blade portion and said second blade portion, and a heat sink to which said light source is thermally coupled.
- 10 2. The retractor of claim 1 wherein said light source comprises a solid-state light source.
3. The retractor of claim 1 wherein said light source comprises at least one light emitting diode.
4. The retractor of claim 1 wherein said light source comprises at least
15 one of an incandescent lamp and a halogen lamp.
5. The retractor of claim 1 wherein said heat sink includes said support.
6. The retractor of claim 5 wherein said light source includes a lead in thermal contact with said support.
- 20 7. The retractor of claim 6 wherein said light source has a body portion in thermal contact with said support.
8. The retractor of claim 1 wherein said support includes a handle portion.
9. The retractor of claim 1 wherein said support includes a mounting
25 post.
10. The retractor of claim 1 wherein said light source is powered by an integral power source.
11. The retractor of claim 10 wherein said integral power source comprises at least one of a battery and a fuel cell contained within said handle.
- 30 12. The retractor of claim 1 wherein said light source is powered by a remote power source.
13. The retractor of claim 1 wherein said second blade portion is disposable, further comprising an attachment member for removably attaching said second blade portion to said first blade portion.

14. The retractor of claim 13 wherein said attachment member comprises at least one clip on one of said first blade portion and said second blade portion for removably engaging the other of said first blade portion and said second blade portion.
- 5 15. The retractor of claim 1 wherein said second blade portion is transparent.
16. The retractor of claim 1 wherein said second blade portion is a light guide.
- 10 17. The retractor of claim 16 wherein said light guide has a gradient printed dot pattern on at least one surface thereof for causing light to be emitted from at least a portion of said light guide.
18. The retractor of claim 16 wherein said light guide has a gradient pattern of light extracting deformities on at least one surface thereof for causing light to be emitted from at least a portion of said light guide.
- 15 19. The retractor of claim 18 wherein said light extracting deformities are arranged to direct light away from a user's eyes and toward a viewing area in proximity of said first blade portion.
20. The retractor of claim 16 wherein said light guide is flexible.
21. The retractor of claim 16 wherein said light guide is rigid.
- 20 22. The retractor of claim 1 wherein said first blade portion is flexible.
23. The retractor of claim 1 wherein said first blade portion is rigid.
24. The retractor of claim 1 wherein at least one of said first blade portion and said second blade portion is illuminated by said light source substantially the entire length of said at least one of said first blade portion and said second blade portion.
- 25 25. The retractor of claim 1 wherein at least one of said first blade portion and said second blade portion has more than one area that is illuminated.
26. The retractor of claim 1 wherein said other end of said first blade portion includes an angled tip for retaining or gripping tissue.
- 30 27. The retractor of claim 26 wherein said tip is serrated.
28. An illuminated surgical retractor comprising a pair of opposed elongated blade portions, at least one elongated substantially transparent light emitter extending along a length of at least one of said blade portions, a connector for coupling said light emitter to a light source integral with said

retractor for illuminating at least a portion of at least one of said light emitter and said blade portions, and a heat sink to which said light source is thermally coupled.

29. An illuminated surgical retractor comprising a support, an elongated
5 blade portion having one end connected to said support and another end remote from said support, and an array of lights along at least a portion of a length of said blade portion for illuminating said blade portion.

30. The retractor of claim 29 further comprising a heat sink to which said lights are thermally coupled.

10 31. The retractor of claim 30 wherein said heat sink includes said blade portion.

32. The retractor of claim 29 wherein said lights are attached directly to said blade portion.

15 33. The retractor of claim 29 wherein said lights are attached to a support extending along the length of said blade portion.

34. The retractor of claim 33 wherein said support is in the shape of a blade.

35. The retractor of claim 34 wherein said support is a printed circuit board.

20 36. The retractor of claim 33 wherein said lights are powered by an integral power source.

37. The retractor of claim 36 wherein said power source comprises at least one of a battery and a fuel cell contained within said support.

25 38. The retractor of claim 33 wherein said support is disposable, further comprising an attachment member for removably attaching said support to said blade portion.

39. The retractor of claim 38 wherein said attachment member includes at least one clip.

30 40. The retractor of claim 29 wherein said lights are oriented along the length of said blade portion for directing light away from a user's eyes and toward a viewing area in proximity to said blade portion.

41. The retractor of claim 29 wherein said support includes a handle.

42. The retractor of claim 29 wherein said support includes a mounting post.

43. The retractor of claim 29 wherein said lights comprise light emitting diodes.

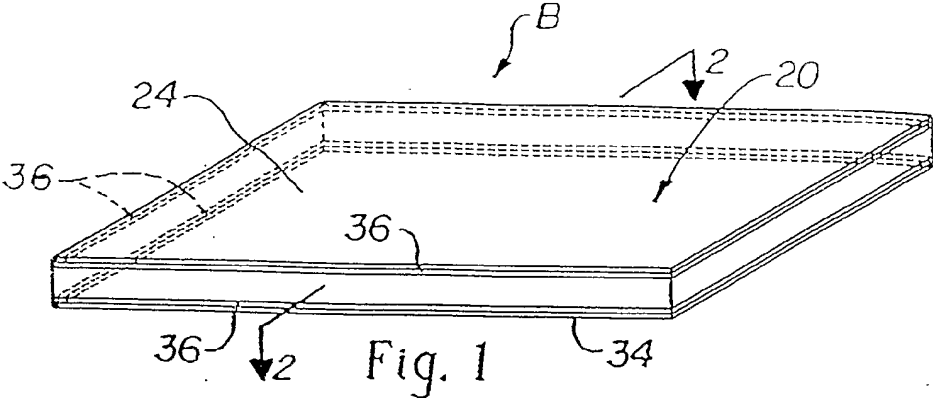
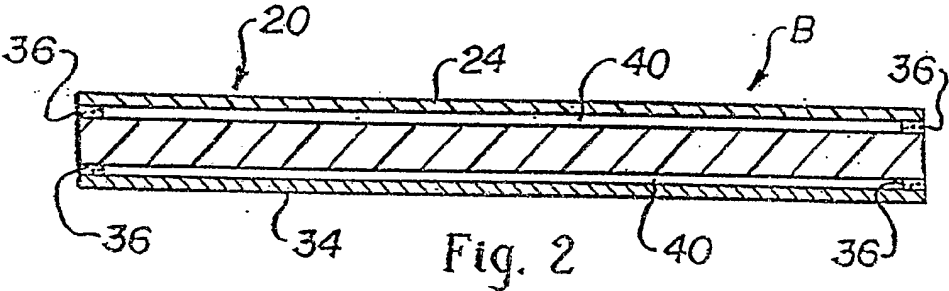
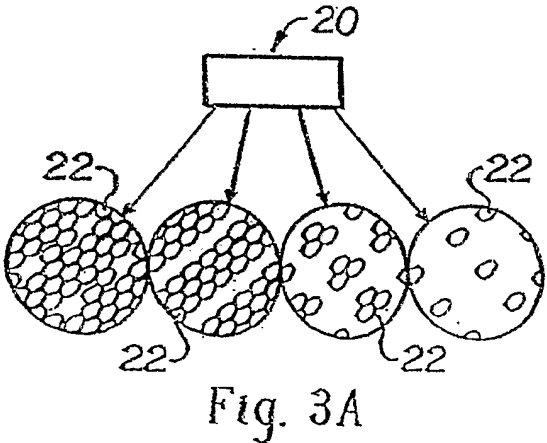
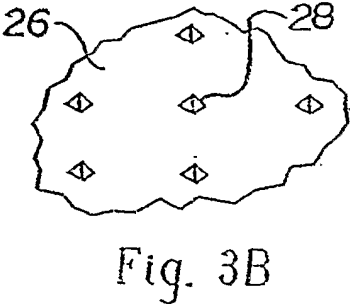
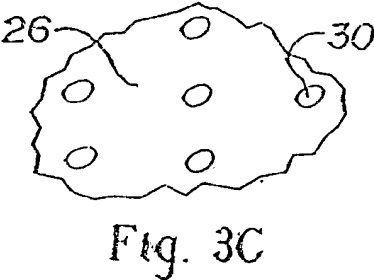
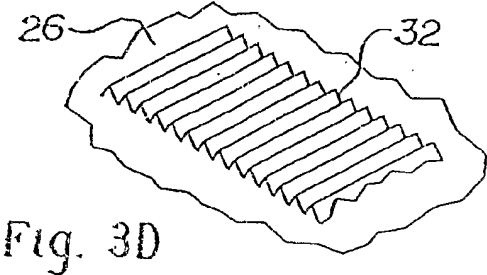
44. The retractor of claim 29 wherein said blade portion is flexible.

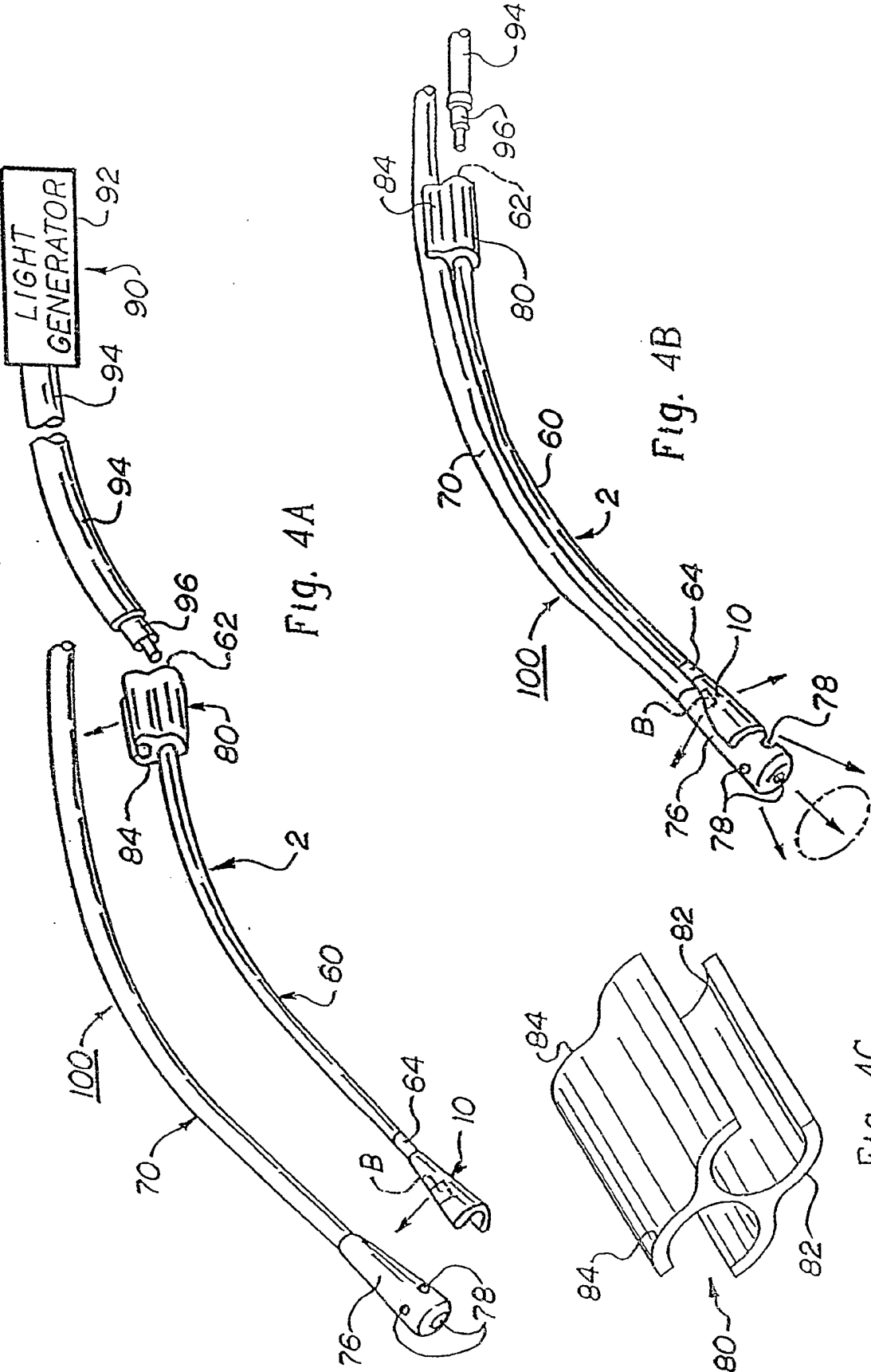
45. The retractor of claim 29 wherein said blade portion is rigid.

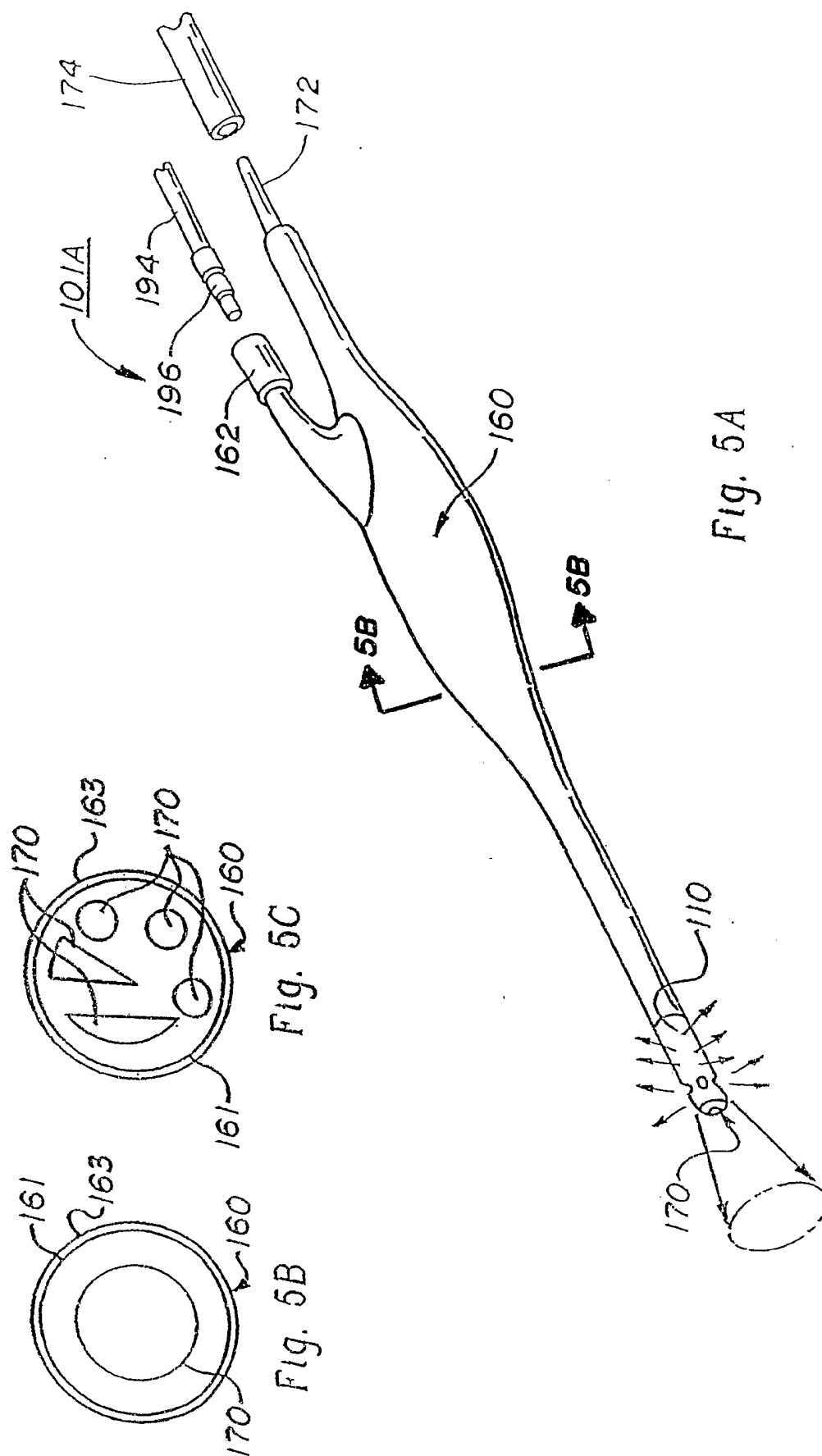
5 46. The retractor of claim 29 wherein said array of lights illuminate said blade portion along substantially the entire length thereof.

47. The retractor of claim 29 wherein said blade portion includes an angled tip for retaining or gripping tissue.

48. The retractor of claim 47 wherein said tip is serrated.







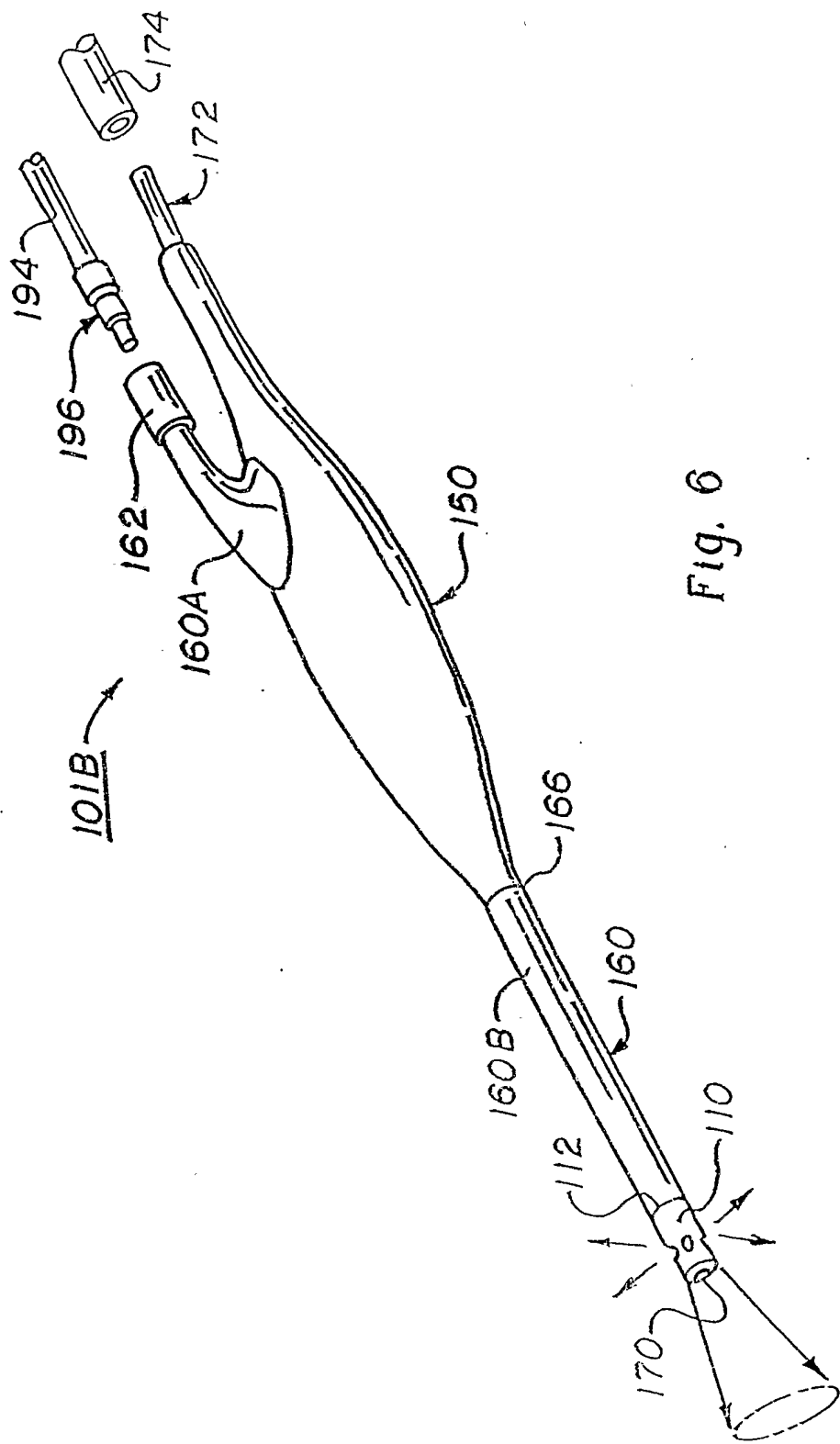
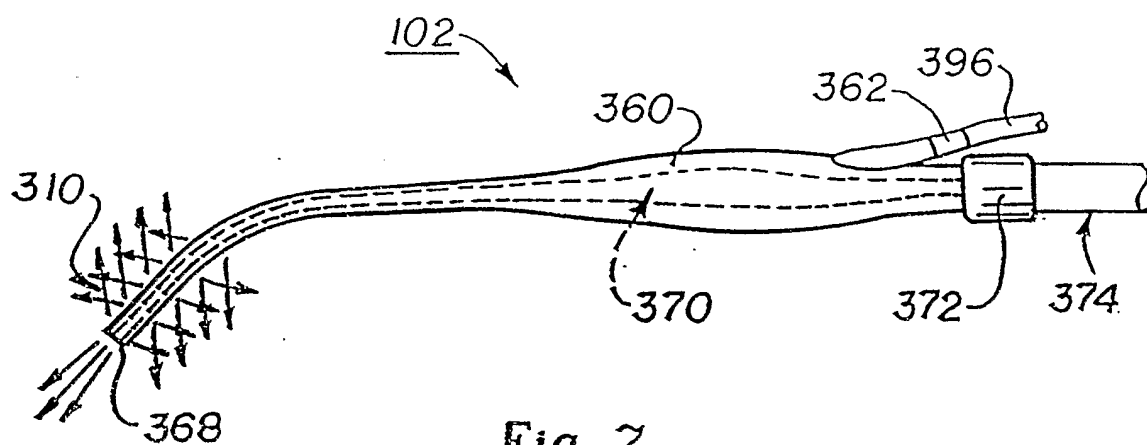
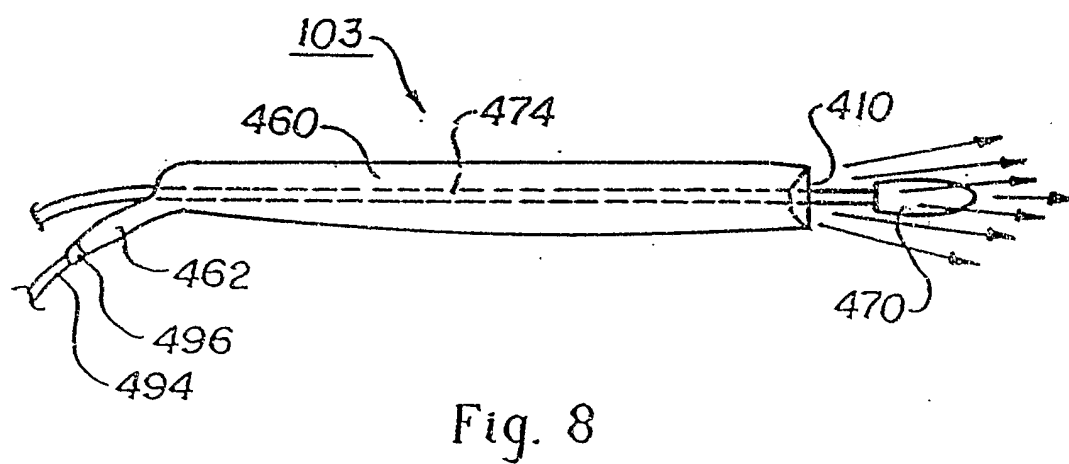
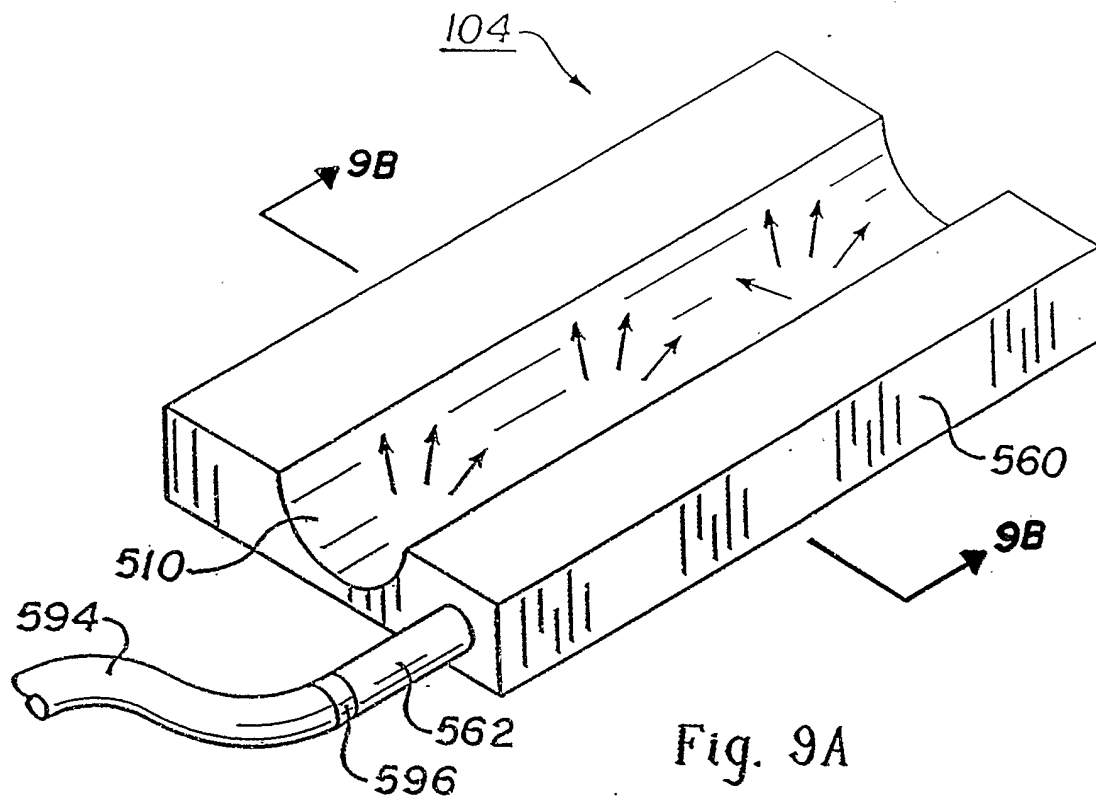
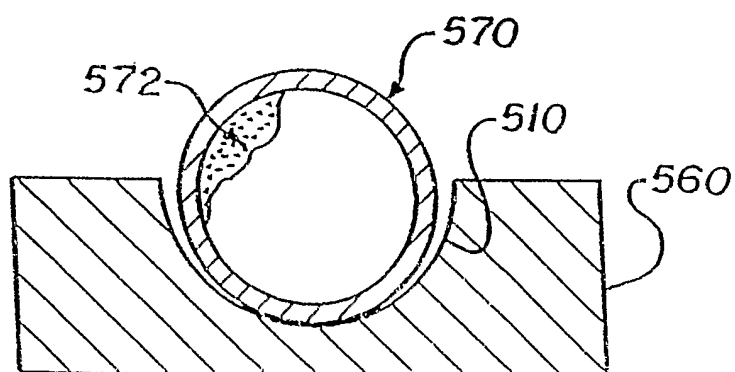


Fig. 6

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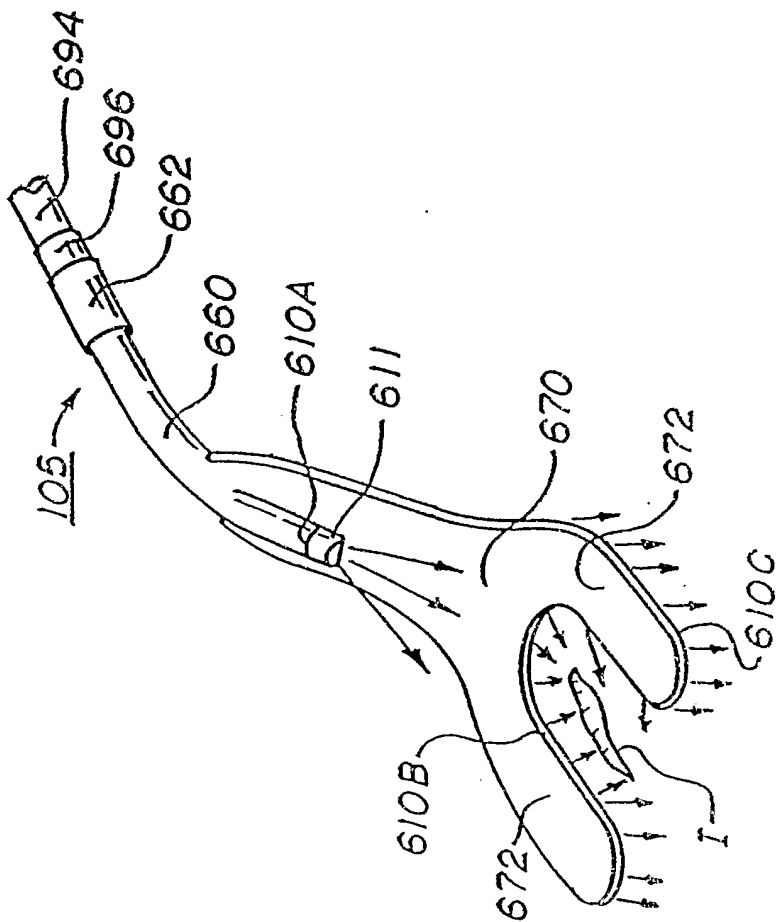


Fig. 10A

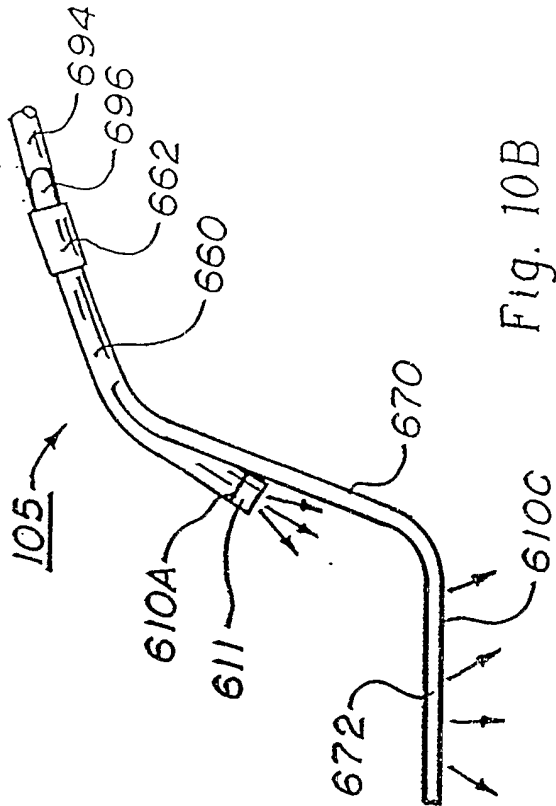


Fig. 10B

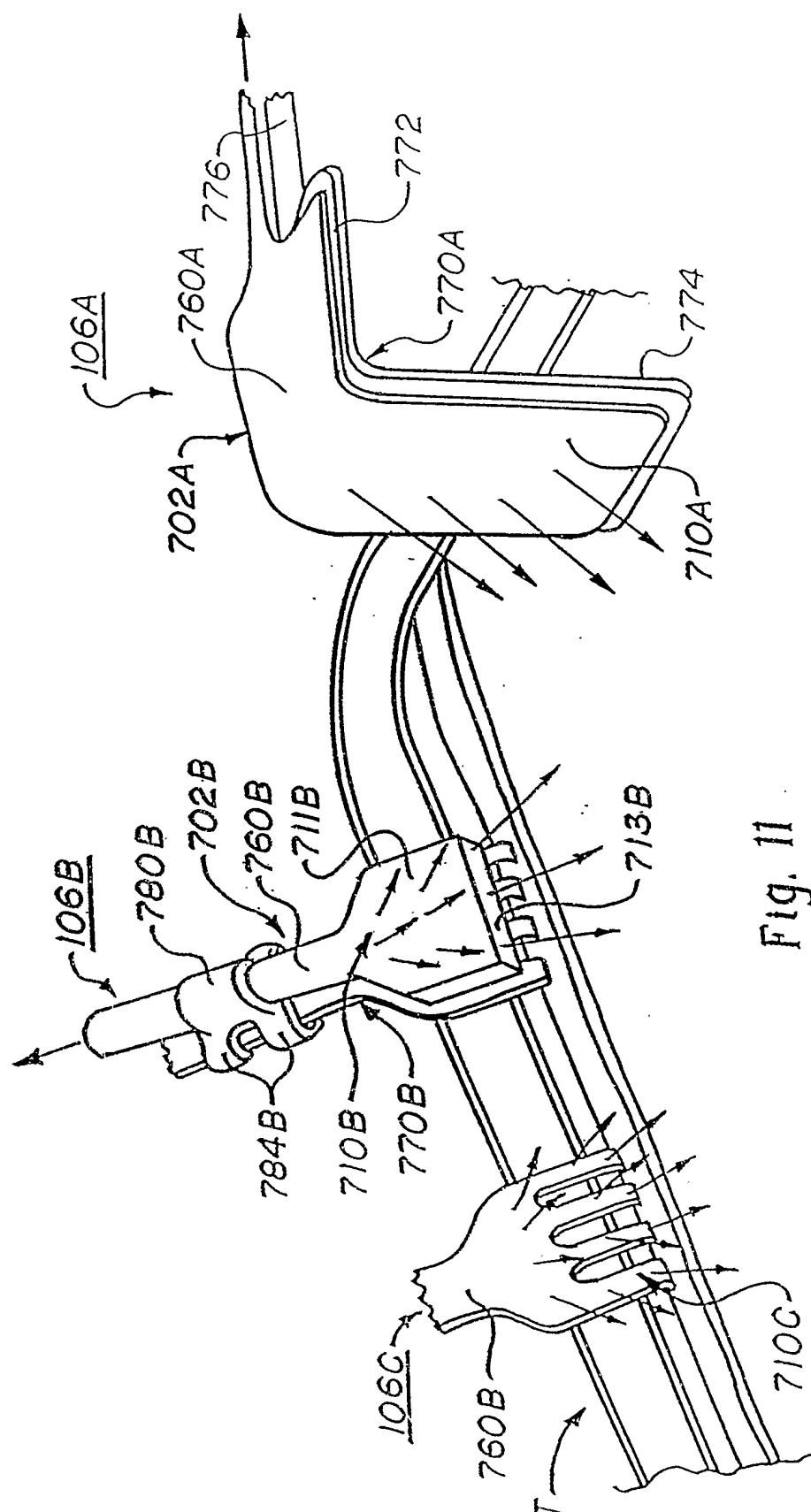


Fig. 11

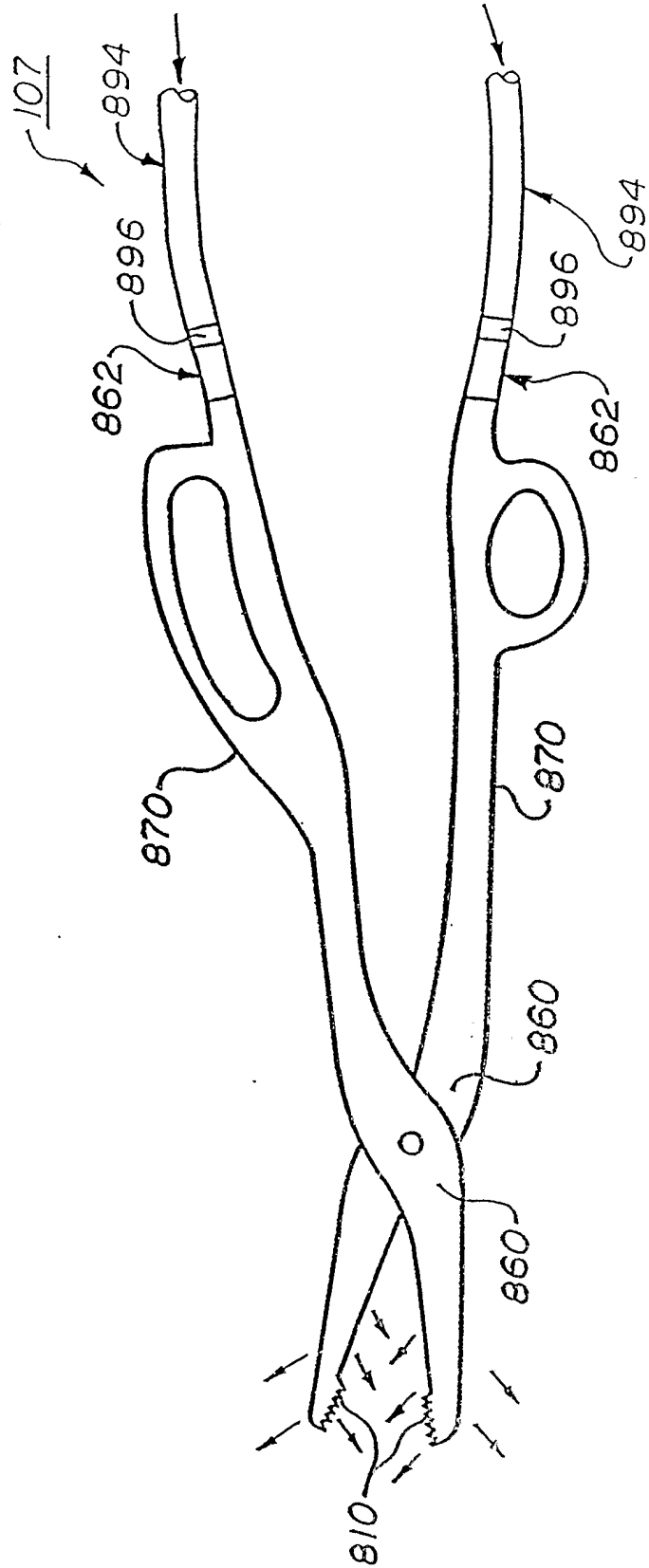
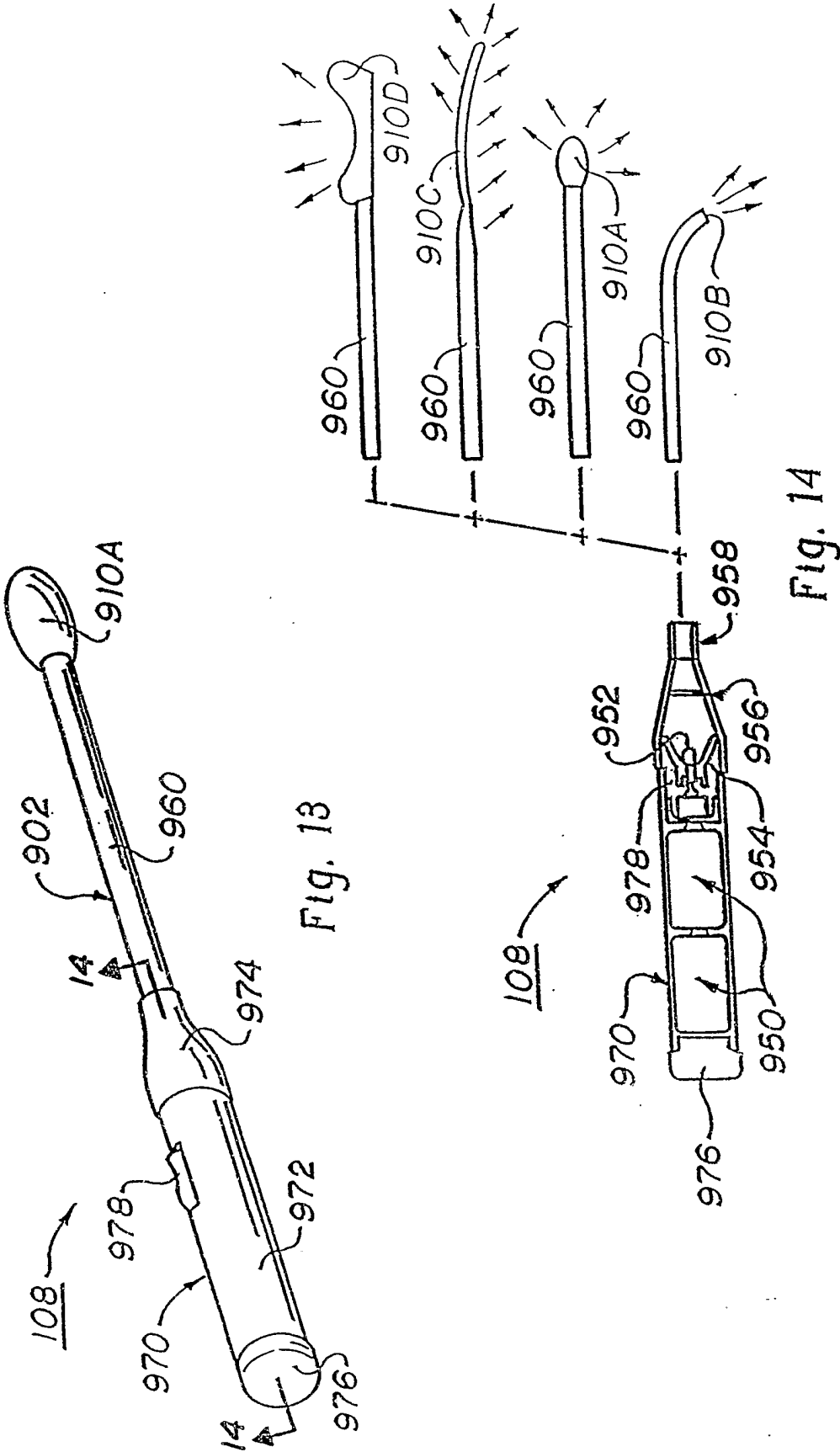
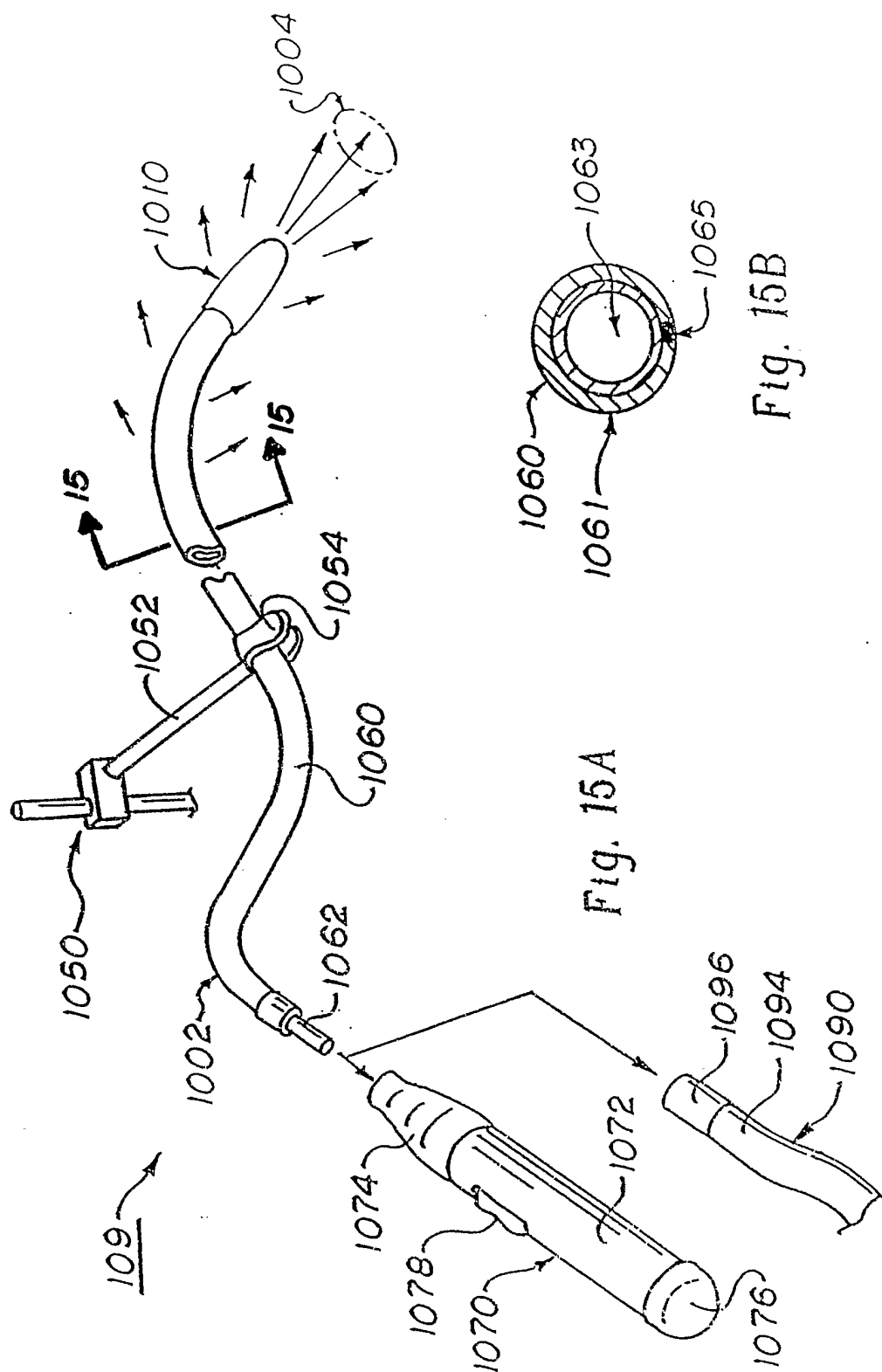


Fig. 12





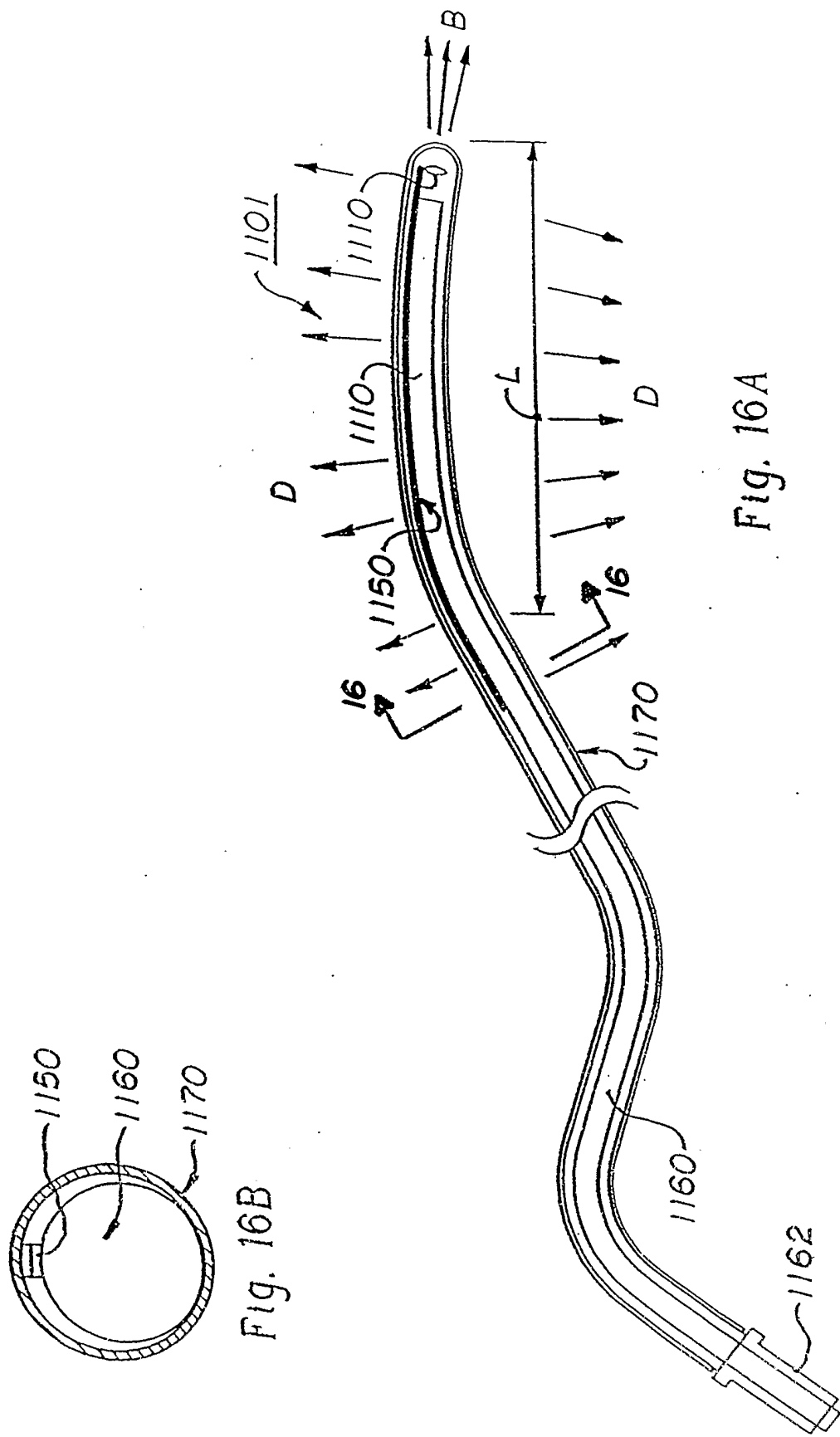
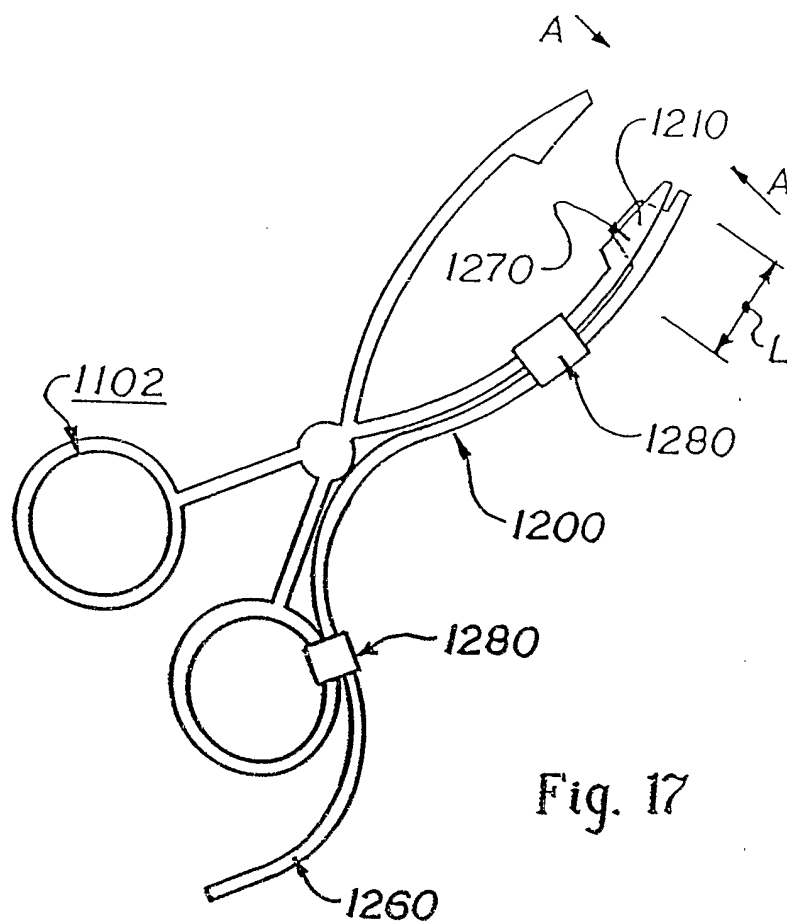
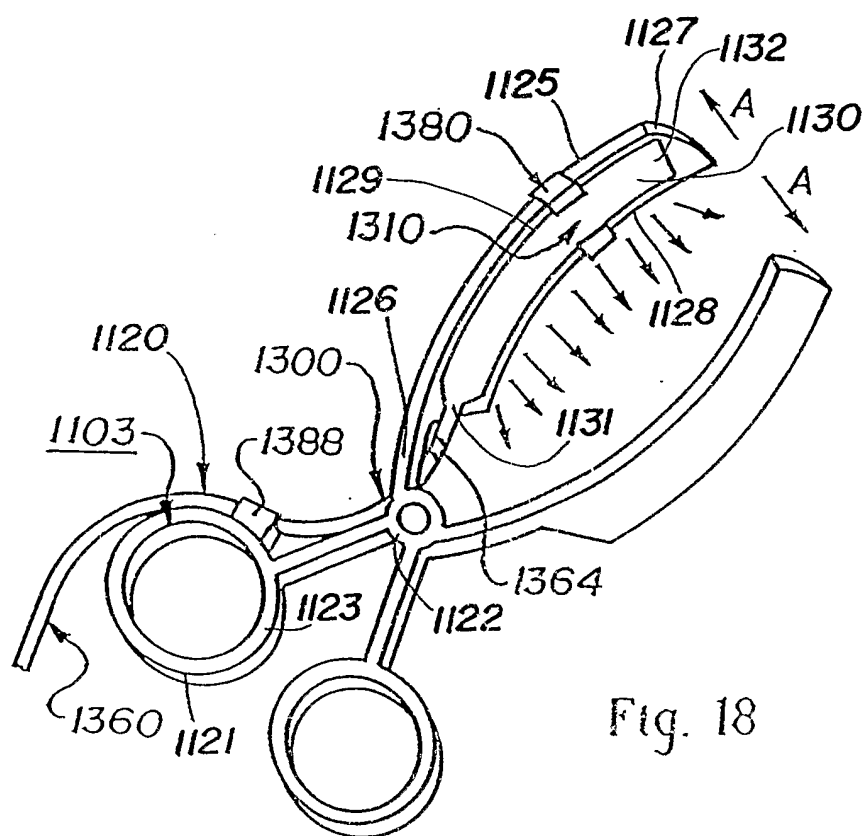


Fig. 16A

Fig. 16B

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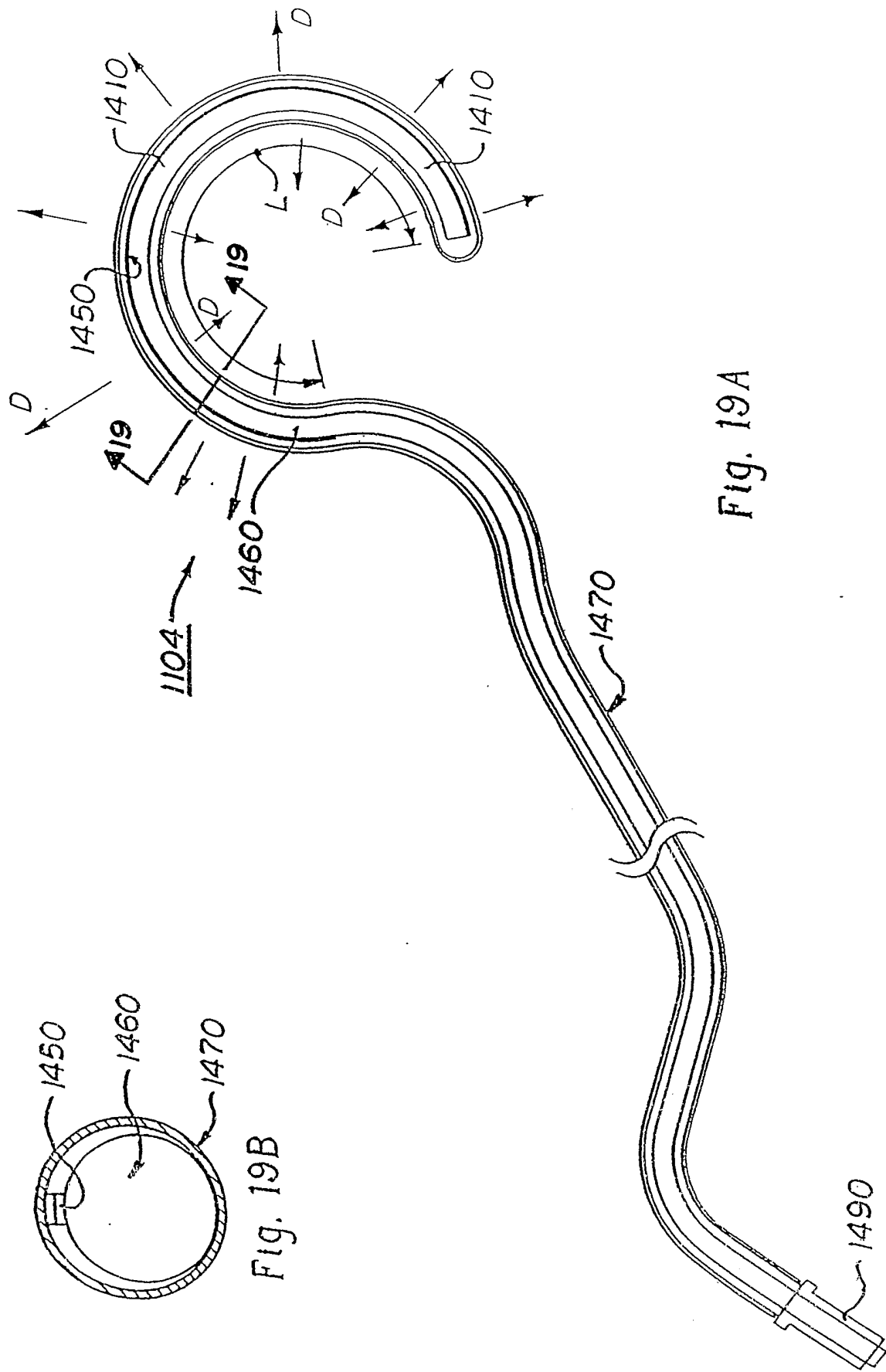


Fig. 19A

Fig. 19B

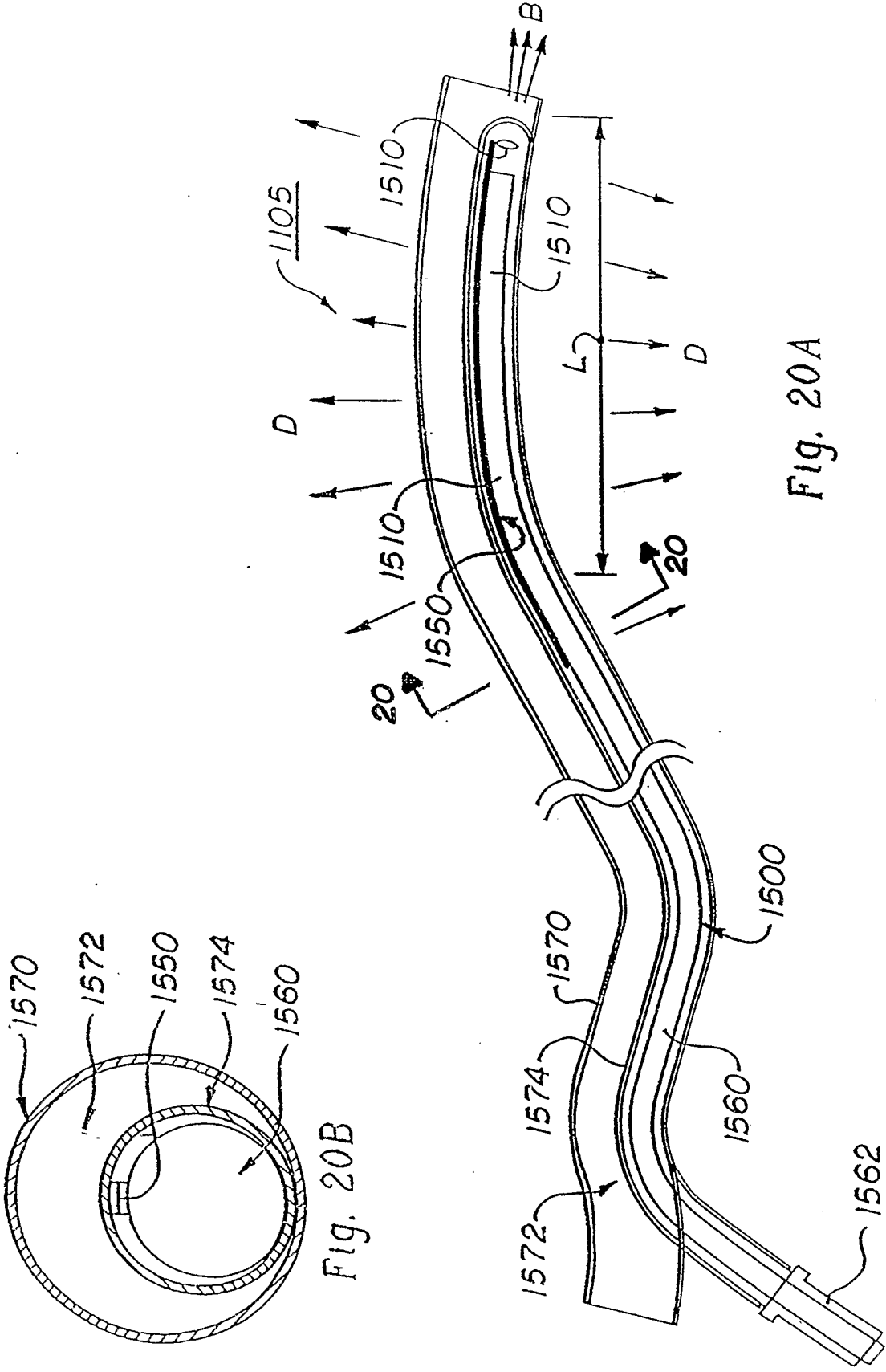


Fig. 20A

Fig. 20B

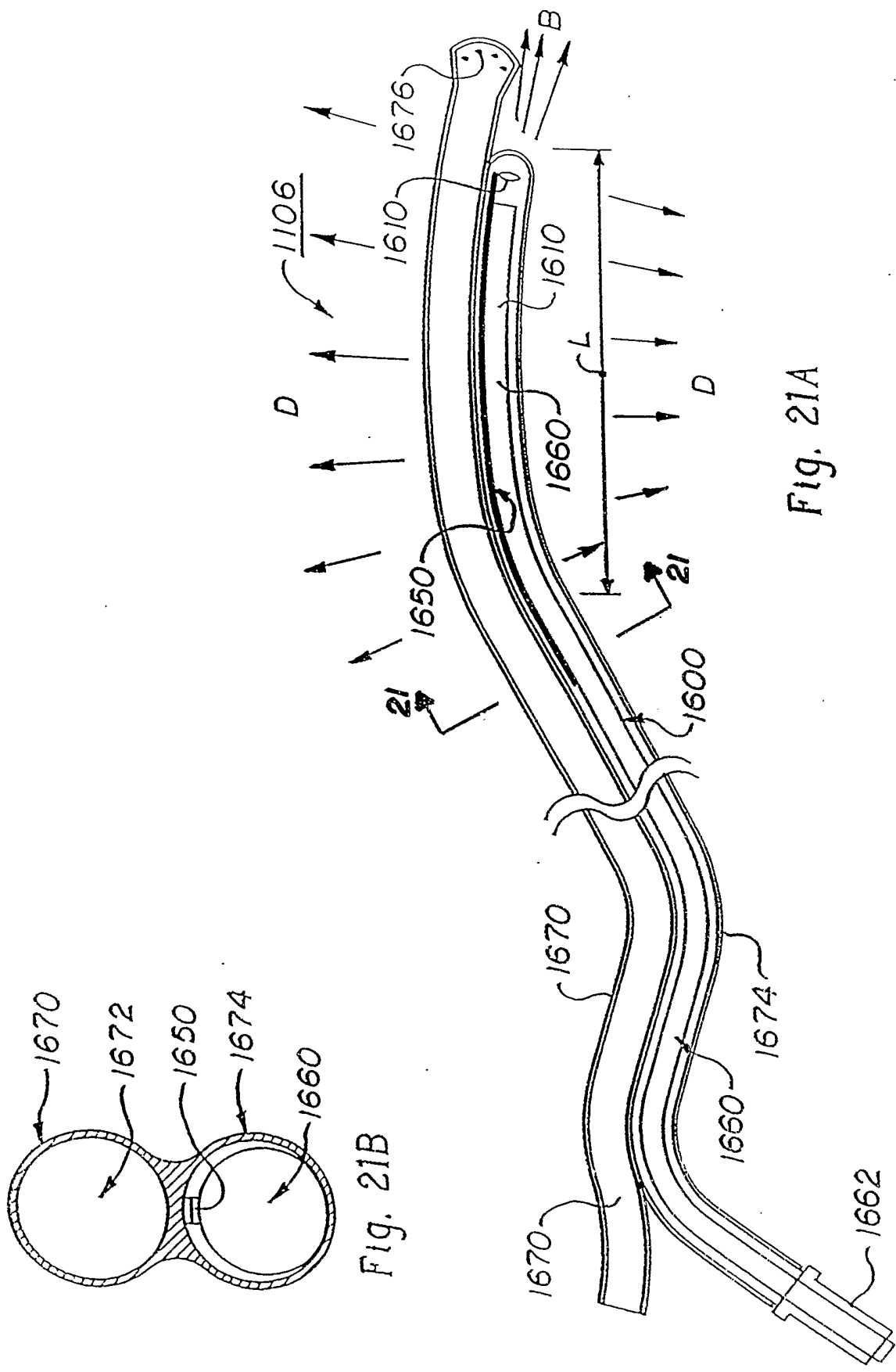
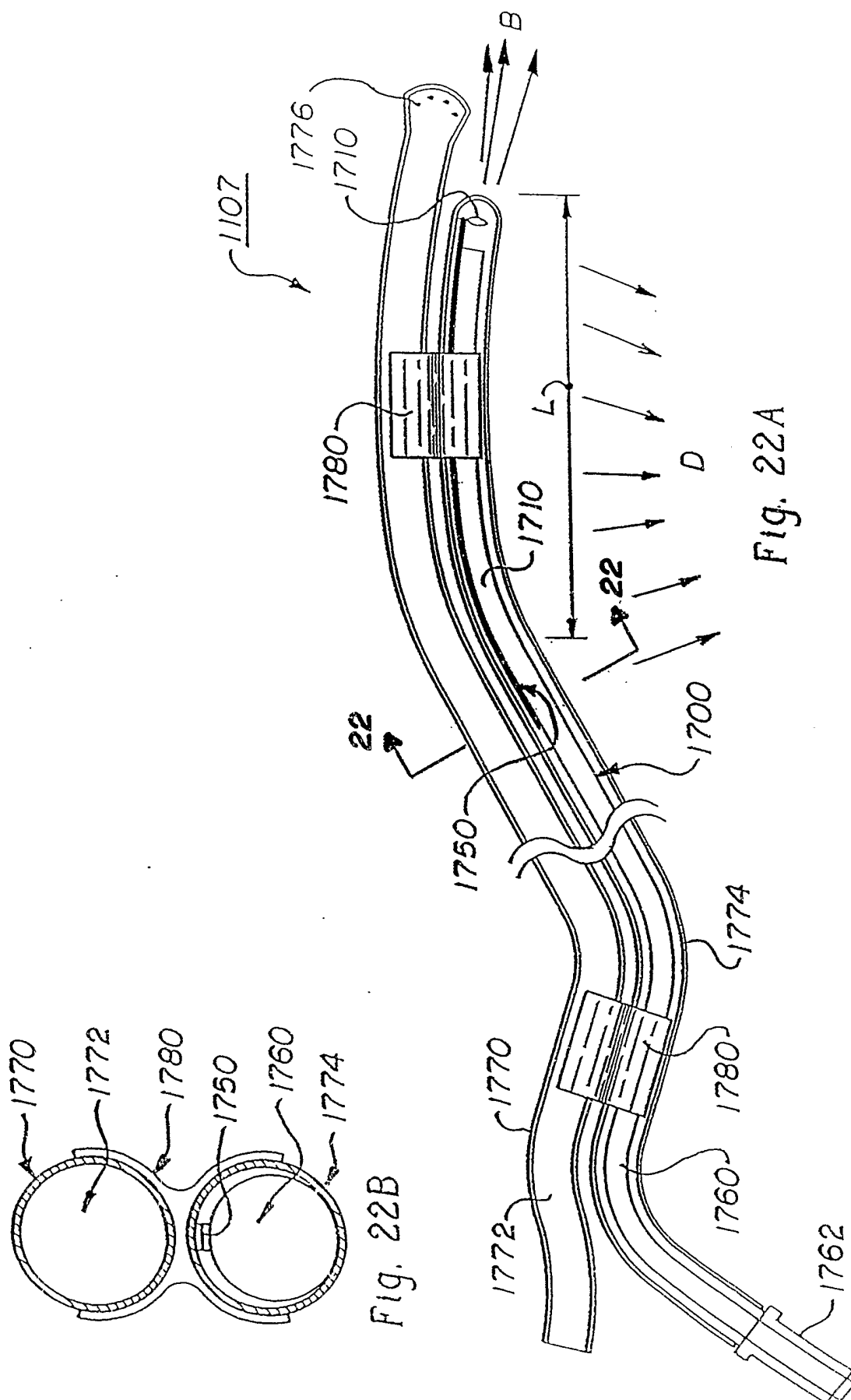


Fig. 21A

Fig. 21B



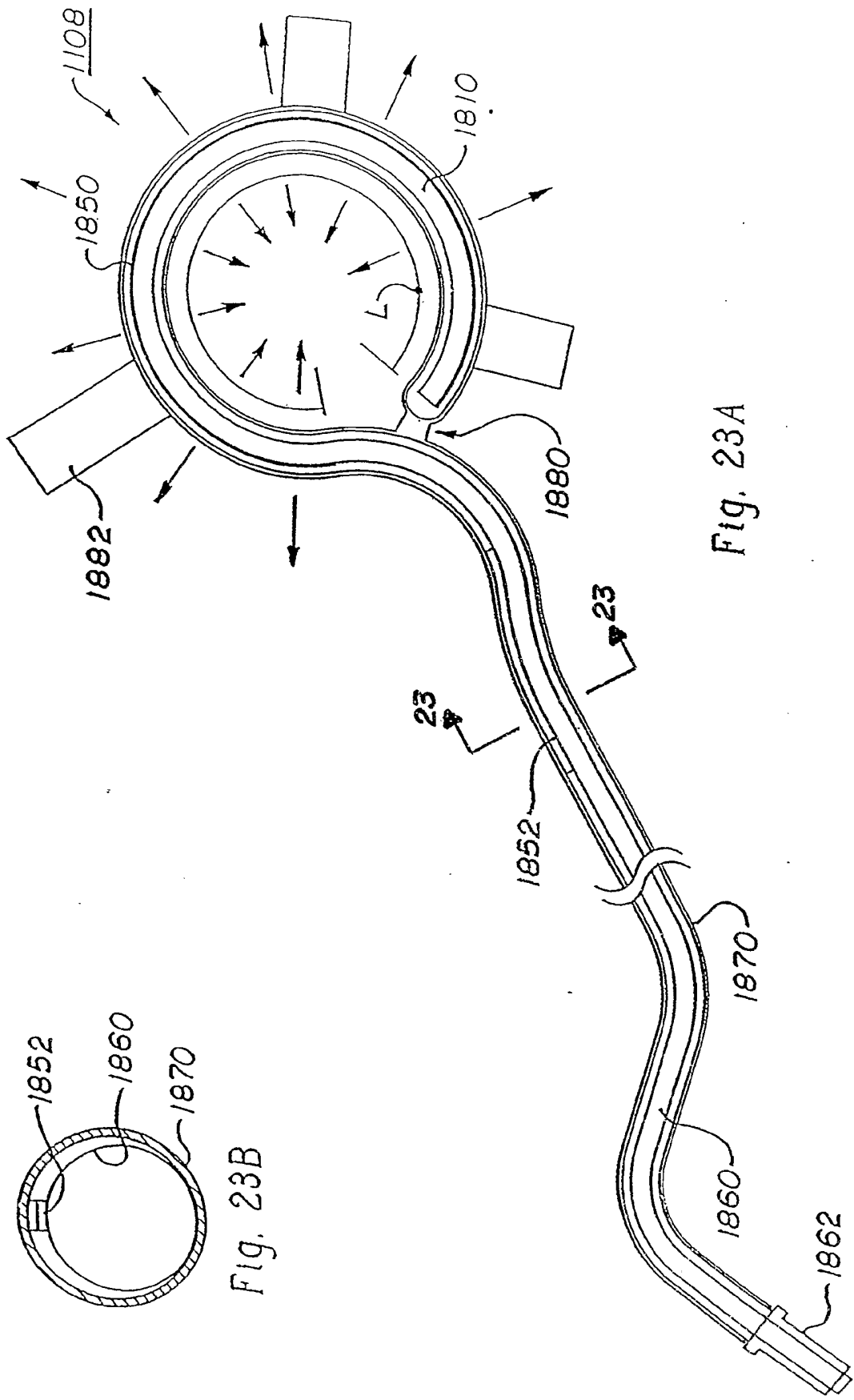
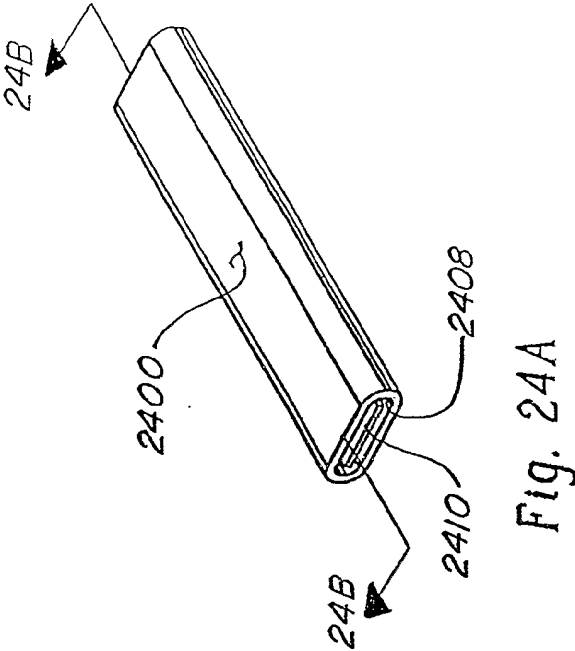
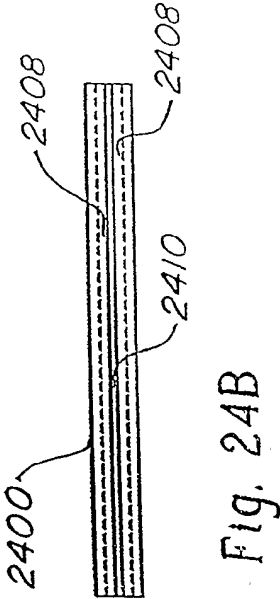
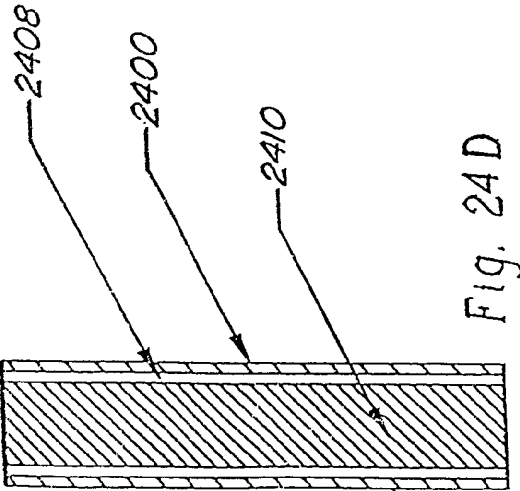
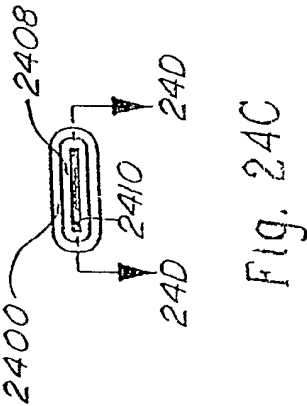
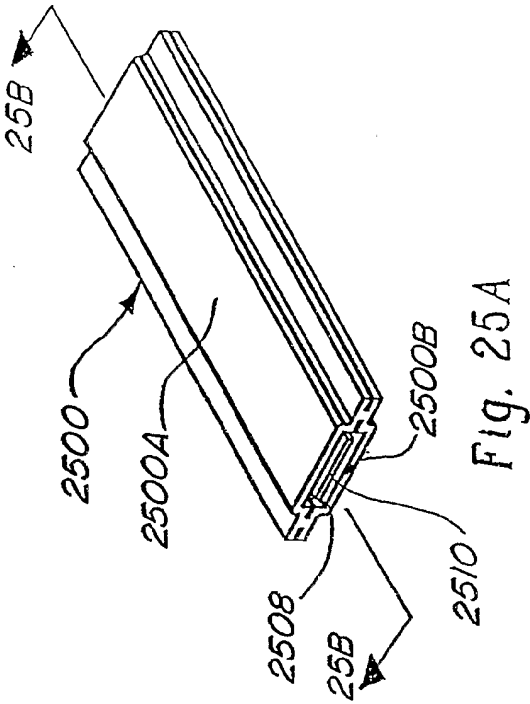
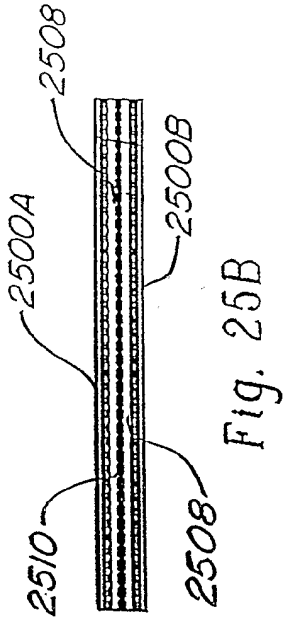
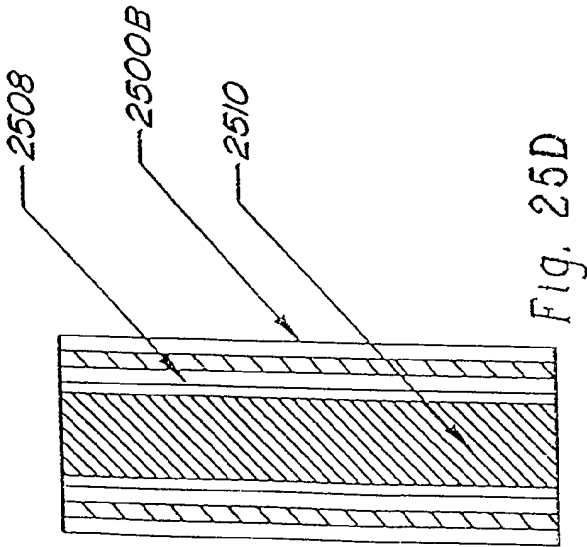
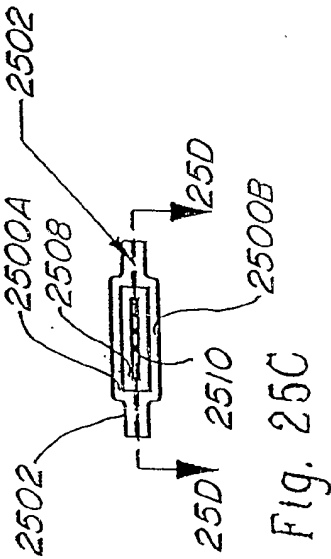


Fig. 23A

Fig. 23B





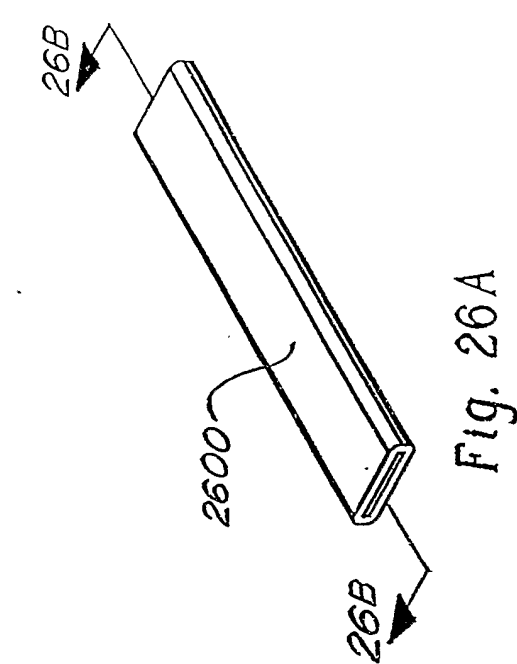


Fig. 26A

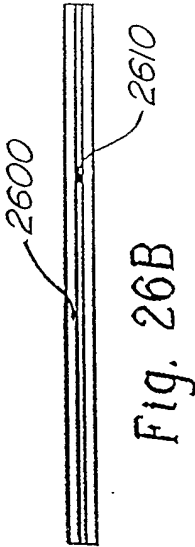


Fig. 26B

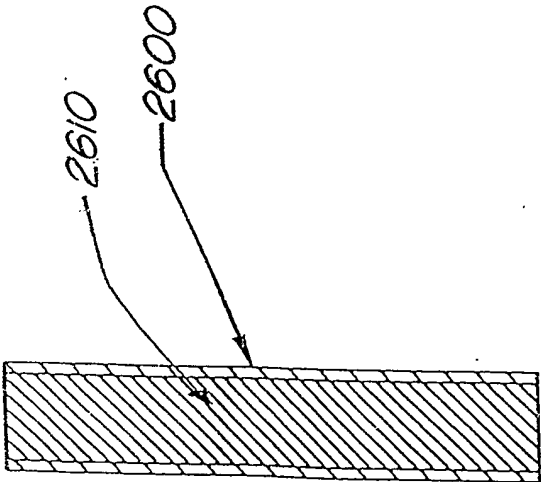


Fig. 26D

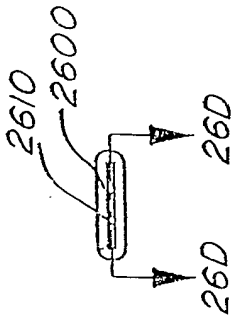
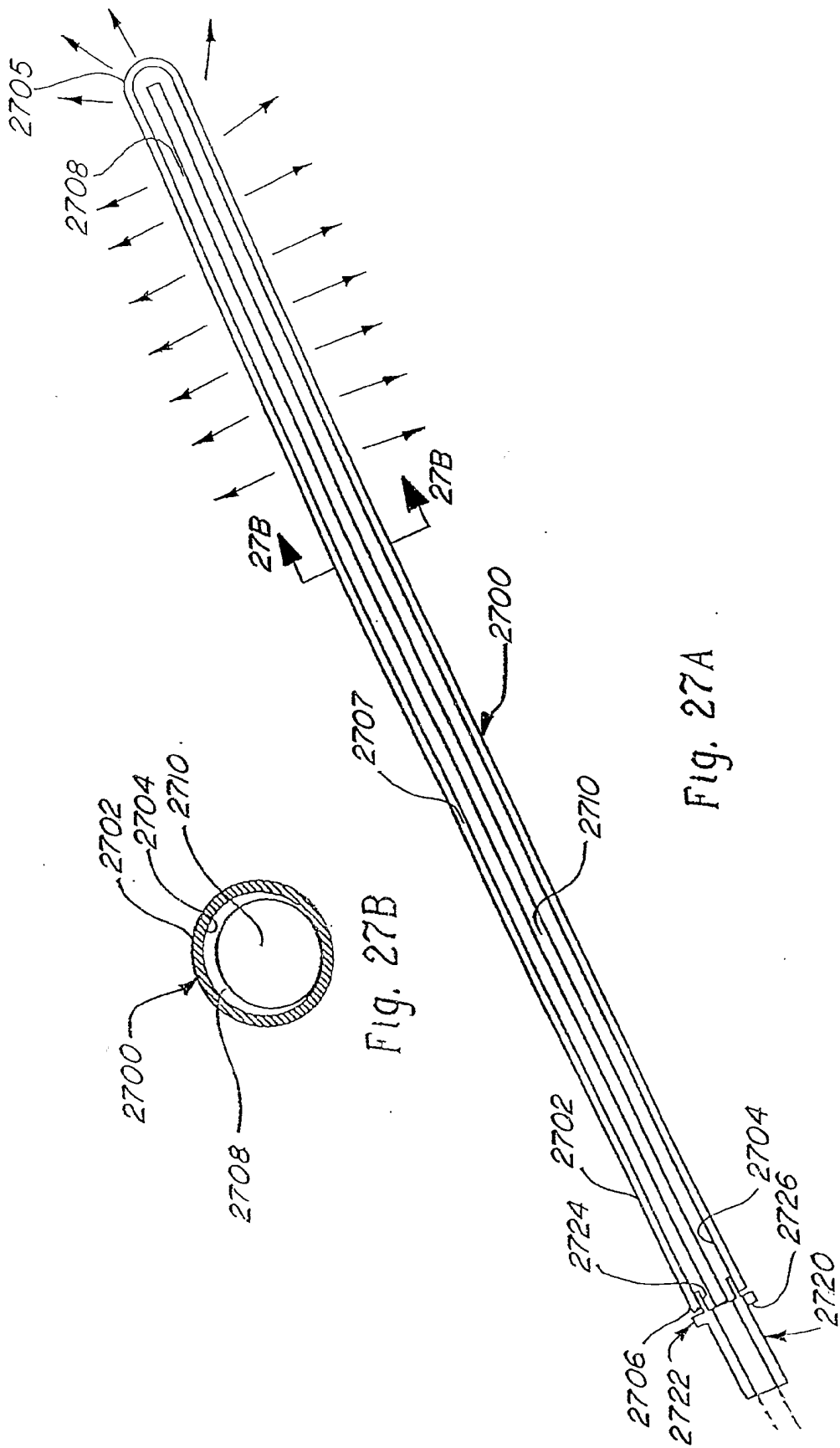
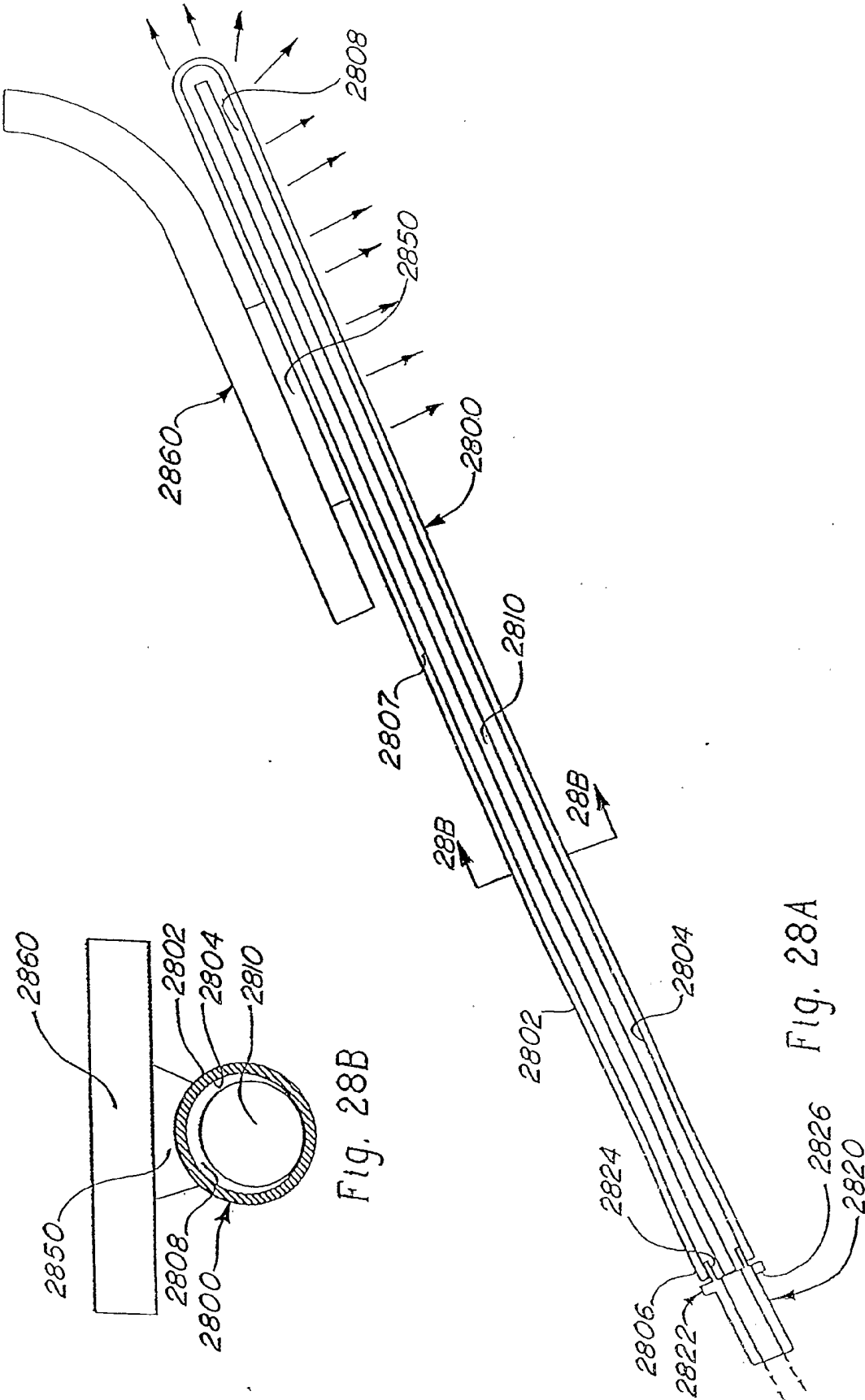
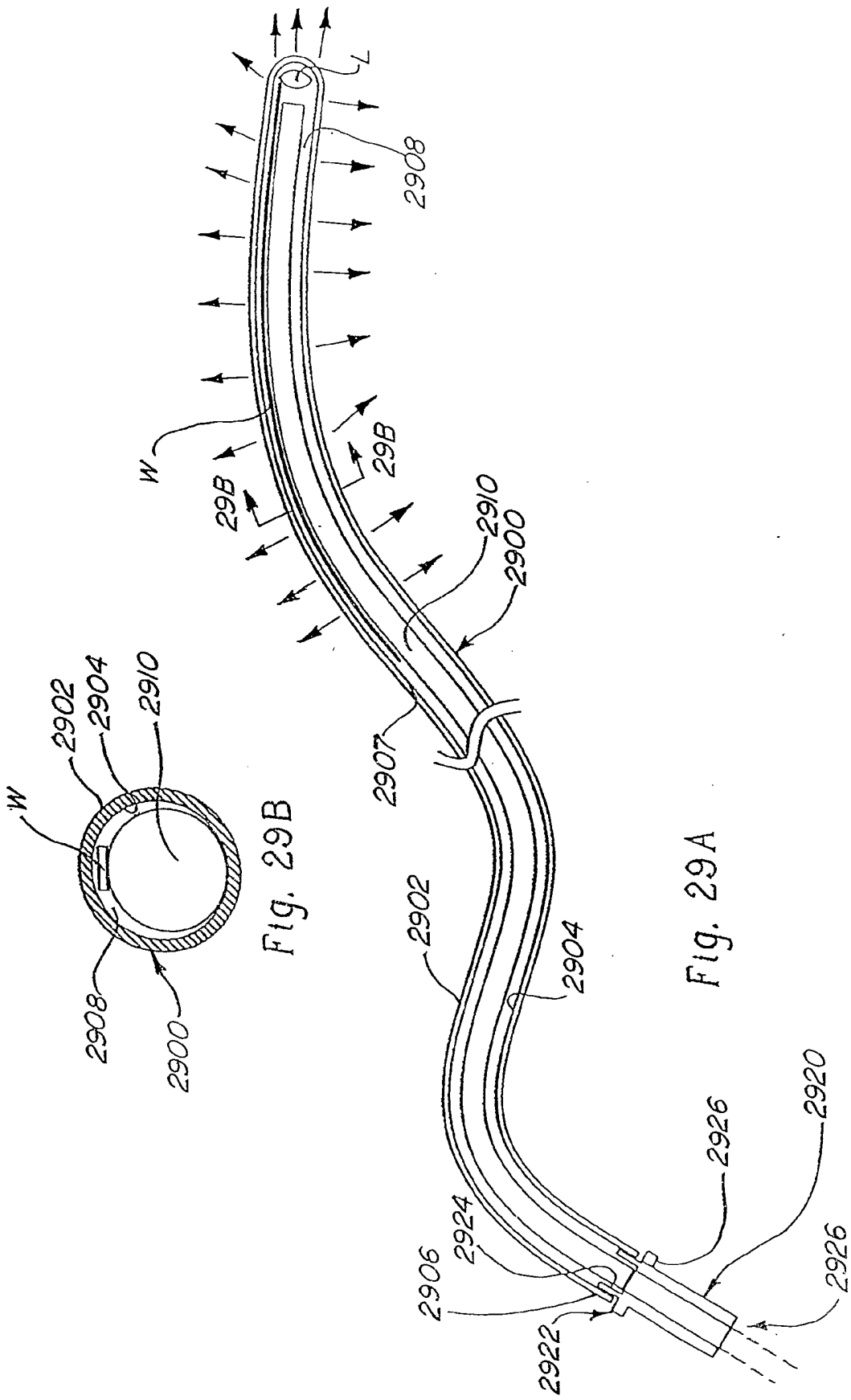
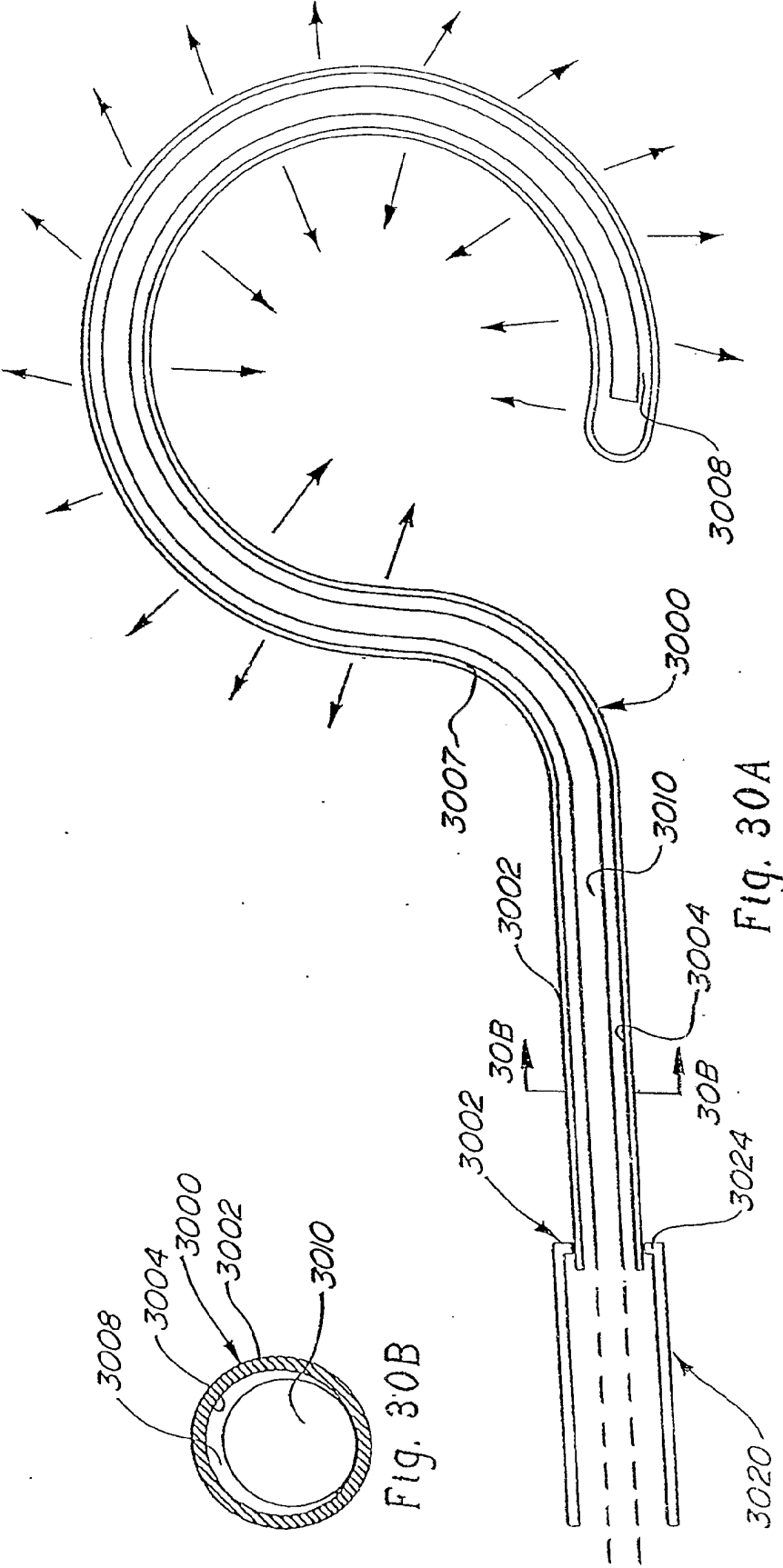


Fig. 26C









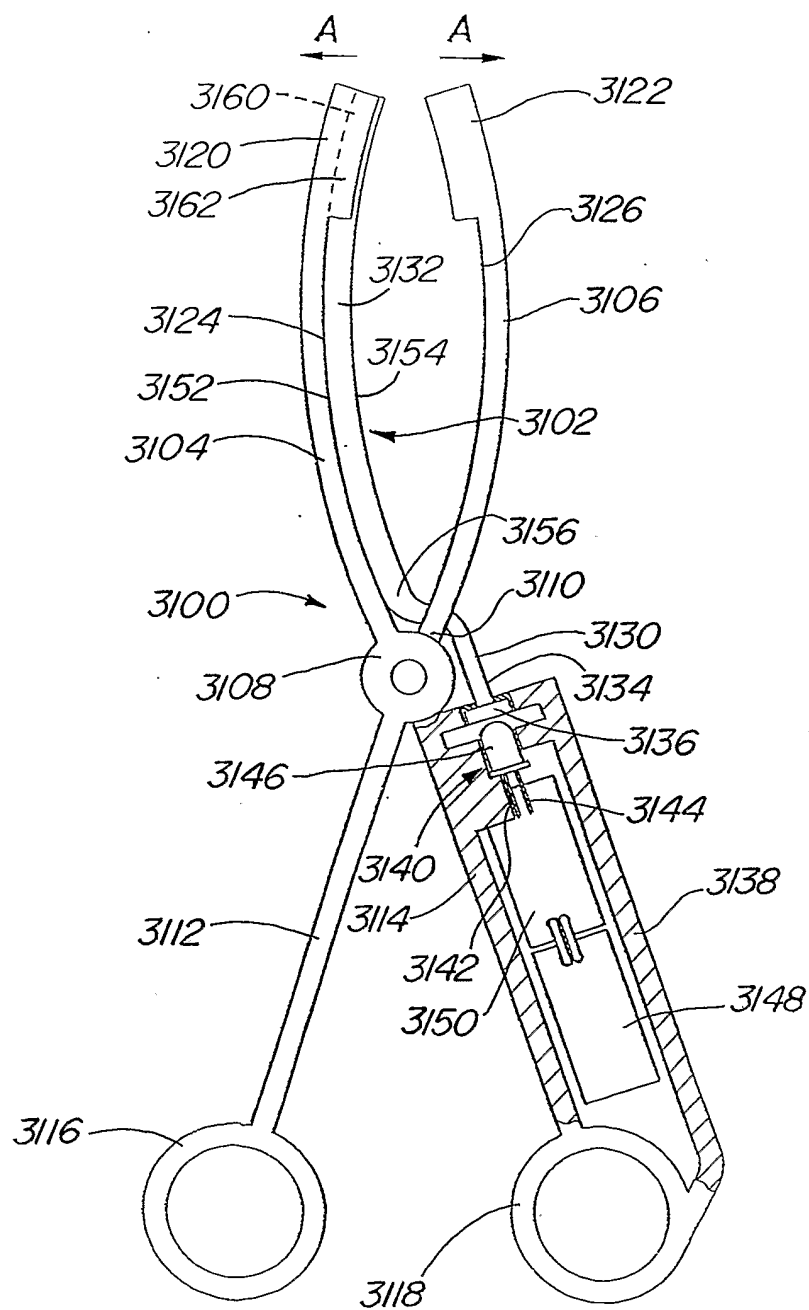


Fig. 31

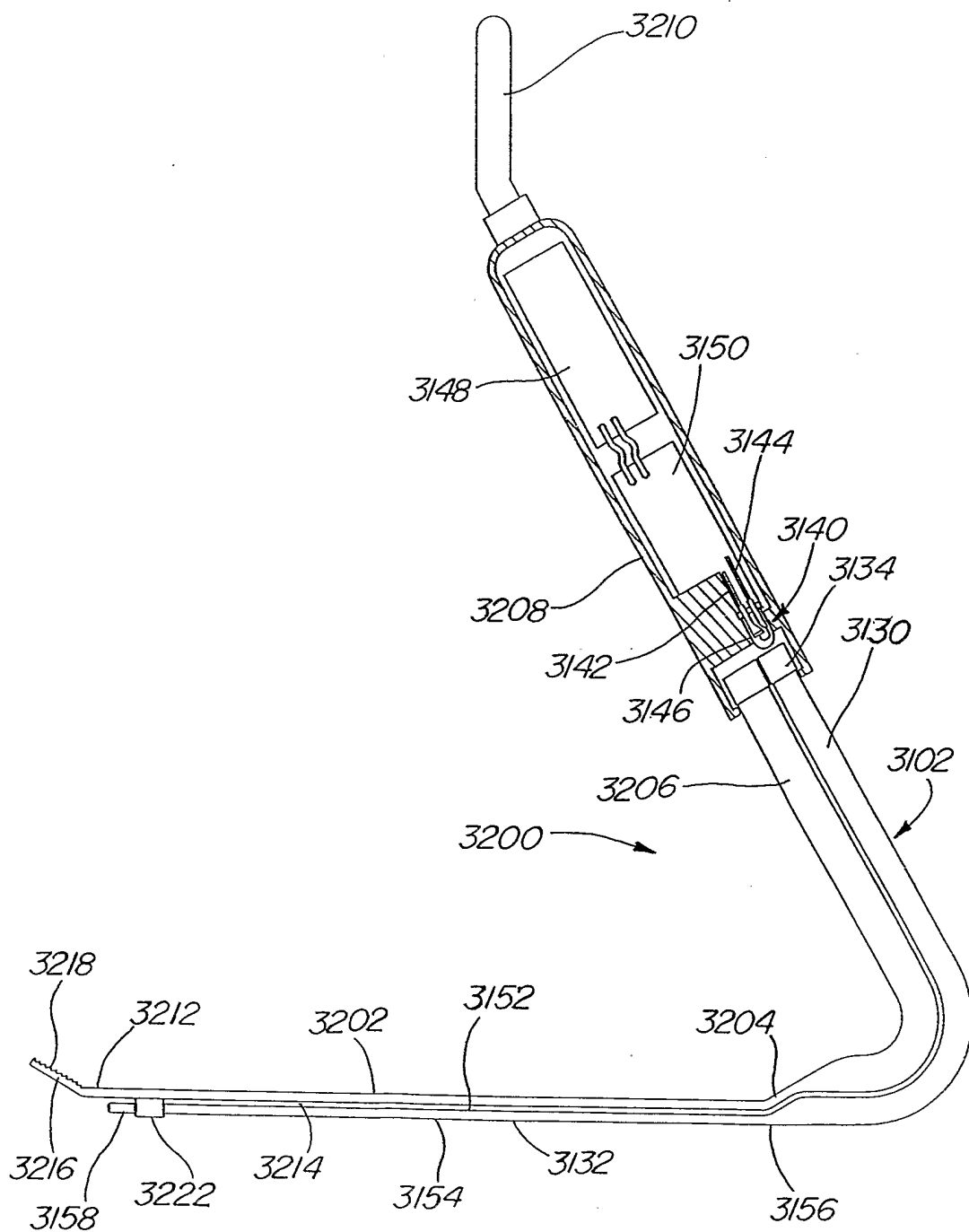


Fig. 32

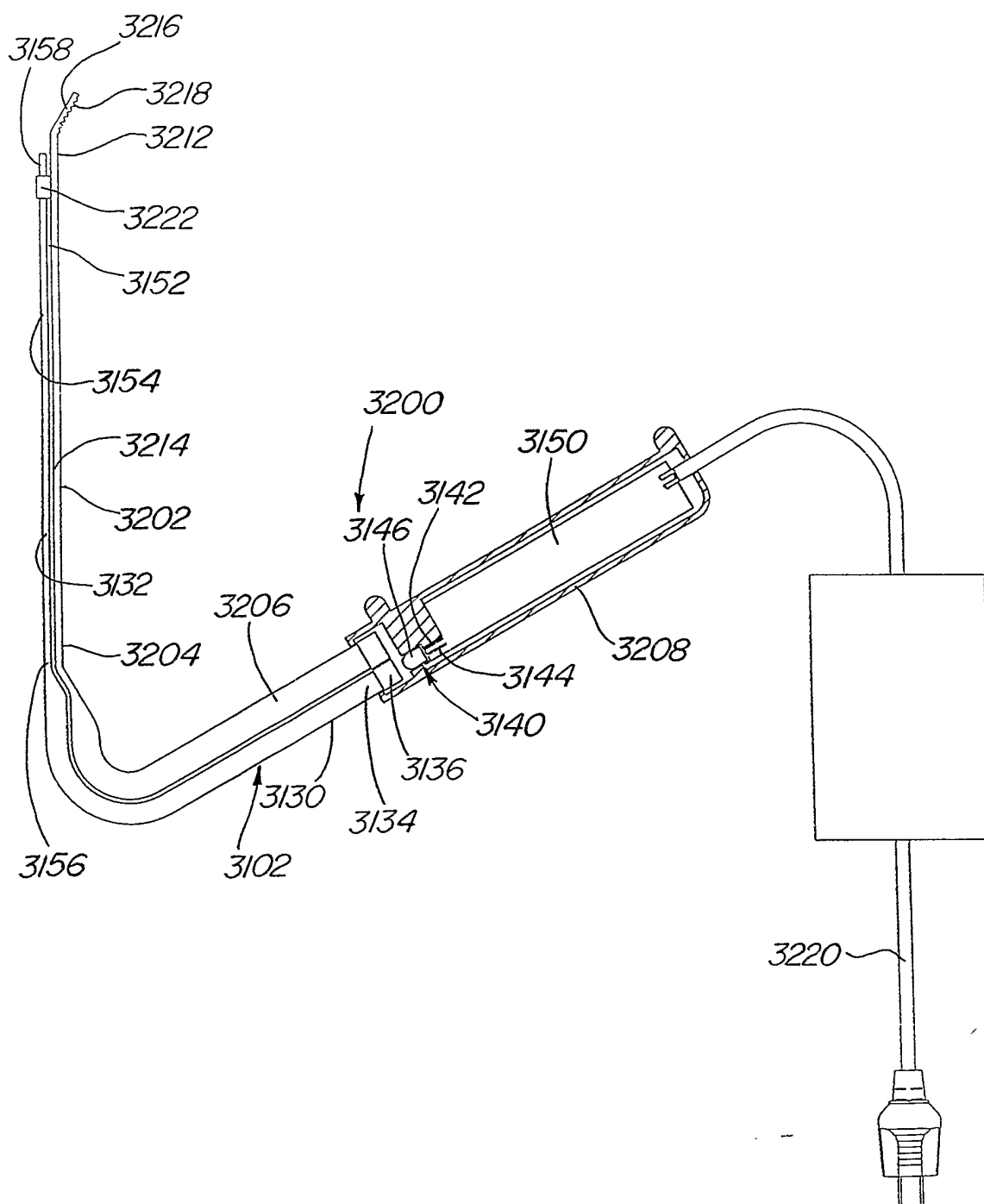


Fig. 33

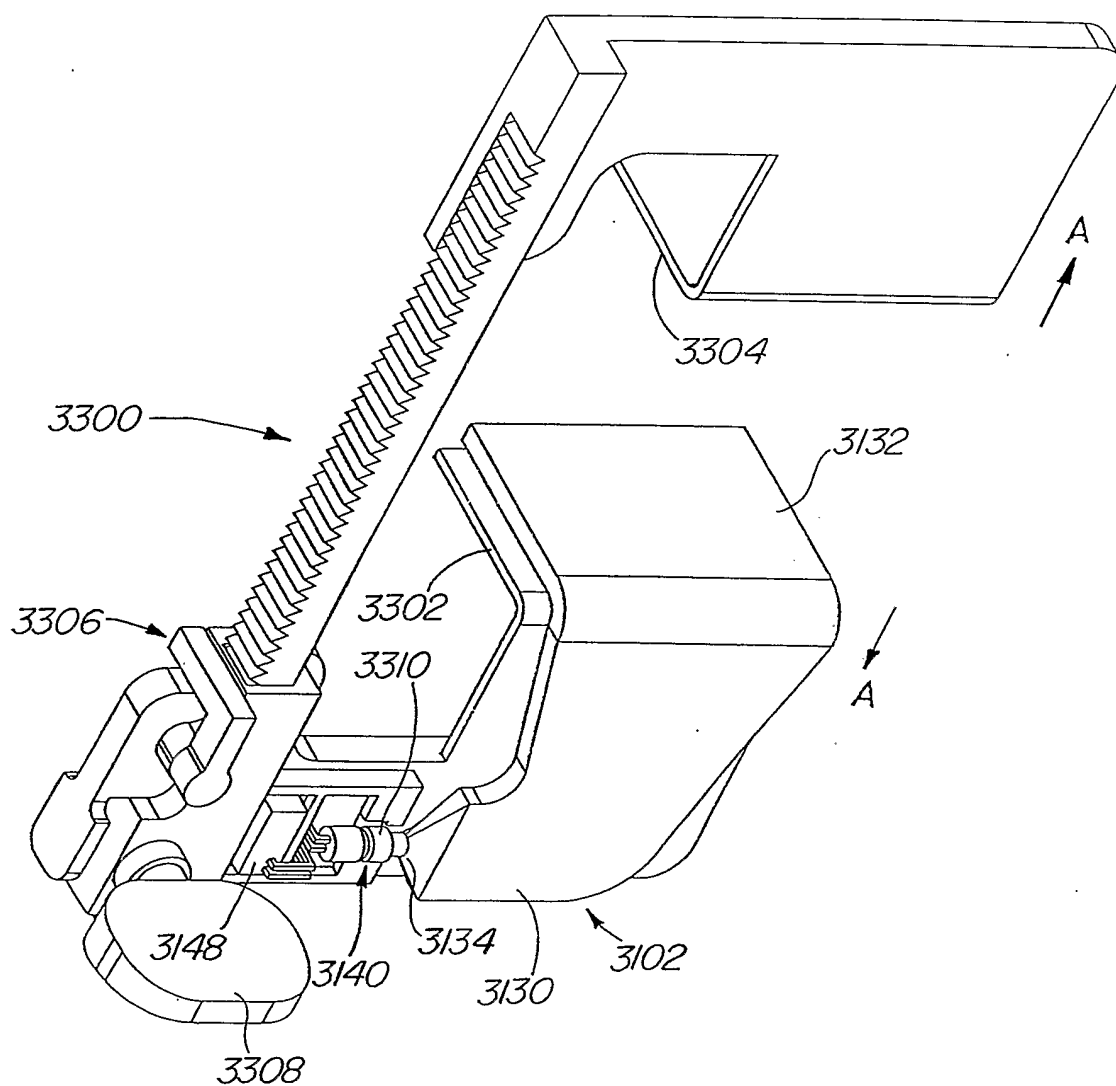


Fig. 34

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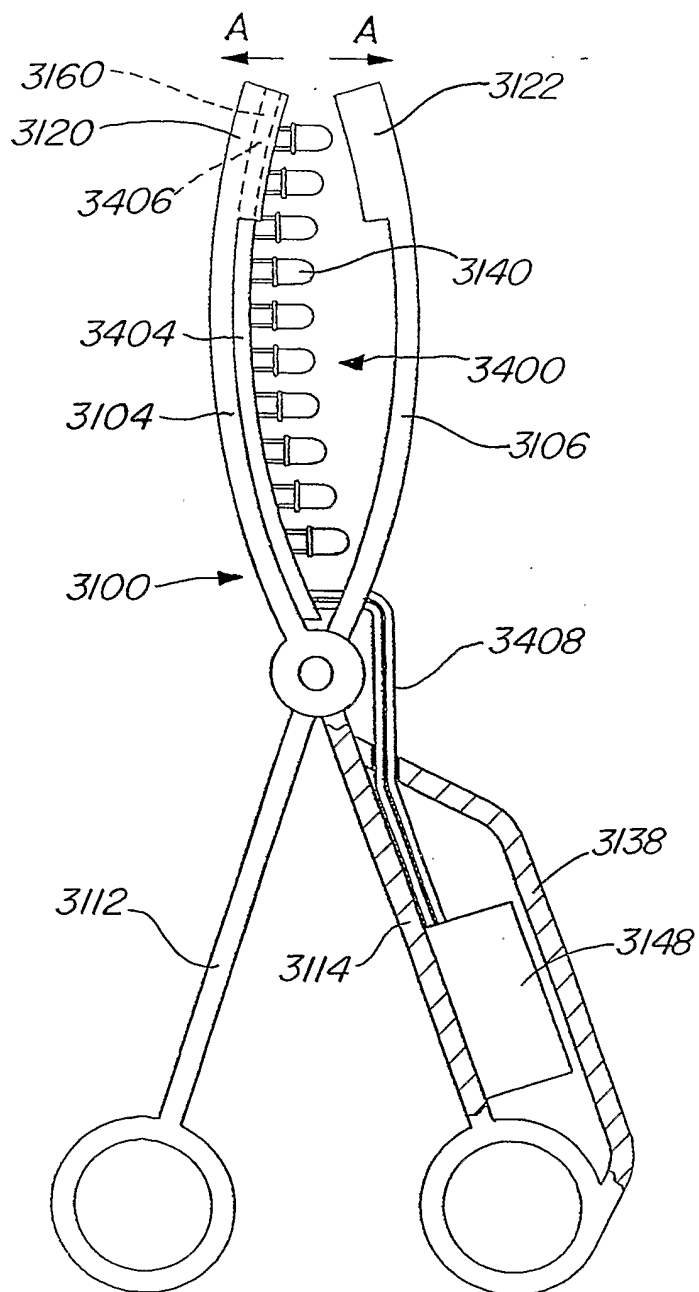


Fig. 35

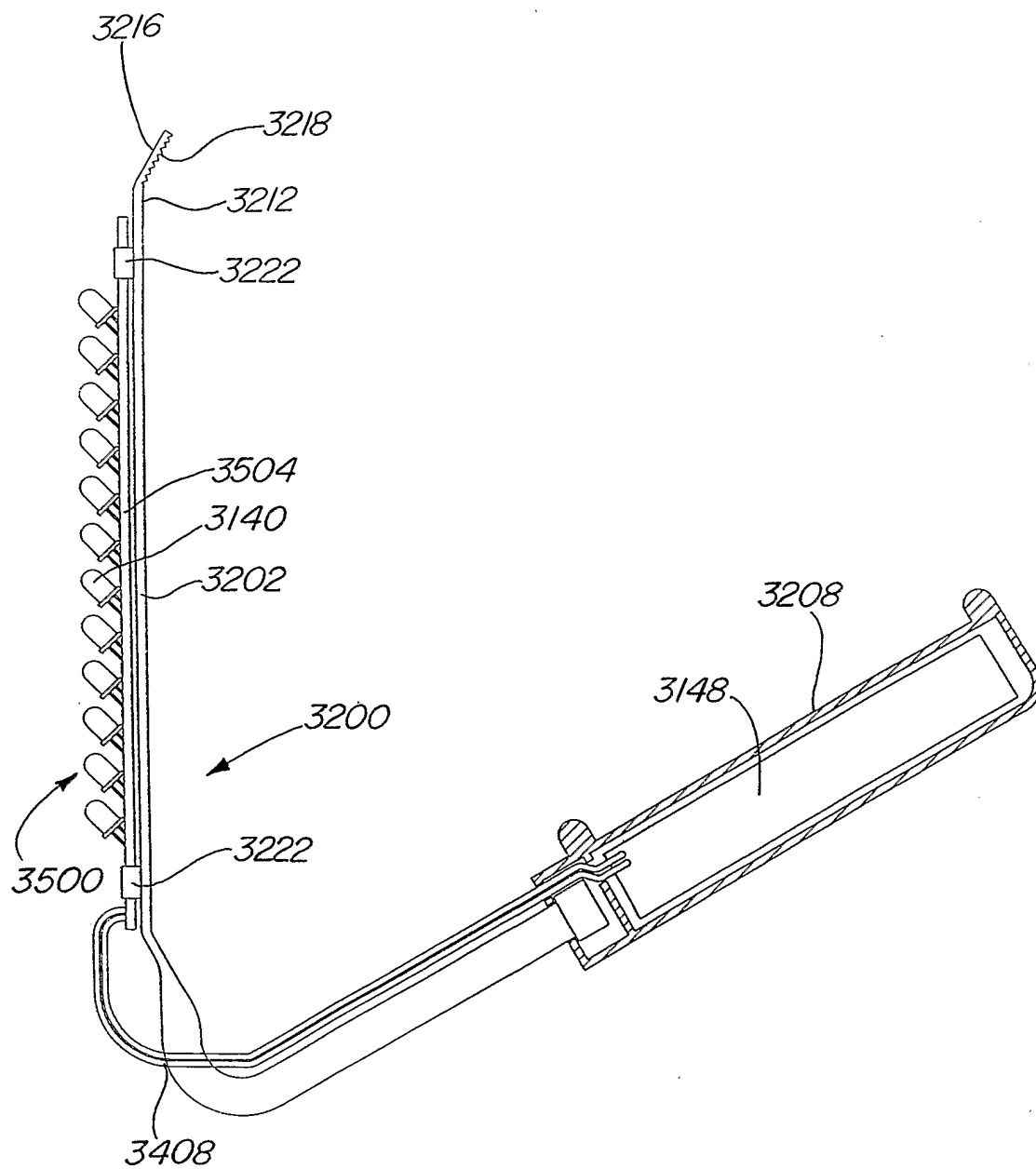


Fig. 36

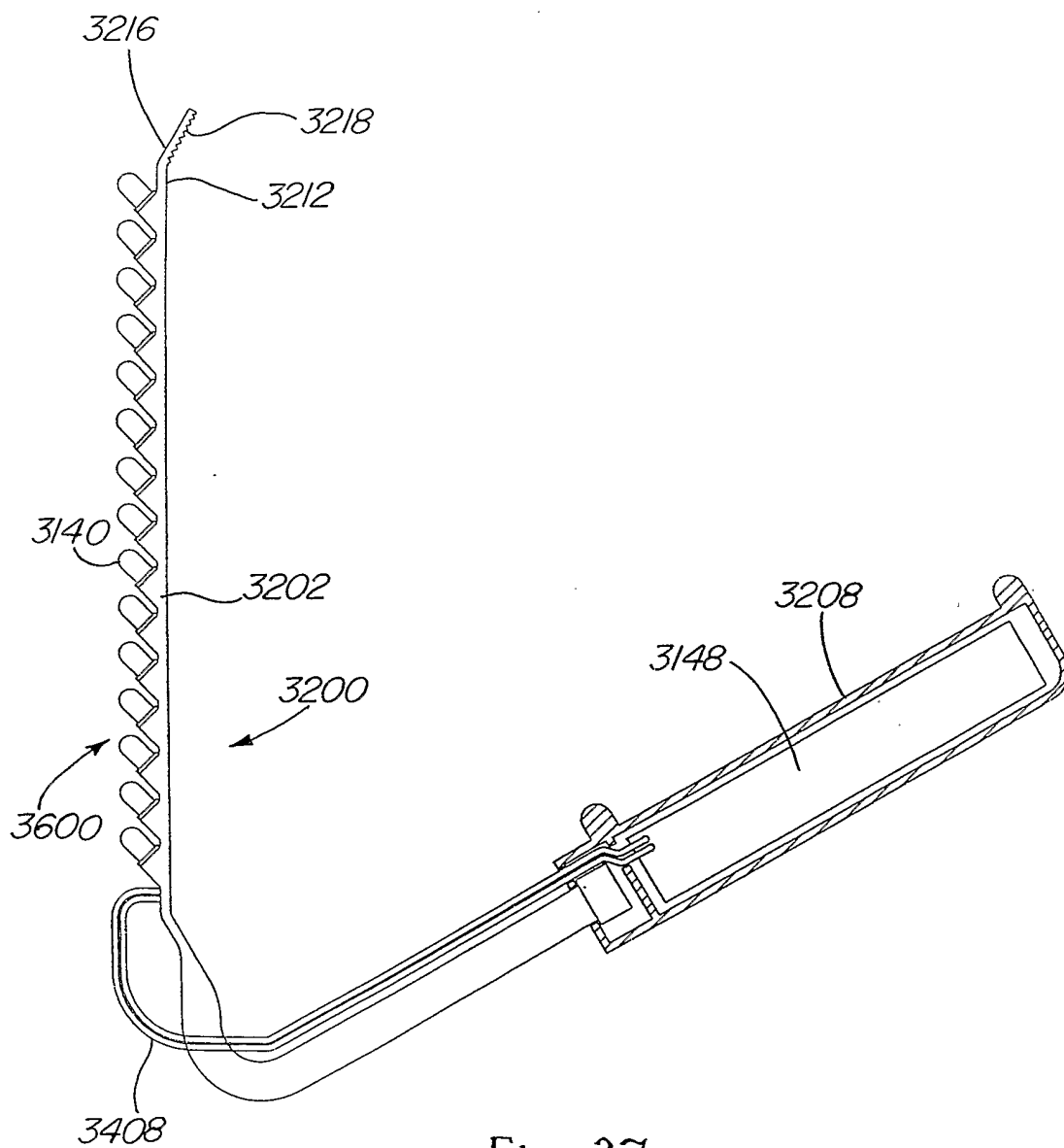


Fig. 37

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/21188

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G02B 6/20

US CL : 385/901; 362/31, 572; 606/2

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 385/146, 901; 362/31, 572; 606/2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST. Searched terms: illuminating, medical, surgical, blade, heat sink, light source.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,499,899 A (LYONS, III) 19 FEBRUARY 1985 (19.02.1985), see entire document.	1-48
A	US 5,843,045 A (DUPONT) 01 DECEMBER 1998 (01.12.1998), see entire document.	1-4
A	US 5,624,432 A (ANGLECHIK) 29 APRIL 1997 (29.04.1997), see entire document.	1-48
A	US 5,582,608 A (BROWN) 10 DECEMBER 1996 (10.12.1996), see entire document.	1-48
A	US 5,916,149 A (RYAN, Jr.) 29 JUNE 1999 (29.06.1999), see entire document.	1-48
A	US 6,428,553 B1 (TRESE) 06 AUGUST 2002 (06.08.2002), see entire document.	1-48
A	US 5,569,300 A (REDMON) 29 OCTOBER 1996 (29.10.1996), see entire document.	1-48

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

23 September 2003 (23.09.2003)

Date of mailing of the international search report

30 OCT 2003

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