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(71) Applicant (for all designated States except US):
TRUPHATEK INTERNATIONAL LTD [IL/IL];
Po Box 8051, 42504 Netanya (IL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PECHERER,**
Eugeny [IL/IL]; 14 Givaty Street, 42140 Netanya (IL).
SOFFER, Shiri [IL/IL]; 1 Herzog Street, 62915 Tel Aviv
(IL).

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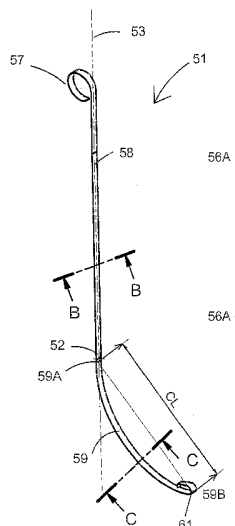
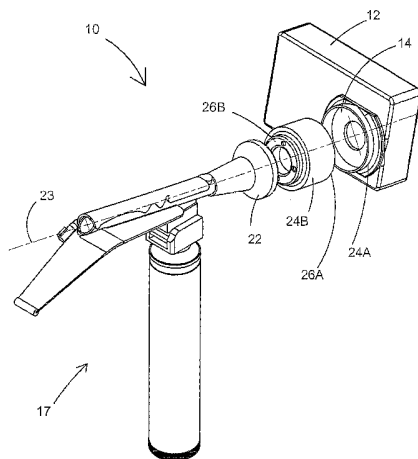
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(54) Title: HANDHELD PORTABLE MEDICAL VIEWING ASSEMBLY FOR DISPLAYING MEDICAL IMAGES DURING ENDOTRACHEAL INTUBATION, AND INTUBATION STYLET FOR USE THEREWITH



(57) Abstract: Adapter for mounting a handheld portable consumer device having a built-in digital camera and a display screen on a handheld portable laryngoscope having an optical system for viewing a subject's laryngeal region during endotracheal intubation for rendering a handheld portable medical viewing assembly for displaying medical images of a subject's laryngeal region during endotracheal intubation. Intubation stylet preferably entirely made from shape memory metal and fashioned into a J-shaped elongated member having a pre-bent arcuate leading portion with a rectangular cross section designed to facilitate a successful first attempt intubation procedure.

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HANDHELD PORTABLE MEDICAL VIEWING ASSEMBLY FOR DISPLAYING MEDICAL IMAGES DURING ENDOTRACHEAL INTUBATION, AND INTUBATION STYLET FOR USE THEREWITH

Field of the Invention

5 The invention pertains to handheld portable medical viewing assemblies for displaying medical images during endotracheal intubation, and intubation stylets for use therewith.

Background of the Invention

Handheld portable laryngoscopes with an optical system for viewing a
10 subject's laryngeal region during endotracheal intubation are illustrated and described in *inter alia* US Patent No. 4,086,919 to Bullard, US Patent No. 4,306,547 to Lowell, US Patent No. 4,901,708 to Lee, US Patent No. 5,263,472 to Ough, and US Patent No. 5,873,818 to Rothfels. Handheld portable video laryngoscopes for displaying medical images during endotracheal intubation are
15 illustrated and described in *inter alia* US Patent No. 5,827,178 to Berall, US Patent No. 6,652,453 to Smith et al., US Patent No. 6,840,903 to Mazzei et al. (see Figure 5), US Patent No. 6,929,000 to Hill, and US Patent Application Publication No. 2003/0195390 to Graumann. Medical viewing assemblies for remote displaying of medical images during endotracheal intubation are
20 illustrated and described *inter alia* in US Patent No. 6,123,666 to Wrenn et al., US Patent No. 6,354,993 to Kaplan et al., and US Patent No. 6,653,447 to Pacey. Such medical viewing assemblies are commercially available from KARL STORZ GmbH & Co. KG, Tuttlingen, Germany, (www.karlstorz.com), and GlideScope® Video Intubations System commercially available from Saturn
25 Biomedical Systems Inc., Burnaby B. C., Canada (www.saturnbiomedical.com).

Intubation stylets for assisting in endotracheal intubations are intended to be inserted into endotracheal tubes with Internal Diameters (IDs) ranging from

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about 4mm to about 6mm for pediatric sized tubes and 7mm to about 8.5mm for adult sized tubes. Conventional intubation stylets are fashioned as malleable elongated members of uniform circular cross section along their entire lengths and are intended to be manually bent to a desired shape prior to an endotracheal intubation. Intubation stylets for insertion in pediatric sized intubation tubes typically have a diameter of about 3mm whilst intubation stylets for insertion in adult sized intubation tubes typically have a diameter of about 4.5 mm which leads to undesirable free play for a successful first attempt endotracheal intubation. Exemplary intubation stylets are illustrated and described in US Patent 3,996,939 and US Patent 5,095,888 whilst US Patent 5,259,377 illustrates and describes an endotracheal tube stylet enabling a user to selectively deflect or induce curvature to an elongated member during an intubation procedure.

Summary of the Invention

The first aspect of the present invention is directed toward an adapter for mounting a handheld portable consumer device including a built-in digital camera and display screen on a laryngoscope with an optical system for viewing a subject's laryngeal region during endotracheal intubation for converting same to a handheld portable medical viewing assembly for displaying medical images of a subject's laryngeal region during endotracheal intubation. The present invention can be implemented using a wide range of suitable handheld portable consumer devices including *inter alia* standalone digital cameras, electronic magnifying devices, PDAs, and mobile telephones, and the like, and suitably designed adapters for, say, stationary objective lens, telescopic objective lens, and the like. Medical viewing assemblies in accordance with the present invention have the comparable functionality as dedicated handheld portable video laryngoscopes but at a greatly reduced cost.

The second aspect of the present invention is directed toward an intubation stylet preferably entirely made from shape memory metal and fashioned into a J-shaped elongated member having a pre-bent arcuate leading portion with a

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rectangular transverse cross section to facilitate a successful first attempt endotracheal intubation. The rectangular transverse cross section also facilitates the use of the same intubation stylet for different diameters of endotracheal tubes. The intubation stylets can emit illumination light at their distal ends and/or optionally be provided with a tube for delivering oxygen or suction purposes. The illumination light can be provided by either a light transmitting fiber optic cable, or an electrical light source, for example, an LED.

Brief Description of the Drawings

In order to understand the invention and to see how it can be carried out in practice, preferred embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which similar parts are likewise numbered, and in which:

Fig. 1 is a front perspective view of a medical viewing assembly for displaying medical images of a subject's laryngeal region during endotracheal intubation in accordance with a first preferred embodiment of the present invention;

Fig. 2 is a rear perspective view of the medical viewing assembly of Figure 1;

Fig. 3 is an exploded view of the medical viewing assembly of Figure 1;

Fig. 4 is a longitudinal cross section of the medical viewing assembly of Figure 1 along line A-A in Figure 2 with a retracted objective lens;

Fig. 5 is a longitudinal cross section of the medical viewing assembly of Figure 1 along line A-A in Figure 2 with a fully protruding objective lens;

Fig. 6 is an exploded view of a medical viewing assembly for displaying medical images of a subject's laryngeal region during endotracheal intubation in accordance with a second preferred embodiment of the present invention;

Fig. 7 is a perspective view of an intubation stylet in accordance with the present invention;

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Figs. 8 and 9 are transverse cross sections of Figure 7's intubation stylet along lines B-B and C-C in Figure 7;

Fig. 10 is a perspective view of an intubation stylet with a fiber optic cable for illuminating a subject's laryngeal region during endotracheal intubation;

5 Fig. 11 is a perspective view of an intubation stylet with an electrical powered light source for illuminating a subject's laryngeal region during endotracheal intubation; and

Fig. 12 is a perspective view of an intubation stylet for delivering oxygen to a subject.

10 Detailed Description of Preferred Embodiments

Figures 1-3 show a handheld portable medical viewing assembly 10 including an adapter 11 for mounting a handheld portable digital camera 12 having a housing 13 with a telescopic objective lens 14 and a display screen 16 on a handheld portable laryngoscope 17 with a handle 18, a blade 19, and an
15 optical system 21 with an eyepiece 22 having an optical axis 23 for viewing a subject's laryngeal region during endotracheal intubation. A suitable digital camera is the Premier Digital Camera DS-5341 having a telescopic objective lens retracted inside its housing when powered down (see Figure 4), and having a maximum outward protrusion of about 25 millimeters (see Figure 5). A suitable
20 laryngoscope is commercially available from the Applicants under the trade name TRUVIEW™ <http://www.truphatek.com/default.php?p=products&p1=2&p2=88>.

The adapter 11 includes a body member 24 for directly aligning the objective lens 14 with the eyepiece's optical axis 23 in the assembled state of the medical viewing assembly 10. The body member 24 is dimensioned not to
25 impede the telescopic movement of the objective lens 14 in its most outwardly protruding position in the assembled state of the medical viewing assembly (see Figure 5). The body member 24 includes a first tubular body component 24A and a second tubular body component 24B. The body component 24A is preferably permanently mounted on the housing 13 to encircle its objective lens 14. The

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body component 24A can be glued on the housing 13, screwed on, and the like. The body component 24B connects the laryngoscope 17 to its counterpart body component 24A and consequently the digital camera 12. The body component 24B has a proximal side 26A and a distal side 26B. The proximal side 26A
5 connecting the body component 24B to the body component 24A typically uses a screw thread, a bayonet connection, and the like. The distal side 26B preferably has magnets for magnetic attraction with a suitable metal eyepiece. Other connection arrangements include a bayonet connection, and the like.

The use of the medical viewing assembly 10 is as follows:

10 A user attaches the body component 24A to the housing 13 to encircle the objective lens 14. The user mounts the body component 24B on the body component 24A to assemble the adapter 11. The user mounts the adapter 11 on a laryngoscope's eyepiece 22 whereupon the user can view medical images displayed on the display screen 16. The user can use the digital camera 12 for
15 taking still and/or video images, and the like.

Figure 6 shows a handheld portable medical viewing assembly 10 including an adapter 31 similar to the adapter 11 but formed from a pair of L-shaped flange members 32A and 32B for defining a U-shaped channel 33 for secure mounting on a housing and a tubular aperture 34 for secure mounting on
20 an eyepiece 22 on screw clamping the L-shaped flange members 32A and 32B together.

Figures 7-9 shows an intubation stylet 51 made from a rolled metal strip of shape memory material, for example, spring steel, and the like, having a rectangular cross section. The intubation stylet 51 has a generally J-shaped
25 elongated member 52 with a longitudinal axis 53, and a rectangular transverse cross section perpendicular to the longitudinal axis 53 with major front and rear surfaces 54A and 54B and minor side surfaces 56A and 56B (see Figure 8). The rectangular transverse cross section affords flexibility in the Y-Z plane and rigidity in the X-Z plane for facilitating successful first attempt intubations. The
30 elongated member 52 includes a hand held trailing portion 57, a generally straight

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intermediate portion 58, and a pre-bent arcuate leading portion 59 with a leading tip 61 curled back upon itself. The leading portion 59 has opposite ends 59A and 59B defining an arc length in the order of about 15 cm and a chord length CL of about 13 cm for an adult sized intubation stylet 51. The intermediate portion 58
5 preferably is formed with a V-shaped cross section in the X-Y plane to afford greater rigidity in the Y-Z plane (see Figure 9). The generally straight intermediate portion 58 may be formed with a circular cross section in the X-Y plane. Alternatively, only the pre-bent arcuate leading portion 59 may be formed from shape memory material and suitably attached to an intermediate portion 58
10 made from non-shape memory material by soldering, and the like.

Figure 10 shows an intubation stylet 62 similar to the intubation stylet 51 and additionally having a fiber optic cable 63 connected to a light source 64 and terminating at its leading tip 62A for illuminating a subject's laryngeal region during endotracheal intubation. Figure 11 shows an intubation stylet 66 similar
15 to the intubation stylet 51 and having an electrical powered light source 67 at its leading tip 66A connected to a power supply 68 via an electrical wire 69 for illuminating a subject's laryngeal region during endotracheal intubation. Figure 12 shows an intubation stylet 71 similar to the intubation stylet 51 and additionally having a tube 72 having an opening 72A at the stylet's distal end
20 71A in flow communication with either an oxygen source 73 for delivering oxygen to a subject during an endotracheal intubation or a suction pump 74 for removing undesirable liquids from a subject's tracheal region during endotracheal intubation.

25 While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications, and other applications of the invention can be made within the scope of the appended claims.

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Claims:

1. Adapter for use with a handheld portable consumer device including a housing having a built-in digital camera with an objective lens having a field of
5 view, and a display screen for displaying visual information, and a handheld portable laryngoscope including an optical system having an eyepiece with an optical axis for viewing a subject's laryngeal region during endotracheal intubation, the adapter comprising a body member for assembling the housing on the laryngoscope for aligning the objective lens' field of view with the eyepiece's
10 optical axis for rendering a handheld portable medical viewing assembly for displaying medical images of a subject's laryngeal region during endotracheal intubation.
2. The adapter according to Claim 1 wherein said body member directly
15 aligns the objective lens with the eyepiece's optical axis in the assembled state of the medical viewing assembly.
3. The adapter according to either Claim 1 or 2 wherein said body member is dimensioned not to impede telescopic movement of the objective lens in the
20 assembled state of the medical viewing assembly.
4. The adapter according to any one of Claims 1 to 3 wherein said body member includes a first tubular body component for permanent attachment onto the housing for encircling the objective lens and a second tubular body
25 component for selective assembly on said first tubular body component.
5. The adapter according to Claim 4 wherein said second tubular body component includes a proximal side for selective assembly on said first tubular body component and a magnetic distal side for mounting on the eyepiece.

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6. The adapter according to any one of Claims 1 to 3 wherein said body member includes a pair of L-shaped flange members for defining a U-shaped channel for secure mounting on the housing and a tubular aperture for secure mounting on the eyepiece on clamping said L-shaped flange members together.

5

7. A medical viewing assembly for displaying medical images of a subject's laryngeal region during endotracheal intubation, the assembly comprising:

(a) a handheld portable consumer device including a housing having a built-in digital camera with an objective lens having a field of view, and a display
10 screen for displaying visual information;

(b) a handheld portable laryngoscope including an optical system having an eyepiece with an optical axis for viewing a subject's laryngeal region during endotracheal intubation; and

(c) an adapter according to any one of Claims 1 to 6 for assembling said
15 housing on said laryngoscope for aligning said objective lens' field of view with said eyepiece's optical axis for displaying medical images of a subject's laryngeal region on said display screen during endotracheal intubation.

8. An intubation stylet comprising a generally J-shaped elongated member
20 having a longitudinal axis, and a hand held trailing portion, a generally straight intermediate portion, and a pre-bent arcuate leading portion, at least said leading portion being formed from shape memory material and having a generally rectangular transverse cross section perpendicular to said longitudinal axis.

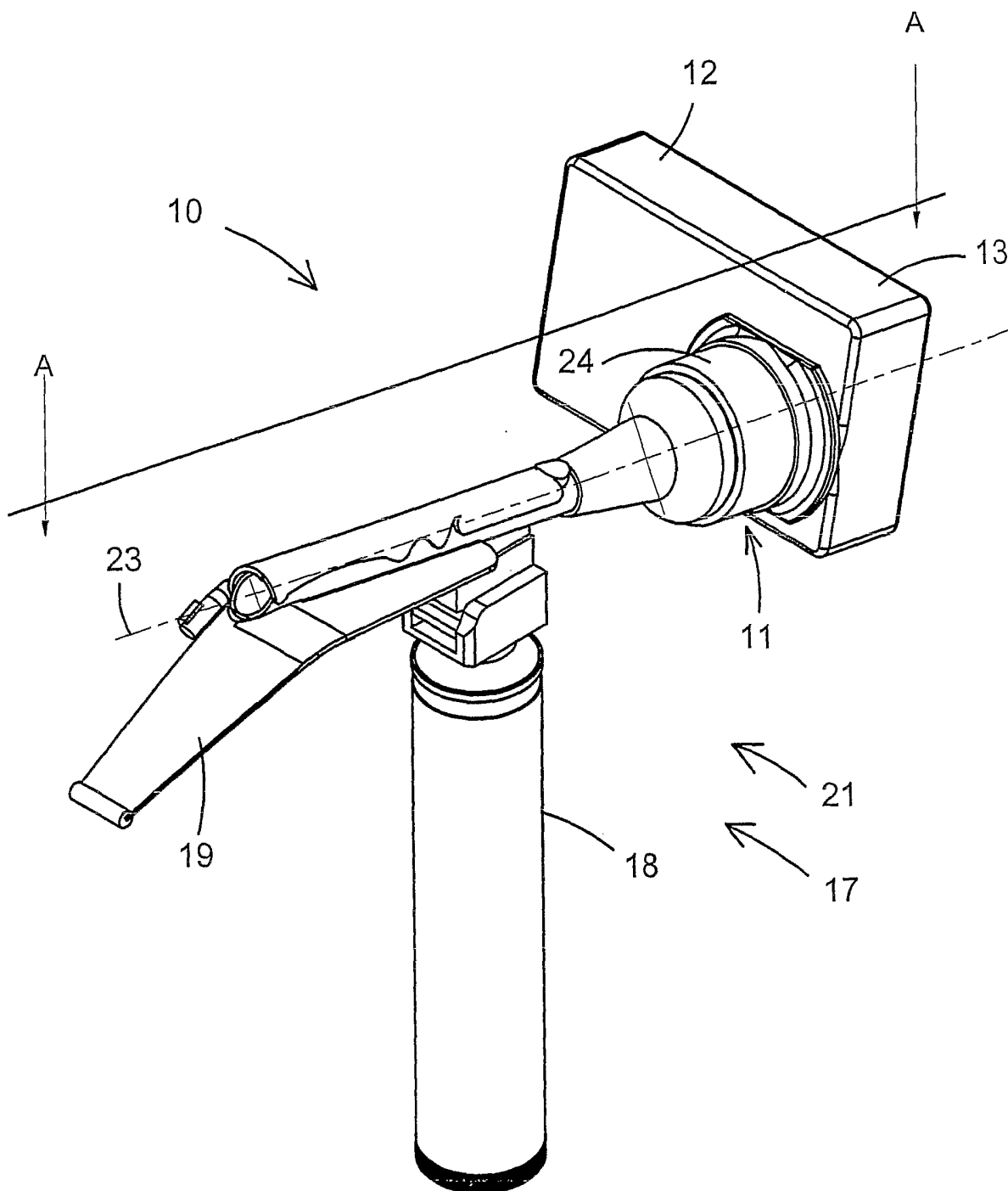
25 9. The stylet according to Claim 8 wherein said intermediate portion has a V-shaped transverse cross section perpendicular to said longitudinal axis.

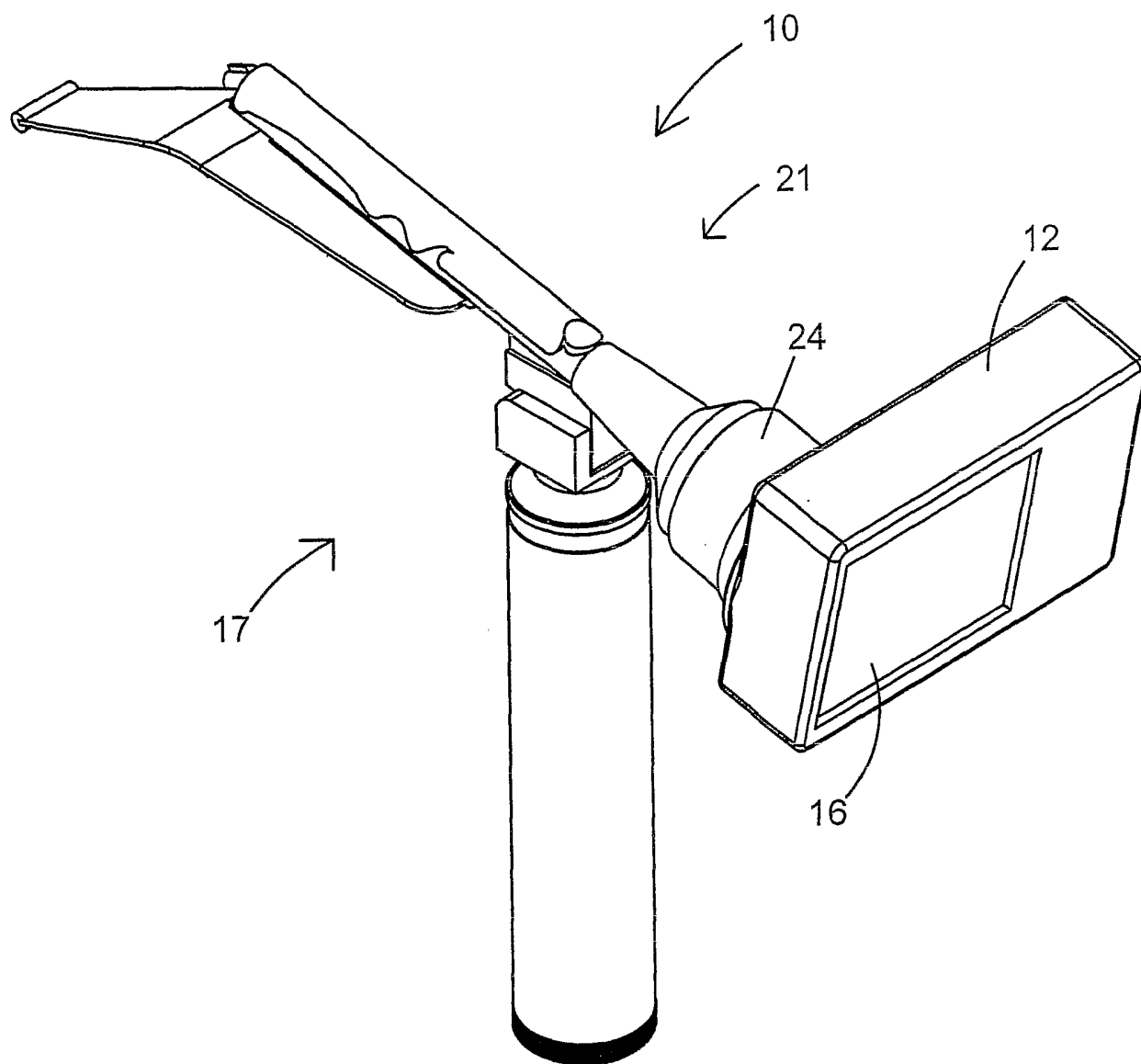
10. The stylet according to either Claim 8 or 9 wherein said leading portion terminates in a tip curled back upon itself.

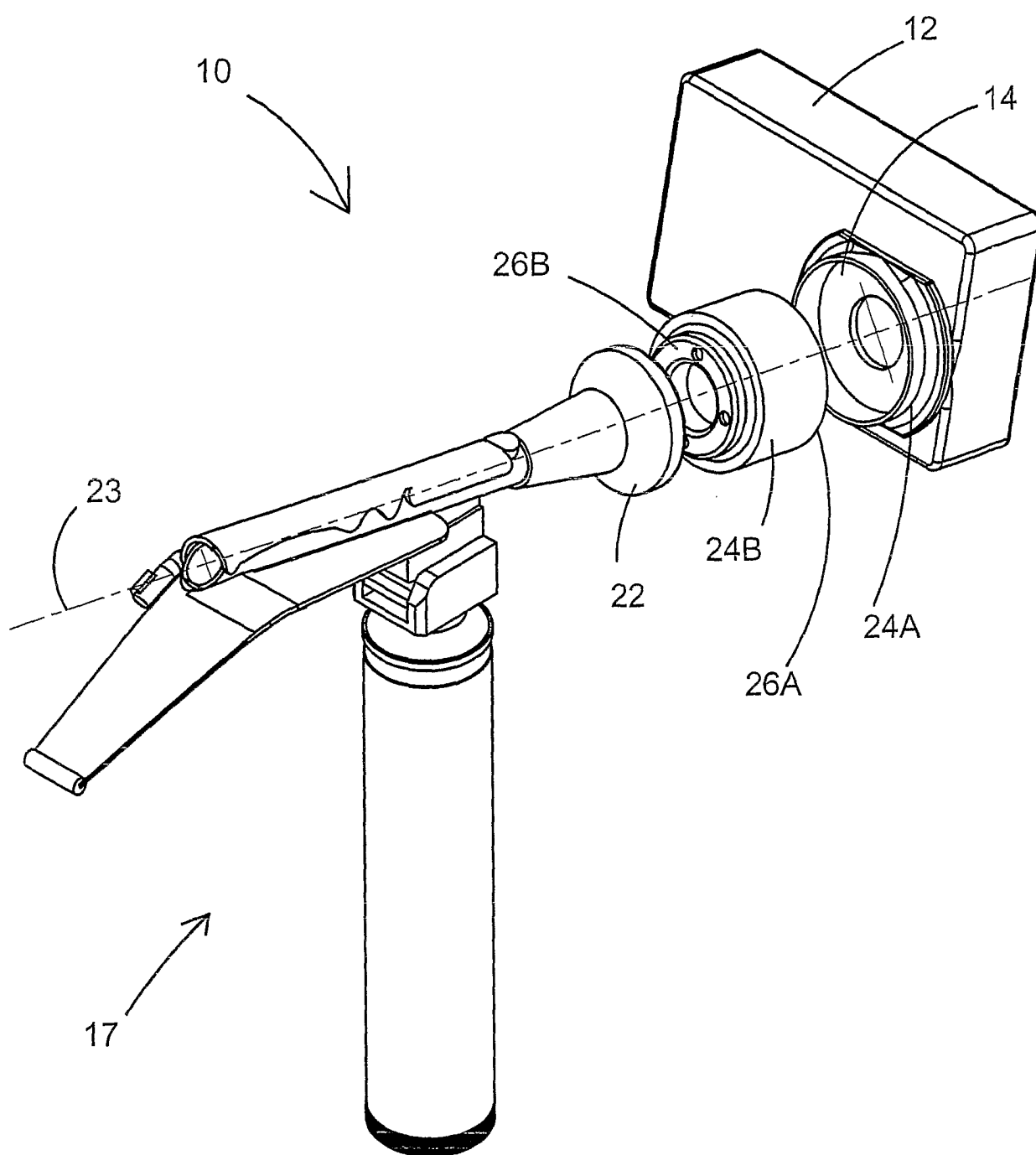
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11. The stylet according to any one of Claims 8 to 10 wherein said elongated member is formed from a rolled metal strip of shape memory material having an initial rectangular cross section along its entire length.
- 5 12. The stylet according to any one of Claims 8 to 11 wherein an adult sized stylet has a leading portion whose opposite ends define an arc length in the order of about 15 cm and a chord length of about 12 cm.
- 10 13. The stylet according to any one of Claims 8 to 12 and further emitting illumination light at its distal end for illuminating a subject's laryngeal region during endotracheal intubation.
14. The stylet according to any one of Claims 8 to 13 and further comprising a tube with an opening at its distal end.

**FIG. 1**

**FIG. 2**

**FIG. 3**

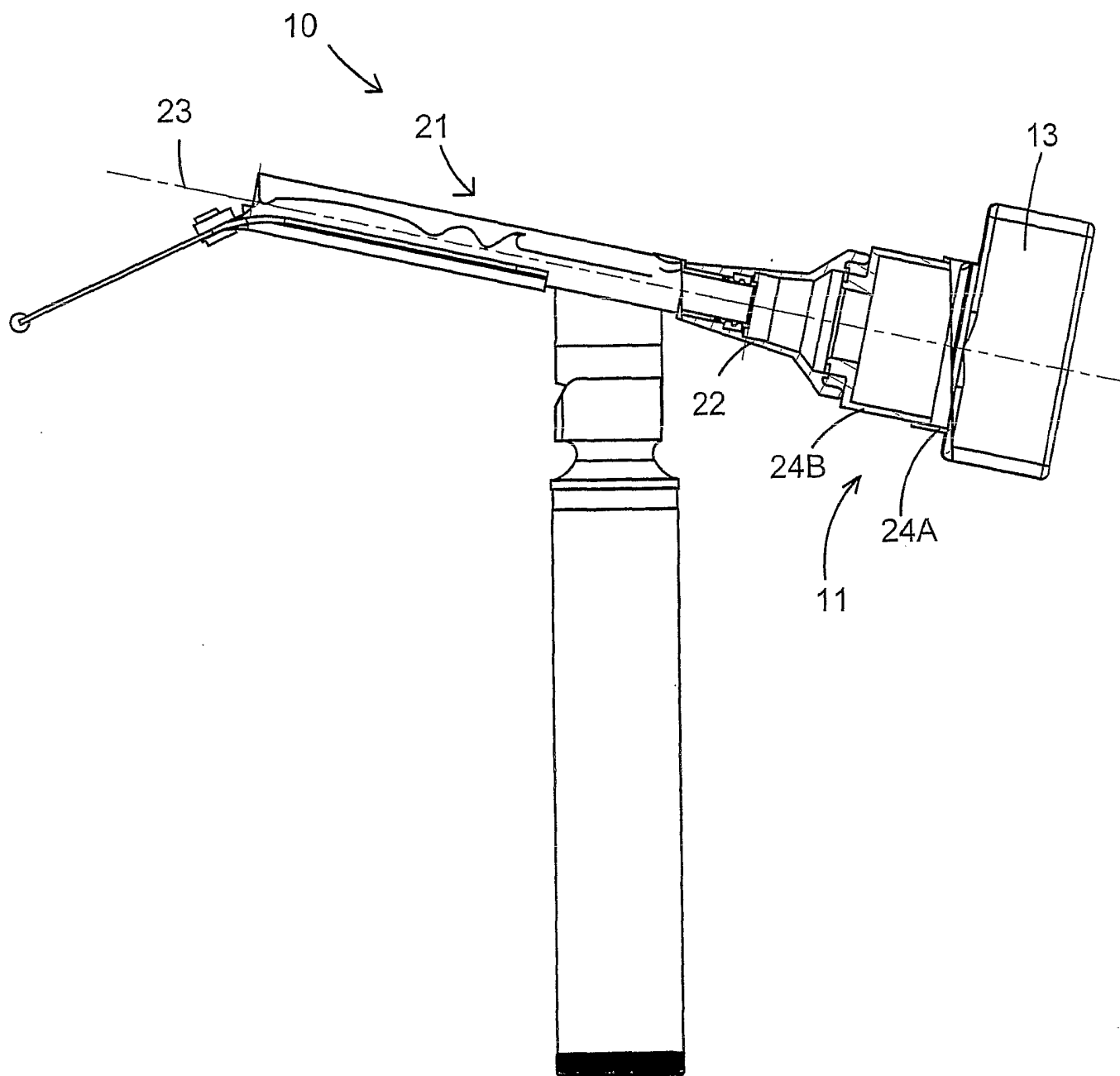


FIG. 4

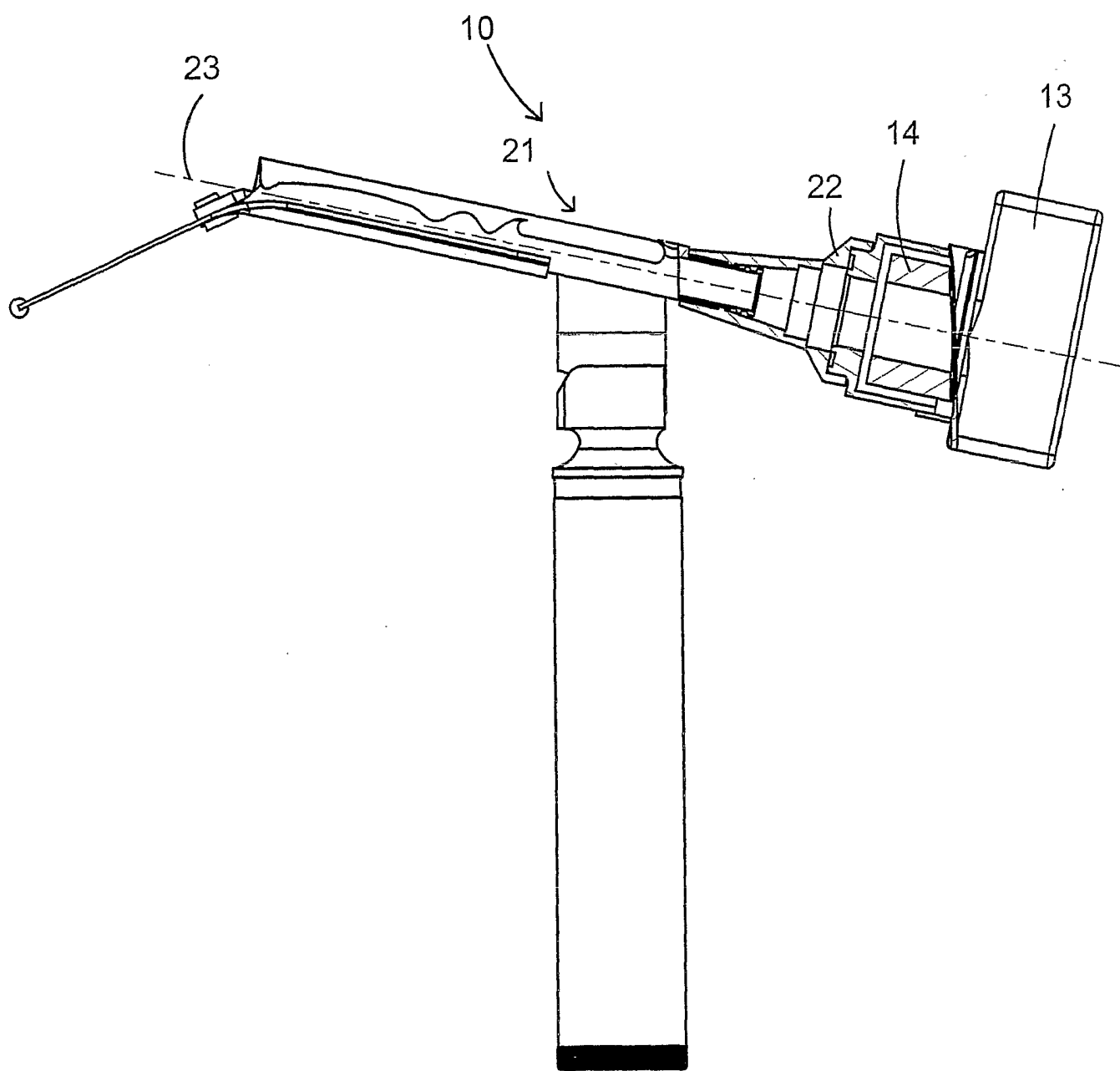


FIG. 5

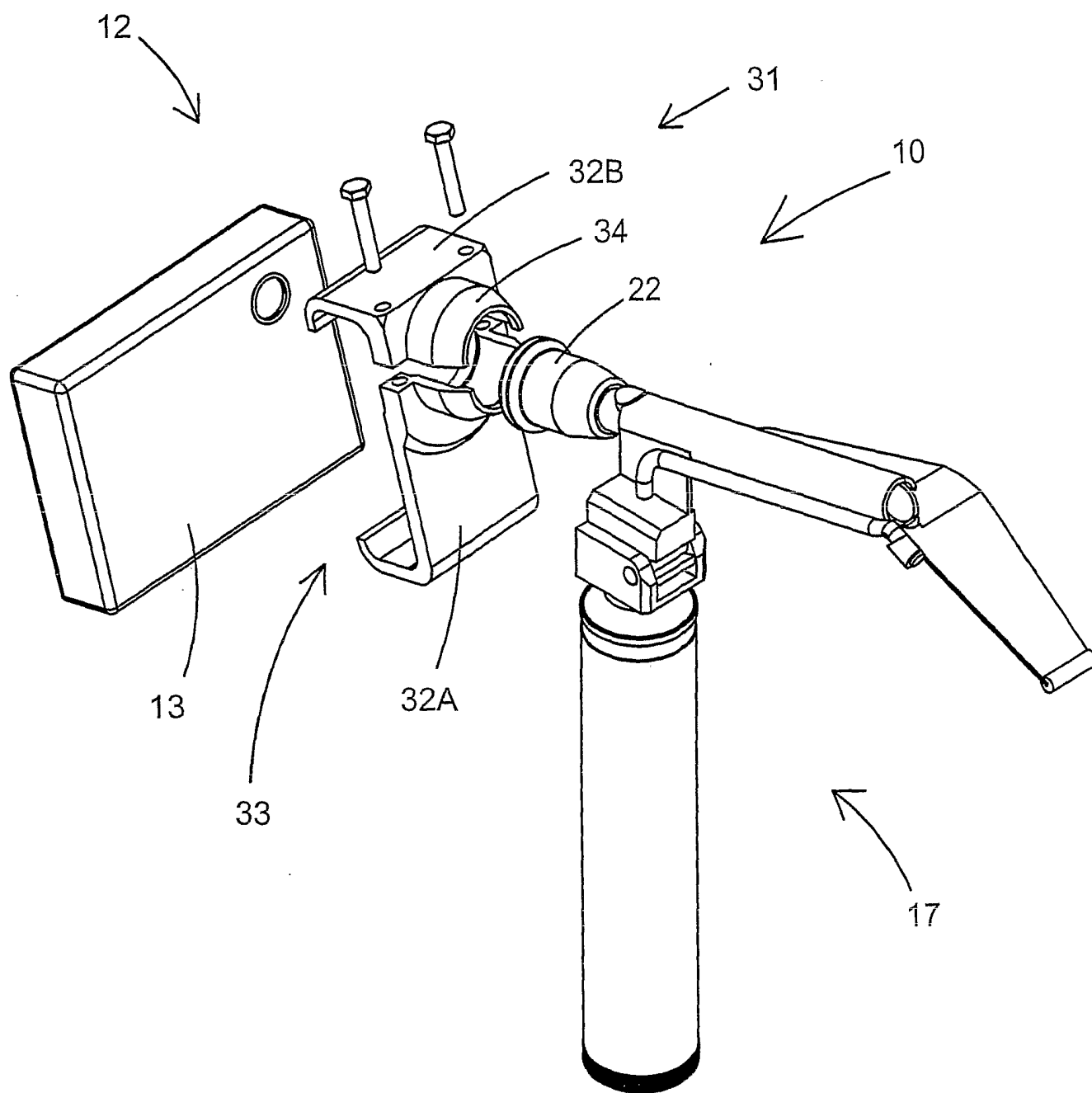


FIG. 6

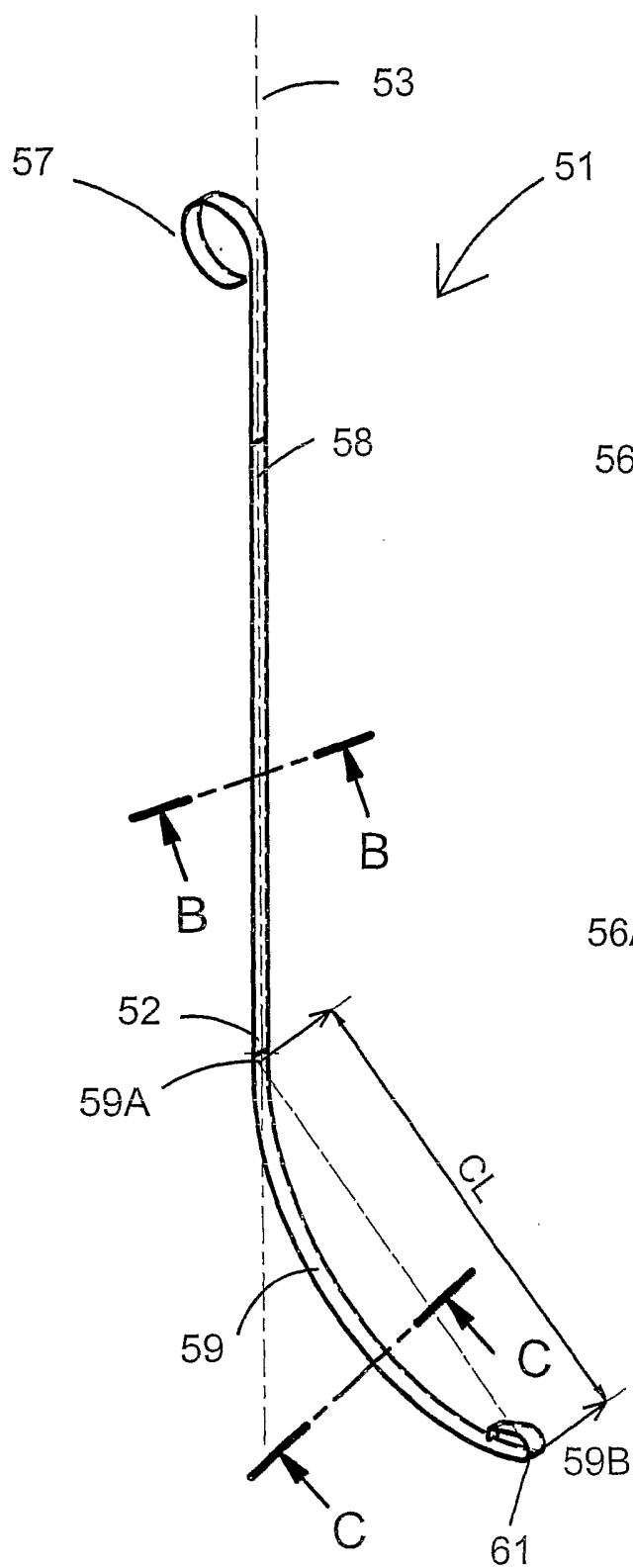


FIG. 7

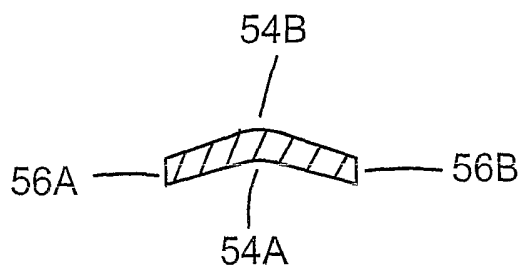


FIG. 8

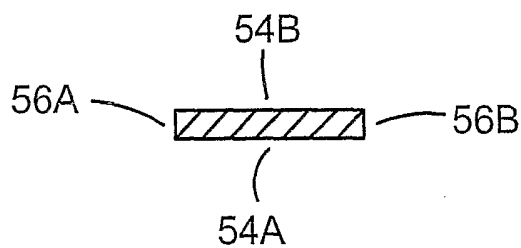
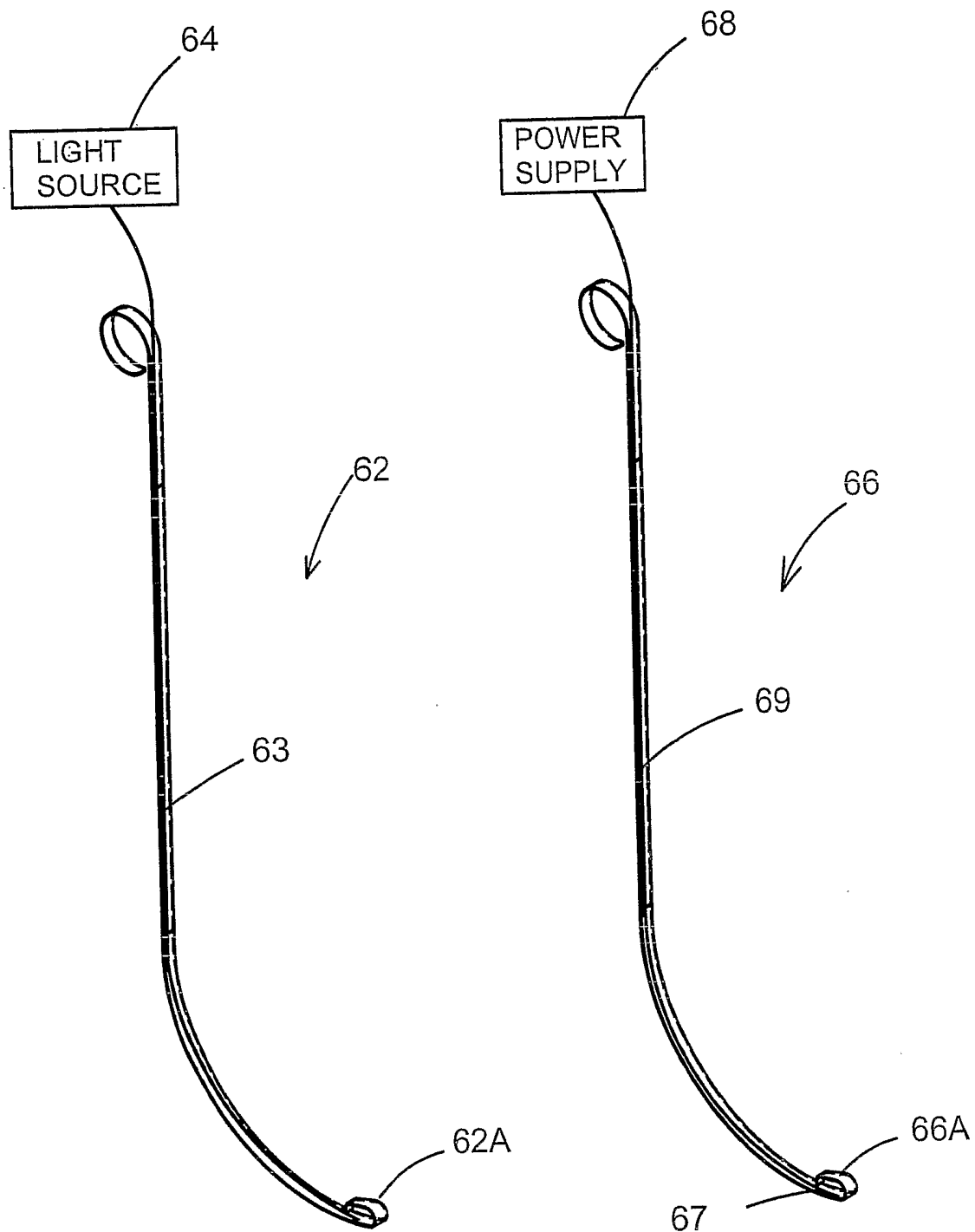
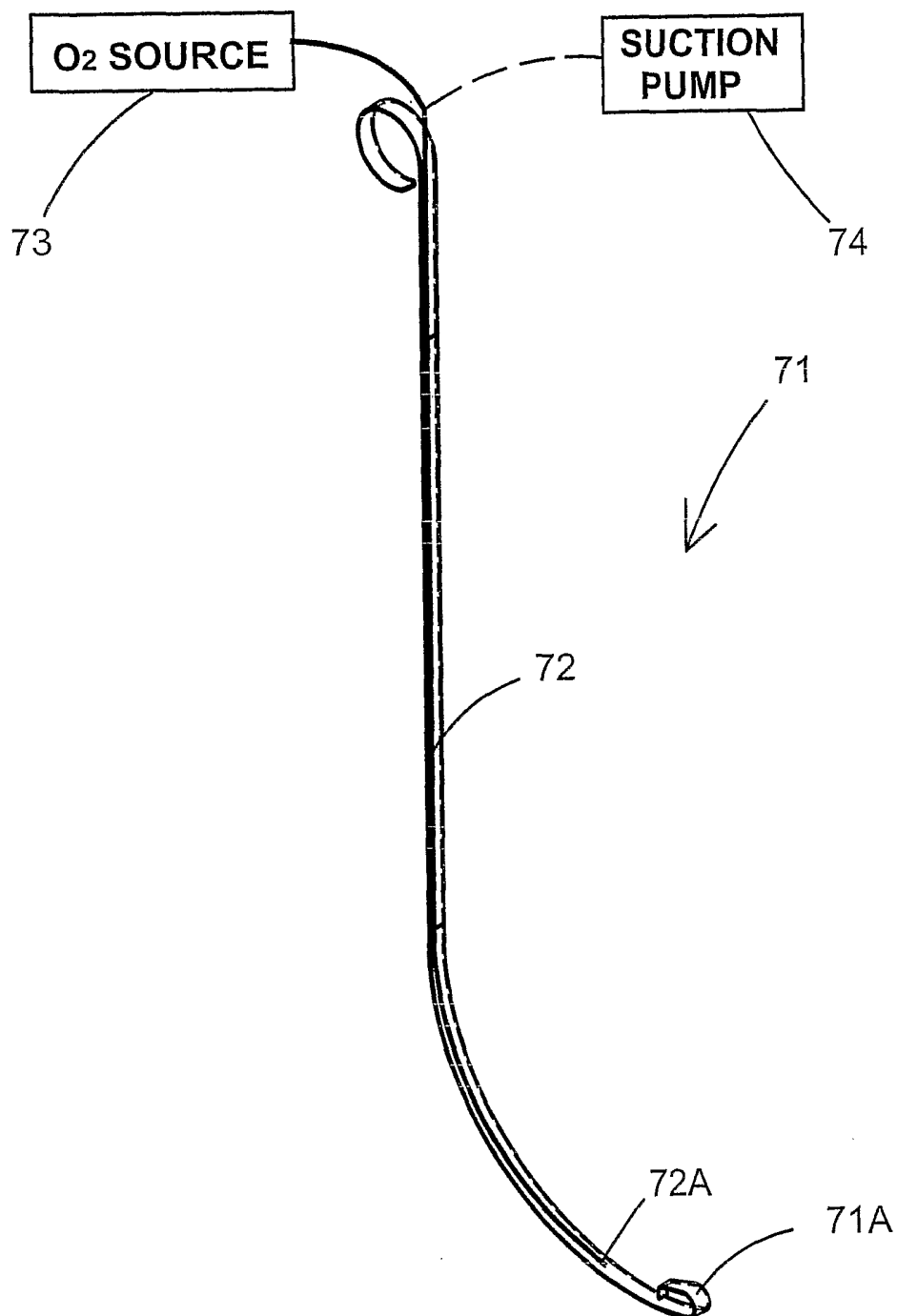


FIG. 9

**FIG. 10****FIG. 11**

**FIG. 12**