

of the tube. The side ports provide ventilation of the patient should mucous enter passageway 117 at the distal end. The obturator tube is typically 70 cm in length with a plurality of indicators such as 119 and 120 positioned approximately 13 and 40 cm from the distal end thereof. The length of the tube is somewhat more than twice the length of the endotracheal tube to permit handling thereof during the replacement procedure. These indicators are formed on the outer surface of the tube with, for example, commercially-available Markem ink which is a radiopaque ink distinguishable from the radiopaque obturator tube material. The physician visually observes these indicators during the insertion of the tube into the endotracheal tube for indicating relative positioning of the obturator tube in the patient. Further verification of the positioning of the obturator tube in the patient is provided with the radiopaque property of the tube and indicators visualized with the use of, for example, X-ray equipment. The distal end 116 of the tube is rounded for minimizing trauma to the trachea of the patient. In a similar manner, proximal end 110 is rounded to provide an airtight or pneumatic seal with connector 109 when inserted therein.

As depicted in FIG. 2, removable connector 109 includes a well-known ventilator fitting 121 and obturator tube fitting 122 that are joined together. As illustrated, ventilator fitting 121 is preferably of a plastic material such as polycarbonate which is available from Bivona, Inc. of Gary, Ind. The ventilator fitting is available as part No. CO-30 from Bivona with a male nipple (not shown) for insertion into a ventilator tube. The ventilator fitting is modified by removing the nipple and increasing distal opening 123 to approximately 0.250".

The removable and lockable obturator tube fitting 122 of the present invention is also preferably of a plastic material such as polycarbonate which is ultrasonically welded to the distal end of ventilator fitting 121. The obturator tube fitting 122 comprises a slotted sleeve 124 having a passageway 125 and a ring-like collar 126 positioned thereabout between radially extending flanges 127 and 128 at the respective ends of the sleeve.

Sleeve 124 has a plurality of slots such as 129 formed from the distal end. The slotting of the sleeve produces a plurality of flexible members 130 and 131, which are radially flexible at the distal end. When proximal end 110 of the obturator tube is inserted in passageway 125, the flexible members move in a radially outward direction. Each flexible member includes a projection or ridge such as 132 and 133 extending into passageway 125. The dimension between the peaks of opposing projections of the flexible members is less than the outside diameter of the obturator tube. As a result, when the obturator tube is inserted in passageway 125, the distal end of the flexible members are moved in an outward direction due to the surface of the obturator tube engaging the projections.

Depicted in FIG. 3 is a partially sectioned view of the replacement apparatus of FIG. 2 with the proximal end 110 of the obturator tube fully inserted into passageway 125 of obturator tube fitting 122. As shown, the proximal end of the obturator tube engages O-ring seal 134 positioned at the proximal end of the obturator tube fitting. The O-ring seal is positioned in recess 141 at the proximal end of the obturator tube fitting. This O-ring seal is made preferably of commercially available Buna-N rubber. When the proximal end of the tube is positioned next to the O-ring seal, obturator tube 106 is pneumatically sealed in fitting passageway 125. As also

shown, the proximal end 110 of the obturator tube flexes the distal end of the members in an outward direction due to the projections engaging the outside surface of the obturator tube.

Cylindrically shaped flexible members 130 and 131 have a conically shaped cam surface 135 and 136 at their distal ends. The inside surface 137 of ring-like collar 126 engages these cam surfaces when the collar is moved toward the distal end of the members as shown. When the inside surface of the collar engages the cam surfaces, projections 132 and 133 are forced in an inward direction indicated by the arrows and into the outside surface of semi-rigid material obturator tube 106.

As depicted in FIG. 4, collar 126 has been moved to a fully distal position to engage retainer flange 128 at the distal end of the members. The inside of the collar is cut to form a notch 138 to engage retaining flange 128. When moved to a fully distal position, surface 137 of the collar fully engages the cam surfaces forcing projections 132 and 133 fully into the outside surface of obturator tube 106. As a result, the flexible members and projections fixedly position longitudinally the proximal end of the obturator tube in the fitting passageway.

When collar 126 has been extended to a full distal position engaging retaining flange 128, the removable connector is in a "locked position." To unlock the removable connector, collar 126 is slid by the physician to the proximal position disengaging cam surface 135 and 136 of flexible members 130 and 131, respectively. The flexible members include a recessed surface or notch 139 and 140 of respective flexible members 130 and 131. These recessed surfaces adjacent cam surfaces 135 and 136 limit the engagement of the collar with the flexible members. As a result, the force necessary to move the collar to a proximal position is significantly reduced. However, sufficient force is exerted by the semi-rigid tube against the projections and flexible members to maintain the connector in a "locked" position.

Although the removable connector has been described for interconnecting an obturator tube to ventilator apparatus, this removable connector may be used for any number of applications for interconnecting two tubes for which quick-release is desired.

Of course, it will be understood that the aforementioned endotracheal tube replacement apparatus and method is merely illustrative of the application of the principles of this invention and that numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention. In particular, the projections extending from the flexible members may be positioned elsewhere along the length of the sleeve passageway. This provides additional force if required depending on the durometer of the semi-rigid material. The depth or the height of the projections may also be increased to further extend into a softer material tube. In addition, any number of different connector fittings may be ultrasonically welded or joined to the lockable and removable fitting of the present invention.

What is claimed is:

1. Apparatus for replacing an endotracheal tube placed in a patient, comprising:

tubular obturator means for ventilating said patient during replacement of said endotracheal tube, said obturator means being insertable into a passageway of said endotracheal tube and having distal and proximal ends, a passageway extending there-through, an outside surface extending longitudinally