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TUBES WITH SAIL CUFFS FOR TRACHEAL INTUBATION

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Fig. 1

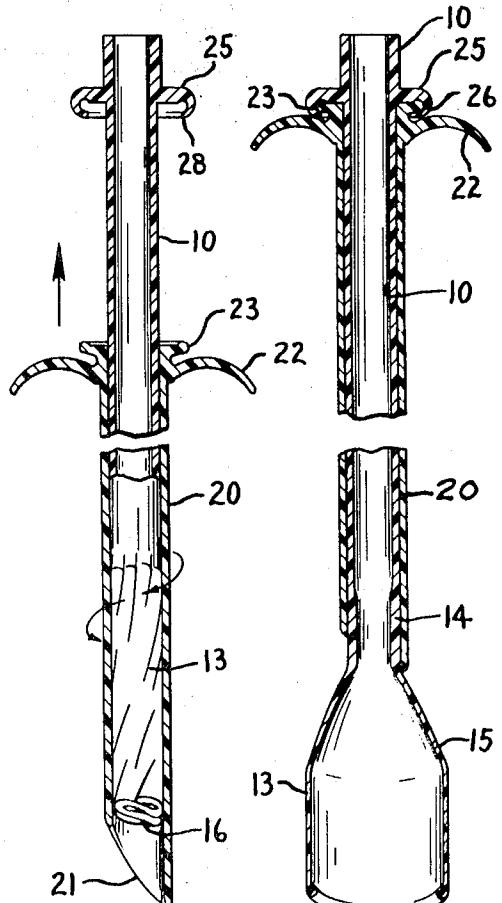
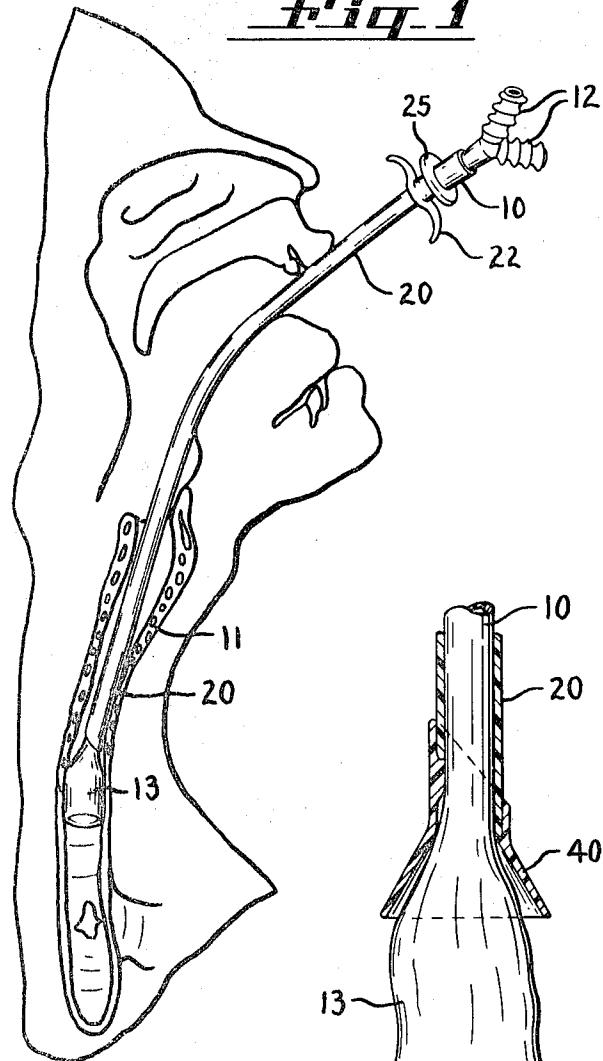


Fig. 2

Fig. 3

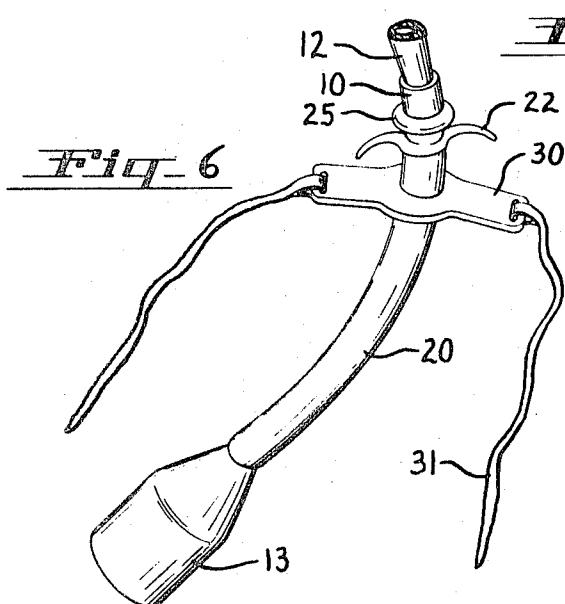


Fig. 7

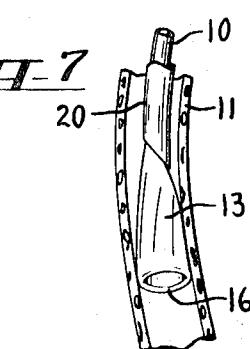


Fig. 4 Fig. 5

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TUBES WITH SAIL CUFFS FOR TRACHEAL INTUBATION
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8 Claims

ABSTRACT OF THE DISCLOSURE

The present cuff is an open ended flaring skirt which is pressed against the tracheal wall during the positive pressure phase of mechanical ventilation of the patient's lungs. The sealing pressure is applied by the ventilating gas itself whereby the pressure of the cuff against the tracheal wall can never exceed that of the ventilating gas and whereby the cuff is relaxed in each breathing cycle when the ventilating gas is not above atmospheric pressure. A slideable sleeve sheathes the skirt for intubation and unsheathes the skirt after intubation. The cuff is used on endotracheal, nasotracheal and tracheostomy tubes.

BACKGROUND OF THE INVENTION

This invention relates to an improved cuff on tubes for tracheal intubation.

Conventional tubes for tracheal intubation, for use with anesthetic machines and mechanical ventilators, are equipped with pneumatic balloon cuffs to form a seal against the tracheal wall. The balloon is inflated until gas leak past the balloon ceases in order to allow ventilation of the patient with a closed system and no leakage of gases.

It has become generally recognized that conventional inflatable balloon cuffs are dangerous in that even slight over-inflation impairs the blood supply to the trachea and tends to produce pressure necrosis of the adjacent tracheal wall. As a result, the tracheal wall undergoes contraction producing stenosis of the involved segment of the trachea. The difficulty is aggravated by the fact that those patients requiring the longest periods of mechanical ventilation are frequently patients with severely depressed cardiac output, making them the most susceptible to pressure necrosis and the resulting stenosis.

Objects of the invention are, therefore, to provide an improved cuff on tubes for tracheal intubation, to provide a cuff which will not produce pressure necrosis, to provide a cuff which cannot be overinflated, to provide a cuff which cannot be inflated beyond the pressure existing in the patient's lungs, to provide a cuff which is relaxed in a portion of each breathing cycle when the ventilating gas is not above atmospheric pressure, and to provide a cuff which is more simple and easy to use than conventional balloon cuffs.

SUMMARY OF THE INVENTION

The present cuff is an open ended flaring skirt having its small end connected to the ventilating tube. When the ventilating gas is above atmospheric pressure, it presses the skirt outward against the tracheal wall, sealing the space between the tube and the tracheal wall. The pressure of the cuff against the tracheal wall thus can never exceed the pressure of the ventilating gas in the lungs, and in each breathing cycle when the ventilating gas is not above atmospheric pressure, the cuff is relaxed. This assures maintenance of normal blood supply in the contacted area of the trachea and prevents pressure necrosis. The ventilating tube is provided with a slideable outer sleeve to sheath the cuff during intubation.

The invention will be better understood and the fore-

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going and additional objects and advantages will become apparent from the following description of certain preferred embodiments of the invention illustrated on the accompanying drawing. Various changes may be made in the details of construction and arrangement of parts and certain features may be used without others. All such modifications are included in the invention.

BRIEF DESCRIPTION OF THE DRAWING

10 FIG. 1 is a view showing an endotracheal tube embodying the principles of the invention in operative position in a patient;
15 FIG. 2 is a longitudinal sectional view with parts broken away, showing the construction of the endotracheal tube in FIG. 1, with the sleeve extended to sheath the cuff for intubation;
20 FIG. 3 is a view similar to FIG. 2 with the sleeve retracted;
25 FIG. 4 is a fragmentary sectional view of a trachea showing the cuff in relaxed condition;
30 FIG. 5 is a view similar to FIG. 4 showing the cuff in distended condition;
35 FIG. 6 is a perspective view of a tracheostomy tube embodying the invention; and
40 FIG. 7 is a fragmentary sectional view of a tube having a sleeve equipped with a conical guide member to assist in sheathing the cuff for intubation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

30 FIGS. 1 to 5 show an endotracheal tube 10 for use in the trachea 11 of a patient. The proximal end of tube 10 is equipped with connections 12 for supplying anesthetic gases or oxygen, or oxygen-containing gases for ventilating the patient's lungs in a closed system wherein a breathing rhythm is induced by an anesthetic machine or mechanical ventilator. The distal end of tube 10 is equipped with cuff 13.
35 Cuff 13 is made of a suitable flexible, gas impervious material, preferably a thin resilient rubber of the same type used for conventional inflatable balloon cuffs. The cuff has a small proximal end 14 integrally concentrically connected with the distal end of tube 10 and a flaring skirt portion 15 preferably terminating in an internal thickened bead 16 on the larger distal end. Bead 16 is molded in circular shape whereby it tends elastically to return to this shape when free of restraint, to keep the distal end of the skirt normally open and distended. The main skirt portion 15 need not necessarily be elastic. Small end 14 is preferably molded integral with tube 10 or otherwise made integral therewith.

40 Surrounding the tube 10 is a slidably mounted flexible rubber or plastic sleeve 20 having a beveled distal end 21. The proximal end of sleeve 20 is equipped with a pair of finger grips 22 and a circumferential flange 23. Parts 22 and 23 may be made of metal or a hard plastic, or they may be molded integral with sleeve 20 making the finger grips 22 of sufficiently thick section, or otherwise reinforced, to provide a suitable degree of stiffness or rigidity 45 in the finger grips. Tube 10 is provided with a flange 25 having a resilient inturned lip 26 arranged to receive flange 23 in a snap fit to lock the two flanges together.

45 The length of sleeve 20 is such that when fully retracted the cuff 13 is emergent from the sleeve and completely unrestrained. The device is supplied by the manufacturer in this condition as shown in FIG. 3 except that it is not necessary for flange 23 to be engaged by the resilient lip 26. In preparation for use, sleeve 20 is rotated and advanced on endotracheal tube 10 to furl and sheath the cuff 13 loosely within the sleeve as shown in FIG. 2. A lubricant such as glycerin which is non-toxic and water soluble is applied between the tubes 10 and 20 by the

manufacturer to reduce friction. Bead 16 folds into a configuration allowing it to enter the sleeve.

The device in the condition shown in FIG. 2 is inserted in the patient's trachea according to conventional procedure. Sleeve 20 forms a pilot to guide the relatively limp cuff 13 into the trachea. Then, by means of the finger grips 22, the sleeve 20 is retracted on the tube 10 while holding the latter stationary until flange 23 snaps into engagement with lip 26. This causes cuff 13 to become emergent from the distal end of sleeve 20 as shown in FIGS. 1 and 3. Flange 25 provides a stop for the retractive movement of sleeve 20, insuring that the cuff 13 is completely unsheathed when the two flanges 23 and 25 are locked together.

When the anesthetic machine or mechanical ventilator is applied to connections 12, the gas pressure in ventilating tube 10 and in the patient's lungs varies rhythmically between some pressure above atmospheric and atmospheric pressure or slightly below to establish a breathing cycle. During each phase of the breathing cycle when the gas pressure is above atmospheric, the gas pressure fills out and distends the cuff 13 in the manner of a sail on a boat when it catches the wind. The cuff then presses against the wall of the trachea as shown in FIGS. 1 and 5, effecting a seal to prevent leakage through the upper trachea. This mode of operation suggests that the cuff may aptly be described as a sail cuff to distinguish it from the conventional balloon cuff. The sealing pressure cannot exceed the gas pressure in the lungs whereby the pressure cannot become intolerable to the trachea.

During the exhalation phase, as the gas pressure drops to atmospheric or slightly below, cuff 13 relaxes its pressure against the trachea as shown in FIG. 4. Bead 16 remains distended by its own resilience but does not apply any appreciable pressure against the wall of the trachea. Its function is merely to prevent collapse of the end of the skirt and hold it open and lightly against or closely adjacent the wall of the trachea during relaxation and contraction of the main portion of the skirt. After use, the device is freely removable from the trachea without sheathing the cuff.

Besides preventing injury to the trachea, the present sail cuff eliminates the usual inflating device and inflation connecting tube used with conventional balloon cuffs and does not require the usual skilled supervision of the balloon inflation pressure. This makes the present device less expensive to manufacture and easier to use.

A nasotracheal tube embodying the invention is essentially the same as the endotracheal tube just described, except that it is dimensioned to pass through the nose 50 instead of through the mouth.

FIG. 6 shows a tracheostomy tube embodying the invention. Here, again, the device is essentially the same as the endotracheal tube just described except in the matter of dimensions and curvature. For tracheostomy use the cuff sheathing sleeve 20 is equipped with aperture ears 30 so that the device may be anchored around the patient's neck by the usual umbilical tape 31.

In circumstances where the curvature of the tubes may prevent easy rotation of the sleeve 20 in sheathing and furling cuff 13 as shown in FIG. 2, the funnel-shaped guide 40 in FIG. 7 is employed. The guide 40 is frictionally and detachably mounted on the distal end of sleeve

20. The device is furnished by the manufacturer in the condition shown in FIG. 7 with cuff 13 emergent from the end of sleeve 20. Tube 10 may then be retracted into sleeve 20 without twisting the sleeve, the flaring skirt portion of cuff 13 being gradually contracted and folded by the funnel shape of guide 40 so that the cuff will freely pass into sleeve 20. The funnel folds bead 16 into a configuration allowing it to enter the sleeve. Then the guide 40 is removed, leaving the device in condition for use as previously described in connection with FIG. 2.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. A tube for tracheal intubation comprising a tube, a cuff for said tube comprising a flaring circular skirt of flexible, gas impervious material, said skirt having a small proximal end concentrically connected with the distal end portion of said tube and a larger, open distal end, a sleeve slidable on said tube in a distal direction to sheath said skirt for intubation and slidable on said tube in a proximal direction after intubation to unsheathe said skirt, a stop on said tube to limit the retractive movement of said sleeve in a proximal direction, and interengaging means on said stop and sleeve to secure said sleeve in retracted position, said interengaging means comprising a flange on said sleeve and a resilient hooked lip on said stop arranged for a snap fit with said flange.
2. A tube as defined in claim 1 including finger grips on said sleeve for sliding the sleeve on said tube.
3. A tube as defined in claim 1 including a resilient circular ring incorporated in said distal end of said skirt, said ring tending to hold said distal end open.
4. A tube as defined in claim 3, said skirt being made of rubber and said ring comprising a bead on said distal end.
5. A tube as defined in claim 1, said small end of said skirt being connected with the extreme end of said tube.
6. A tube as defined in claim 1 including a detachable conical guide member on the distal end of said sleeve arranged to funnel said skirt into said sleeve in sheathing said skirt.
7. A tube as defined in claim 1, said lip and flange being circular so as to fit together in all rotative positions of the parts.
8. A tube as defined in claim 1 including means on said sleeve for anchoring a tape to secure the device in position on a patient.

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