

[54] **ENDOTRACHEAL TUBE WITH
POSITIVE CHECK VALVE AIR SEAL**

[75] Inventor: **Ronald Hamilton Hayward**, Temple,
Tex.

[73] Assignees: **Scott and White Memorial Hospital;
Scott, Sherwood and Brindley Foun-
dation**, Temple, Tex.

[22] Filed: **April 28, 1970**

[21] Appl. No.: **32,627**

[52] U.S. Cl. 128/351

[51] Int. Cl. A61m 25/00

[58] Field of Search.....128/351, 348, 349 R, 349 B,
128/349 BV, 350, 344, 325, 246, 240, 245

[56] **References Cited**

UNITED STATES PATENTS

3,616,799	11/1971	Sparks.....	128/351
724,913	4/1903	Montgomery.....	128/245

3,565,079	2/1971	Jackson.....	128/351
3,459,175	8/1969	Miller	128/349 B
3,481,339	12/1969	Puig	128/351
3,460,541	8/1969	Doherty	128/351

OTHER PUBLICATIONS

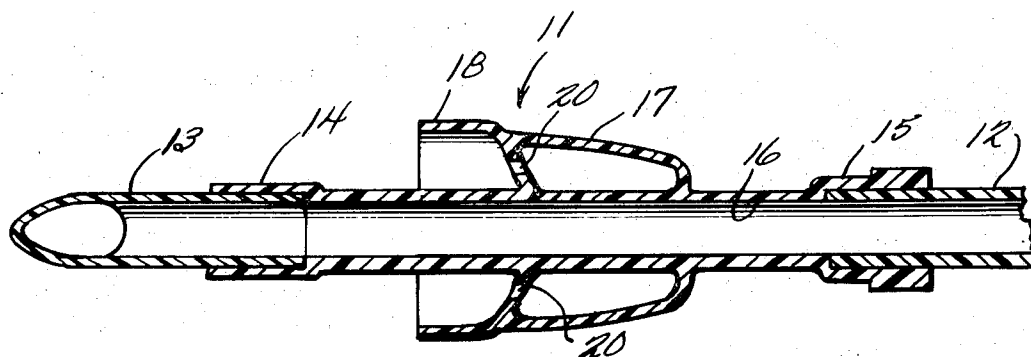
Martinez "An Improved Cuffed Tracheotomy Tube
for Use w/I.P.P.B." Jo. Thorac. & Card. Surg., Vol.
4703, Mar. 1964, pp. 404-405.

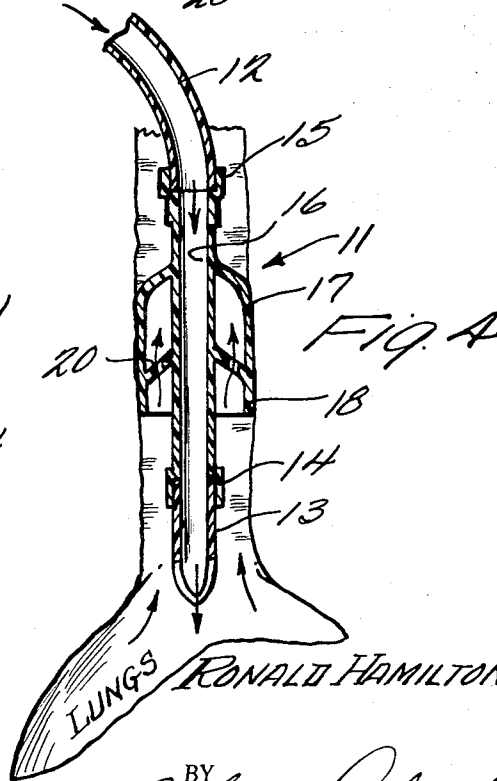
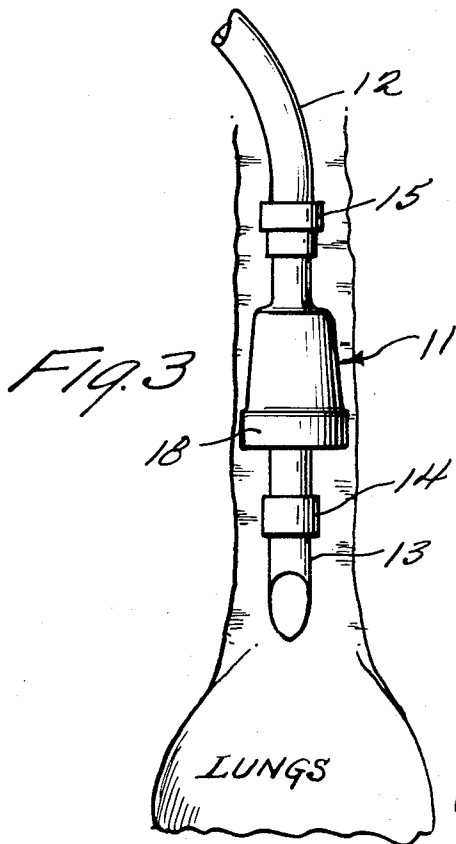
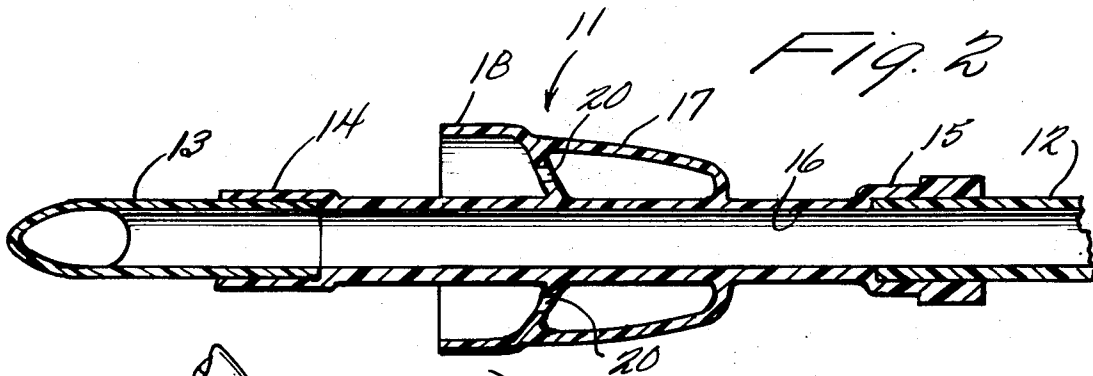
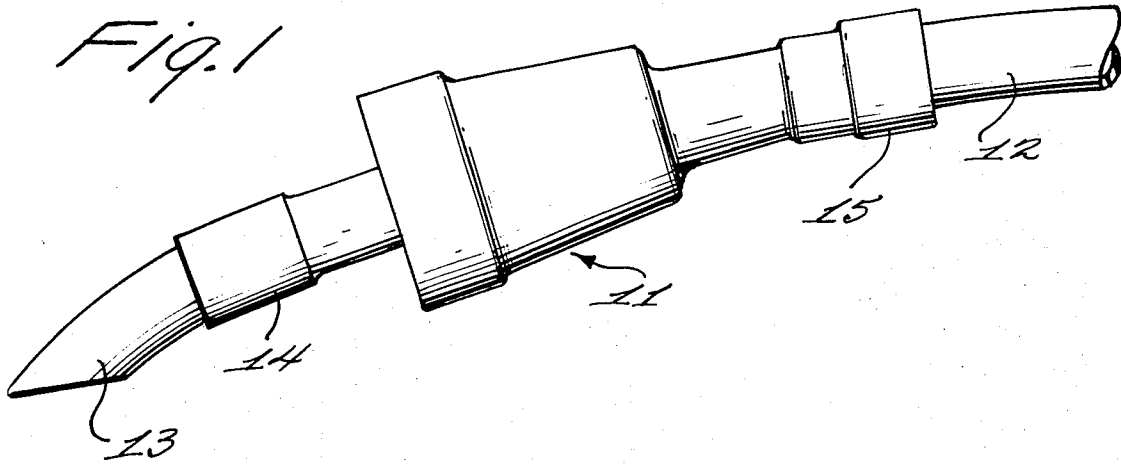
Primary Examiner—Charles F. Rosenbaum
Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

An endotracheal tube for ventilation of the lungs
wherein a valve member is provided to seal against the
walls of the trachea and wherein said valve has a flexi-
ble lip mounted on a hollow flexible body and wherein
said body is inflated by forcing gas into the patient's
lungs.

3 Claims, 4 Drawing Figures





INVENTOR

RONALD HAMILTON HAYWARD

BY

Cushman, Daley & Cushman
ATTORNEYS

ENDOTRACHEAL TUBE WITH POSITIVE CHECK VALVE AIR SEAL

BACKGROUND OF THE INVENTION

The present invention relates to the problem of providing free ventilation of a patient's lungs during operations and prolonged treatments and more particularly to the use of an endotracheal tube in cases where there is breathing trouble or paralysis of the cranium or thorax during operations.

There are two different procedures which can be used for inserting an endotracheal tube for ventilation of the patient's lungs. The first, tracheotomy, requires that an incision be made in the base of the throat and extending into the inner cartilage wall of the trachea to allow insertion of the tracheostomy tube there through. The second, endotracheal intubation, requires only the insertion of the tube through the upper air way, (mouth or nose, larynx and trachea) by use of a laryngoscope and does not require an incision.

In either of the above two procedures the insertion could be temporary or remain permanently as long as air or gases entering and leaving the lungs are required to bypass the upper air ways.

In the two procedures outlined above, it may be necessary to form a seal between the endotracheal tube and the inside of the tracheal wall so as to obtain two results; first, the isolation of the respiratory organs from the feeding tract to avoid the aspiration of secretions, regurgitations, etc., and second, to achieve artificial respiration, either by intermittent positive pressure or alternative positive-negative pressure on the lungs.

To obtain this seal, endotracheal tubes are universally used with an inflatable valve placed at their lower end. These valves usually have additional tubes which communicate with a high pressure source which is used to inflate these valves until they contact the inner walls of the trachea.

These valves have been used previously, but suffer from certain disadvantages which can have very serious consequences for the patient. The major problem in the use of this type of valve is that the inflation of the valve to a high pressure will produce pressure necrosis of the trachea. This is due to the fact that when the valve is inflated, it has to be inflated equal to or greater than the maximum tracheal gas pressure that the lungs are capable of generating. It has also been found that when this pressure is high enough to hold the endotracheal tube and valve in place and prevent leakage, that there is interruption of blood circulation in the trachea tissue and lesions are produced in the walls of the trachea.

It has been proposed that these valves be deflated periodically to momentarily permit circulation of blood through the tissues surrounding the valve. If these decompressions are to be carried out during an operation, a highly skilled person is required to perform the deflation because, if the deflation is excessive, the tube is apt to be moved out of position and produce difficulties in the patient's breathing and loss of the seal.

SUMMARY OF THE PRESENT INVENTION

To eliminate these disadvantages of the tracheal tubes discussed above, the present invention incorporates the use of a valve on the end of an endotracheal tube which is not inflatable by an auxiliary high pressure source. This eliminates the high pressure valve on

the end of the endotracheal tube, which in the prior art was inflated to produce a seal. Since it is the effects of the high pressure which caused damage to the trachea wall, it therefore, can be seen that a valve which is not inflated to such a high level will be successful in reducing damage to the trachea wall.

The valve in the present invention incorporates a lip forming part of a flexible skirt-like valve member which is mounted around the end of the trachea tube. This hollow flexible valve member is provided with ports to allow gas to communicate from the lungs to the inside of the flexible body.

It is therefore the primary object of this invention to provide a trachea valve which operates to seal the lungs but does not produce a high pressure in the trachea and therefore damage the tissue.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the device showing the valve placed on the end of the endotracheal tube.

FIG. 2 is a plan view showing the valve and endotracheal tube in section.

FIG. 3 is a plane view showing the valve and endotracheal tube inserted in the trachea.

FIG. 4 is a plan view showing the valve and endotracheal tube in section in the inflated position inserted in the trachea.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 an endotracheal valve member 11 attached between an endotracheal tube 12 and an extension tube 13. The tube 12 can be constructed from plastic or common surgical tubing and is used to connect to valve 11 to a medical treating device which supplies gases to a patient's lungs. The tube 13 which is attached to the lower portion of the valve member 11 is used to exhaust the supply of gas from the tube 12 to an area near the lungs.

Referring now to FIG. 2, it can be seen that the valve member 11 is provided with a lower and upper connection 14 and 15 respectively. These connections 14 and 15 are in the form of female couplings of a size which seal with and connect to the exterior surfaces of the extension tube 13 and the endotracheal tube 12 respectively. Although the valve member 11 is shown with these connections, it is anticipated that the tubes 12 and 13 could be integrally formed with the valve member either by molding the assembly in one piece by heat or adhesively sealing the various parts together.

The valve member 11 is constructed from flexible material, such as plastic or rubber, and has a central hollow passage way 16 providing fluid communication between the tubes 12 and 13. It can be seen that this passage way 16 as well as the center of the tubular members 12 and 15 are unobstructed by an additional tube which is needed in the devices disclosed in the prior art to inflate the seal member.

Concentrically attached to the exterior of the central hollow passage way is an inflatable member 17. This inflatable member 17 also has an annular lip or seal member 18 which is attached thereto and extends in a

direction toward the lower joint 14. This lip 18 is mounted so that it is resiliently urged in an outward radial direction. This lip performs a sealing function which will later be described. Ports 20 are formed in the member 17 to provide fluid communication between the gas pressure below the lower end of the valve and the interior of the inflatable member 17.

The operation of this device can be seen by examining FIGS. 3 and 4. In FIG. 3 the device is shown as inserted into the trachea just above the lungs of a patient with the valve in an unactuated position. To utilize this device, first the tube 12 with the valve 11 attached thereon is inserted into the trachea as shown in FIG. 3. Note that the outer surface of the flexible lip 18 lies in loose contact with the inner wall of the trachea. Next, gas under positive pressure is applied to the tubular member 12 and is transmitted through the central hollow passage way 16, through the extension 13 and into the lungs of the patient. As the gas is supplied to the end of the endotracheal tube 12 and hence the lungs, air flows through the ports 20 and into the inflatable member 17 causing the member 17 to swell and contact the tracheal wall as shown in FIG. 4. It can also be seen that the lip 18 is held against the tracheal wall and provides a check valve type sealing function as long as positive pressure is kept on the lungs. It can be seen that when the valve is used in a situation requiring artificial respiration of the patient, that the valve only exerts a sealing pressure on the lungs when a positive pressure is exerted on the lungs. In this situation, the valve is automatically and periodically released as the lung pressure varies during artificial respiration.

The valve is in effect a check valve which can be easily released to free the tracheal wall from the dangerous effects of prolonged pressure. It can also be seen that due to the ports 20, the pressure in the inflatable member 17 can never exceed the pressure in the lungs and that extremely high harmful pressures cannot be created in the inflatable member which would injure the trachea.

It should be understood, of course, that the foregoing disclosure relates to only the preferred embodiment of this invention and that numerous modifications or alterations may be made therein without departing from the spirit or scope of the invention as set forth in the appended claims.

I claim:

1. An endotracheal device for insertion into the trachea or other passage to ventilate the lungs during operations and prolonged treatments, comprising: a tubular base means for transmitting fluids to place a positive pressure on the lungs by inserting one end of said tubular base into the trachea,

a flexible annular lip surrounding said base means adjacent said one end and having a free edge extending toward said one end, said lip being movable from a first position to a second radially expanded position and in said first position being radially retracted away from the trachea, said lip in

said second position being radially expanded to provide sealing between the outer surface of said lip and the interior walls of said trachea whereby fluid pressure from the lungs acts only on the inner surface of said lip thereby preventing the flow of compressible fluid along said trachea from said one end to said other end,

and means for moving said lip from said first position to said second position when a positive pressure is placed on the lungs, said means including a hollow inflatable member connected to said lip along the edge thereof opposite said free edge and surrounding said tubular base means at a location axially adjacent said lip and having axially facing ports in communication with the lungs, said member being inflated and radially expanded by the flow of fluid under positive pressure from the lungs.

2. An endotracheal tube comprising: an elongated, flexible, hollow tube having a first end, a second end adapted to be inserted into a trachea and valve means associated with the exterior of said tube near said second end for releasable sealing engagement with the trachea, said valve means including an annular flexible flap-valve lip surrounding said tube in spaced-apart relationship thereto and having an inner surface adjacent said lip being radially movable toward and away from said tube whereby the outer surface is engageable with the trachea and whereby in this position the inner surface is exposed only to the pressure existing in the trachea between said lip and the lungs, said valve means further including means for urging said lip radially outwardly upon the application of gas pressure through said tube, said means comprising a flexible annular body surrounding an imperforate longitudinal portion of said tube, said body having a first end sealed to the exterior of said tube, said lip extending from said body toward said second end of said tube, said body being provided with ports to receive gas pressure from the space between said inner surface of said lip and said tube.

3. An endotracheal tube comprising: an elongated, flexible, hollow tube having a first end and a second end adapted to be inserted into a trachea; and a flexible, skirt-like valve structure surrounding and spaced from said tube at a location near said second end such that said second end of said tube extends axially beyond said valve structure, said valve structure having a first end sealed to said tube and a free end defining a flexible lip which is radially spaced from said tube whereby the interior of said valve structure is open through said free end, said lip extending axially of said tube toward said second end of said tube and being radially movable toward and away from said tube, said valve structure further including means connecting said tube to said valve structure at a location intermediate said lip and said first end of said valve structure and defining parts for passage of gas pressure into and out of said valve structure.

* * * * *