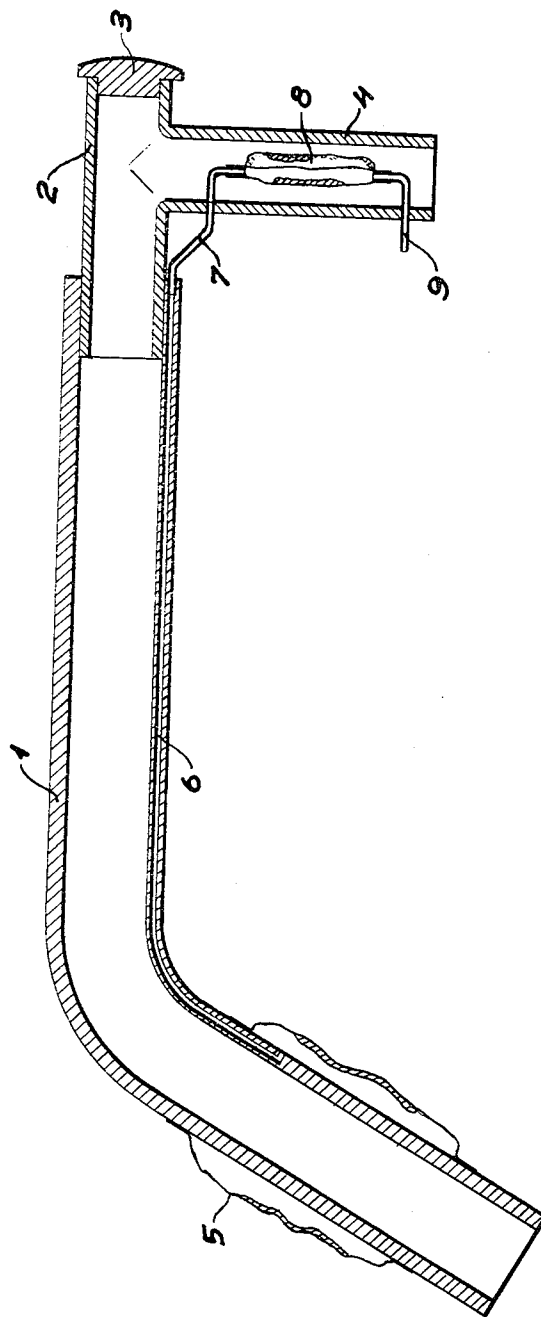


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ENDOTRACHEAL BALLOON CATHETER PROVIDED WITH
INFLATION PRESSURE REGULATING VALVE
Filed June 13, 1967

3,504,676



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ENDOTRACHEAL BALLOON CATHETER PROVIDED WITH INFLATION PRESSURE REGULATING VALVE

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3 Claims

ABSTRACT OF THE DISCLOSURE

A respiratory catheter in which the tube for delivering respiration air under pressure to a patient's lungs is enclosed along a portion of its lower end with a bladder of non-resilient material adapted to engage the patient's trachea and provide a seal preventing entry of vomit to the lungs, the bladder being connected with a separate source of air under lesser pressure than that delivered to the lungs by means of a pipeline connected with a two-way blocking valve disposed in the tube and controlled by the respiration air. The respiration air during the inhalation phase closes the two-way valve and applies pressure to the outside of the bladder at the downstream end to maintain the seal, whereas, during exhalation, the absence of the respiration air pressure allows the two-way valve to open to enable the lower pressure air to provide sufficient inflation of the bladder for sealing purposes.

This invention relates to respiratory catheters of the type consisting of a tube for introducing air to the lungs of the patient, adapted to be introduced in the trachea of the patient and provided with a tube surrounding bladder to create a tightening in relation to the wall of the trachea, whereby the interior of said bladder is in connection with a separate pipe connected to a source of pressure.

It has been found to be most important in using respiratory catheters to obtain a really effective tightening or construction therewith in relation to the wall of the trachea and especially to maintain the tightening also during the expiration phase, more especially because when treating unconscious patients, one may be in need of a breathing security, i.e. a protection against any vomit that may arise and push through the trachea and down to the lungs. In respiratory catheters such as are known in the art, various types of tightening means for providing construction between the catheter and the trachea wall have been used, such as a vesicle or bladder made of a resilient material and, therefore, capable to be inflated against the trachea wall and thereby provide tightening. It appears, however, that such a tightening in order to be efficient under all conditions has to be provided at a comparatively high pressure, the resilient bladder for sealing purposes being constantly required to exert a pressure against the mucous membranes of the trachea during both the inspiratory and expiratory sure. Such a constant pressure against the trachea wall often has a harmful effect on the mucous membranes of the wall, leading to a decrease of or eventually a cessation of the blood circulation in the area in question.

The aim of the present invention is to provide a respiratory catheter applicable to artificial respiration without such disadvantages as found in prior art respiratory catheters. It is an object of the present invention to provide means with which to obtain an airtight closure of the trachea during both the inspiratory and expiratory phase of artificial ventilation of the lungs without subjecting the mucosa of the trachea to pressures harmful

thereto. This is achieved according to the present invention by a respiratory catheter tube which is provided with a bladder comprised of a thin, preferably non-resilient foil material with such dimensions that it can readily be brought into tightening abutment against the wall of the trachea without resilient deformation of the bladder, and which communicates with a compressed air source through a two-way blocking valve disposed in the pipe through which respiration air is supplied to the catheter tube, said blocking valve being controlled by the pressure of the respiration air.

The invention will now be described with reference to the accompanying drawing, representing a longitudinal section view of a respiratory catheter incorporating the principles of the present invention.

In the drawing is shown a respiratory catheter consisting of a catheter tube 1, which at one or its upper end is joined to a T-shaped tube 2, one branch of which is closed off as by a cork 3, the main branch 4 of the tube serving as inlet nozzle for the respiration air to the catheter tube 1.

The opposite or lower end of the catheter tube is provided with an appropriate bent segment and has a bladder 5 secured on the outside of said tube around said bent segment. The bladder may be supplied with air under pressure through a duct 6 in the wall of the tube 1. From the duct a thin pipeline 7 leads into the main branch 4 of T-shaped tube 2 and is connected to one end of an inflatable-collapsible blocking valve 8 disposed in said main branch 4 as shown. The blocking valve 8 may comprise two plane foil members 8 welded together along their rims to thus form a hollow inflatable-collapsible valve. A thin pipe 9 is connected with the other end of the blocking valve and in turn outlets from the tube branch 4 to serve as an inlet nozzle for delivering compressed air to the bladder 5 from a source separate from that supplying the respiratory air.

The respiration air pressure applied is of course dependent on the patient and on varying external circumstances and should normally be of a pressure height corresponding to 20–70 cm. column of water, whereas, the air pressure in the bladder 5 may be maintained somewhat lower, e.g. at a height corresponding to 16–20 cm. column of water. A pressure like that cannot injure the mucous membranes of the trachea and the increase of pressure caused by the respiration pressure does not exceed the pressure imposed on the rest of the air passage by the respiratory treatment.

When using the catheter of the present invention, practically no force is required for pressing the bladder 5 against the trachea wall and the pressure exerted within the bladder is consequently entirely utilized to provide sealing. Moreover, the bladder tends, without alterations of the internal pressure, to comply with any alteration of the dimensions of the trachea still without requesting a particular pressure application; thus it is possible to maintain pressure in the bladder at the lowest possible level.

When using a blocking valve such as valve 8 to control pressure in bladder 5 with the opening and closing of the blocking valve in turn being controlled by the respiration pressure, a performance is achieved where the amount of air pressure introduced into the bladder 5 through duct 6 from a separate source of compressed air at a lower pressure than the respiration air so as to fill and enlarge said bladder, such air is confined in said bladder as soon as the respiration air under pressure being delivered through tube 1 rises. Thus the respiration air pressure closes blocking valve 8 preventing entry or outflow of the air under lower pressure from bladder 5, with the respiration air itself exerting a pressure against the outside of the bladder at the lower part, i.e., facing the lungs causing an in-

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crease of the abutting pressure of the bladder against the trachea. In the expiration periods, a rather low air pressure in the bladder is all that is required for proper operation of the bladder for tightening purposes. Such air pressure supply to the bladder during the expiration periods is substantially below a possibly harmful pressure. During the expiration period, the absence of the higher pressure air in branch 4 allows the blocking valve 8 to open or inflate and connection of the bladder 5 with the separate lower air pressure source occurs to thereby permit enlargement of the bladder against the trachea. Generally compressed air is used as pressure medium and since the respiration pressure frequently is considerably higher than the pressure required to provide breathing security, the confining of the amount of compressed air introduced in the bladder will merely lead to a squeezing by the respiration pressure of the extremity of the bladder which turns downwards the lungs to an extent resulting in a decrease of the total volume of the bladder and the pipe connected thereto, whereby the pressure will increase precisely as much as required to ensure the tightening.

As was indicated earlier, blocking valve 8 is located in branch 4 so as to provide an effective control of the valve. This allows for a utilization of the drop of pressure which occurs in the course of the passage of the air between the entry orifice of the respiration tube 1 and the valve 8. When, e.g., the respiration pressure decreases from its maximum value, an opening of the valve 8 will occur which allows a part of the volume of air in the bladder and which was compressed therein by the externally located maximal respiration pressure, to escape, whereby the pressure in the bladder for a short moment becomes too low to keep up a perfect sealing of the trachea against the respiration pressure not yet dropped to its minimum value. By virtue of this, during a short moment a passage will be produced along the mucous membranes and between them and the bladder along which upward transport of phlegm and other undesirable matter can take place, just as said trachea and adjacent organs in the natural state always manage to remove such impurities. The perfect sealing is, however, again provided when the respiration pressure drops right down to its minimal value and the separate lower air pressure supply enlarges the bladder against the trachea.

What I claim is:

1. A respiratory catheter comprising a tube adapted to be introduced into the trachea of a patient for delivery of respiration air under pressure to the patient's lungs,

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said tube having an upper entry end and a lower bent section, a bladder of thin, non-resilient material enclosing the bent section of said tube and being secured thereto, said tube having a duct therein communicating with the interior of said bladder, an elongated inflatable-collapsible blocking valve disposed in said tube at the entry end thereof, a pipe line connecting one end of said blocking valve with said duct, and a pipe connecting the opposite end of said blocking valve with a source of air at a pressure lower than that of the respiration air, the pressure of respiration air flowing through said tube during inspiration collapsing said blocking valve to isolate said bladder from the source of air at pressure lower than that of said respiration air whereby the respiration air flowing to the patient's lungs exerts a pressure on the outside of said bladder at the end nearest the lugs to thereby force said bladder into tightening engagement with said trachea, said blocking valve becoming inflated during expiration when the pressure of said respiration air is released whereby said air at a pressure lower than that of said respiration air can flow to said bladder to enlarge same against the patient's trachea.

2. The respiratory catheter of claim 1, further comprising a T-shaped fitting on the entry end of said tube, said fitting having one branch received in said tube, another branch closed off with a plug, and a third branch serving as an inlet for respiration air, said blocking valve being disposed in said third branch.

3. The respiratory catheter of claim 2 wherein said blocking valve is comprised of a pair of foil sheets connected together along their rims to form an inflatable-collapsible structure.

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DALTON L. TRULUCK, Primary Examiner

U.S. Cl. X.R.

128—208

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,504,676 Dated April 7, 1970

Inventor(s) Vagn Niels Finsen Lomholt

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 43, "construction" should read
--constriction--;

Column 1, line 51, "construction" should read
--constriction--;

Column 1, lines 60 and 61, after "trachea" on line 60,
"during both the inspiratory and expira-
tory sure." should read --amounting to the
maximum respiratory pressure.--;

Column 1, line 71, "phase" should read --phases--.

Column 4, line 5, "in-flata-" should read --inflata---;

Column 4, line 17, "lugs" should read --lungs--.

SIGNED AND
SEALED
SEP 15 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents