

[54] **TRACHEAL INSTRUMENT**

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[58] Field of Search ... 128/351, 348 R, 350 R, 142.2, 128/142.3, 145 R, 145.5, 145.8, 208; 3/1.3; 137/517

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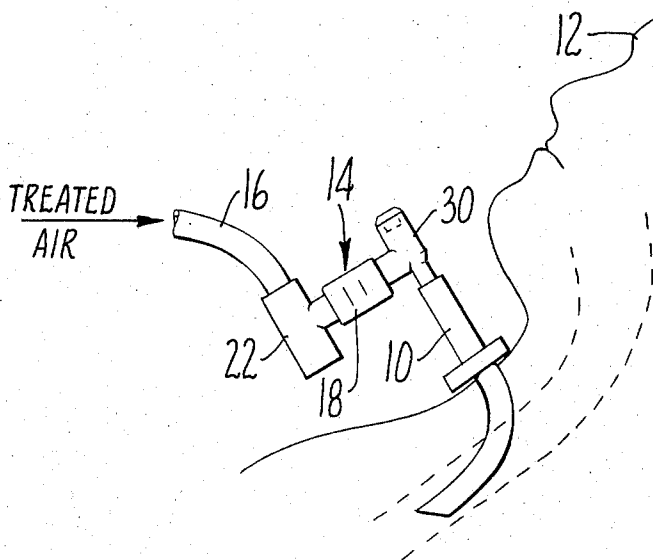
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[57] **ABSTRACT**

A tracheal instrument adapted for connection to a tracheotomy tube to control the ingress and egress of air by the patient with which the tracheotomy tube is associated. The tracheal instrument includes a housing having an interior and inlet and outlet passageways providing communication between the interior of the housing, a source of air, and the tracheotomy tube, respectively. A moveable valve element is disposed within the housing to selectively open or close at least one of said passageways in accordance with the ingress or egress of air by the patient. Due to the action of a biasing member connected thereto the valve element operates to permit ingress of air to the patient through the tracheal instrument while preventing egress of air therethrough. In this manner the patient output air passes through his vocal cord area to enable him to speak at will. The instrument further comprises conduit means open to the interior of the tracheotomy tube which permits direct access by instruments to the tube.

3 Claims, 3 Drawing Figures



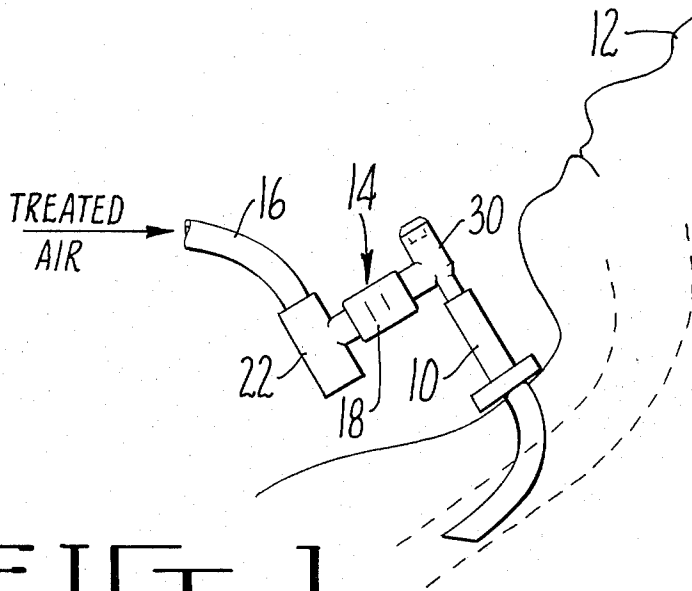


FIG. 1.

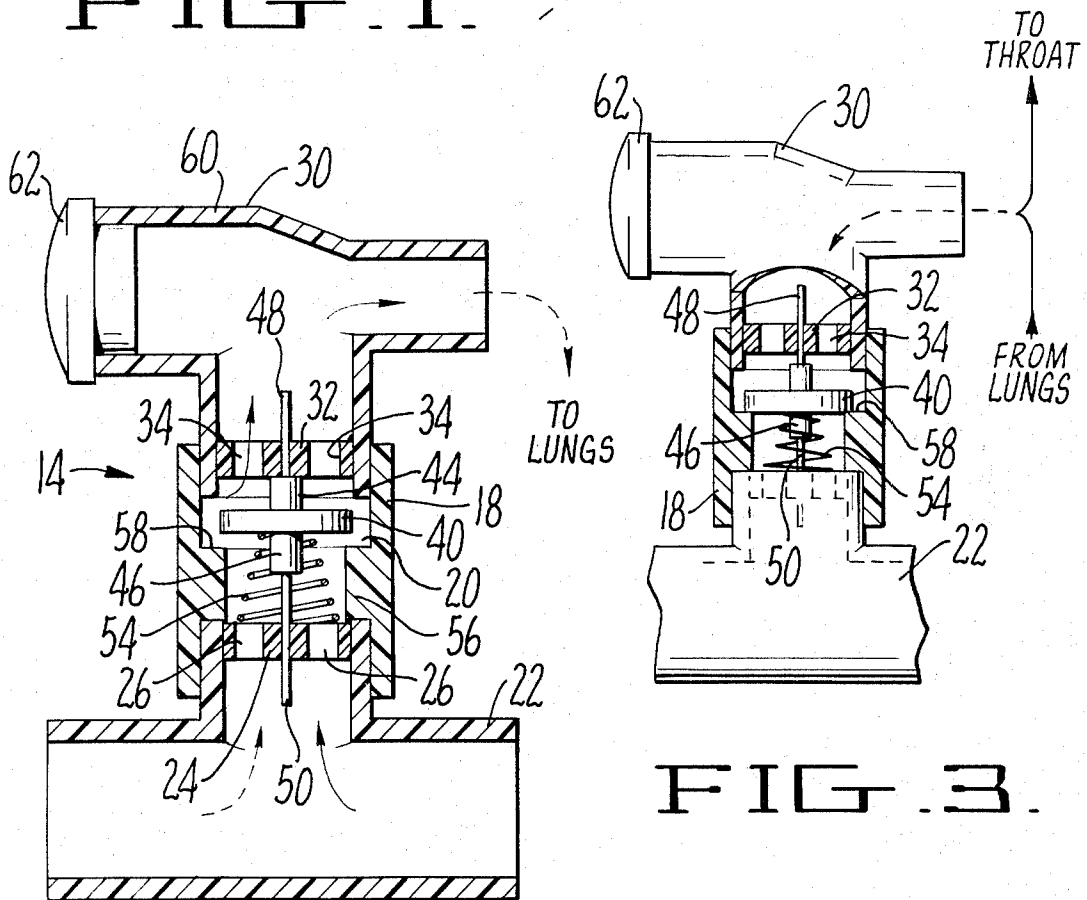


FIG. 3.

FIG. 2.

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TRACHEAL INSTRUMENT

BACKGROUND OF THE INVENTION

The present invention relates to equipment for use with a tracheotomy tube, and more particular, to a tracheal instrument to facilitate respiration and/or speech by a patient upon whom a tracheotomy has been performed.

For certain medical conditions wherein a patient has encountered breathing difficulties, it is often necessary to perform a tracheotomy wherein an incision is made in the patient's throat to establish communication with the interior of the trachea. A conduit called a tracheotomy tube is then commonly inserted into the incision to facilitate breathing by the patient.

Most tracheotomy tubes are of simple construction and merely provide a conduit for both the ingress and egress of air by the patient while breathing. It will be appreciated that if exhaled air freely passes out through the tracheotomy tube the patient will be unable to speak.

In an effort to provide the patient with this latter facility several devices have been devised in the past for use with tracheotomy tubes which permit ingress of air to the patient therethrough but direct exhaled air through the patient's larynx. Such devices have not found widespread acceptance in the medical profession since they are characterized by a relatively high degree of complexity and/or unreliability. It is absolutely necessary that devices of this type operate in a fool-proof manner since in the event of mechanical breakdown the patient may be deprived of life-sustaining air. In addition, such a device while functioning should not require any undue expenditure of energy by the patient when operating same.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a tracheal instrument for facilitating breathing and/or speech a patient which is relatively simple and inexpensive in construction and yet affords a high degree of reliability in the operation thereof.

It is a further object of the present invention to provide a tracheal instrument of the foregoing type which is readily operated in response to the normal breathing of the patient and without additional expenditure of energy on his part.

It is yet another object of the present invention to provide a tracheal instrument of the foregoing type which readily adapts itself to use in conjunction with a conventional tracheotomy tube and while compact in configuration affords a high degree of use flexibility.

These and other objects have been attained in accordance with the teachings of the present invention by providing a tracheal instrument adapted for connection to a tracheotomy tube for controlling the ingress and egress of air by the patient with which the tracheotomy tube is associated. The tracheal instrument comprises an open ended housing having an interior. First means defining an inlet passageway is connected at one end of the housing to provide communication between the housing interior and a source of air. Second means defining an outlet passageway is connected to the other end of the housing to provide communication between the housing interior and a tracheotomy tube. Within the interior of the housing is disposed a moveable valve

element. The valve element is selectively engageable with a valve seat formed within the interior of the housing so that air may readily pass through the instrument to the patient upon inhalation and exhaled air will be prevented from passing through the instrument. A biasing means in the form of a spring is disposed within the housing and continuously urges the moveable valve element away from the valve seat. Cooperating guide means is provided between said first and second means and said valve element so that said valve element will move along a predetermined path. Movement of the valve element into engagement with the valve seat is effected against the continuous urging of the spring by the patient's exhaled breath. Upon inhalation by the patient the spring urges the valve element away from the valve seat so that air may readily flow therebetween.

DESCRIPTION OF THE DRAWINGS

The above-noted and other objects of this invention will be understood from the following description taken with reference to the drawings wherein:

FIG. 1 is a side view illustrating apparatus constructed in accordance with the teachings of the present invention in use with a patient;

FIG. 2 is an enlarged cross-sectional side view of the apparatus of the present invention with the elements thereof in the respective positions assumed thereby when the patient with which the instrument is associated is inhaling; and

FIG. 3 is a side view of the instrument constructed in accordance with the teachings of the present invention with portions thereof broken away so that details of the elements may be seen in the respective positions assumed thereby upon exhalation by the patient.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawings a tracheotomy tube 10 of more-or-less conventional design is illustrated as being inserted into the trachea of a patient 12. Affixed to the outer end of tracheotomy tube 10 is a tracheal instrument, generally indicated by means of reference numeral 14, constructed in accordance with the teachings of the present invention. At the outermost end thereof tracheal instrument 14 is connected to a supply hose 16 which is connected at the other end thereof to any suitable source for breathing by the patient.

The detailed construction of tracheal instrument 14 may more readily be seen with reference to FIGS. 2 and 3. The tracheal instrument includes a housing 18 defining an interior 20. Housing 18 is in the general form of an open-ended cylinder having a central longitudinal axis. Received within one end of housing 18 and secured thereto by any desired expedient is an inlet conduit 22 of generally tee-shaped configuration. Fixedly positioned within the central branch of the inlet conduit 22 as shown is a plate 24 having a plurality of apertures 26 formed therein. Together the inlet conduit 22 and plate 24 define an inlet passageway between housing interior 20 and a suitable source of air (not shown). One of the divergent branches of the inlet conduit may, if desired, be left open to the atmosphere while the other divergent branch is connected as by means of hose 16 (FIG. 1) to a nebulizer or the like.

Positioned within the open end of the housing 18 oppositely disposed from inlet conduit 22 and secured therein by any desired expedient is an outlet conduit 30 also of generally tee-shaped configuration. Secured within the central branch of the outlet conduit 30 in the manner illustrated is a second plate 32 having apertures 34 therein. Together outlet conduit 30 and second plate 32 define an outlet passageway between housing interior 20 and the tracheotomy tube (FIG. 1).

Positioned within the interior 20 of housing 18 is a valve element comprising a substantially flat circular plate 40 and a pair of columns 44 and 46 centrally disposed on said plate and extending from opposite sides thereof. Secured to columns 44 and 46 and extending outwardly therefrom in the manner illustrated are guide shafts 48 and 50, respectively. Guide shafts 48 and 50 are mounted for free sliding reciprocal movement within central guide apertures formed in apertured plates 32 and 24, respectively. It may thus be seen that the guide shafts and aperture plates cooperate to maintain the valve element centrally disposed within housing 18 and restrict movement thereof along the longitudinal axis of the housing.

A coil compression spring 54 is positioned upon apertured plate 24. The coil spring is centrally disposed along the housing longitudinal axis and surrounds column 46 and guide shaft 50. At the upper extent thereof as viewed in FIGS. 2 and 3 coil spring 54 is in engagement with the bottom surface of valve element plate 40. In this manner, as viewed in these latter two figures, the coil spring continuously urges the valve element in an upward direction, i.e., away from aperture plate 24 and toward aperture plate 32.

FIG. 2 illustrates the respective positions assumed by the various elements of tracheal instrument 14 when the patient is inhaling. Ingress of air into the tracheotomy tube 10 (FIG. 1) is had through inlet conduit 22, apertures 26, housing interior 20, apertures 34, and thence outwardly through outlet conduit 30 to be tracheotomy tube. As previously stated, the air supply source may comprise both the ambient atmosphere entering through one divergent leg of inlet conduit 22 and treated air such as that exiting from a nebulizer or the like entering the other divergent leg of the inlet conduit. Projecting into the interior of the housing 18 in the manner illustrated in an annular shoulder 56. The shoulder projects into the interior sufficiently so that it projects under valve element plate 40. It may thus be seen that the upper surface 58 of the shoulder comprises a valve seat which is adapted to be contacted by plate 40 upon downward movement thereof. The above described passage of air through the tracheal instrument 14 when the patient is inhaling is permitted by virtue of the fact that coil spring 54 urges valve element plate 40 out of engagement with the shoulder valve seat 58.

Upon exhalation of air by the patient only a small portion thereof enters into the tracheal instrument due to the fact that the air pressure forces the valve element downwardly against the urging of spring 54 so that plate 40 of the valve element contacts the valve seat 58 as shown in FIG. 3. Since this prevents any additional passage of air through the tracheal instrument all additional exhaled air is directed to the throat of the

patient so that he may speak in a substantially normal fashion. Upon renewed inhalation by the patient the valve element will again be displaced to the position illustrated in FIG. 2 so that ingress of air may be had through the tracheal instrument.

From the foregoing description it may readily be seen that spring 54 must have a strength sufficient to displace the valve element upwardly in the absence of any external pressure thereon while at the same time be readily compressed under the application of positive air pressure downwardly upon the flat plate 40. Apertured plate 32, in addition to providing strength to the overall arrangement and serving as a guide for the movement of the valve element has the apertures 34 thereof positioned so that air entering therethrough will impinge directly upon the upper surface of plate 40. In this manner, maximum utilization is had of the exhaled air of the patient insofar as displacement of the valve element is concerned, thereby avoiding any undue effort on the part of the patient. In like manner the various elements of the tracheal instrument should be constructed of materials which are of lightweight construction and yet facilitate the operation and maintenance of the device. A material which has been found particularly suitable for construction of housing 18, conduits 22 and 30, and aperture plates 24 and 32 is latex plastic. This material readily adapts itself to cold sterilization and is relatively lightweight. For the construction of coil spring 54 and guide shafts 48 and 50 stainless steel has been found to be particularly advantageous. For construction of the valve element tetrafluoroethylene has been found to be very suitable. All of the above materials, in addition to being lightweight and relatively strong may be easily cleaned and resist corrosion. This latter facility is especially important since the device must work for extended periods of time in heated, high humidity conditions.

It should be noted that the branch of outlet conduit 30 which is not connected to housing 18 or adapted for connection to the tracheotomy tube is of an enlarged configuration. This branch, which is indicated by means of reference numeral 60, is open-ended so that it may accommodate therein a plug 62 which may be constructed of latex plastic, rubber or the like. During normal usage of the tracheal instrument plug 62 remains disposed over branch 60 in the manner illustrated so that air may not readily pass therethrough. The plug, however, may readily be removed when necessary to provide access to the patient's trachea such as when it is desired to remove by means of a suction device or the like undesirable materials which may impede breathing by the patient.

With reference to the foregoing description, it will be apparent to those skilled in the art, that various changes and modifications may be made to the illustrated embodiment without departure from the spirit of the invention or from the scope of the appended claims.

I claim as my invention:

1. A tracheal instrument comprising an abbreviated conduit body having first and second end portions, first and second conduit legs having portions substantially in alignment and communicating with each other and with said first end portion of the conduit body, a tracheotomy tube connected to said first leg, removal

5

ble plug means connected to said second leg, a one-way inlet valve disposed within said body, an air source communicating with said second end portion of said body, and biasing means within said body in connected relation to said valve operable to position said valve in an open position to enable the flow of air through said body in the direction of said first end portion and operable to yield to permit the closing of said valve when the gas pressure condition in said first end portion is increased to a predetermined valve.

2. The instrument of claim 1, including treated air conduit means also communicating with said second end portion of said body.

3. A tracheal instrument adapted for connection to a tracheotomy tube and for controlling the ingress and egress of air by the patient with which said tracheotomy tube is associated, said tracheal instrument comprising a source of air, a tubular housing having an interior, first means defining an inlet passageway between said housing interior and said source of air, second means defining an outlet passageway between said housing interior and said tracheotomy tube, a disc valve element mounted within said housing interior for axial move-

6

ment toward and away from a valve seat therein, said element being movable from a first position, wherein both of said passageways are open so that communication is had through said housing between said tracheotomy tube and said source of air, to a second position wherein at least one of said passageways is closed by engagement of said element with said seat, and biasing means in engagement with said valve element, said valve element being movable to said first position under the urging of said biasing means in response to ingress of air to said patient and being movable to said second position in response to egress of air from said patient, said second means comprising a conduit having a central branch and having first and second diverging branches communicating with said central branch, said first and second diverging branches having portions substantially in alignment, said central branch being secured to said housing in communication with said housing interior, said first branch being adapted for connection to said tracheotomy tube, and plug means releasably secured in said second branch.

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