

[54] **INTERMITTENT POSITIVE PRESSURE BREATHING APPARATUS**

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[58] Field of Search 128/145.8, 142.2, 128/145.5, 146.4, 146.5, 194, 204, 145, 196, 145.6, 145.7, 197, 209, 210

[56] **References Cited**

UNITED STATES PATENTS

3,584,621	6/1971	Bird	128/145.8
3,486,502	12/1969	Wilson	128/146.5
2,897,833	8/1959	Seeler	128/145.8

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[57] **ABSTRACT**

An intermittent positive pressure breathing apparatus is provided to deliver gas to a patient under pressure intermittently upon demand and has a slidable tube with a nozzle on one end for directing an input gas through the tube into a venturi connected to a mouth-piece and exhalation valve. Flaps on the tube force the tube to move in accordance with the breathing of a patient and slide an opening in the tube into an alignment with a connection to a gas under pressure. An additional outlet from the tube also may be used to drive a nebulizer and the movements of the flaps connected to the tube is utilized to open and close an inlet for a second gas to be aspirated into the venturi.

8 Claims, 4 Drawing Figures

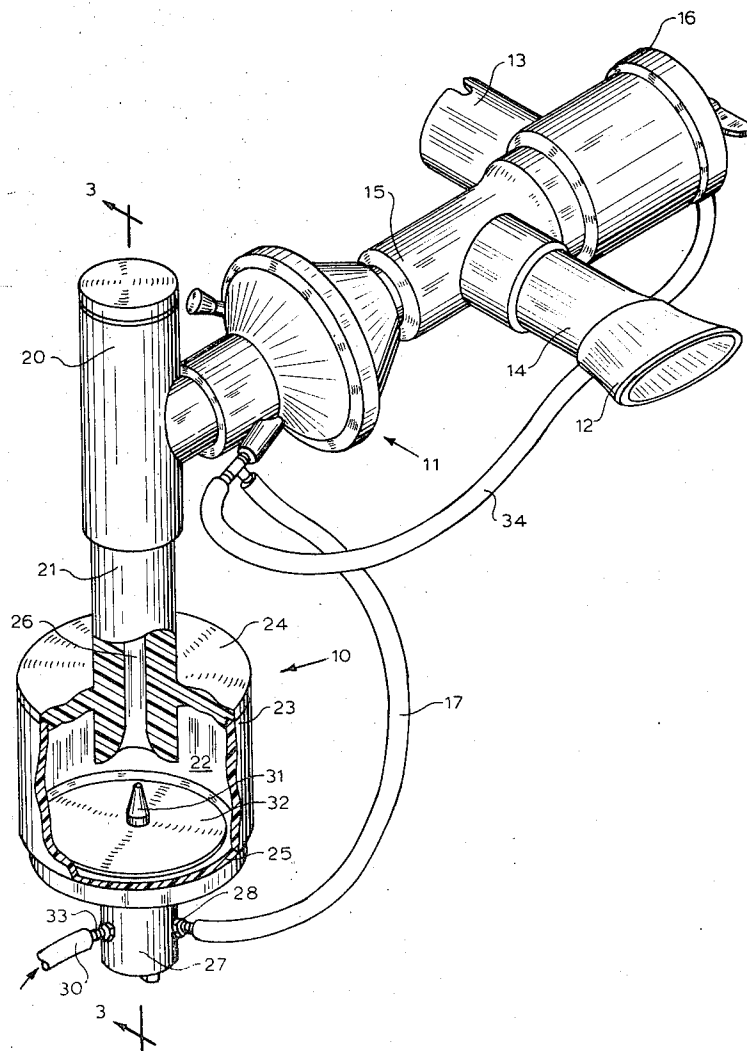


Fig. 1.

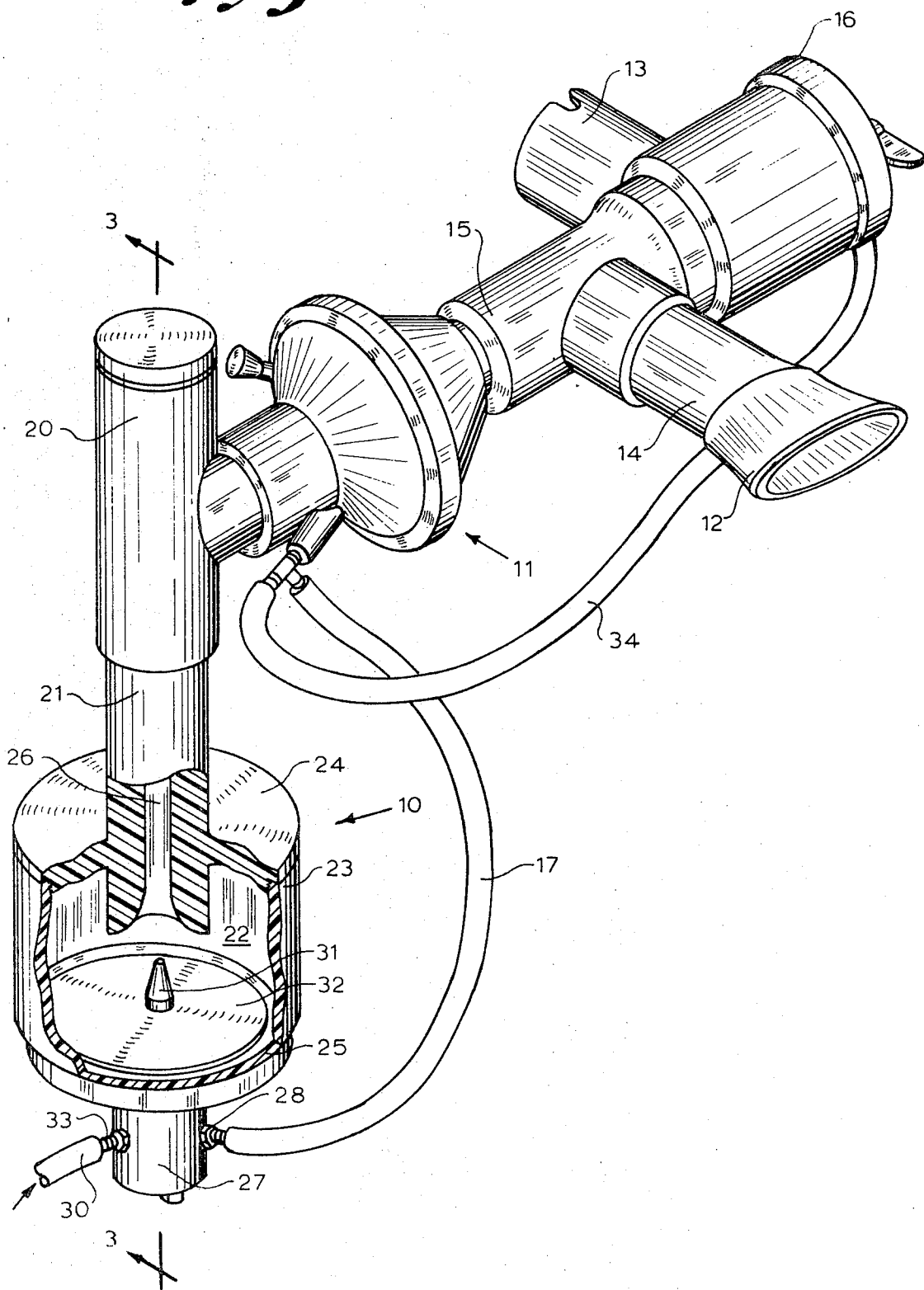


Fig. 2.

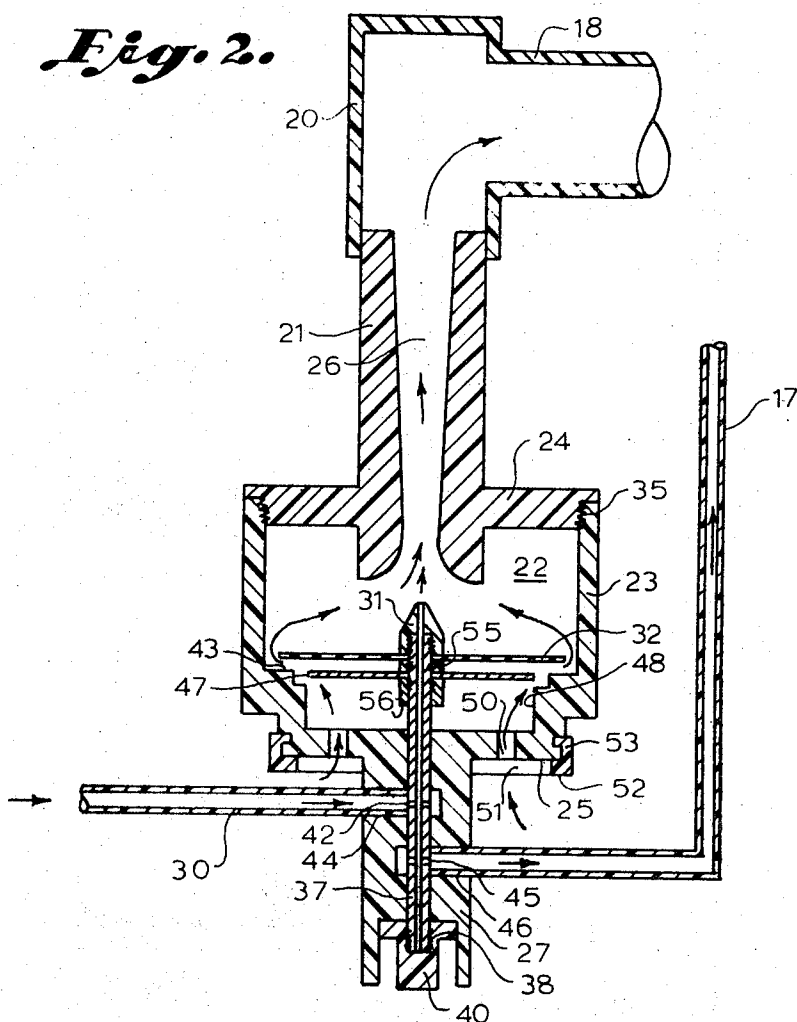


Fig. 3.

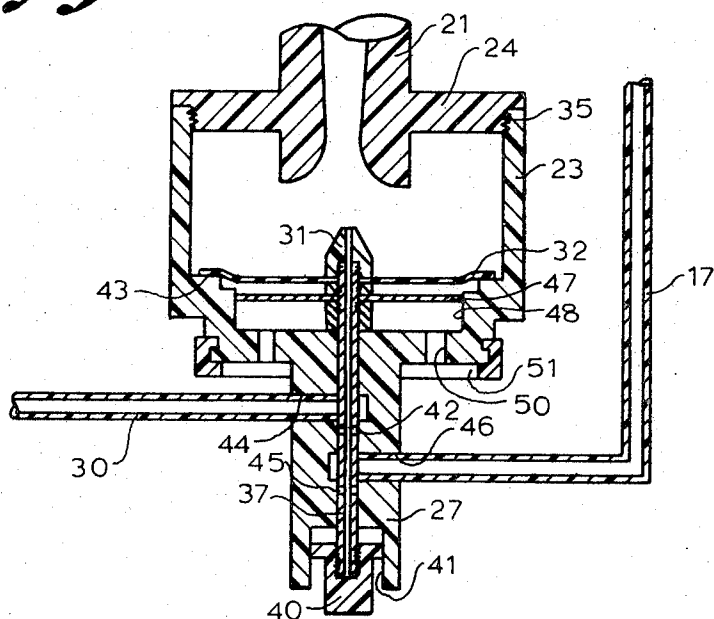
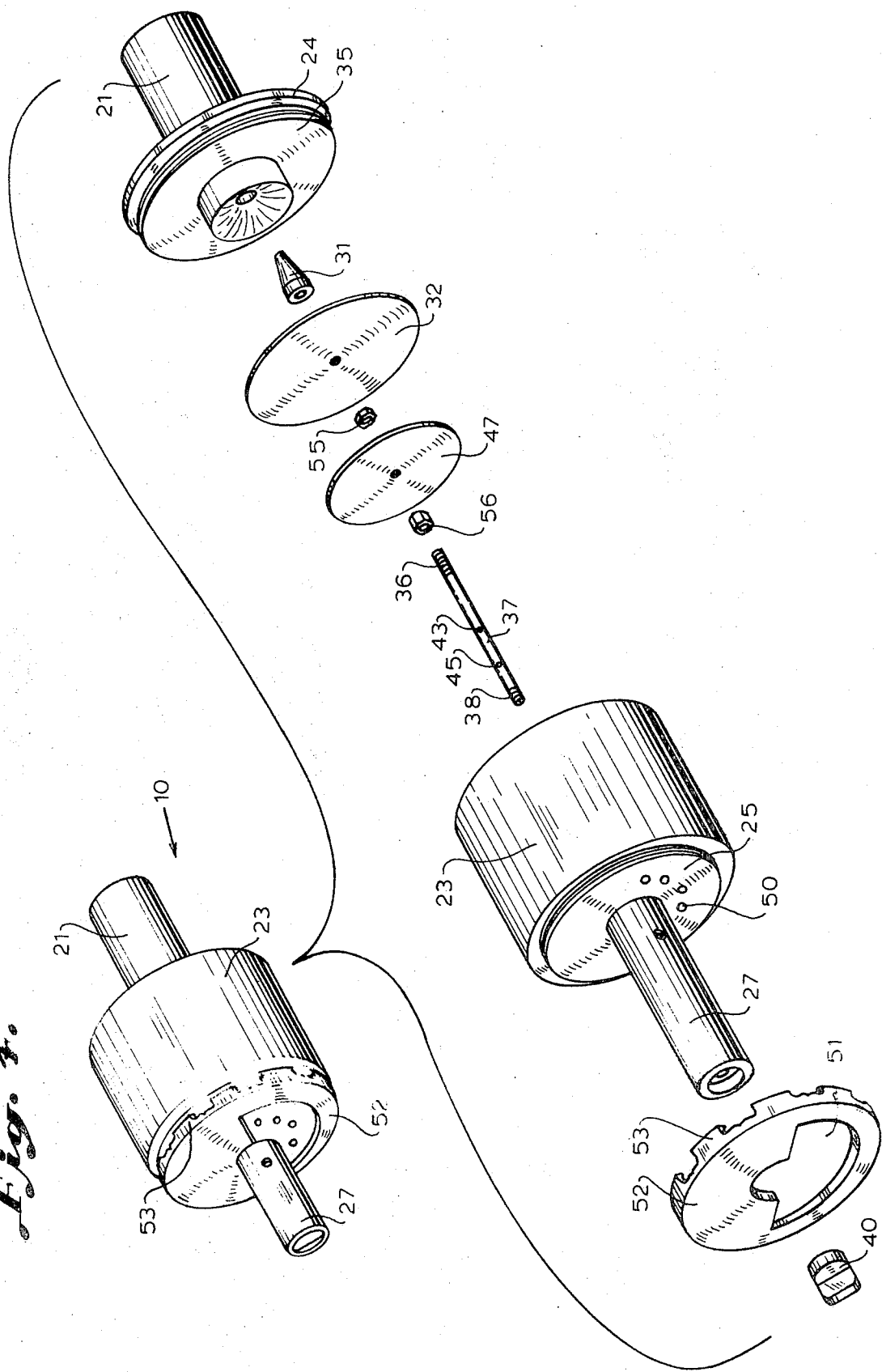


Fig. 1.



INTERMITTENT POSITIVE PRESSURE BREATHING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a breathing apparatus for use in hospitals and patient homes in which a gas is delivered to a patient under pressure intermittently and to a means for applying positive pressure to the patient's lungs while adding a supplemental gas to the gas under pressure for enrichment or dilution purposes and for the obtainment of a desired flow pattern.

In the past there have been numerous proposals for intermittent positive pressure breathing devices and these frequently include means for adding another gas to the positive pressure gas being fed to the patient. These devices usually operate intermittently responsive to the breathing of the patient, whereby breathing in will activate the device to supply positive pressure to the patient while breathing out will stop the positive pressure and exhaust the exhaled air. Typical of the prior art devices include means for enriching the air by operating a nebulizer with oxygen and also by enriching the air by aspirating oxygen from the demand valve through the venturi. One of the problems experienced by prior art devices has been that the complexity has made the intermittent positive pressure valves somewhat difficult to clean and sterilize resulting in expending a great deal of time by the technicians operating the devices which must be cleaned and sterilized between use by different patients. It is accordingly one advantage of the present invention to produce an intermittent positive pressure breathing apparatus which is simple in operation and yet can be easily cleaned and sterilized.

In the past intermittent positive pressure breathing apparatus have included any number of ways for controlling the positive pressure of a gas such as air or oxygen and include, for instance, fluidic actuated devices which include a fluidic bistable or monostable element for switching the positive pressure on and off. Another device, in U. S. Pat. No. 3,319,627 illustrates an intermittent positive pressure breathing apparatus supplying a positive pressure fed directly into a venturi so as to aspirate a second gas into the system.

This positive pressure flow cut-off respiration system may be seen in U.S. Pat. No. 3,486,502 and combines poppet and shuttle valve which vertically move between two positions controlling the gas flow from a supply to a patient's face mask. The valve is closed through a combination of gravity forces and the magnetic forces.

In addition to these patents, there are numerous other devices controlling the positive pressure flow of gases to a face mask or to a patient, including devices having nebulizers connected between the intermittent positive pressure valve and the face mask.

The present invention is directed towards an intermittent positive pressure valve which is simple and reliable in operation and which may be easily cleaned and sterilized. In addition to providing the intermittent positive pressure it provides means for operating the nebulizer from the positive pressure gas along with means for aspirating additional gas into the positive pressure gas.

SUMMARY OF THE INVENTION

The present invention related to an intermittent positive pressure breathing apparatus having a chamber

with a venturi connected to the chamber to form a passageway into the chamber. The venturi is connected to a mouthpiece and exhalation valve or connected through a nebulizer to a mouthpiece, if desired. The chamber has a slidable inlet tube slidably connected to the chamber with an opening facing the venturi passageway. The slidable tube has an opening which can be slid into and out of alignment with a positive pressure gas inlet for turning the positive pressure gas on and off with the sliding of the tube. The tube is slid back and forth responsive to the breathing of the patient, which draws a flap, or the like, connected to the tube within the chamber. The tube may have a nozzle directing the flow of positive pressure gas into the venturi and the flap controlling the operation of the tube may include means for allowing the input of various amounts of a second gas which is aspirated into the venturi. Finally, the slidable tube may include a second opening for allowing the positive pressure gas to be fed through a separate outlet line to operate a nebulizer. The nebulizer is connected between the mouthpiece and the venturi passageway.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of this invention will be apparent from a study of the written description and the drawings in which

FIG. 1 is a perspective view with portions cut away of one embodiment of the present invention connected to a nebulizer;

FIG. 2 is a sectional view taken along lines 2—2 of FIG. 1;

FIG. 3 is a sectional view of the embodiment illustrated in FIG. 2, showing the valve in a closed position; and

FIG. 4 is an exploded view of the embodiment illustrated in FIGS. 1-3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, an intermittent positive pressure breathing (IPPB) valve 10 is illustrated connected to a nebulizer 11 which is connected to a mouthpiece or outlet 12 so that a patient may breathe into and out of the breathing portion 12. An exhaust valve 13 allows air exhaled from the patient into the mouthpiece 12 to be exhausted at 13 through tubes 14 and 15. Exhaust valve 13 is a one-way or check valve operated so that air may be exhausted but inhalation by the patient in the mouthpiece 12 will not allow air to enter through the valve 13. Valve 13 is also closed while the IPPB valve is applying a positive pressure to the mouthpiece 12. An end portion 16 blocks the entry of an exhaust of air through the end of the tube 15. Tube 15 has the nebulizer 11 connected to it. The nebulizer 11 is connected to the intermittent positive pressure valve 10 by a tube 17 which operates the nebulizer which may be of any type desired, such as the one disclosed in U. S. Pat. No. 3,172,406. The present apparatus can work with or without a nebulizer and in view of the nebulizer being used being of commercially available designs, it is not described in detail.

It should be pointed out, however, that the mouthpiece portion 12 can be a tracheotomy assembly, an endotracheal tube, a breathing circle system or a face mask, each for making connection to the airway of a patient to be treated. The nebulizer 11 is connected to

the positive pressure valve through a tube 18 and in the absence of the nebulizer 11, tube 18 would connected directly to the tube 15. Tube 18 has a tube 20 connected thereto for connecting to the end of a venturi passageway tube 21 which is connected into a chamber 22 having a cylindrical wall 23 with end portions 24 and 25. The interior of the pipe 21 is a venturi passageway 26 opening into the chamber 22 through the top portion 24 of the chamber 22. The bottom portion 25 has a tube 27 connected thereto which has the tube 17 connected at an inlet 28 for connection to the nebulizer 11. A tube 30 is also connected at an inlet 33 to the cylindrical portion 27. Tube 30 is connected to a gas such as oxygen under positive pressure for supplying the positive pressure to the valve 10, as will be described in more detail. Inside of chamber 22, a nozzle 31 extends from a tube extending into the cylinder 27 and has a flexible flap or movable diaphragm 32 attached to the tube next to the nozzle 31. The apparatus is operated generally by a patient breathing into the breathing circle 12 and when the patient inhales, air is sucked through the tubes 14 and 15 through the nebulizer 11 through tubes 18 and 20 and through the venturi passageway 26 which actuates the intermittent positive pressure valve 10 to allow the gas under positive pressure in pipe 30 to immediately apply positive pressure to the patient by directing gas through the nozzle 31 into the venturi. This will allow an additional gas to be aspirated through the chamber 22 into the venturi and to the patient. Exhaling into the circle 12 will put a back pressure through the same system to close the valve 10, shutting off the positive pressure gas from line 30 along with the alternate gas being fed through chamber 22, as will be described in more detail in connection with the FIGS. 2-4. This will then force the check valve 13 to open and allow air to exhaust from the system. A tube 34 connects the nebulizer 11 to the end portion of the exhaust valve 16.

Turning now to FIGS. 2 and 3, details of the operation of the intermittent positive pressure valve 10 are illustrated, with FIG. 2 showing the valve in an open position, with the positive pressure gas being delivered through the output to the tube 18, and FIG. 3 illustrating the valve in a closed position blocking the flow of the positive pressure gas. Inhalation by the patient will draw air from the pipe 18 through the cylindrical tube 20 through the cylindrical venturi tube 21 having the venturi passageway 26 therein and being connected to the top portion 24 of the cylindrical body 23 forming the chamber 22 and having a bottom portion 25. The top portion 24 is threaded at 35 to the cylindrical walls 23 to form the chamber 22. A nozzle 31 is threaded at 36 to a slidable tube 37 which slides in the cylindrical tube 27. Slidable tube 37 has a threaded end 38 which threads it to a positive stop 40 riding in a hollowed cylindrical portion 41 so that the tube 37 can ride in one direction until the stop 40 engages a surface 27 at the bottom of the hollowed cylindrical portion 41 and can ride in the reverse direction until the flexible flaps 32 engage annular ledge 43 and the reverse stop 56 engages the top of cylindrical tube 27. Air being inhaled or exhaled by the patient through the line 18 and through the venturi passage 26 operates to suck the inflexible valve member 47 in an open direction, as shown in FIG. 2, bringing the tube 37 having an opening 42 into alignment with an opening 44 connected to the tube 30 having the positive pressure gas source

passing therethrough so as to allow the positive pressure gas to pass through the tube 37 and out the nozzle 31 aimed directly into the venturi passageway 26. At this point, a second opening 45 in the tube 37 aligns itself with an opening 46 in the cylinder 27 which is connected to the tube 17 and some of the positive pressure entering through pipe 30 is forced through the opening 45 and through the tube 17 to operate the nebulizer. At the same time the inflexible valve member 47 is connected to the nozzle 31 and to the tube 37 to slide with the tube 37 and into a cylindrical portion 48 of the chamber 22 which in its open position of FIG. 2 allows the air to enter into passageways 50 through an opening area 51 in a rotatable control 52 which rotatably attaches at 53 to the cylindrical walls 23 bottom portion 25, thus air from the atmosphere or from another gas source is allowed to feed, as illustrated by the arrows around the valve member 47 and flap 32, and is aspirated into the venturi 26 by the flow of the positive pressure gas from the nozzle 31 into the venturi 26. Rotation of the control 52 varies the number of openings 50 opened to the atmosphere and thereby to control the flow of gas being aspirated into the chamber 22 into the venturi passage 26. Exhaling by the patient produces a back pressure in the venturi passageway 26 which breaks up the flow of the system and drives the flap 12 to slide the tube 37 into a second or closed position, as shown in FIG. 3. This brings the openings 43 and 45 out of alignment with their respective tubes 30 and 17 thereby shutting off the flow of gases from 30 through the tube 37 and shutting off the operation of the venturi and nebulizer. Simultaneous with this operation, inflexible valve member 47 slides into the cylindrical portion 53 of the chamber 22 and the flap valve member 33 engages the ledge 43 of the chamber 22 to close off the flow of air or other gas through the openings 50 and 51 from being aspirated into the venturi 26. Tube 37 is blocked from sliding further by the flap 32 but could of course be stopped by the end portion of the nozzle 31 or by the valve member 47 without departing from the spirit and scope of the present invention. The valve flap 32 only operates to assure downward movement of the tube 37 in response to back pressure from the patient through the venturi while the initiation of the respiratory cycle is completely dependent upon the inflexible valve member 47 which moves the tube upward in response to the patient's respiratory effort. Both valves, however, assure a complete respiratory cycle.

Referring now to FIG. 4, an exploded view of the valve 10 can be seen having the cylindrical walls 23 having the bottom portion 25 with the openings 50 therein, and the cylindrical tube 27 having the hollowed out end portion 41 thereof, along with the opening 44 in one side thereof. The rotatable control portion 52 can be seen to have the snaps 43 for attaching it to an annular groove in the bottom portion 25 of the chamber 22 and having an open portion 51 which can be rotated to open or block off any number of the openings 50 to increase or decrease the flow of air or gas into the apparatus. The stop member 40 which attaches to one end of the tube 37 is also illustrated, and the tube 37 has openings 43 and 45 therein along with threaded ends 36 and 38 for attaching the nozzle 31, flap 32, locknut 55, valve member 47, second locknut 56 to the threaded portion 36. The threaded portion 38 is connected to the stop member 40 which can be ad-

justed to allow any desired amount of sliding movement to the feed tube 37. The chamber top portion 24 has the venturi tube 21 attached thereto along with the threaded portion 35 for attaching to the chamber walls 23 and the overall assembly 10 is illustrated in a perspective view. The exploded view in FIG. 4, along with the assembled view more clearly illustrates the operation of the air control 52 for operating in conjunction with the openings 50 in the bottom portion 25 of the chamber, but also clearly illustrates the simplicity of the operation of the valve both in terms of manufacturing the valve and for purposes of cleaning and sterilizing the valve which may be easily disassembled, cleaned, sterilized and reassembled with a minimum of effort by the hospital technician, and which also provides for the easy replacement of broken or worn parts.

This invention, however, is not to be construed as limited to the particular forms described herein which are to be considered illustrative rather than restrictive.

I claim:

1. An intermittent positive pressure breathing apparatus comprising in combination:

a. chamber means;

b. venturi means connected to said chamber means and forming a passageway into said chamber means;

c. slidable inlet tube slidably connected to said chamber means and having an opening therein adapted to be aligned with a first gas inlet in one position to allow gas to flow into said tube and into said venturi means and to be moved out of alignment with said first gas inlet to block said opening from said inlet into said tube when in a second position; and c' said chamber means including an air opening; and

d. means attached to said tube to slide said tube responsive to a patient's breathing opening said air opening into said chamber means when said tube is in said one position, and closing said air opening into said chamber means when said tube is in a second position, whereby said intermittent positive

pressure breathing apparatus will allow gas to be intermittently directed under pressure to a patient responsive to the sliding of said tube.

2. The apparatus in accordance with claim 1 in which said air opening to said chamber includes adjustment means for varying the flow of air to said chamber where said gas is being aspirated into said venturi being operated by said inlet tube gas under pressure.

3. The apparatus in accordance with claim 2 in which said means attached to said tube to slide said tube includes a flexible disc member.

4. The apparatus in accordance with claim 3 in which said air opening into said chamber opens through a flow control means to the surrounding atmosphere, said flow control means having a plurality of openings with a rotating member attached to shut off any desired number of said openings.

5. The apparatus in accordance with claim 4 in which said slidable tube has stop means for limiting the distance said tube can slide in either direction.

6. The apparatus in accordance with claim 1 having a nebulizer means attached thereto for nebulizing a fluid for inhalation by a patient and said slidable inlet tube having a second opening therein which aligns itself with an outlet tube connected to said nebulizer when said slidable inlet tube is in said one position and moves out of alignment with said outlet tube when said slidable inlet tube is in a second position, so that positive pressure gas entering said first opening in said slidable inlet tube will be directed out said second opening in said slidable inlet tube to drive said nebulizer means.

7. The apparatus in accordance with claim 6 in which said inlet tube has a nozzle for directing the flow of positive pressure gas into said venturi means, when said tube is in said one position.

8. The apparatus in accordance with claim 7 in which said apparatus includes an exhalation valve to exhaust air being exhaled by a patient, but which blocks the inhalation of air to said valve.

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