United States Patent

[11] 3,630,196

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[54] **MANUAL POSITIVE PRESSURE BREATHING DEVICE**
8 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **128/145.8,** 128/145.7, 128/194
[51] **Int. Cl.** **A62b 7/02**
[50] **Field of Search** 128/145.5–145.8, 173, 185, 186, 194, 145, 201, 146.5, 195–197, 142.3, 142.2

[56] **References Cited**

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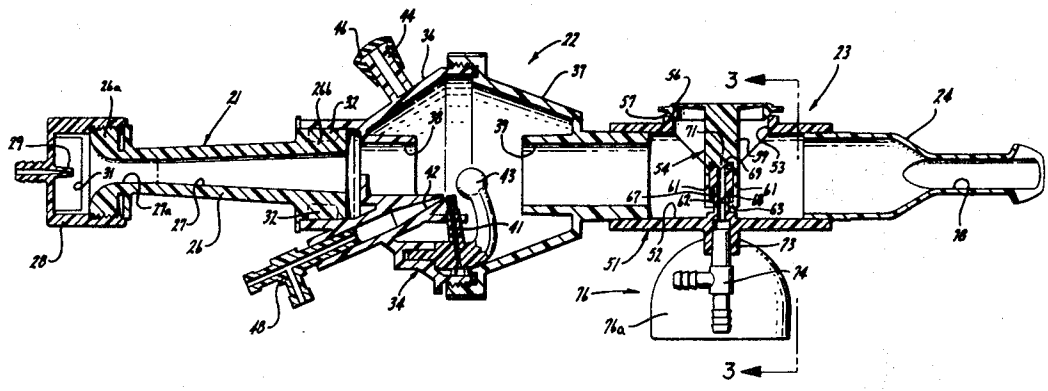
ABSTRACT: A manual positive pressure breathing device in which the mainstream gas flow is in axial alignment to provide a laminar flow and utilizing a nebulizer and a manually operated exhalation valve which is located adjacent to the patient's airway.



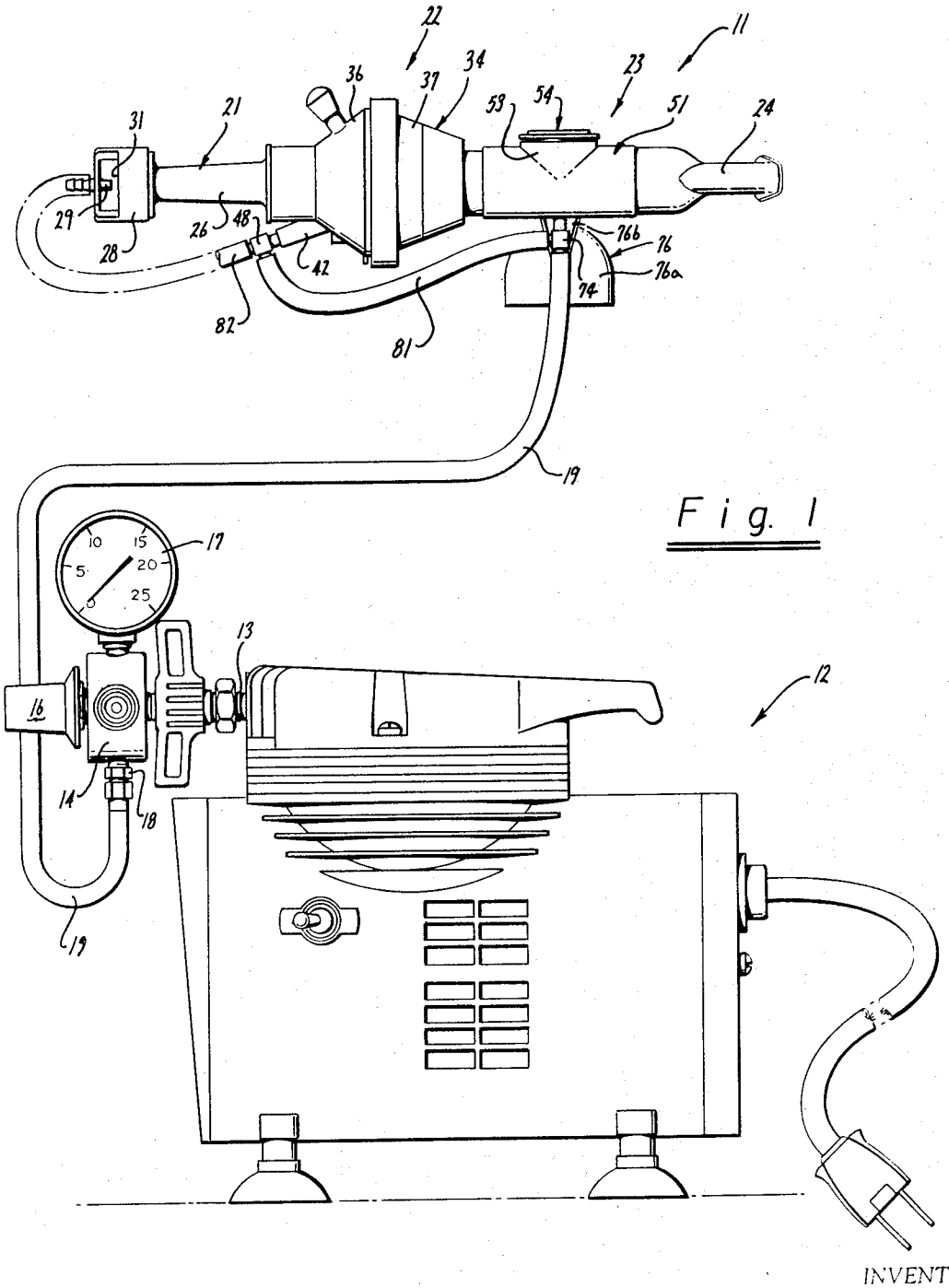


Fig. 1

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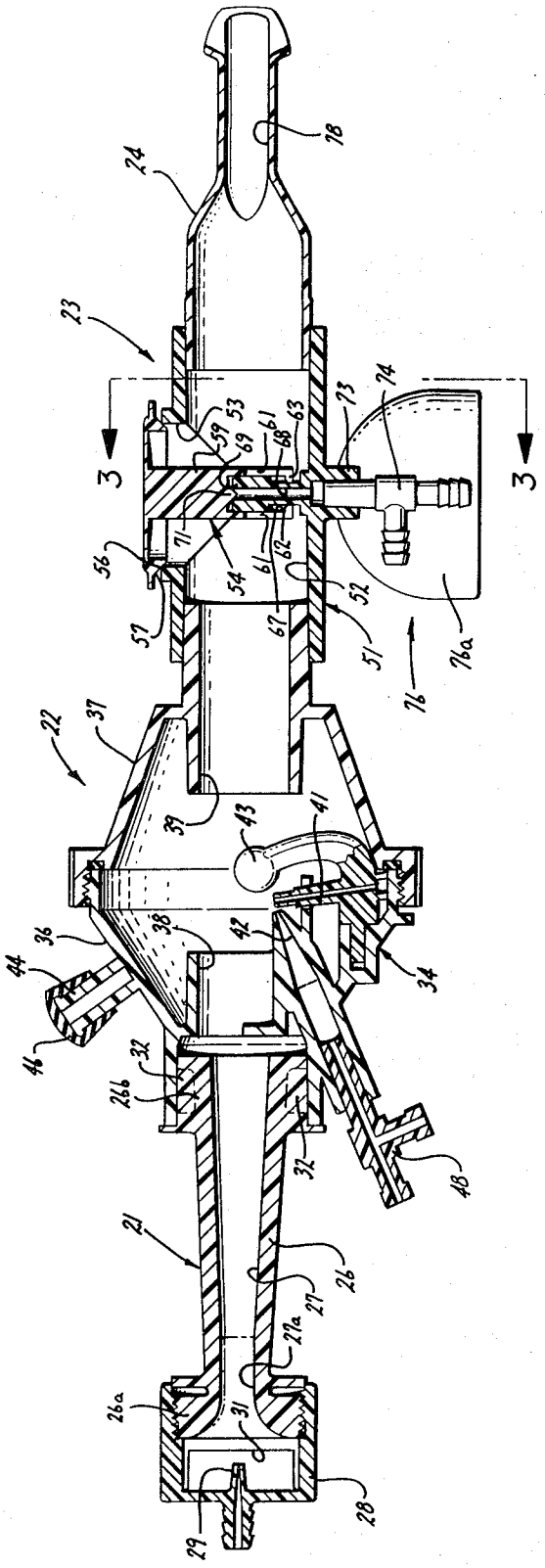

Fig. 2

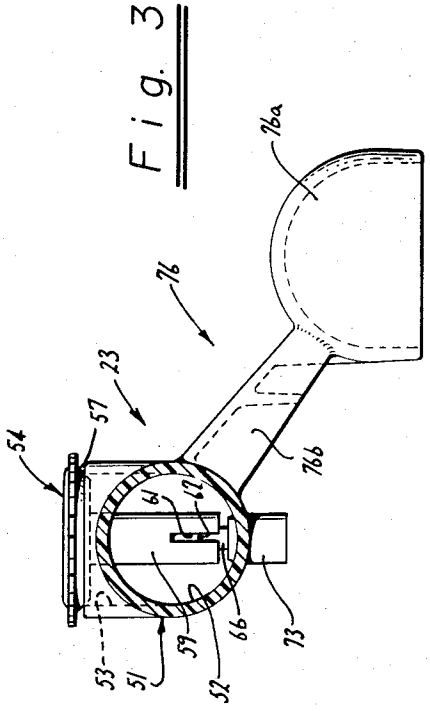

Fig. 3

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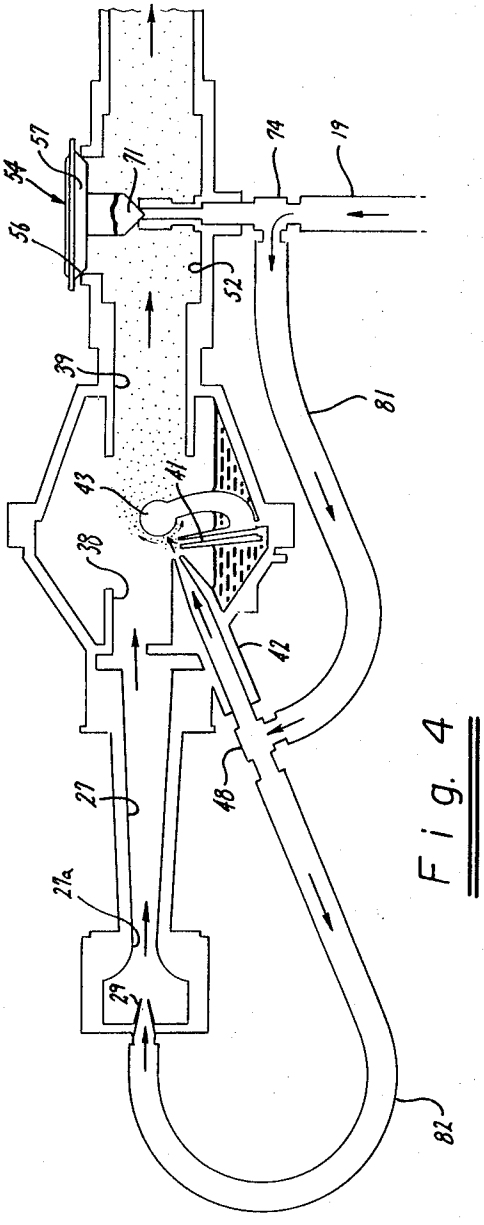

Fig. 4

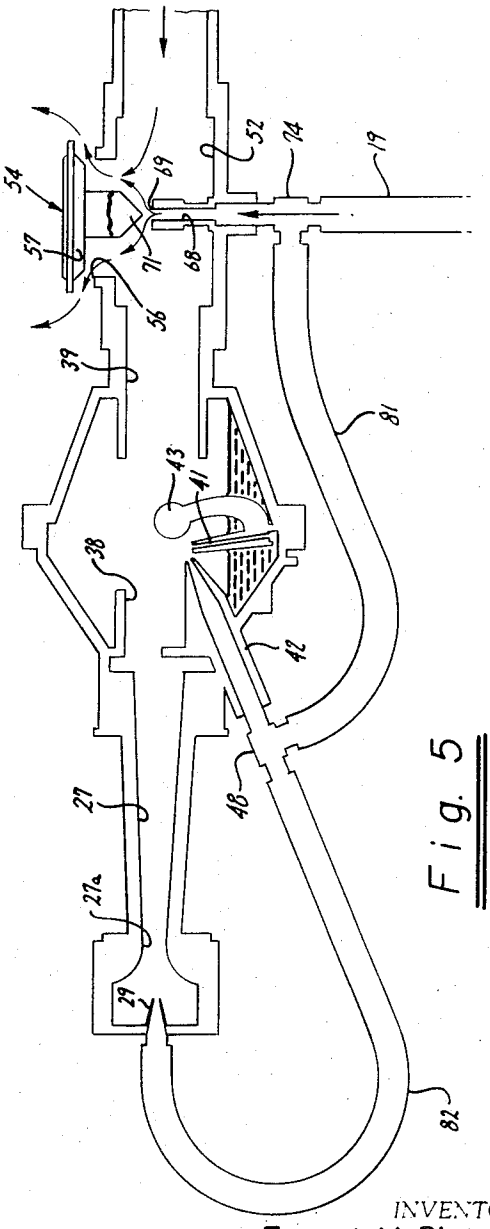

Fig. 5

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MANUAL POSITIVE PRESSURE BREATHING DEVICE

BACKGROUND OF THE INVENTION

Manual positive pressure breathing devices have heretofore been provided. However, such devices have several limitations. For example, the inspiratory gases are delivered to the patient at right angles to the nebulizer and to the mouthpiece. In addition, such devices have been relatively inefficient in operation. There is, therefore, need for a new and improved device.

SUMMARY OF THE INVENTION AND OBJECTS

The manual positive pressure breathing device is adapted to be connected to a source of gas under positive pressure and consists of a venturi assembly, a nebulizer, a saddle and a patient adapter. The venturi assembly has a venturilike passageway and a nozzle mounted on the venturi assembly and adapted to be connected to the source of gas under positive pressure for introducing a jet stream into the venturilike passageway. The nebulizer and the body have flow passages therein in axial alignment with the flow passage in the venturi assembly. The patient adapter is mounted on the body and has a flow passage in axial alignment with the venturilike flow passage. The manually operated exhalation valve is mounted on the body for controlling inhalation and exhalation phases in the device.

In general, it is an object of the present invention to provide a manual positive pressure breathing device in which the flow passages are axially aligned to the laminar flow of the gases through the device.

Another object of the invention is to provide a device of the above character in which there is less tendency for turbulent precipitation or premature fallout of nebulized particles in the airflow passages.

Another object of the invention is to provide a device of the above character in which the patient is always connected to the atmosphere and is therefore safeguarded from overpressures.

Another object of the invention is to provide a device of the above character from which the exhale gases are delivered directly to the atmosphere without any substantially expiratory resistance.

Another object of the invention is to provide a device of the above character in which there is rapid termination of the inspiratory phase.

Another object of the invention is to provide a device of the above character in which two venturis are provided which complement each other.

Another object of the invention is to provide a device of the above character which can be readily operated.

Another object of the invention is to provide a device of the above character which can be readily disassembled and cleaned.

Additional objects and features of the invention will appear from the following description in which the preferred embodiments set forth in detail in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a manual positive pressure breathing device incorporating the present invention and connected to a source of positive pressure.

FIG. 2 is a cross-sectional view of the positive pressure breathing device shown in FIG. 1.

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 2.

FIG. 4 is a cross-sectional view showing the operation of the device during the inspiratory phase.

FIG. 5 is a cross-sectional view of the device showing the operation of the device during the exhalation phase.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The manual positive pressure breathing device **11** is adapted to be connected to a source of positive pressure in the form of an air compressor **12** which has its outlet **13** connected to a flow control valve **14**. The flow control valve is provided with a knob **16** to adjust the rate of flow through the flow control valve **14**. A pressure gauge **17** is mounted on the flow control valve **14** and measures the pressure of the air which is being supplied to the flow control valve **14**. The flow control valve **14** is provided with an outlet fitting **18** which is connected to a flexible pressure line **19**. The pressure line **19** is connected to the breathing device **11** in a manner hereinafter described.

The manual positive breathing device **11** consists of a venturi assembly **21**. A micronebulizer **22** is mounted in the venturi assembly **21** and a saddle **23** is mounted on the micronebulizer **22**. A patient adapter in the form of a mouthpiece **24** is mounted in the saddle **23**.

The venturi assembly **21** consists of a body **26** which has a venturilike passage **27** extending therethrough. The venturilike passage **27** is provided with a throat portion **27***a*. The body **26** has enlarged end portions **26***a* and **26***b*. The end portion **26***a* is threaded as is shown and carries a threaded cap **28**. The cap **28** is provided with a jet nozzle **29** which has this discharge end in axial alignment with the venturilike passage **27**. The cap **28** is provided with side openings **31** so that the venturilike passage **27** is open to the atmosphere. The end portion **26***b* of the body **26** is provided with ribs **32** which are adapted to frictionally engage by the micronebulizer **22**.

The micronebulizer **22** is substantially conventional and is of the type described in U.S. Letters of Pat. No. 3,172,406. As described therein, the micronebulizer **22** consists generally of a body **34** formed of two sections **36** and **37**. Both sections **36** and **37** are provided with main flow passages **38** and **39** which are in axial alignment with each other and with the venturilike passage **27**. The body **34** is adapted to contain a liquid medication which is to be utilized during operation of the device. This liquid is picked up by the capillary tube **41** carried by the section **36**. The jet nozzle **42** is mounted on the section **36** and is adapted to introduce a jet of air across the opening in the capillary tube **41** and into the main airstream passing through the main flow passages **38** and **39** of the micronebulizer. A ball **43** is also mounted on the section **36** opposite the jet nozzle **42** so that any liquid which is drawn up through the capillary tube **41** is broken up into small particles which pass into the main airstream and through the passages **38** and **39**. A fitting **44** is mounted upon the section **36** and is provided with a cap **46**. The fitting **44** is provided so that liquids can be introduced into the micronebulizer by the use of a hypodermic needle. A tee **48** is mounted in the jet nozzle **42**.

The saddle **23** consists of a body **51** which has a main flow passage **52** extending therethrough which is in axial alignment with the venturilike passage **27**. The body **51** is provided with a large exhalation port **53** generally intermediate at the ends of the same which is in communication with the flow passage **52**. A combination button and exhalation valve member **54** is carried by the body **51** and is adapted to close the exhalation port **53**. The exhalation port **53** is provided with the valve seat **56** which is adapted by the conical seating surface **57** of the valve member **54**. The conical surface **57** helps to insure that the valve member **54** will center itself with respect to the valve seat **56**. The valve member **54** is provided with a stem **59** which depends therefrom. The stem **59** is provided with four circumferentially spaced slots **61** which extend upwardly from the bottom of the stem **59**. A bore **62** has been provided within the stem **59** and extends upwardly from the lower extremity thereof and has been undercut so that inwardly extending lips **63** are formed on the lower extremity of the stem **59**. The valve member **54** is slidably mounted upon a vertical stemlike support member **66** formed integral with the body **51** and extending generally diametrically through the flow passage **52**. The support member **66** is generally cylindrical in shape and is

provided with an undercut annular recess 67 by which is adapted to receive the lips 63 of the stem 59. The support member 66 is provided with a flow passage 68 which extends upwardly through the support member 66 through a valve seat 69 which is adapted to be engaged by a conical seat 71 carried by the valve member 54. The valve member 54 is formed of such a material so that the lower extremity of the valve stem 59 can be readily slipped over the tip of the valve support member 66 so that the annular lips 63 can seat within the recess 67. The seat 69 can be identified as the bleed valve seat whereas the valve seat 56 can be identified as the exhalation valve seat. The spacing between the seats 56 and 69 and the conical surfaces which are carried by the valve member 54 are such that they are within very close tolerances and are closed and opened substantially simultaneously. The vertical height of the recess 67 is such as to permit limited travel of the valve member 54 between open and closed positions with respect to the seats.

The body 51 is provided with a fitting 73 in which there is mounted a tee 74. The saddle 23 is provided with a handle 76 which permits the patient to readily hold the device. The handle 76 is in the form of a bolt on a gun. As can be seen, it is provided with a generally hemispherical portion 76*a* and a tapered portion 76*b*. The handle 76 extends downwardly at approximately a 45° angle from the body 51 and the lower surface of the hemispherical portion 76*a* lies in a plane which is generally parallel to the axis of the flow passages of the gases through the device.

The mouthpiece is conventional and is mounted by a slip fit to the saddle 23. The mouthpiece is provided with a flow passage 78 which is in axial alignment with the venturilike passage 27 and the main flow passage through the nebulizer 22.

As shown in FIG. 1, the breathing device 11 is adapted to be connected to the pressure line 19. The pressure line 19 is connected to the tee 74 and a connecting line 81 connects the tee 74 to the tee 28. The tee 48 is connected by a line 82 to the jet nozzle 29.

Operation of the manual positive pressure breathing device may now be briefly described as follows. The nebulizer 22 is disconnected from the saddle 23 and is then inclined to an angle and filled with the suitable medication. As soon as this has been completed, the nebulizer 22 is again mounted on the saddle 23. The breathing device 11 is then connected to the pressure line 19 and thereafter, the compressor 12 is turned on. The device 11 is then supported by grasping the hemispherical or ball-like portion 76*a* by the palm of one of the hands while holding the device in a generally horizontal direction. The valve member 54 is then grasped by the hand and shifted to a closed portion. The flow rate control valve 14 should then be adjusted to deliver the desired amount of inspiratory pressure as for example 15 cc. of water. The functioning of the device can then be checked by periodically holding down the valve member 54 and observing the gases passing from the mouth piece 24 for external vapor and the nebulizer for internal precipitation. When this is satisfactory, the device is ready to be used. The patient, to start the treatment, closes his lips around the mouthpiece 24 and as he begins to inhale, he presses the center portion of the valve member 54 downwardly to start the inhalation phase as shown in FIG. 4. This valve member is held down by the patient until the lungs are filled. As soon as the lungs have been filled and the patient desires to exhale the valve member 54 is released by the patient permitting the exhaled gases to exhaust to the atmosphere as shown in FIG. 5. After the exhalation phase has been completed, the inhalation phase is commenced by pressing down on the valve member 54. The same cycle of the operation is then repeated until the patient has completed the treatment. Thereafter, the breathing device can be disassembled and washed and allowed to dry ready for the next use.

During the inhalation phase as shown in FIG. 4, the gases under positive pressure can no longer bleed into the saddle 23 and are forced through the jet nozzle 42 in the nebulizer 22 and also through the jet nozzle 29 of the venturi assembly. The operation of the jet nozzle 29 causes additional atmospheric air to be drawn in through the side passages 31 through the venturi passage 27 where they are introduced through the main stream flow passages 38 and 39 in the micronebulizer. The jet nozzle 42 causes the medication to be drawn up through the capillary tube 41 where it is broken into small particles by the ball 43 and entrained in the main stream air flow where it passes directly through the saddle 23 and through the mouthpiece 24 into the lungs of the patient.

From FIG. 4 can be seen that all the main flow passages in the device are in axial alignment with each other so that there is created a more laminar flow of gases through the device and into the airway of the patient. By creating a more laminar flow, there is a lesser tendency for turbulent precipitation or premature fallout of the nebulized particles in the upper airways of the patient. It should be noted that even during the inspiratory phase, the patient is always connected to the atmosphere through the openings 31. It is merely necessary for the patient to overcome the positive pressure created in the venturi assembly by the jet nozzle 29 and also the positive pressure created by the jet nozzle 42 in the micronebulizer 22. The two jet nozzles 29 and 42 aid each other in creating a positive pressure during the inspiratory phase.

As soon as the buttonlike valve member 54 is released, it is urged in an upward direction by gas under positive pressure in the patient circuit pressing against the large circular surface 57 and the gas bleeding through the passage 68 and exiting through the exhalation port 53. The exhalation port 53 is very close to the patient and therefore there is very little, if any, resistance to the flow of exhaled gases from the patient. They will be discharged directly to the atmosphere through the large exhalation port 53. During the time that the gases from the line 19 are bleeding off through the passage 68, very little, if any, gases pass through the nozzle 42 and the nozzle 29.

From the foregoing it can be seen that there has been provided a manual positive pressure breathing device which now makes it possible to create a main stream of gases which sweep nebulized particles directly towards the patient's airway. There are no right angle turns which would have a tendency to create fallout of nebulized particles. The patient can readily control the inhalation and exhalation phases merely by operation of the button valve member. As soon as the bleed passage is closed, the pressure builds up and the two jets are placed in operation. Since the venturi assembly is connected to the atmosphere, the patient is always protected from overpressures. The patient can at will release the valve member and thereby determine the length of the inspiratory phase in accordance with his desires. The exhalation valve port is located adjacent to the patient's airway so that the exhaled gases are delivered directly to the atmosphere without expiratory resistance. The handle is constructed in such a manner that the patient can either hold it with his right or left hand. Since the patient's airway is connected to a source of gas through the venturi assembly, it is possible to overcome momentary resistances and obstructions by turning the flow into pressure and then when these obstructions and resistances are overcome, turning the pressure into flow again. This makes it possible to accommodate the inspiratory inconsistencies of the patient. The inspiratory pressure can be readily adjusted by the patient by the time that he holds the exhalation valve button down, and by adjusting the source pressure delivered by compressor 12 through control valve 16.

We claim:

1. In a manual positive pressure breathing device adapted to be connected to a source of gas under pressure, a venturi assembly having a venturilike passageway with one end open to the atmosphere, a jet nozzle adapted to be connected to said source of gas under pressure, means mounting the jet nozzle in the venturi assembly so that the jet passing therefrom is directed into the venturilike passageway, a nebulizer having a flow passage extending therethrough in axial alignment with the venturilike passageway, said nebulizer having a jet nozzle

therein adapted to be connected to said source of gas under pressure and serving to assist movement of the main stream of air through the nebulizer, a saddle having a flow passage in axial alignment with and in communication with the venturilike passageway in the venturi assembly, said saddle having an exhalation port open to the atmosphere in communication with the flow passage and a seat surrounding said port, a manually operated exhalation valve mounted on the saddle and adapted to close said port and a patient adapter mounted on the saddle and having a flow passage in axial alignment with the venturilike flow passage.

2. A breathing device as in claim 1 wherein said valve member is provided with a stem and wherein said saddle is provided with a stem support member and cooperative means carried by the stem support member and by the stem permitting limited axial movement of the valve member relative to the stem support member.

3. In a manual positive pressure breathing device adapted to be connected to a source of gas under pressure, a venturi assembly having a venturilike passageway with one end open to the atmosphere, a jet nozzle adapted to be connected to said source of gas under pressure, means mounting the jet nozzle in the venturi assembly so that the jet passing therefrom is directed into the venturilike passageway, a saddle having a flow passage in axial alignment with and in communication with the venturilike passageway in the venturi assembly, said saddle having an exhalation port open to the atmosphere in communication with the flow passage and a seat surrounding said port, a manually operated exhalation valve mounted on the saddle and adapted to close said port, a patient adapter mounted on the saddle and having a flow passage in axial alignment with the venturilike flow passage, said valve member being provided with a stem, said saddle being provided with a stem support member and cooperative means carried by the stem support member and by the stem permitting limited axial movement of the valve relative to the stem support member, said stem support member being provided with a bleed passage extending therethrough adapted to be connected to said source of positive pressure, said bleed passage being in axial movement with the exhalation port, said valve member including a valve surface adapted to seat upon said stem member to close such passage in said stem support member.

4. A breathing device as in claim 3 wherein said seat on said saddle and said seat on said stem support member are precisely spaced so that they are closed substantially simultaneously by said valve member.

5. A breathing device as in claim 4 wherein said valve member is provided with upper and lower conical surfaces adapted to engage said seats.

6. In a manual positive pressure breathing device adapted to be connected to the source of gas under pressure, a venturi assembly having a venturilike passageway with one end open to the atmosphere, a jet nozzle, means mounting said jet nozzle so that the jet stream passing therefrom is directed into the venturilike passageway, a saddle having a flow passage in axial alignment with and in communication with said venturilike passageway in the venturi assembly, a patient adapter mounted on the saddle and having a flow passage in communication with the flow passage in the saddle, said saddle having an exhalation port therein open to he atmosphere in communication with the flow passage, said saddle being formed with a seat surrounding said port, a manually operated exhalation valve mounted in he saddle, a support member mounted in he saddle, said support member having a flow passage therein, means adapted to connect a source of positive pressure to the support member so that gases bleed from the support member, said valve member having a stem and means forming a cooperative relationship between the stem of the valve member and said support member whereby axial movement of said valve member is permitted relative to said support member, said valve member carrying a surface adapted to close said passage through said support member when said valve member is in a closed position, said valve member also having a surface adapted to close said port when said valve member is in a closed position.

7. A breathing device as in claim 6 wherein said surfaces are inclined with respect to the axis of the exhalation port.

8. A breathing device as in claim 6 wherein said cooperative means includes a recess in the support member and inwardly extending lips carried by the valve member and extending into the recess.

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