United States Patent [19]

Brown

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[54] HUMIDIFIER - NEBULIZER

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[52] **U.S. Cl.**.....**128/194,** 55/255

[51] **Int. Cl.**.....**A61m 11/00**

[58] **Field of Search**.....128/184, 185, 186, 187, 188, 128/194; 55/255, 256; 261/78 A, 121, 122, 124, DIG. 65

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[57] **ABSTRACT**

A container defining a chamber partially filled with a liquid such as water is provided with a pair of pressurized oxygen flow inlet ports and an outlet port from which humidified or nebulized oxygen flow is discharged for breathing. A humidifying device connected to one of the inlet ports includes a diffuser immersed in the water and provided with relatively small slots through which pressurized oxygen is forced to form minute bubbles that rise through the water to provide humidified oxygen flow which passes out of the outlet port. A nebulizing device connected to the second inlet port includes a tube having one end extending into the water and an opposite end exposed to a low pressure region generated by high velocity oxygen flow through an orifice. Water thereby aspirated through the tube is broken up and entrained by the oxygen flow and the resulting mixture discharged into an enlarged volume chamber and directed against a fixed pin or baffle in the chamber to further break up the entrained water particles. An adjustable inlet port communicates the chamber with room or ambient air to provide preselected dilution of the nebulized oxygen flow with room air which room air is aspirated into the chamber by sub-atmospheric pressure generated therein. The diluted nebulized oxygen flow subsequently passes out of the outlet port. The humidifying and nebulizing devices are independently operatively depending upon which one of the pair of inlet ports is connected to a suitable pressurized oxygen source.

1 Claim, 6 Drawing Figures

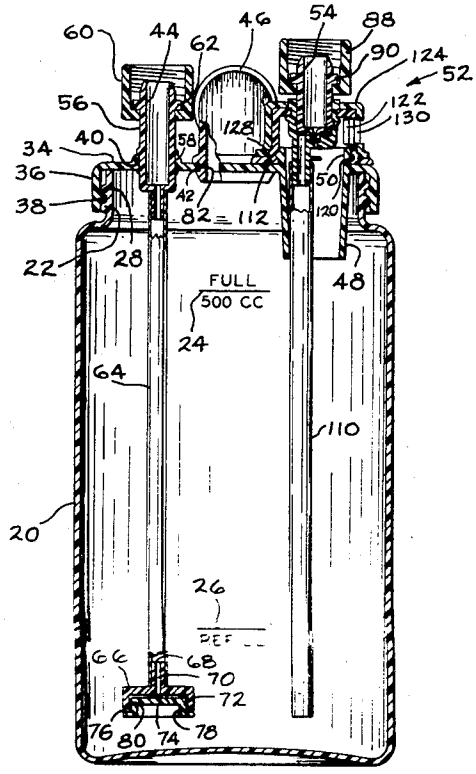


FIG. 1

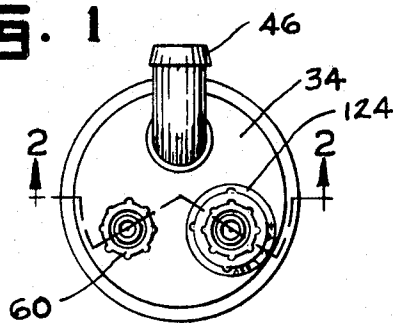
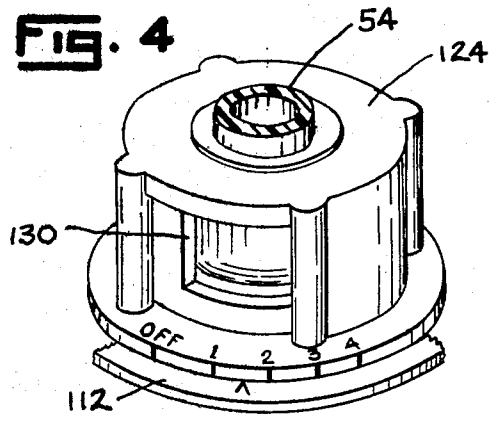


FIG. 4



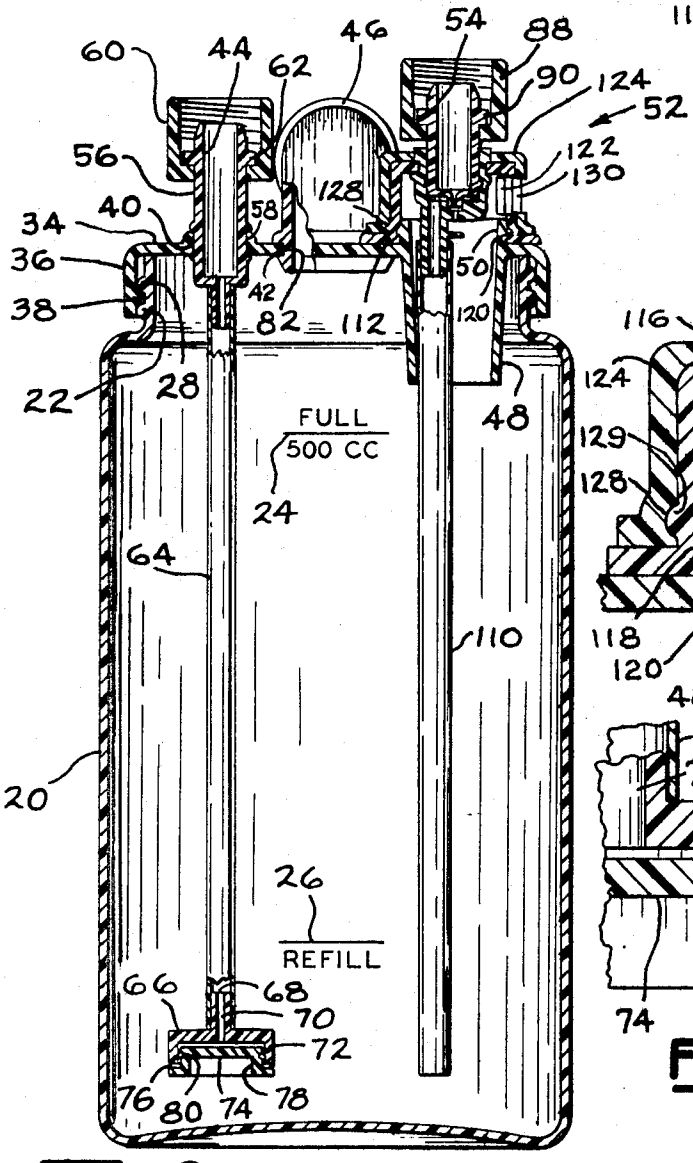


FIG. 2

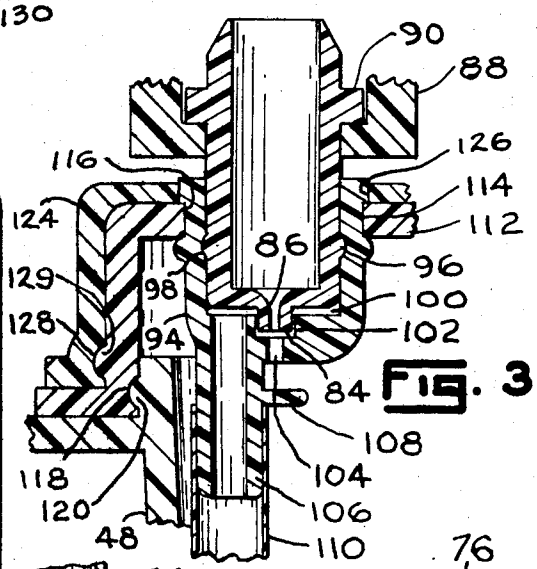


FIG. 3

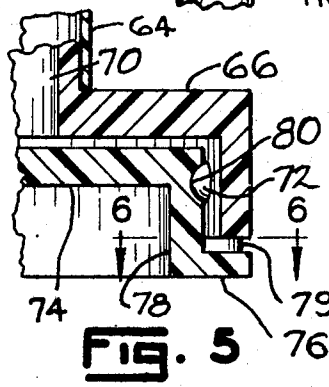


FIG. 5

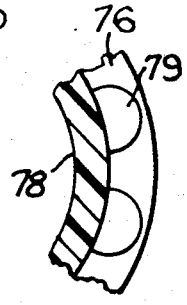


FIG. 6

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HUMIDIFIER - NEBULIZER

BACKGROUND OF THE INVENTION

Prior art humidifiers including nebulizers for humidifying dry oxygen gas used in hospital or home treatment of a person having respiratory or related complications have taken numerous forms. However, the prior art humidifiers of which I am aware of not entirely satisfactory due to one or more disadvantages including relatively high cost, complex operation, significant bulk and weight either of which tend to discourage portable use, and difficulty in cleaning and sterilization of parts subject to contamination. Other disadvantages may include the need for an electric power source for operation which introduces undesirable shock hazard to a therapist or patient as well as inability of the device to function independently as a simple humidifier or nebulizer.

It is an object of the present invention to provide a simple and relatively inexpensive humidifier and nebulizer device for administering humidified or nebulized oxygen gas to a patient.

It is another object of the present invention to provide a simple and reliable humidifier including nebulizer means formed from a relatively inexpensive material thereby making disposal after use practical and economical.

An important object of the present invention is to provide a humidifier including nebulizer for dry oxygen gas which is compact and relatively lightweight and does not require an electrical power source thereby rendering the same practical for portable use.

Still another object of the present invention os to provide a combination humidifier and nebulizer for treatment of oxygen gas wherein the humidifier and nebulizer portions thereof operate independently and may be selectively put into operation quickly and simply.

An important object of the present invention is to provide a disposable, simple and reliable nebulizer including ambient air dilution means for treatment of a gas.

Other objects and advantages will be apparent from the following description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic representation of a top view of the present invention;

FIG. **2** is a sectional view taken on line **2**—**2** of FIG. **1**;

FIG. **3** is an enlarged sectional view of a portion of FIG. **2**;

FIG. **4** is an enlarged view of an adjustable portion of FIG. **2**;

FIG. **5** is an enlarged sectional view of a portion of FIG. **2**;

FIG. **6** is a sectional view taken on line **6**—**6** of FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **2** in particular, numeral **20** designates a liquid container or casing provided with an opening defined by an annular rim **22**. Preferably, the container **20** is formed from a relatively inexpensive material such as plastic which is suitably transparent to provide a visual indication of the level of a liquid such as water contained by container **20** which may be sized to hold 500 cubic centimeters of water as indicated by an upper level marking **24** impressed on container **20**, thereby providing for relatively long term therapy. A lower level marking **26** on container **20** provides a visual indication of a need for refill thereof. The rim **22** is provided with a helical rib or thread **28**.

A cover **34** is provided with a depending annular wall **36** having a helical rib or thread **38** formed thereon which threadedly engages rib **28** to secure cover **34** in position on casing **20**. The cover **34**, like container **20**, may be formed of a plastic material. Spaced-apart openings **40** and **42** in cover **34** are adapted to receive an oxygen inlet fitting **44** and an oxygen outlet fitting **46**, respectively. A third opening in cover **34** is defined by an integral sleeve **48** having a converging wall, a minor portion **50** of which extends outward from cover **34**. A nebulizing unit generally indicated by **52** is secured to sleeve **48** and includes an oxygen inlet fitting **54**.

The oxygen inlet fitting **44** includes a tubular section **56** having axially spaced-apart ribs defining a recess **58** adapted to snap fit with cover **34** thereby securing tubular section **56** in position in opening **40**. A threaded coupling **60** slidably carried on tubular section **56** and retained thereon by an annular stop **62** is adapted to threadedly engage a mating coupling, not shown, connected to a hose communicating with a conventional pressurized source of oxygen, not shown. A tubular member **64** having a suitable interference fit with a reduced diameter end of tubular section **56** extends therefrom into container **20** to a position below the refill level of water. A cup-shaped member **66** is provided with a stem **68** having a central passage **70** and a suitable interference fit with tubular member **64** to thereby secure member **66** to the same. The inner wall of the axially extending portion of member **66** is provided with a plurality of spaced-apart projections **72**. A cap **74** having a radially extending shoulder **76** and an axially extending wall **78** is slidably received by cup-shaped member **66**. The shoulder is provided with a plurality of spaced-apart ribs or projections **79** which abut member **66** to establish a plurality of restricted passages through which oxygen gas may escape from the interior of member **66** to the water surrounding the same (see FIGS. **5** and **6**). An annular recess **80** in wall **78** is adapted to snap fit with projections **72** to secure cap **74** in position.

The oxygen outlet fitting **46** is tubular and provided with a conventional male coupling end adapted to connect to the mating end of an oxygen supply hose, not shown, leading to an oxygen mask or tent. The opposite end of fitting **46** is provided with an annular recess **82** adapted to snap fit with cover **34** to secure fitting **46** in position thereon.

The oxygen inlet fitting **54** of nebulizing unit **52** is a tubular member having a reduced diameter end portion **84** provided with a restricted outlet flow passage or nozzle **86**. A threaded coupling **88** slidably carried on fitting **54** and retained thereon by an annular stop **90** is adapted to threadedly engage the mating coupling, not shown, connected to the hose supplying pressurized oxygen. The fitting **54** is retained in the cavity of a cup-

shaped member 94. An annular rib 96 on fitting 54 is adapted to snap fit into mating recess 98 formed in member 94 to thereby establish a fixed spaced relationship or annular chamber 100 between adjacent parallel surfaces of fitting 54 and member 94. The nozzle 86 extends into a relatively larger diameter recess 102 in the base portion of cup-shaped member 94 which base portion is further provided with a passage 104 coaxial with nozzle 86 and through which jet flow from nozzle 86 is directed into sleeve 48. The relative diameters of nozzle 86 and recess 102 as well as the axial spacing between nozzle 86 and the base or recess 102 establish a predetermined clearance providing fluid communication between annular chamber 100 and passage 104. An integral tubular extension 106 in the base portion of cup-shaped member 94 is offset relative to passage 104 and extends into sleeve 48. An integral pin or baffle 108 extends radially outwardly from tubular extension 106 and perpendicular to the axis of passage 104 in spaced-apart relationship to the outlet end of passage 104 to thereby intercept jet flow out of passage 104.

A tubular member 110 having a suitable interference fit with tubular extension 106 extends therefrom into container 20 to a position below the refill level of water.

A cupped member 112 is provided with an opening 114 therein through which member 94 extends. The wall defining opening 114 is adapted to snap fit into an annular recess 116 in member 94 to thereby secure members 94 and 112 together. The cupped member 112 is provided with an annular recess 118 which mates with an annular rib 120 integral with sleeve 48 to provide a snap fit thereby securing cupped member 102 in position on cover 34. An opening or port 122 in cupped member 112 is controlled by an adjustable cupped member 124 having an opening 126 in the base thereof to permit member 124 to overlap member 112. An annular recess 128 in cupped member 124 mates with an annular rib 129 integral with cupped member 112 to provide a snap fit coupling rotatably securing cupped member 124 to cupped member 112. An opening or port 130 in cupped member 124 is adapted to mate with opening or port 122 in member 112 to establish a corresponding variable flow area depending upon the position to which cupped member 124 is rotated relative to cupped member 112. The member 124 may be provided with suitable markings which cooperate with a reference mark on cupped member 112 as shown in FIG. 4.

Preferably, the above-described structure is made from any of the well known plastic materials which are characteristically inexpensive, lightweight, strong and easily formed to shape to thereby provide a relatively inexpensive and disposable humidifying and nebulizing device.

It will be assumed that the above-described device is to be used for simple humidification of dry oxygen gas supplied by a suitable tank of pressurized oxygen gas, not shown, in which case the supply hose therefrom is connected to oxygen inlet coupling 60. The container 20 is filled with water to the indicated upper mark 24. The nebulizing unit 52 is sealed by means of a plug, not shown, adapted to snap fit into fitting 54 thereof and member 124 of unit 52 is rotated to its OFF position thereby blocking port 122. Pressurized oxygen gas flows through inlet fitting 44 and tubular member 64 to cup-shaped member 66 which, in combination with cap 74 secured thereto, functions as a diffuser. To that end, oxygen gas passes through the narrow passages defined by ribs 79 and emerges therefrom in the form of small bubbles which rise through the water thereby accumulating additional water vapor. The humidified oxygen gas passes out of fitting 46 to the mask or tent supplying oxygen to the patient. It will be noted that the volume of water in container 20 is sufficient to provide relatively long term humidification of the oxygen gas. The level of water in container 20 may be readily observed with respect to the refill marks 26 to signify a need for refilling container 20.

The nebulizing unit 52 may be put into operation by attaching the pressurized oxygen supply hose to inlet coupling 88 in which case the inlet coupling 60 is sealed by a suitable plug, not shown, similar to that used to seal unit 52. The pressurized oxygen gas passes through flow passage or nozzle 86 creating a relatively high velocity jet flow which is discharged through passage 104 and produces a low pressure in the volume established by the clearance between nozzle 86 and access 102 as well as the chamber 100. The resulting pressure differential between the chamber 100 and end of tubular member 110 immersed in water aspirates water through tubular member 110 into chamber 100 and the clearance volume surrounding the jet flow from nozzle 86. Water entrained by the jet flow is carried through passage 104 with the resulting water and oxygen gas mixture impinging the pin 108 causing the water particles entrained in the oxygen to break up into smaller particles, producing a nebulized mixture which is conducted through sleeve 48 to the volume above the water level from which the mixture exits via outlet fitting 46 to the mask or tent supplying the patient. If desired, the oxygen gas may be diluted with ambient or room air by rotating the cupped member 124 to one of the numbered positions relative to the reference mark on member 112 thereby establishing a corresponding effective flow area of port 122 and thus predetermined air flow therethrough. The relatively high velocity flow of oxygen and entrained water particles passing through sleeve 48 creates a relatively lower pressure in the annular volume between cupped member 112 and cup-shaped member 94 supported thereby and thus a pressure differential across open port 122 through which room air is drawn into sleeve 48. The room air mixes with the oxygen gas-water particle mixture thereby diluting the oxygen gas accordingly.

It will be recognized by those persons skilled in the art that the above-described humidifier-nebulizer may be operated with a pressurized gas other than oxygen and a liquid medicant may be substituted for water. Furthermore, the inlet fittings 44 and 54 may be connected to separate sources of pressurized oxygen and pressurized air in which case the cupped member 124 may be rotated to close port 122 thereby establishing separate flows of oxygen and air into casing 20 and a resulting diluted flow of oxygen out of outlet 46.

I claim:

1. A humidifier-nebulizer apparatus for conditioning a breathable fluid supplied to a recipient, said apparatus comprising:

a container having a chamber therein for retaining a liquid, said chamber having a first inlet port, a second inlet port and an outlet port in communication with said recipient, said first inlet port adaptable to be connected to a source of oxygen under pressure, said second inlet port adaptable to be connected to said source of oxygen;

first conduit means retained in said first inlet port having a cup shaped end thereon which extends into said liquid, said cup shaped end having a plurality of inwardly spaced apart projections;

a cap on the end of the first conduit means having an annular wall with a radially extending shoulder, said axially extending annular wall having an annular recess therein, said shoulder having a plurality of ribs thereon, said plurality of ribs abutting said cup shaped end upon said spaced apart projections being positioned in said annular recess to form a corresponding plurality of restricted passages through which said source of oxygen can pass under pressure, said oxygen under pressure upon passing through said restricted passages into said liquid forming minute oxygen bubbles that rise through said liquid into said chamber, said oxygen bubbles absorbing said liquid upon passing therethrough and into the chamber as humidified oxygen;

first sleeve means located in said second inlet port and extending into said chamber;

cover means connected to said first sleeve means having a cupped surface, said cupped surface having an axial opening in the end and a radial opening in the side thereof;

second sleeve means surrounding said cover means having a radial opening therein, said second sleeve means being adapted to rotate on said cover means to selectively vary the communication of air at atmospheric pressure into said first sleeve means with substantially the same precision repeatedly, said second sleeve means being rotated to prevent the c communication of said air into said cover means upon oxygen being communicated through said first conduit;

cylinder means located in said axial opening in said cover means having a closed end, and an open end with an annular shoulder on the other end, said annular shoulder contacting said cover means to position the cylinder within said first sleeve means, said closed end having an axial opening therein;

tubular means extending from the closed end of said cylinder means into said liquid, said tubular means having a radial baffle located below said closed end and extending beyond said axial opening in the cylinder means, said tubular means having an annular recess on the internal surface a predetermined distance from said closed end; and

second conduit means having a nozzle on the end thereof through which said oxygen under pressure is adapted to pass, said conduit means having an annular rib thereon a predetermined distance from said nozzle, said annular rib being retained in said annular recess to form an annular chamber with said closed end, said second sleeve means being rotated to selectively allow the communication of air through a predetermined size of opening into said cover means upon oxygen under pressure being communicated through said second conduit means, said oxygen communication to the second conduit means passing through said nozzle and axial opening causing a pressure drop in said annular chamber to aspirate said liquid into said annular chamber, said liquid in the annular chamber being entrained by said oxygen before passing through said axial opening, said liquid entrained in said oxygen impinging upon said baffle causing the liquid to nebulize, said oxygen and nebulized liquid being directed into said chamber by said first sleeve means for distribution to the recipient through said outlet.

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