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van Amerongen

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[54] **NEBULIZER**

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[73] Assignee: **Respiratory Care, Inc.,** Arlington Heights, Ill.

[21] Appl. No.: **553,081**

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Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **3,771,721**
Issued: **Nov. 13, 1973**
Appl. No.: **286,692**
Filed: **Sep. 6, 1972**

[51] **Int. Cl.**[2] **A61M 11/02**

[52] **U.S. Cl.** **239/338;** 128/194

[58] **Field of Search** 239/338, 343, 309, 124, 239/120, 370, 433; 128/194

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,605,764	8/1952	Adams	128/194 X
3,525,476	8/1970	Boling	239/338
3,652,015	3/1972	Beall	239/338

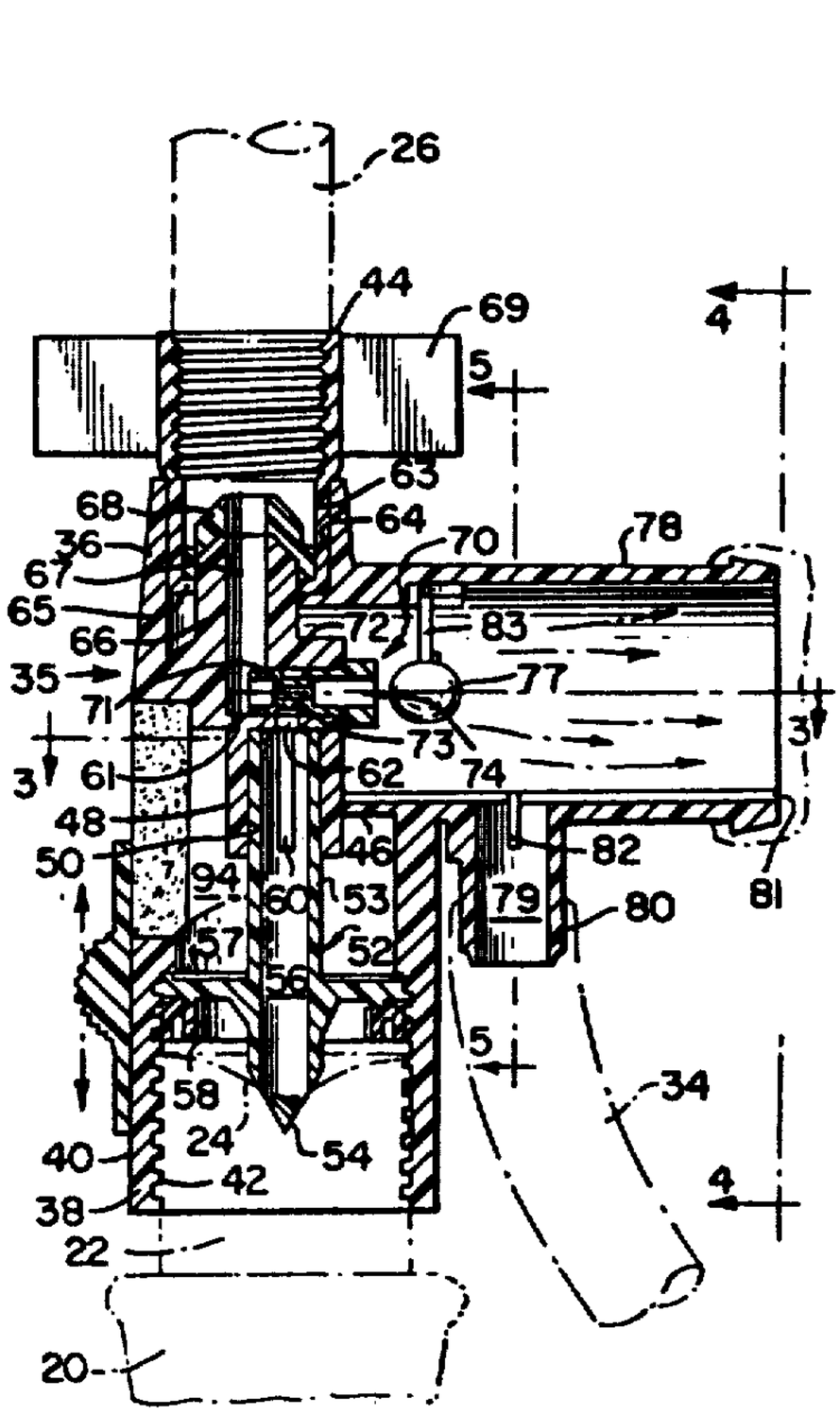
Primary Examiner—Richard A. Schacher
Attorney, Agent, or Firm—Eric P. Schellin

[57] **ABSTRACT**

A water supply is adapted as a source for nebulized liquid through the agency of an adapter which couples oxygen pressure to a container for the water. A venturi within the adapter draws from the water supply and directs highly atomized water and oxygen through an outlet pipe on the adapter. The adapter is also provided with means of providing air to the outgoing stream in order to dilute the oxygen content.

A depending suspended ball is disposed in the path of flow downstream of the venturi in a chamber. It traps water particles which should not pass to the patient. The water particles or drops collected in the chamber are drained into a means located at the bottom of the chamber. Means is located along and at the bottom to assist in collecting the liquid water and conducting it to the drain means. Conduit means is fluidally connected to the drain means and to the container for both carrying back the collected liquid water and for stabilizing pressure in the container by providing gas replacement for water removed from the system.

10 Claims, 9 Drawing Figures



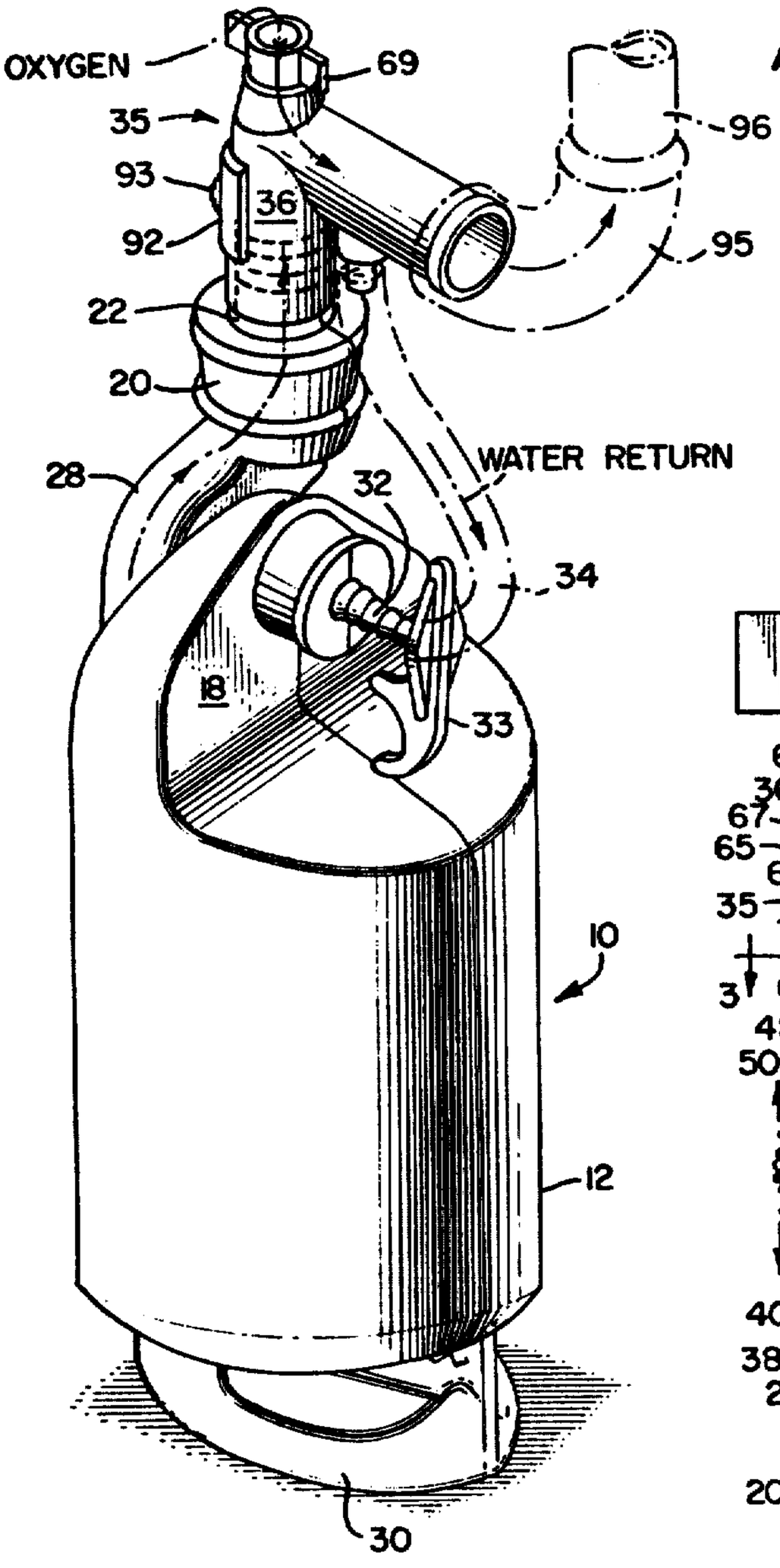


FIG. 1.

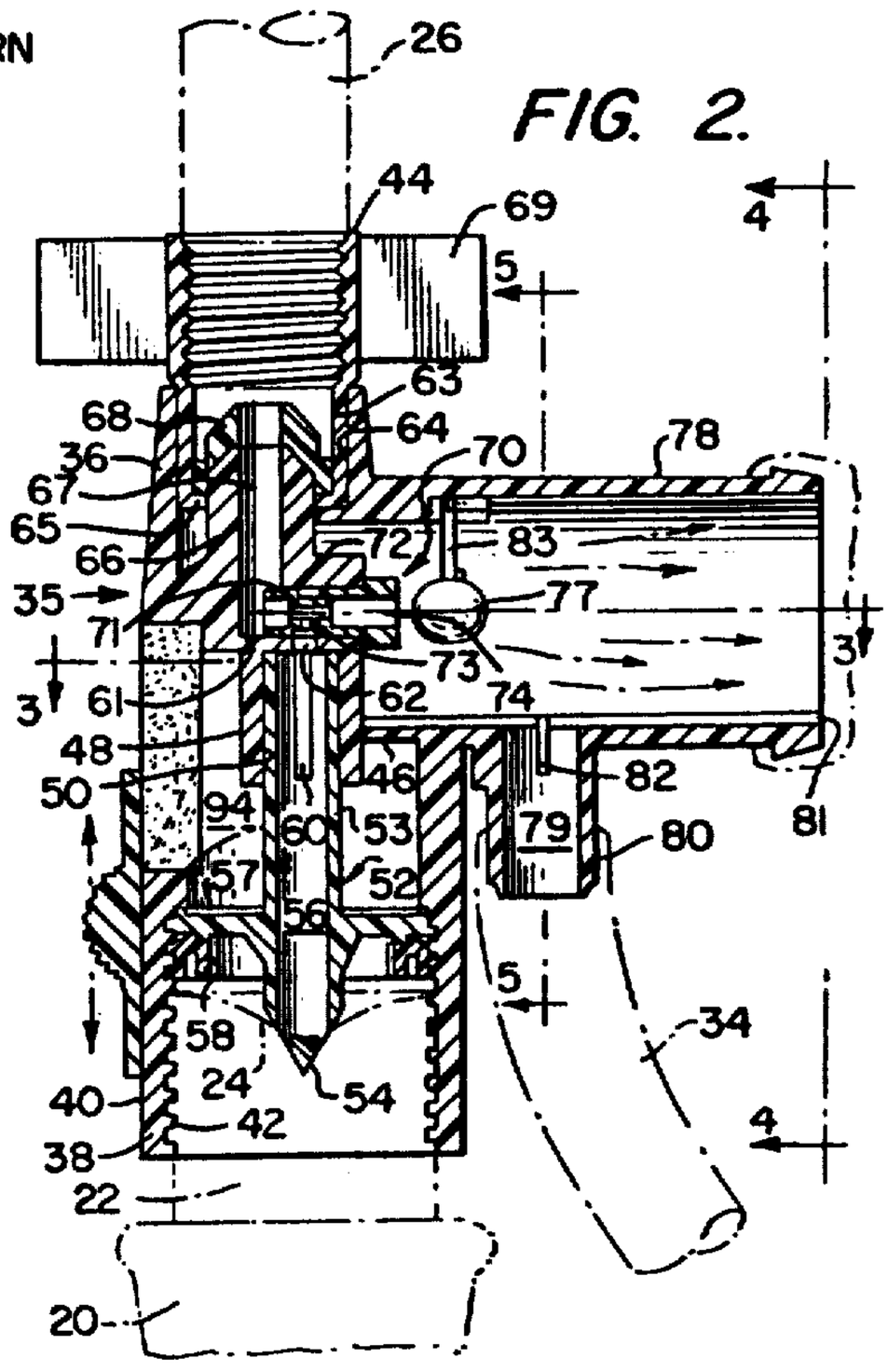


FIG. 2.

FIG. 3.

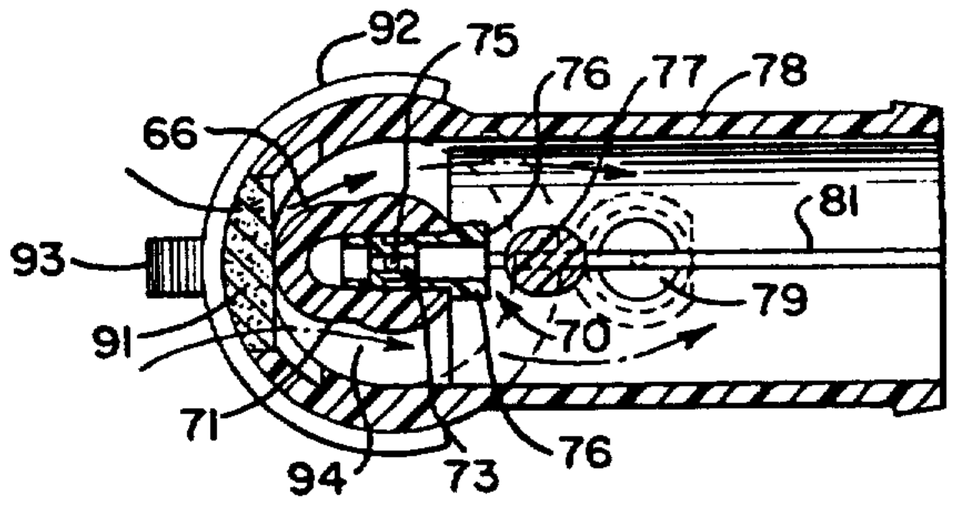


FIG. 4.

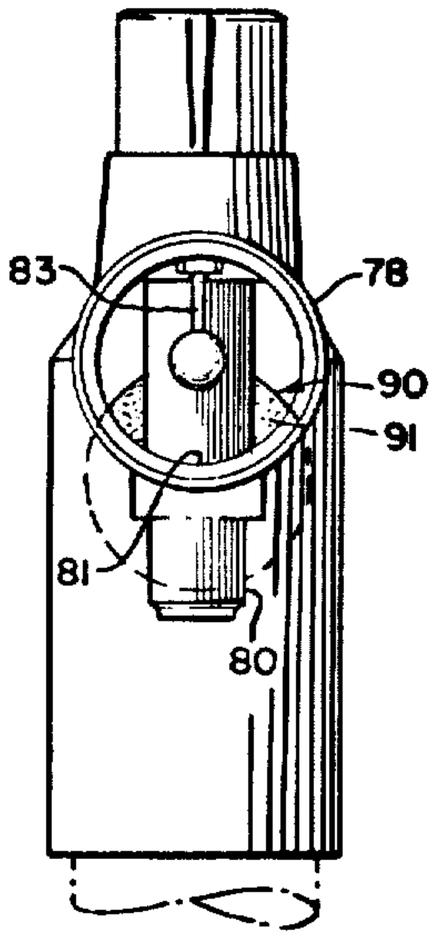


FIG. 5.

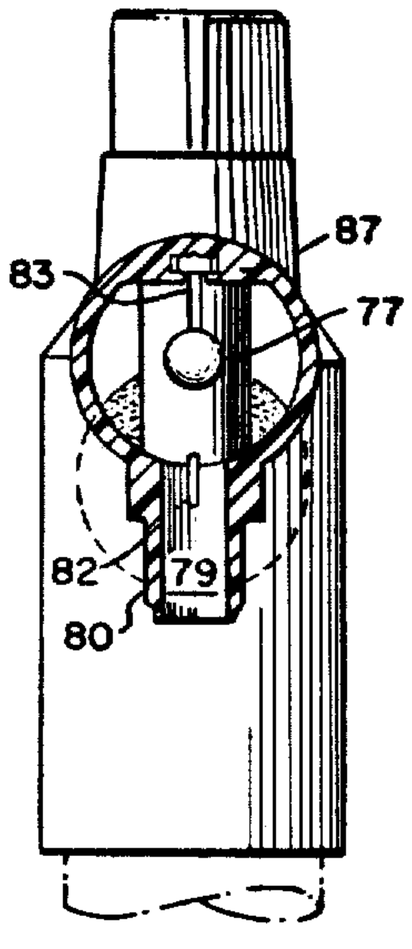


FIG. 6.

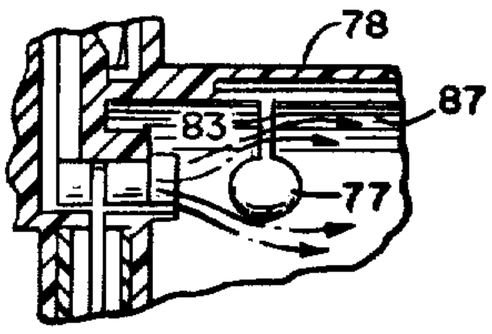


FIG. 7.

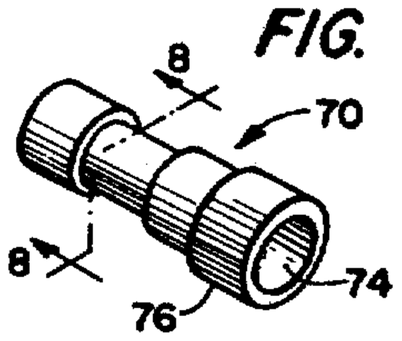


FIG. 8.

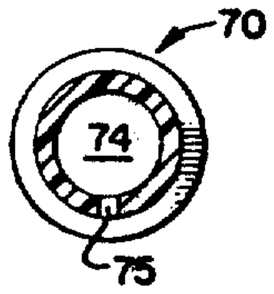
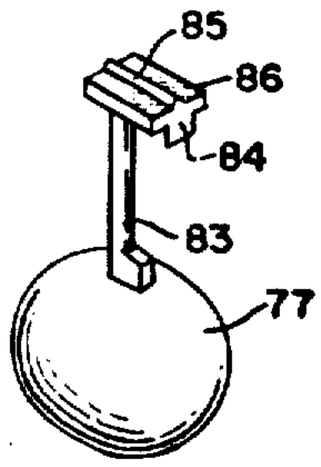


FIG. 9.



NEBULIZER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

FIELD OF THE INVENTION

The present disclosure relates to inhalation therapy. Particularly it relates to nebulizers. Specifically it concerns a nebulizer adapter for a liquid container.

BACKGROUND OF THE INVENTION

Inhalation therapy is the medical art of treating with oxygen or a mixture of oxygen and air having a high moisture content. Several classes of devices, one of which comprises atomizers or nebulizers, are adapted for effecting such treatments. A heretofore known system for inhalation thereby comprises a container for pure water which has means enabling operation of the container in one of several modes. A fitting, comprised of a venturi, when associated with said enabling means, adapts the container as a nebulizer reservoir and itself is adapted for providing nebulized water. However, in that device, some of the water which has been removed from the container either fails to break into a mist, or condenses at or about the fitting after atomization.

The patentee in the recently issued U.S. Pat. No. 3,652,015, goes a long way to solving some of the basic problems in this area. The present invention constituting the subject matter herein provides for an improved means for disposing of the unatomized water. It also provides for a more expeditious construction. It also provides for better mode of securing the parts of the device to connecting conduits and to the container constituting the nebulizer reservoir.

Accordingly, it is an object of the invention to provide an improved nebulizer.

It is a further object of the invention to provide an improved fitting for adapting a water container as a nebulizer.

It is another object of the invention to remove condensate from a mist produced by a nebulizer, particularly a nebulizer comprised of a venturi.

It is an additional object of the invention to improve the quality of a nebulized mist.

Further, it is an object of the invention to improve the fitting arrangements of the nebulizer device.

Moreover, it is an object of the invention to easily return condensate in a nebulizer to its associated reservoir.

SUMMARY OF THE INVENTION

To effect the foregoing, and other objects of the invention which will be apparent from the ensuing description, a nebulizer, has a venturi for mist forming means disposed within a body having chamber means with a mist outlet opening. Provided are means for removing from said body a stream of fluid collected in said chamber means. More particularly, the nebulizer has a delivering pipe disposed in fluid receiving association with said venturi. A wall section of said pipe has a ridge portion arranged for coalescing and draining said chamber means; and an opening in said wall is adapted to drain said chamber means.

BRIEF DESCRIPTION OF THE DRAWINGS

In the ensuing description, reference is made to the accompanying drawings in which:

FIG. **1** is a perspective of the device of the present invention mounted on a reservoir containing water.

FIG. **2** is a vertical sectional view through a nebulizer embodying the inventive, only an upper portion of an associated container with a nebulizer adapter being shown.

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

FIG. **4** is a front elevational view of the device of the present invention.

FIG. **5** is a cross-sectional view taken along line **5—5** of FIG. **2**.

FIG. **6** is a fragmentary vertical sectional view of the device showing a different mode for a baffle means.

FIG. **7** is a perspective view of the venturi means of the present invention.

FIG. **8** is a cross-sectional view taken along line **8—8** of FIG. **7**.

FIG. **9** is a perspective view of the baffle means employed in the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring now more particularly to the drawings, shown is a container generally designated **10**, which may be of semirigid fabrication and has a general vertical orientation. It is comprised of a body **12** having therein a chamber which defines a reservoir for water. A neck **18**, being an upper restricted end portion of body **12** serves as a transition component atop of which is fashioned an integral head **20**. Inlet means comprised of a duct **22** is integrally fashioned with **20** and extends vertically upwardly, its inlet end portion having mounted therein a flexible sealing disc, membrane or diaphragm **24** which is shown ruptured for fluidally connecting the container with an oxygen supply source **26**.

A septum (not shown) is formed integrally with and is disposed within the body **12**, with the wall of said body, defines a duct **28** with a generally vertical aspect. The septum separates the chamber, being primarily the reservoir, from duct **28**; but at its lower end **30** terminates short of the container bottom, whereat the chamber and the duct are fluidally connected. The upper portion of the septum extends obliquely across the chamber. The neck **18** being fashioned such that a path for gas is formed between the duct **22** and the duct **28**.

The foregoing construction enables use of container **10** as a humidifier reservoir (such use not being illustrated herein) as well as nebulizer reservoir, as illustrated herein. This dual feature is disclosed and described in detail in a copending application, Ser. No. 856,756, filed Sept. 10, 1969.

A liquid return nipple **32** is fashioned integrally with neck **18** and preferably is disposed above the highest level in the chamber. In addition, nipple **32** comprises venting means through which gas is supplied to compensate for fluid withdrawn from the chamber in a manner which will be appreciated from ensuing description. As shown in FIG. **1**, the nipple **32** has a break away sealing means **33**. After the said sealing means **33** is removed, a hose **34** has one end secured thereto.

A nebulizer fitting or adapter generally designated **35** has a body **36** preferably of rigid plastic fabrication. A

vertically orientable lower socket **38** is formed in said body with an internal spiral thread **40**. The latter operably matches external thread **42** formed on duct **22**, whereby the adapter may be mounted on container **10**. An internally threaded upper socket **44** formed above socket **38** in body **36** for receiving the male component of oxygen supply means **26** adapts fitting **36** for connection to an oxygen pressure source.

Above socket **38** is an upper horizontally extending member **46** which terminates centrally with the bore of the socket **38** therebelow with an downwardly projecting cylindrical section **48** with a pocket **50**. A breaching tool, generally, **52** has an upper tubular end **53** snugly seated in pocket **50**. It has a lower breaching element **54** which is adapted for rupturing diaphragm **24** and projects into duct **22** when fitting **35** is operably associated with container **10**. An axial vertical bore **56** for water projects through breaching tool **52**.

The breaching tool has an outwardly radially projecting portion **57** intermediate tubular end **53** and the breaching element **54** which is approximately the same diameter as the internal diameter of the socket **38**. An annular gasket **58** fits snugly against the underside of the projecting portion **57**. The outer edge of the annular gasket **58** is threaded in a manner whereby it is screwed into the socket. The radially projecting portion **57** is held at its upper portion against a shoulder **59** of the socket by screwing the annular gasket **58** up against the underside of portion **57**.

The tubular end **53** has a longitudinal axial slot **60** whereby the said end may be slightly compressed prior to being inserted into pocket **50**.

Cylindrical section **48** terminates in an upper relatively flat top **61** having axially disposed a relatively small opening **62**.

The upper socket **44** is rotably sealingly secured to body **36**. The said upper socket **44** has a lower cylindrical extending portion **63** which extends into a secondary socket **64** within body **36** and is concentrically disposed with respect to said secondary socket. The bottom of socket **44** terminates with a fairly large orifice **65**, but less than the internal diameter of the socket **44**. The orifice **65** encompasses concentrically upwardly extending cylindrical projection **66** which has a bore **67** therethrough. The projection **66** and the bore is somewhat vertically displaced with respect to conduit **56** and cylindrical section **48**. An annular member **68** is secured to the projection **66** and has a somewhat larger diameter. The larger dimension adapts it to overlie the uppermost portion of projection **66**. The annular member **68** fits snugly against the internal side of socket **44**. The downwardly extending underside abuts against the bottom of the socket **44**. The annular member **68** retains the socket **44** in place but, as it is not affixed thereto, the socket is rotatable. By the assistance of ears **69** on the socket **44** the socket may be threaded onto the male member **26** of the oxygen supply means.

The venturi effect is produced by separate tubular venturi means **70** which fits into a bore **71** in a section **72** at the confluence of section **48** and projection **66**. The venturi means **70** has a bore **74** therethrough with a restriction **73** intermediate the ends thereof. A downwardly radially extending bore **75**, in the said restriction **73** provides a fluid communication between conduit **56** and the bore **74** of the venturi means **70**.

For an enlarged view of the venturi means **70**, attention is directed to FIGS. **7** and **8**. It will be noted that, especially from FIGS. **2** and **3** that what constitutes the

downstream portion has a wider portion **76** which has an external somewhat larger than bore **71** and the external diameter of the remainder of the venturi means **70**. The wider portion **76** acts as a flange to permit the venturi means **70** to be thrust into bore **71** only up to the beginning of the said wider portion **76**. This arrangement assists in the assembly of the device as the bore **75** of the venturi means **70** is in proper alignment when the wider portion **76** and is in abutment with section **72**.

The degree of delivery of the venturi means **70** depends in part on the diameter of the bore **75**. By presizing the bore of a variety of venturi means it is possible to make available fittings **35** with a predetermined delivery.

The water is drawn up conduit **56** and is entrained with oxygen which is passed through bore **67** into the end of bore **74** and therethrough in the direction of ball **77** which acts as a further atomizer for the oxygen and water mixture. Droplets of water, not properly nebulized will form on the ball **77** and fall therefrom to the bottom inside of horizontally disposed tubular chamber **78**. This chamber **78** will be seen to be perpendicular to the main body **36**.

The chamber **78** has an opening **79** at the bottom thereof with a downwardly descending nipple **80** to which the other end of the water return line **34** is secured. To assist in collecting and leading the droplets of water to the opening **79** a ridge **81** is positioned along the bottom of chamber **78**. This ridge **81** can be best seen from FIGS. **3** and **4**. The ridge **81** extends over the bore **79**. Downwardly depending therefrom is a relatively short projection **82** which assists in the formation of drops for return through water return conduit **34**.

The ball **77** is suspended from the top of chamber **78** by means of downwardly depending spoke **83** which is secured to substantially one end of a small base **84**. The base **84** has somewhat a T-shaped configuration with a ridge **85** at the top thereof. As the chamber **78** is cylindrical the base **84** will touch the inner surface of the chamber along the ridge **85** and the longitudinal side edges **86**. The base is secured to the top of the chamber **78** by integral downwardly depending rails **87** which converge to hold the base **84** securely. The convergence feature provides ease for assembly.

As the spoke **83** is attached to the base **84** at one end, it will be appreciated that when assembled, the ball **77** will be closer to the venturi means **70** when the base is facing in one direction than when it is facing in the opposite. In FIG. **2** the base **84** is secured in the chamber **78** with the spoke at the left side on that the ball is closest to the venturi means **70**. From FIG. **6**, it will be gleaned that the base **84** has been inserted between the rails **87** in an opposite manner. The result being that the ball **77** is not as close.

The device of the present invention is also supplied with means to provide for the addition of a controlled amount of filtered air. Accordingly, body **36** is provided with an orifice **90** at the side opposite to chamber **78**. The orifice **90** is fitted with a filter medium **91** such as a foamed polyurethane disc. The degree of air entrainment is controlled by a slidably mounted arcuate plate **92** which is designed to monitor the effective aperture size with respect to the orifice **90**, as seen from FIGS. **1–3**. The plate **92** is easily moved by thumb projection **93** in a vertical manner. The air is drawn into chamber **94** which surrounds section **48**, **66** and **72** and communicates with chamber **78**.

In operation a 90° elbow **95** is provided and is secured to the open ended portion of chamber **78**, as in FIG. **1**. The other end of the elbow is secured to an elongated flexible conduit **96** which is directed towards the patient. It is important that the elbow **95** be secured so that the end secured to the conduit **96** is facing upwardly. In this manner the droplets of water in chamber **78** will be sure to run towards bore **79** eventually and no liquid water will run into the conduit **96** in the direction of the patient.

As many changes in the described construction could be conceived, and as many changes could be made therein without departing from the spirit and scope of the claims, it is intended that all matter contained in the specification shall be considered or illustrative only and not in a limiting sense.

What is claimed is:

1. A nebulizer adapted to be screwed onto a receptacle having an upwardly facing threaded portion adapted to receive the nebulizer, the receptacle being closed at said threaded portion by a breachable membrane, *said nebulizer* comprising a body having a hollow portion and downwardly facing socket, said socket being threaded whereby the nebulizer may be screwed onto the threaded portion of said receptacle, said socket having concentrically a breaching tubular means adapted for one end to breach said membrane, said body having a venturi means positioned in the hollow portion, the other end of said breaching tubular means being in fluid communication with a conduit terminating at the venturi transverse with the venturi means, a second socket means adapted to receive a connection means from a source of pressurized fluid, said second socket means being in fluid communication with the upstream portion of said venturi means, said body having a chamber means, the downstream portion of said venturi means terminating in said chamber means, said chamber means having a ball means disposed downstream of said venturi and displaced therefrom, whereby fluid emanating from said venturi impinges on said ball, said chamber means having an outlet at the bottom thereof for draining liquid, said chamber means having at the bottom an elongated axially disposed ridge, said hollow portion being at one side in fluid communication with said chamber means, and said body having an opening at substantially the other side thereof in communication with said hollow portion.

2. [The nebulizer of claim **1**] *A nebulizer adapted to be screwed onto a receptacle having an upwardly facing threaded portion adapted to receive the nebulizer, the receptacle being closed at said threaded portion by a breachable membrane, said nebulizer comprising a body having a hollow portion and downwardly facing socket, said socket being threaded whereby the nebulizer may be screwed onto the threaded portion of said receptacle, said socket having concentrically a breaching tubular means adapted for one end to breach said membrane, said body having a venturi means positioned in the hollow portion, the other end of said breaching tubular means being in fluid communication with a conduit terminating at the venturi transverse with the venturi means, a second socket means adapted to receive a connection means from a source of pressurized fluid, said second socket means being in fluid communication with the upstream portion of said venturi means, said body having a chamber means, the downstream portion of said venturi means terminating in said chamber means, said chamber means having a ball means disposed downstream of said venturi and displaced therefrom, whereby fluid emanating from said venturi impinges on said ball, said chamber means having an outlet at the bottom thereof for draining liquid, said hollow portion being at one side in fluid communication with said chamber means, and said body having an opening at substantially the other side thereof in communication with said hollow portion,* wherein [the] *an* elongated axially disposed ridge bridges said outlet and has a member downwardly depending into said outlet from said bridging portion.

3. [The nebulizer of claim **1**] *A nebulizer adapted to be screwed onto a receptacle having an upwardly facing threaded portion adapted to receive the nebulizer, the receptacle being closed at said threaded portion by a breachable membrane, said nebulizer comprising a body having a hollow portion and downwardly facing socket, said socket being threaded whereby the nebulizer may be screwed onto the threaded portion of said receptacle, said socket having concentrically a breaching tubular means adapted for one end to breach said membrane, said body having a venturi means positioned in the hollow portion, the other end of said breaching tubular means being in fluid communication with a conduit terminating at the venturi transverse with the venturi means, a second socket means adapted to receive a connection means from a source of pressurized fluid, said second socket means being in fluid communication with the upstream portion of said venturi means, said body having a chamber means, the downstream portion of said venturi means terminating in said chamber means, said chamber means having a ball means disposed downstream of said venturi and displaced therefrom, whereby fluid emanating from said venturi impinges on said ball, said chamber means having an outlet at the bottom thereof for draining liquid, said hollow portion being at one side in fluid communication with said chamber means, and said body having an opening at substantially the other side thereof in communication with said hollow portion,* wherein a filter is positioned in the opening at the side of the body opposite to the chamber means.

4. The nebulizer of claim **3** wherein the opening has a valve means to control the size thereof.

5. [The nebulizer of claim **1**] *A nebulizer adapted to be screwed onto a receptacle having an upwardly facing threaded portion adapted to receive the nebulizer, the receptacle being closed at said threaded portion by a breachable membrane, said nebulizer comprising a body having a hollow portion and downwardly facing socket, said socket being threaded whereby the nebulizer may be screwed onto the threaded portion of said receptacle, said socket having concentrically a breaching tubular means adapted for one end to breach said membrane, said body having a venturi means positioned in the hollow portion, the other end of said breaching tubular means being in fluid communication with a conduit terminating at the venturi transverse with the venturi means, a second socket means adapted to receive a connection means from a source of pressurized fluid, said second socket means being in fluid communication with the upstream portion of said venturi means, said body having a chamber means, the downstream portion of said venturi means terminating in said chamber means, said chamber means having a ball means disposed downstream of said venturi and displaced therefrom, whereby fluid emanating from said venturi impinges on said ball, said chamber means having an outlet at the bottom thereof for draining liquid, said hollow portion being at one side in fluid communication with said chamber means, and said body having an opening at substantially the other side thereof in communication with said hollow portion,* wherein the said ball is secured to a base means and is

suspended from an internal wall portion of said chamber means, said wall portion having converging rails adapted to receive said base means.

6. The nebulizer of claim 5 wherein the ball is secured to substantially one end of said base means.

7. The nebulizer of claim 1 wherein the breaching tubular means has a radially extending portion adapted to fit said downwardly facing socket to constitute the end thereof and to constitute the bottom of the hollow portion of said hollow body.

8. The nebulizer of claim 7 wherein the breaching tubular means is retained in position by a threaded annular member adapted to be screwed into said downwardly facing socket and to lie in abutment against the underside of said radially extending portion.

9. [The nebulizer of claim 1] *A nebulizer adapted to be screwed onto a receptacle having an upwardly facing threaded portion adapted to receive the nebulizer, the receptacle being closed at said threaded portion by a breachable membrane, said nebulizer comprising a body having a hollow portion and downwardly facing socket, said socket being threaded whereby the nebulizer may be screwed onto the threaded portion of said receptacle, said socket having concentrically a breaching tubular means adapted for one end to breach said membrane, said body having a venturi means positioned in the hollow portion, the other end of said breaching tubular means being in fluid communication with a conduit terminating at the venturi transverse with the venturi means, a second socket means adapted to receive a connection means from a source of pressurized fluid, said second socket means being in fluid communication with the upstream portion of said venturi means, said body having a chamber means, the downstream portion of said venturi means terminating in said chamber means, said chamber means having a ball means disposed downstream of said venturi and displaced therefrom, whereby fluid emanating from said venturi impinges on said ball, said chamber means having an outlet at the bottom thereof for draining liquid, said hollow portion being at one side in fluid communication with said chamber means, and said body having an opening at substantially the other side thereof in communication with said hollow portion,* wherein the said second socket means include an internally threaded rotatable portion.

10. [The nebulizer of claim 1] *A nebulizer adapted to be screwed onto a receptacle having an upwardly facing threaded portion adapted to receive the nebulizer, the receptacle being closed at said threaded portion by a breachable membrane, said nebulizer comprising a body having a hollow portion and downwardly facing socket, said socket being threaded whereby the nebulizer may be screwed onto the threaded portion of said receptacle, said socket having concentrically a breaching tubular means adapted for one end to breach said membrane, said body having a venturi means positioned in the hollow portion, the other end of said breaching tubular means being in fluid communication with a conduit terminating at the venturi transverse with the venturi means, a second socket means adapted to receive a connection means from a source of pressurized fluid, said second socket means being in fluid communication with the upstream portion of said venturi means, said body having a chamber means, the downstream portion of said venturi means terminating in said chamber means, said chamber means having a ball means disposed downstream of said venturi and displaced therefrom, whereby fluid emanating from said venturi impinges on said ball, said chamber means having an outlet at the bottom thereof for draining liquid, said hollow portion being at one side in fluid communication with said chamber means, and said body having an opening at substantially the other side thereof in communication with said hollow portion,* wherein the venturi means comprises a separate tubular means and said nebulizer has a bore in a block means in the hollow portion adapted to operatively accept said separate tubular means.

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