United States Patent [19]

Cambio, Jr.

[11] **3,913,843**

[45] **Oct. 21, 1975**

[54] **HUMIDIFIER**

[75] Inventor: **Orlando D. Cambio, Jr.**, Bristol, Wis.

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

[22] Filed: **Oct. 30, 1974**

[21] Appl. No.: **519,239**

[52] **U.S. Cl.** ..... **239/338**; 261/78 A; 261/98; 128/194

[51] **Int. Cl.²** **B05B 7/30**

[58] **Field of Search** ..... 239/337, 338, 398; 261/DIG. 65, 78 A, 98; 128/194

[56] **References Cited**

UNITED STATES PATENTS

3,213,966	10/1965	Veres et al	239/338 X
3,384,103	5/1968	Lansky	261/78 A X
3,857,909	12/1974	Huggins	261/78 A

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Michael Mar
Attorney, Agent, or Firm—Eric P. Schellin

[57] **ABSTRACT**

A water supply is adapted as a source for humidifying an oxygen stream through the agency of an adapter which couples pressurized oxygen to a container for the water. A venturi type member within the adapter helps to draw water therethrough from the water supply and directs atomized droplets of water and oxygen towards a foraminous filtering member where any surplus entrained water droplets are removed. The humidified oxygen stream passes through the foraminous member and is directed through an outlet nozzle and through a flexible hose to the patient for inhalation therapy. The venturi type member in the adapter is part of an insert which is vertically disposed in the upper socket of the adapter. The main venturi channel is positioned horizontally at the bottom of the insert and the venturi's perpendicular channel communicates with the lower socket of the adapter. Disposed axially below the venturi, a breaching member is positioned in the lower socket of the adapter for piercing a sealing diaphragm across the neck of the liquid container. The adapter is also provided with an annular excess water collecting channel below the foraminous member for draining excess water back into the container. The adapter is further provided with a pressure-relief valve for venting the humidified oxygen stream to the atmosphere whenever the stream exceeds a predetermined pressure.

16 Claims, 8 Drawing Figures

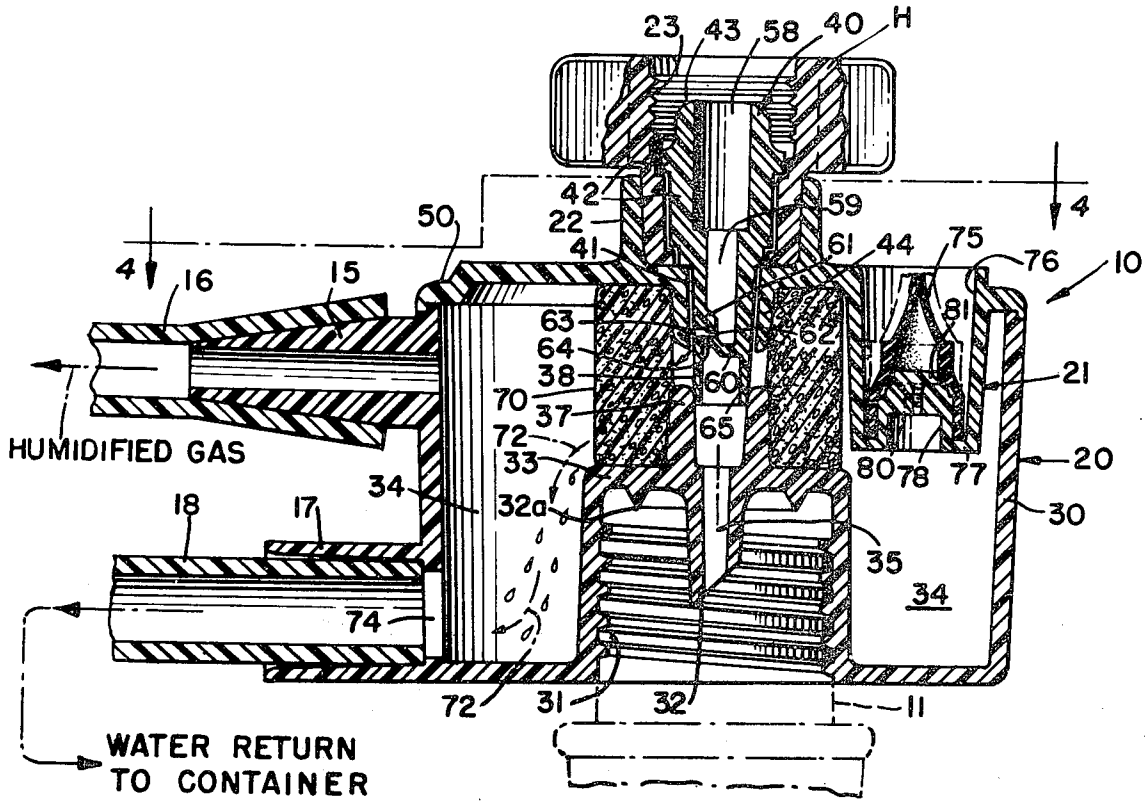


FIG. 1.

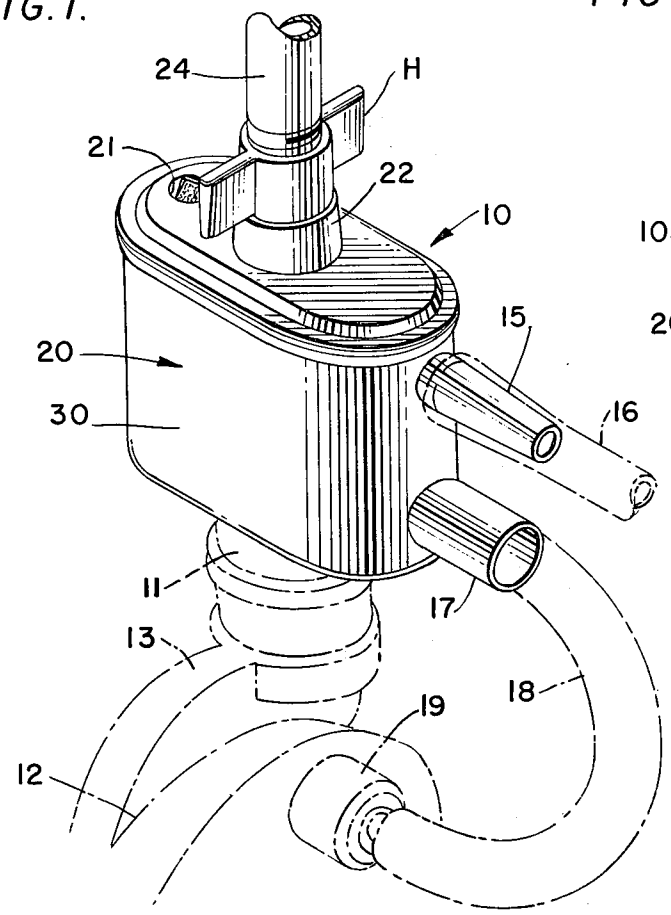


FIG. 2.

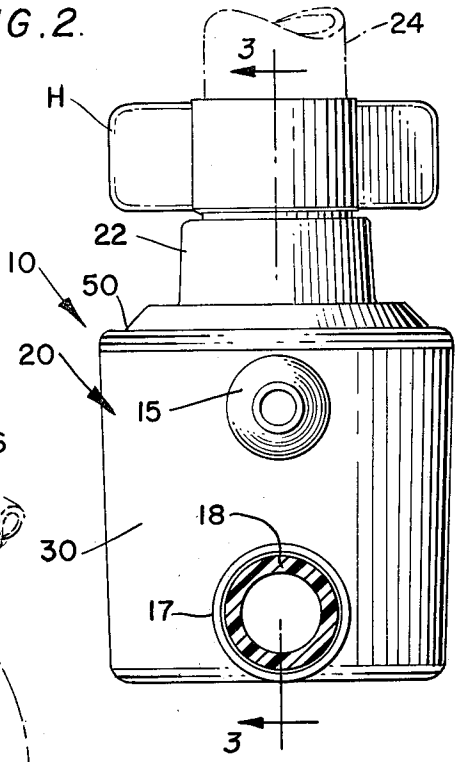


FIG. 3.

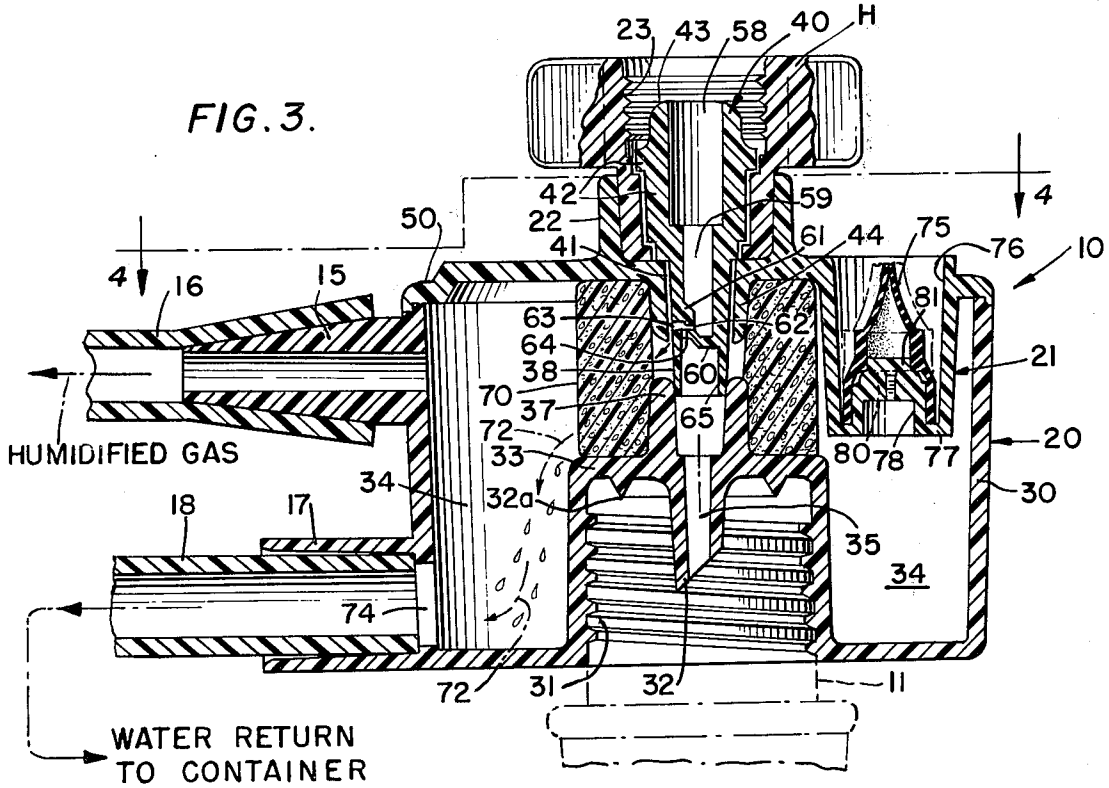


FIG. 4.

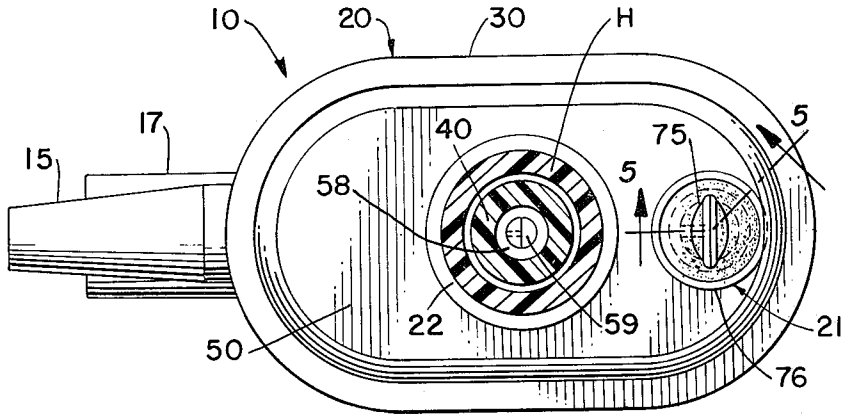


FIG. 5.

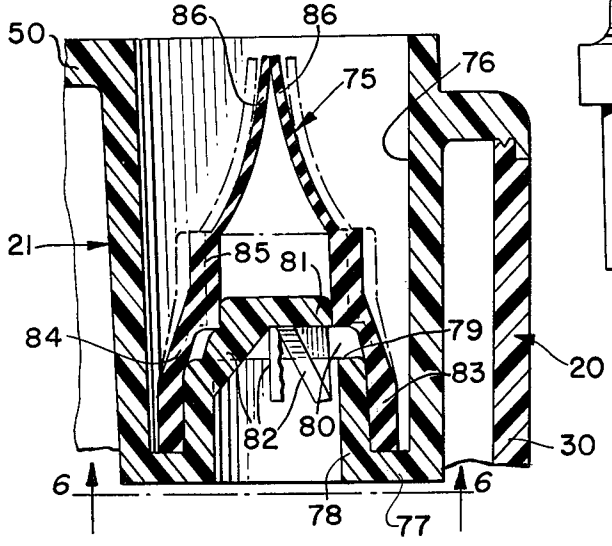


FIG. 7.

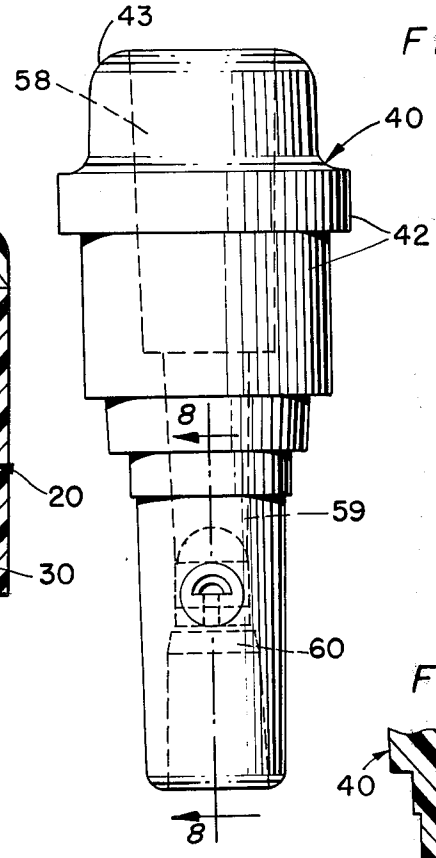


FIG. 6.

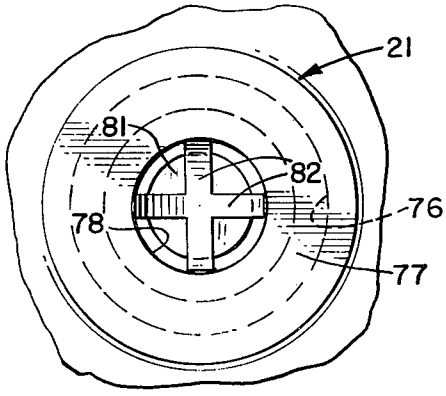
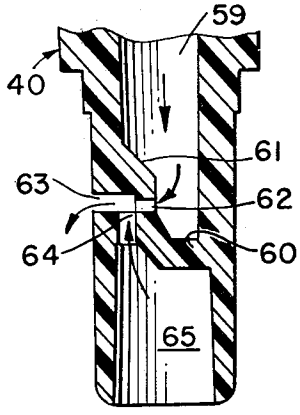


FIG. 8.



HUMIDIFIER

BACKGROUND OF THE INVENTION

The present invention relates to inhalation therapy and more particularly to a humidifier in the form of an adpater for a liquid container.

As indicated in U.S. Pat. No. 3,771,721, issued Nov. 13, 1973, 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, including atomizers and humidifiers, are adapted for effecting such treatments. With respect to atomizers, or nebulizers as they are sometimes called, a heretofore known system for inhalation therapy 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 type member, when associated with the enabling means, adapts the container as a nebulizer reservoir and by itself provides nebulized water in the sense that small droplets of water are carried by the oxygen. Thus, in this form of inhalation therapy, atomized droplets are delivered in an oxygen carrier to the patient.

However, under certain conditions, inhalation therapy calls for the inhalation of oxygen carrying water vapor as opposed to atomized droplets. The present invention constituting the subject matter herein provides for an improved means for providing a water vapor laden oxygen stream utilizing a venturi member to draw up water from a reservoir. The water emerges from the venturi member in the form of entrained atomized droplets which are filtered through a foraminous member interposed in the oxygen stream downstream of the venturi member to restrict the humidification to the water vapor form. The invention thus calls for an adapter which is simple in construction and inexpensive in manufacture. It also provides for a better mode of securing the parts of the device to connecting conduits and to the container constituting the humidifier reservoir.

Accordingly, it is an object of this invention to provide an improved humidifier.

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

It is another object of this invention to generate water droplets with the help of a venturi construction, with the droplets impinging on a foraminous member through which the oxygen stream passes thereby restricting the humidification to the form of water vapor for delivery to the patient.

An additional object of this invention is to improve the quality of a humidified oxygen stream.

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

Moreover, it is an object of the invention to easily return excess water from a humidifier to its associated reservoir.

SUMMARY OF THE INVENTION

To effect the foregoing, a humidifier is provided in the form of a fitting attachable to and which adapts a reservoir of purified water into a source of atomized droplets formed by a Venturi member, hereinafter simply referred to as the venturi, in the fitting. The output channel of the venturi is skirtingly radially directed through an encircling foraminous member at which the Venturi-generated atomized droplets are essentially filtered and thereby passing only vaporized water in downstream of the foraminous member combination with the oxygen stream through the foraminous member to form a humidified oxygen stream. An outlet nozzle is disposed downstream of the foraminous member for directing a flow of humidified oxygen to the patient. Below the preferably annular foraminous member is an outlet channel for receiving excess water droplets which are returned to the fluid reservoir. The adapter fitting is also provided with a pressure-relief valve downstream of the filter.

BRIEF DESCRIPTION OF THE DRAWINGS

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

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

FIG. **2** is a front elevational view of the device shown in FIG. **1**;

FIG. **3** is a longitudinal cross-sectional view taken substantially on line **3—3** of FIG. **2** but with the wing-nut handle fastener rotated 90°;

FIG. **4** is a view of the device of FIGS. **1–3** taken from above, being partially a top plan and horizontal cross-sectional view as seen on line **4—4** of FIG. **3**;

FIG. **5** is an enlarged angular cross-sectional detail view taken on line **5—5** of FIG. **4**;

FIG. **6** is a bottom view of the vent valve housing and mounting stem as might be seen generally on line **6—6** of FIG. **5**;

FIG. **7** is an enlarged elevational view of the unique Venturi insert body member; and

FIG. **8** is a fragmentary cross-sectional detail view taken on line **8—8** of FIG. **7.**

DETAILED DESCRIPTION

Referring now, more particularly to the drawings in FIG. **1,** an adapter fitting **10,** preferably having an oval shape in top plan view, is shown mounted on a neck portion **11** of a container similar to that described in the aforementioned U.S. Pat. No. 3,771,721. Neck portion **11** is provided with male threads to receive fitting **10.** Only the top portion of the container is illustrated, and this top portion is indicated by reference numeral **12.** A duct **13** extends above top portion **12** and communicates with the bottom of the container so that the purified water contained therein may pass through duct **13** and neck **11** into adapter fitting **10.** Adapter fitting **10** is provided with an upper outlet nozzle **15** to which is attached a flexible hose **16** through which is delivered a humidified oxygen stream. Adapter fitting **10** is also provided with a lower outlet pipe **17** adapted to have connected thereto one end of a flexible pipe **18** whose other end leads back to a fitting **19** on the top of the container. Flexible pipe **18** functions not only to primarily equalize the pressure of head space of the container with that of the outlet of the venturi, but also permits excess water to be returned via drain pipe **18** to the reservoir to be used for further humidification. Fitting **19** and flexible pipe **18** thereby assure that any back pressure which might be created by the various downstream patient devices will not affect the lift characteristics of the venturi. Without the drain tube **18,** back pressure would cause the oxygen to divert down into the container or bottle.

As further illustrated in FIG. 1, adapter fitting 10 may compositely include a housing body 20 including in a top portion thereof with an integrally formed relief valve housing 21 to be further described hereinafter. A handle member H, preferably of the wing nut type, is rotably mounted within a collar 22 on the housing body 20 and has a threaded recess forming an upper socket 23. An oxygen delivery pipe 24 is threaded into the upper socket 23 for supplying oxygen to adapter fitting 10. The front elevational view of FIG. 2 and the top view of FIG. 4 further illustrate the external parts of the adapter.

Referring now to FIG. 3, adapter fitting 10 is illustrated in cross-section. Housing body 20 of adapter fitting 10 is comprised of a preferably oval tub-like bottom housing member 30 and a top cover or housing member 50, both preferably made of molded plastic. Bottom housing 30 includes an integrally formed lower socket member 31 having integrally formed peripheral screw threads to complementally attach it to the thread neck 11 of container 12. This lower socket member projects up into bottom housing member 30 to form a generally oval-shape channel 34 at the base of which the lower outlet pipe 17 projects. Outlet nozzle 15 is integrally formed with bottom housing member 30 and is located immediately above the outlet pipe 17, which is also integrally formed with bottom housing member 30.

Lower socket 31 has a transverse inner wall 33 provided with an axially extended breaching member 32 which depends downwardly from the said inner wall 33, with the bottom cutting edge of the breaching member extending midway down socket member 31. Breaching member 32 is provided with an axial bore 35 and an annular seat formed by upwardly extending annular wall 37. This seat receives a downwardly projecting portion 38 of a venturi insert 40 adapted to be carried axially within the handle member H. Wall 33 may also be provided with an annular concentric sealing lip 32*a* to better seal the fitting 10 onto the container's neck portion 11.

Insert 40, in one acceptable form as shown, is in axial alignment with the upper socket 23 and serves to fasten handle member H to the top housing member 50 so that the handle can rotate with respect to the adapter's housing. In fabrication, insert 40 is slipped into socket 23 and is passed through a downwardly sleeved orifice 41 in the top housing member 50. Insert 40 may be secured to top portion 50 in any conventional manner at sleeved orifice 41 and/or at the seat formed by the annular wall 37. Once the insert 40 is secured to either the top and/or the bottom housing members 30 and 50, two shoulders 42 on the insert co-act with mating shoulder portions of socket 23 to help hold handle member H in place. As can be seen, venturi insert 40 is also provided with a rounded upper portion 43 which co-acts with the bottom of pipe 24 to form a fluid tight seal.

Top housing member 50 is provided with the preferably integrally formed cylindrical sleeve 44 which extends downwardly to constitute or define the sleeved orifice 41.

Turning again to the insert, insert 40 is provided with an axial channel 58 commencing at the top end, which channel is narrowed at an inward portion 59 having transverse wall 60 and venturi housing projection 61 within the insert. A venturi (FIG. 8) is formed within the projection 61 so that a narrow first horizontal venturi channel 62 is formed transversely to the axial channel 58. Channel 62 connects with a slightly enlarged horizontal second venturi channel having an outlet orifice 63 as illustrated. Intermediate the orifice 63 and the inner opening of venturi channel 62 is a downwardly perpendicular water hole or channel 64 which extends downwardly and communicates with an integrally formed conduit 65. As shown, the I.D. of conduit 65 preferably is of larger cross-section than inner portion 59 of the axial channel 58 and communicates with bore 35 of the breaching member 32.

As can be seen, once the diaphragm sealing the container neck 11 is pierced by breaching member 32 when the lower socket is threaded onto container neck 11, a fluid path exists from the conainer through bore 35 to the venturi formed by channels 62 and channel 63. When oxygen under pressure is introduced through conduit 24 into bore 58, the venturi induced flow as indicated by the arrows (FIG. 8), sweeps past the water hole channel 64 forming a suction and thereby drawing the liquid from the reservoir container 12 up through bore 35 in the breaching member 32. Atomized droplets are then formed at orifice 63 which ultimately impinge upon foraminous member 70 which encircles and is interposed downstream of the venturi in the path of the flow. This filter member 70 may either be a reticulated polyurethane foam having a porosity sufficient to permit flow of oxygen therethrough at a predetermined rate, or any foraminous material such as a microporous filter in which the atomized droplets may be entrained or interstitially held. The sleeve 44 is of a length to slightly overlay the venturi orifice 63, thereby baffling the stream of humidified oxygen leaving the venturi to help improve the suction or lift of the water from container 12. When the humidified oxygen passes through the foraminous member 70 any excess water droplets are absorbed thereby, to assure that only vaporized water is entrained in the oxygen stream. The humidified oxygen stream then passes through outlet nozzle 15 while excess water, as indicated by arrow 72, drops to the bottom of the oval shape cavity 34. This water then proceeds through an aperture 74 provided in the lower portion of the adapter housing and out through flexible pipe 18 which is preferably fixedly held as by bonding in place within outlet pipe 17.

Radially adjacent the foraminous member 70 is the relief valve housing 21 within which is disposed a pressure-relief valve 75 located within a preferably cylindrical pocket 76 in the top housing member 50. A bottom wall 77 of the pocket 76 is preferably molded into a generally hollow cylindrical (FIG. 5) stem 78 concentrically within and spaced radially from the relief valve housing wall 21. Stem 78 has a generally annular top shoulder 79 (FIG. 5) forming a vent passage 80 between it and a preferably reduced diameter top wall 81 held in place by a plurality of web or gusset members 82 as shown in FIG. 5. The stem 78 is designed to receive thereon the inside diameter of a cylindrical stem 83 of a uniquely modified, novel, molded duck bill type of audible relief valve 75. The valve 75 has a tapered reduced thickness wall 84 between thicker axially spaced stem portion 83 and intermediate wall portion 85, (FIG. 5) the latter of which converges into the duck bill portion constituted by vibratable opposed flexible wall portions 86, 86 adapted to vibrate and produce an audible signal when gas flows between them. The re-

duced thickness tapered wall **84** acts as a hinge to permit expansion and lifting of intermediate thicker wall portion **85** allowing it, at a predetermined pressure, to unseat from around the sides of top wall **81** and open the valve passage **80.** Accordingly, oxygen flow exceeding a predetermined pressure is audibly vented to the atmosphere through the duck bill end in a novel, audible manner.

It is apparent that there has been provided an adapter fitting for a container in which a rotatable winged-nut-like handle portion H contains an insert which includes a venturi, one portion of which communicates with the liquid in the container so that an atomized stream of water droplets is produced when oxygen under pressure is introduced into the venturi. The resulting atomized stream passes through the foraminous filter material which basically filters the droplets to assure passage only water vapor laden oxygen to provide the more desired form of humidified oxygen. Excess water not carried off by the oxygen stream is returned to a chamber at the bottom of the adapter and is carried off through the outlet orifice **74** at the bottom of the adapter for draining off the excess water back into the fluid reservoir **12** via pipe **18.** In this manner a humidified oxygen stream as opposed to an oxygen stream carrying atomized droplets is provided for inhalation therapy.

Various changes and modifications may be made by those skilled in the art without departing from the scope of the inventive concept as defined in the annexed claims.

What is claimed is:

1. A humidifier device particularly adapted for use in an inhalation therapy system, and adapted to be connected to both a source of liquid and also to a pressurized gas stream, and having means for channeling and directing a humidified gas stream issuing therefrom to a predetermined use, said humidifier device comprising in combination:

a. venturi means including an insert body carried in said deivce and having a generally vertical upper main flow channel and a transverse venturi channel generally perpendicular to said main flow channel; said venturi channel having an exit port in said insert body communicating downstream thereof with said means for channeling and directing the humidified gas stream to a predetermined use; said venturi channel also having an intermediate port connecting said venturi channel with a generally vertical lower channel or conduit at least operatively connected with said insert body;

b. means for connecting said main flow channel to said pressurized gas stream;

c. means for connecting said lower vertical channel of said insert body to said liquid source, whereby the flow of gas down through said upper main flow channel and through said venturi channel creates a suction on said intermediate port thereof such that droplets of said liquid are drawn through said generally vertical lower channel and are aspiratively carried by said gas exiting said venturi channel;

d. foraminous means spaced adjacent from said venturi exit port for filtering out said droplets while permitting the flow of gas therethrough so that essentially only a liquid vapor passing from said foraminous means is carried in the gas stream exiting therefrom and directed via said channeled gas stream to said predetermined use.

2. The humidifier device of claim **1** further including in combination therewith liquid collecting receptacle means downstream of said foraminous means for collecting excess liquid from said foraminous means and for returning said excess liquid to said liquid source.

3. The humidifier device of claim **2,** further including in combination therewith pressure relief means located downstream of said foraminous means within said liquid collecting receptacle means, for venting said vapor-laden gas to the atmosphere when said vapor-laden gas exceeds a predetermined pressure.

4. The humidifier device of claim **3** wherein said means of paragraph (c) for connecting said lower vertical channel to said liquid source includes a lower socket-type connector on said liquid-collecting receptacle having within said socket membranebreaching means carried thereby and adapted to breach a membrane for sealing aseptic liquid within a receptacle of the liquid constituting the liquid source.

5. The humidifier device of claim **1** wherein said means for connecting said upper vertical main flow channel to said pressurized gas flow includes an upper connector having an upwardly opening conduit-receiving socket and a handle portion integral therewith; said socket having a smaller downward leading opening to supportingly receive therethrough said insert body of paragraph (a) so that said upper main flow channel of said insert body is in fluid communication with said conduit-receiving socket; said venturi channel lying in a generally horizontal plane when said insert body is generally vertically disposed in said upper connector.

6. The humidifier device of claim **5** wherein said means of paragraph (c) for connecting said lower vertical channel to said liquid source includes a lower socket-type connector having membrane-breaching means carried thereby; a seat at the top of said latter-mentioned socket; said seat adapted to receive a lower end of said lower vertical channel or conduit of said insert body when the latter is in place, and said seat having an orifice providing fluid communication between said lower vertical channel and said liquid source via said latter-mentioned socket and said membrane breaching means.

7. The humidifier device of claim **2,** wherein said means for channeling and directing a humidified gas stream to a predetermined use includes an outlet nozzle downstream of said foraminous means and adjacent thereto disposed on an upper part of said liquid collecting receptacle for channeling the vapor-laden gas stream from said foraminous member in said predetermined direction.

8. The humidifier device of claim **3** wherein said pressure relief means includes an audible duck bill type of flexible relief valve mounted therein downstream of said venturi channel.

9. The humidifier of claim **1** wherein said device includes sleeve means closely surrounding a portion of said insert body intermediate it and said foraminous means of paragraph (d); and said sleeve means including a sleeve having one end terminating adjacently below said venturi exit port.

10. A humidifier fitting adapted to be mounted on the neck of a container having a breachable seal sealing therein a source of pure water, and to be connected to

a conduit containing a pressurized gas stream for providing a humidified gas flow from the container-attached fitting, said fitting comprising in combination:

a. a lower housing member having endless peripheral side walls and a bottom, said lower housing member having a first socket member extending upwardly from said bottom and generally centrally located with respect to said peripheral side walls so as to define curvalinear fluid chamber between said side walls and said first socket member, said first socket member having a top member and a membrane-breaching member integrally formed with and depending downwardly from said top member, said membrane-breaching member having an axial channel therethru, a seat integrally formed with said top member and having an opening in fluid communication with said axial channel, said lower housing member having an outlet pipe at the bottom of said lower housing member and in fluid communication with said curvalinear chamber; an outlet nozzle positioned above said outlet pipe in fluid communication with the interior of said lower housing member;

b. an upper housing member including a top wall having an upwardly opening socket and a rotatable handle member mounted for rotation in said latter socket, said rotatable handle member having a central conduit-receiving socket and recessed aperture;

c. an insert body positioned in said recessed aperture and extending therethrough such that said insert body depends downwardly into said lower housing member, said insert body having a vertical channel and a horizontal venturi channel below said upper housing member, said venturi channel having an exit orifice in said insert body, said insert body having a lower conduit portion which complementarily mates with said seat of said first socket top member, said lower conduit portion of said insert body having a channel in fluid communication both with said axial channel in said membrane-breaching member and with a narrowed channel portion in fluid communication with and disposed perpendicular to said horizontal venturi channel to form a venturi; and

d. a foraminous member disposed between said venturi exit orifice and said outlet nozzle and outlet pipe.

11. The humidifier fitting of claim **10,** wherein said upwardly opening socket and said handle member have complemental shoulders; said handle member having inner stepped shoulders; and said insert body including shoulders which mate with said inner stepped shoulders of said handle member, all collectively acting to maintain said handle member in proper assembly in said upwardly opening socket of said upper housing member.

12. The humidifier fitting of claim **10** and further including pressure relief means positioned in said upper housing member between said foraminous member and said outlet nozzle.

13. The humidifier fitting of claim **11,** and further including a projection integrally formed in said insert body projecting into said vertical channel immediately above said horizontal venturi channel thereby to commence a positive substantial restriction of said vertical channel immediately above said horizontal venturi channel.

14. The humidifier fitting of claim **13,** and further including a sleeve member extending downwardly from said upper housing member and co-acting in slightly spaced relation around said insert body venturi orifice to help baffle said humidified gas stream exiting from said venturi orifice thereby improving its lift effectiveness; said sleeve member also of a size and disposed to help position and carry said foraminous member in spaced surrounding spaced relation to said venturi orifice and insert body.

15. The humidifier fitting of claim **14** and further including pressure relief means positioned in said upper housing member between said foraminous member and said outlet nozzle.

16. The humidifier fitting of claim **15,** wherein said pressure relief means includes an audible duck bill type of flexible relief valve member cooperating with a sleeved valve support and seat on said upper housing member.

* * * * *