United States Patent [19]

Huggins

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[54] **GAS HUMIDIFICATION APPARATUS**

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[73] Assignee: **Med-Pak Corporation,** Charlestown, W. Va.

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[52] **U.S. Cl.**..... **261/121 R,** 128/188, 261/DIG. 65

[51] **Int. Cl.**..... **B01f 3/04,** A61m 15/00

[58] **Field of Search** ..... 128/185, 186, 188, 194; 261/DIG. 65, 77, 78 A, 122, 123; 222/400.7, 153

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[57] **ABSTRACT**

Apparatus for administering humidified gas (e.g., oxygen) to a patient includes a one-piece plastic connector having a tubular portion for connection to an oxygen supply, a tubular spike portion, and a smaller diameter oxygen supply tube within the spike portion and extending beyond the end of the spike portion for first piercing the stopper in an intravenous solution bottle. The spike portion enlarges the hole pierced by the oxygen supply tube. The oxygen from the supply tube is delivered to the bottom of the bottle and bubbles upwardly through the liquid therein. The humidified oxygen enters a chamber formed by that part of the bore of the spike portion that is not occupied by the gas tube. The humidified gas then leaves the chamber and enters a conduit on the connector that is connected to a nasal cannula.

3 Claims, 6 Drawing Figures

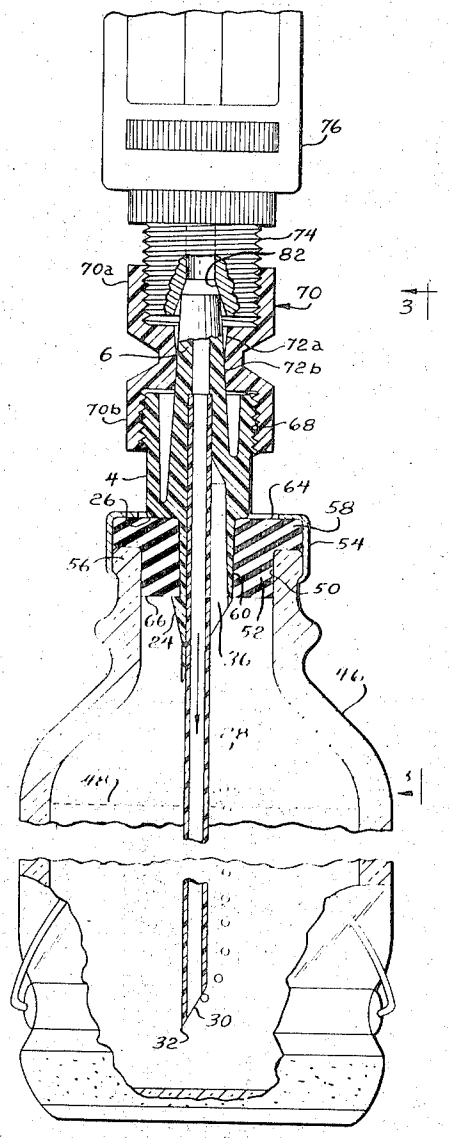

Fig. 1

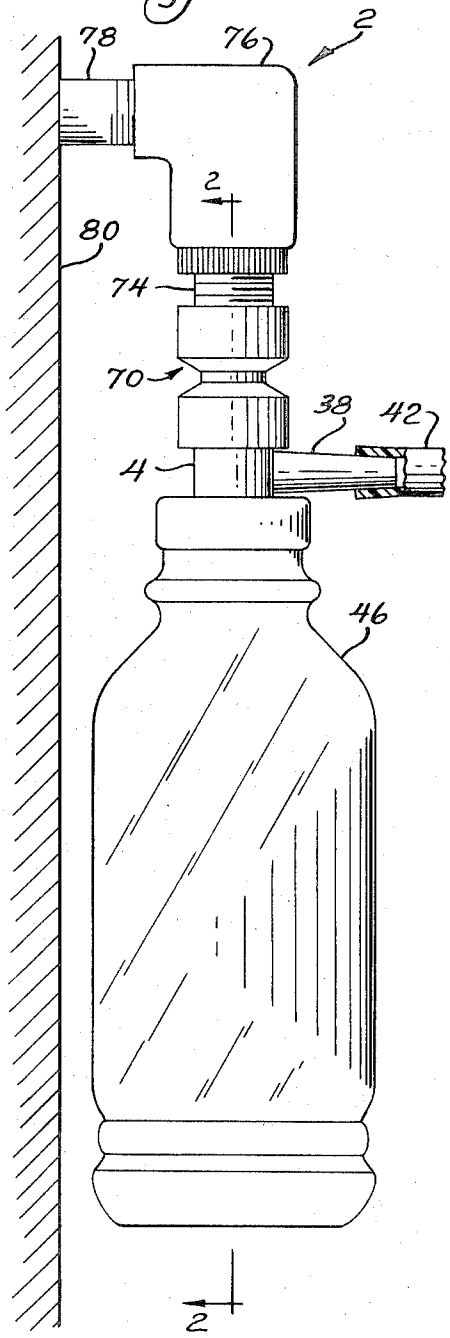
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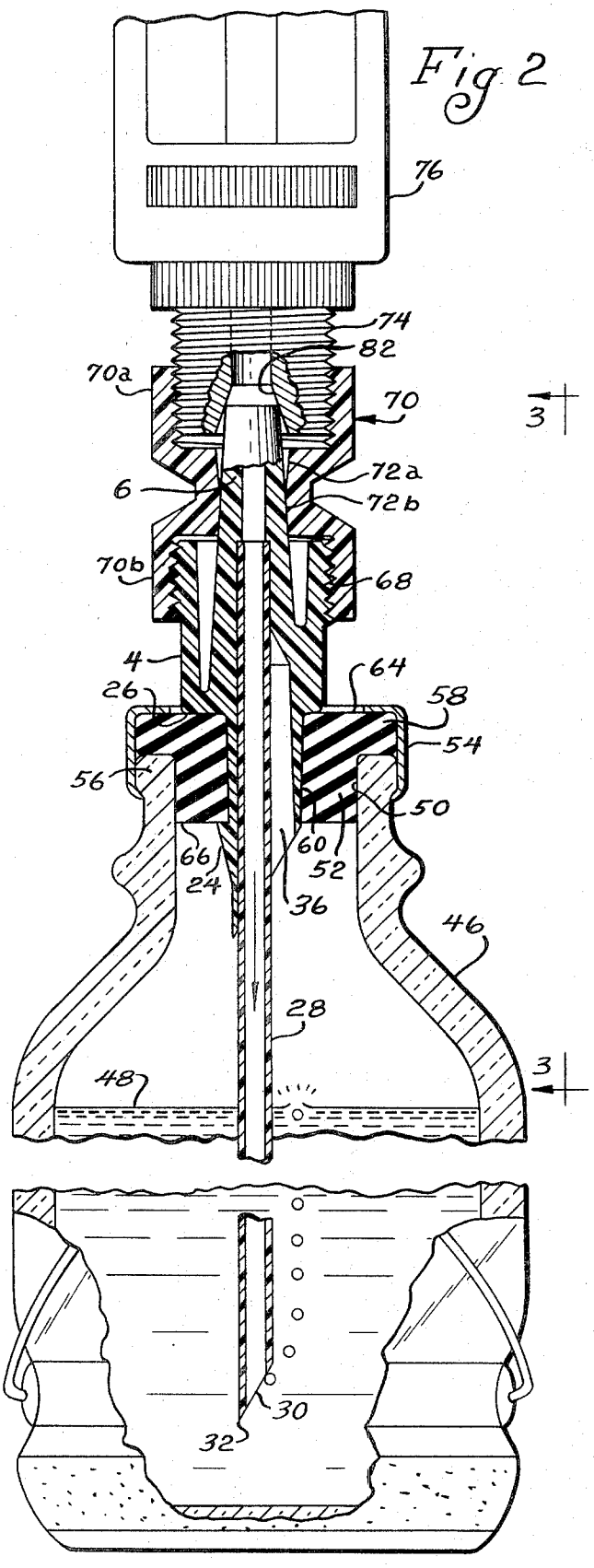
Fig. 2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70b
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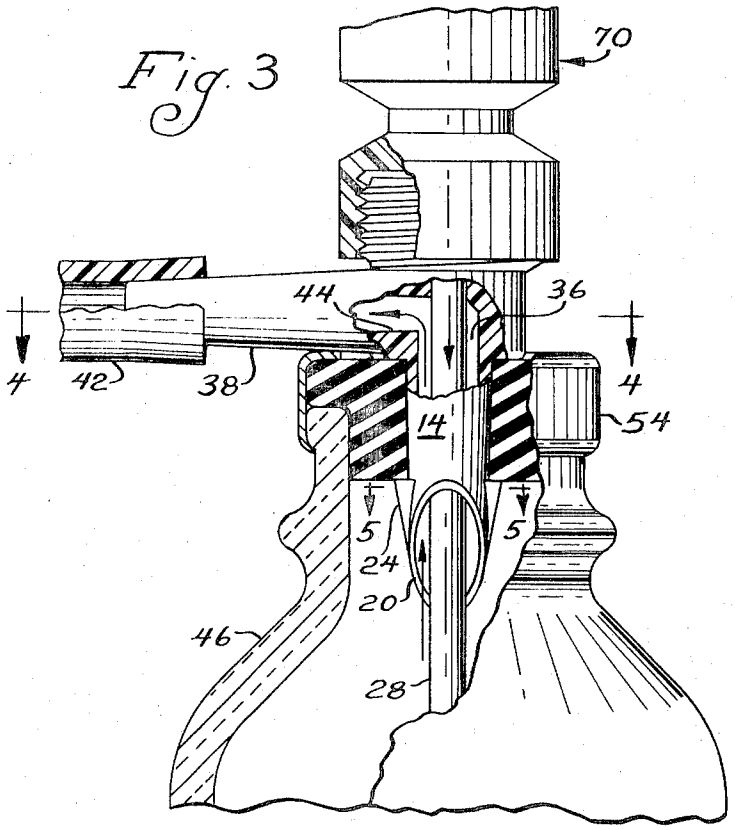
Fig. 3



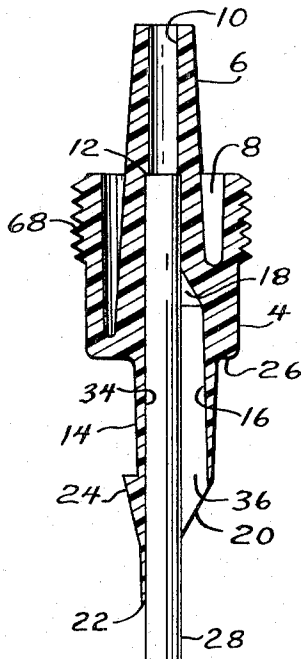
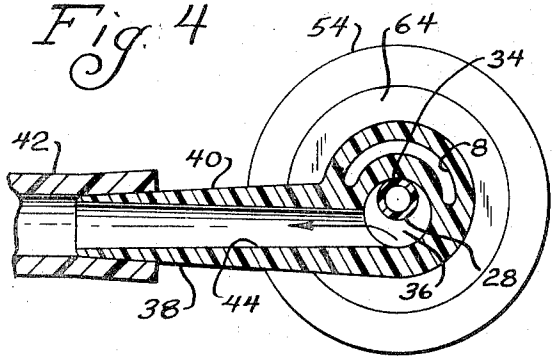


Fig. 4



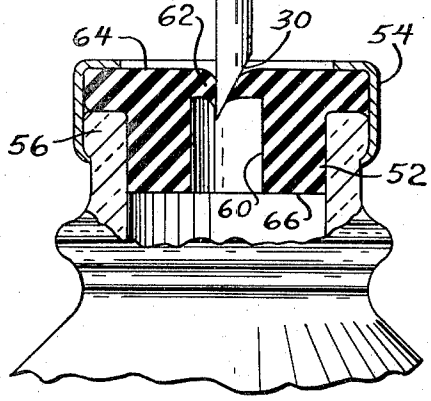
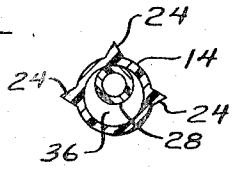


Fig. 6

Fig. 5



GAS HUMIDIFICATION APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to improvements in apparatus for gas humidification systems, particularly systems for humidifying oxygen prior to delivery to a patient. It is well known that the oxygen in conventional supply tanks used by hospitals has a relatively low humidity, and for this reason the oxygen cannot, in many instances, be directly administered to the patient. As a result, the oxygen is frequently passed through humidifiers prior to being delivered through a nasal cannula to the patient. The oxygen or oxygen-containing gas is usually humidified by bubbling the gas through a reservoir of water, saline solution, or other medicated solution.

In order to maintain sterility, I have previously proposed utilizing a standard intravenous solution bottle as the reservoir through which the gas is bubbled. The intravenous solution bottle has the advantage that it contains its own sterilized supply of water or other solution. Also the bottle is disposed of after use. Thus, assuming proper handling procedures, sterility is preserved.

One problem with my aforesaid prior proposal is the fact that a special type of stopper has been required. This adds considerable to the cost to the hospital (and hence to the patients) because these bottles with special stoppers must be separately inventoried. Since the stoppers are of special construction the intravenous solution bottles are often not adaptable to medical procedures in which intravenous solution bottles of the conventional type and with conventional stoppers are used.

OBJECTS AND SUMMARY OF THE INVENTION

An object of this invention is to provide a gas humidification system that utilizes conventional intravenous solution bottles having conventional stoppers therein, whereby the hospital does not need to inventory bottles with specially constructed stoppers for use with oxygen humidification procedures that utilize such bottles as the solution reservoir.

A further object of this invention is to provide a novel connector which forms part of the system and which serves as the principal component that facilitates the use of conventionally stoppered intravenous solution bottles in the system.

It is a further and more specific object of the present invention to provide a connector of the type and for the purpose stated that is adapted to puncture a conventional intravenous solution bottle stopper, and wherein the connector prevents accidental removal thereof from the bottle stopper while also permitting the bottle to be suspended from the connector.

In accordance with the foregoing objects the connector of the present invention comprises a body with a first tubular means for connection to a gas supply, such as the outlet of a metering valve. The gas is typically oxygen, but it may be ordinary air, or air modified by additional oxygen. The body also includes a second tubular means which is a spike portion for piercing the stopper or like closure for the container. A third tubular means is comprised of a gas supply tube of smaller diameter than that of the tubular spike portion and telescoped therein. The gas supply tube extends outwardly

beyond the puncturing end of the spike portion a sufficient distance so that when the connector is in proper position on the stopper, the lower end of the gas tube will be near the bottom of the solution bottle. The free end of the gas tube is constructed to perforate initially the bottle stopper following which the spike portion enlarges the hole made by the gas tube and seats on the top of the stopper. Barbs on the spike portion retain the latter in place and also permits the stoppered bottle to be suspended from the spike portion. Gas bubbling up from the gas supply tube leaves the surface of the liquid in a humidified condition and then flows to a chamber that is formed by the part of the spike portion bore that is not occupied by the gas tube. This chamber at which the humidified gas is collected is in communication with a conduit member that is also part of the connector body and which is adapted to be connected to a nasal cannula for transmitting the humidified gas to the patient.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a fragmentary side elevational view of gas humidifying apparatus constructed in accordance with and embodying the present invention;

FIG. 2 is a fragmentary sectional view, on an enlarged scale, taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary elevational view, partially broken away and in section, as seen from line 3—3 of FIG. 2;

FIGS. 4 and 5 are fragmentary sectional views taken along lines 4—4 and 5—5 respectively of FIG. 3; and

FIG. 6 is a sectional view showing a step in the assembly of the connector of the present invention with a conventional intravenous solution bottle.

DETAILED DESCRIPTION

Referring now in more detail to the drawing, which illustrates a preferred embodiment of the present invention, there is shown an apparatus 2 that includes a connector 4 that is in the form of a molded plastic body of high density of polyethylene or other suitable material. The connector 4 includes a first tubular portion or stem 6 for connection to a source of gas as will hereinafter be more fully described. The stem 6 extends upwardly from an annular cavity 8 in the body, the stem 6 being externally tapered as best seen in FIGS. 2 and 6. The bore 10 of the stem 6 is generally cylindrical and has a shoulder 12 intermediate its ends. Downwardly from the shoulder 12 the bore 10 is of slightly enlarged diameter.

The connector 4 also integrally includes a second tubular portion in the form of depending spike 14 having a bore 16 that is of a diameter substantially larger than that of the bore 10. Thus, the upper portion 18 of the bore 16 tapers upwardly to merge with the lower end of the bore 10. It will also be noted that the central axis of the bore 10 is eccentric to the central axis of the bore 16. The lower end of the spike 14 has a bevel 20 whereby the tip 22 of the spike 14 provides a piercing or penetrating end. Upwardly from the tip 22 the spike 14 is externally provided with barbs 24 which are circumferentially spaced about the spike, as best seen in FIG. 5. The distance between the barbs 24 and the lower external surface 26 of the connector is a predetermined amount to facilitate sealing and gripping with

a bottle stopper for reasons presently more fully apparent.

Rigidly mounted within the lower portion of the bore **10** is a third tubular member or gas supply tube **28** which is preferably formed of the same material as that of the connector body **4**. The external diameter of the gas supply tube **28** is such as to fit snugly within the lower portion of the bore **10** so that the end of the gas supply tube **28** seats against the shoulder **12**. The gas supply tube **28** and connector **4** may be maintained in assembled relationship by the friction fit therebetween, or suitable adhesive may be used for this purpose. The gas supply tube **28** extends downwardly beyond the tip **22** of the spike **14** and terminates in a beveled end **30** that provides a sharp penetrating point or tip **32**. It will also be seen that the tube **28** is substantially coaxial with the bore **10** but is eccentric to the axis of the bore **16**, the eccentricity being such that the tube **28** abuts the wall surface of the bore **18** along a line of tangency **34** that extends to the tip **22**. It will thus be seen that since the gas tube **28** has an external diameter that is substantially smaller than the diameter of the bore **16**, the bore **16** and the tube **28** cooperate to define a chamber **36**. Viewed another way, the chamber **36** is comprised of the part of the bore **16** that is unoccupied by the tube **28**.

Also integrally formed on the connector body **4** is a lateral or horizontal conduit **38** having a tapered exterior surface **40** for receiving a conventional nasal cannula **42**. The conduit **38** is substantially at right angles to the spike **14** but with the central axis of the bore **44** of the conduit **38** being offset from the central axis of the bore **16** of the spike **14**. Nevertheless, the bore **44** is in direct communication with the upper end of the chamber **36** to provide a passageway for gas from the chamber **36** to flow into the nasal cannula **42** for delivery to the patient.

The intravenous solution bottle **46** is typically a glass container that constitutes a reservoir for liquid **48** which may be sterile water, saline solution or other medicated solution. At its upper end, the bottle **46** is of a standard construction. Thus, there is an opening **50** of standard size and at which is a closure, such as a rubber or rubber-like resilient stopper **52**. The stopper **52** is clamped in place by a metal clamping ring **54** that underlies the top bead **56** of the bottle and overlies the peripheral flange **58** of the stopper. The stopper **52** also conventionally includes a central cylindrical hole **60** which opens at the bottom of the stopper but is closed off at its top to provide a membrane **62** (FIG. **6**) that is adapted to be pierced when access to the solution within the bottle **46** is desired. In some instances the exposed part of the stopper may be covered with a disc to preserve sterility. If this is not done the top of the membrane **62** may be wiped with an alcohol swab just prior to piercing the same. In any event the external diameter of the gas tube **28** is substantially less than the diameter of the hole **60** whereas the external diameter of the spike **14** between the barbs **24** and surface **26** is preferably slightly greater than the diameter of the hole **60**. Furthermore, the distance between the barbs **24** and the surface **26** is preferably slightly less than the overall thickness of the stopper **52**, that is between its top and its bottom surfaces **64**, **66**.

As pointed out previously, the stem **6** is intended for connection to a source of gas supply whereby gas can be delivered through the bore **10** and to the gas supply tube **28**. Various means may be provided for coupling the connector **4** to the gas supply. By way of example but not of limitation, the connector has an external thread **68** surrounding the base portion of the stem **6** for threaded connection with the internal thread of a plastic coupling **70**. The plastic **70** is symmetrical, as seen in FIG. **2**, in that it has two opposed internally threaded sections **70***a*, **70***b*, of like construction. Within the coupling **70** are opposed conically tapered surfaces **72***a*, **72***b*, one of which is adapted to seat against the external, conically tapered surface of the stem **6**. This forms a seal with the stem **6**. The symmetry of the coupling **70** permits it to be threaded onto the connector **4** at either end, namely utilizing the section **70***a* or the section **70***b*. The section of the coupling **70** that is not threaded onto the thread **68** is threaded onto a thread **74** (which may be a pipe thread) that forms part of the discharge end of an oxygen supply valve **76**. This valve is used to control or meter the flow of gas into the humidification system. The flow control valve **76** may, as shown in FIG. **1**, take the form of a right angle or elbow whereby the inlet end of the valve **76** is connected to a threaded nipple **78** that projects outwardly from a wall or other support **80**. The thread **74** and the thread on the nipple **78** may be pipe threads so that seals are formed with the mating threads. Also, as seen in FIG. **2**, the threaded stem of the valve **76** has an internal bore with a tapered entrance end **82** against which the free end of the stem **6** firmly engages.

It will also be apparent that a plastic coupling **70** of the type previously referred to need not be used, depending upon the construction of the outlet device for supplying the oxygen. For example, the tapered shape of the stem **6** readily facilitates connection to a flexible tube or other coupling from which gas may be supplied.

In use the connector **4** with its attached gas tube **28** is mounted on the intravenous solution bottle **46**. This is done by first causing the tapered end of the tube **28** to pierce the membrane **62**, as shown in FIG. **6**, following which the spike **14** enlarges the hole made by the tube **28** so that only one opening is formed in the stopper, and this opening is approximately the size of the membrane **62**. As the spike **14** is firmly pressed so that its surface **26** engages the top surface **64** of the stopper, the barbs **24** will underlie the bottom surface **66** of the stopper. A seal will be formed between the external surface of the spike **14** and the stopper **52**.

It should be noted that the preassembled connector **4** and gas tube **28** can be packaged in a sterile wrapper. The end of the wrapper adjacent to the piercing end **30** of the gas tube can be peeled back to permit insertion of the beveled end **30** into the membrane **62** while gripping the connector body **4** through the sterile wrapping. This, of course, enhances the sterile condition of the connector **4** since the gas tube **28** and the spike **14** do not have to be grasped or otherwise touched by the human hand. When the connector and gas tube are assembled with the stopper as shown, for example, in FIGS. **2** and **3**, the lower end **30** of the gas tube **28** will be near the bottom of the bottle, the length of the gas tube **28** being designed in accordance with the standard height of the bottle **46**.

The coupling **70** may then be threaded onto the threads **74** and **68** preparatory for turning on the oxygen by means of the valve **76**. When the coupling **70** is used in the arrangement here described, the solution

bottle 46 is suspended from the spike 14. The barbs 24 permit this suspension of the bottle through the stopper 52. Even where the solution bottle is not suspended the barbs otherwise prevent accidental withdrawal of the connector 4 from the stopper 52.

When the gas supply is turned on, the gas flows through the bore 10 and tube 28 and is bubbled upwardly through the liquid 48, as best shown in FIG. 2. The humidified gas then enters the chamber 36 and from there is conveyed to the bore 44 of the conduit 38 and then to the nasal cannula 42.

The invention is claimed as follows:

1. A connector assembly for use in a gas humidification system that includes a container with liquid and an opening with a closure therein, said connector comprising a body having first tubular means for receiving gas from a gas supply, a threaded coupling cooperable with said body for connecting said first tubular means to the gas supply, second tubular means, third tubular means telescoped within said second tubular means and being in communication with said first tubular means, said third tubular means having a sharp pointed end for piercing a hole in the closure, an end portion of said second tubular means being cross-sectionally larger than said third tubular means and shaped to enlarge the hole pierced by said pointed end, said end portion of said second tubular means being barbed to prevent accidental withdrawal of said connector assembly from the closure and to permit the container to be suspended from said connector assembly, said third tubular means and said second tubular means defining a chamber that is part of the bore of said second tubular means, a part of said third tubular means that includes said pointed end extending beyond end portion of said second tubular means for immersion in the liquid of the container such that gas will flow from said first tubular means through said third tubular means into the liquid to humidify the gas and the humidified gas will then flow from the surface of the liquid into said chamber, and means forming a conduit for conveying said humidified gas from said chamber, said conduit projecting laterally from said second tubular means and having a decreasing external diameter in a direction away from said second tubular means for telescopically receiving a nasal cannula.

2. A connector according to claim 1 in which said body is a one-piece plastic member that includes said second tubular means and said conduit means.

3. Apparatus for administering humidified gas such as humidified oxygen to a patient comprising a container with liquid and having an opening with a stopper thereacross, a connector, threaded coupling means for connecting an inlet of said connector to a gas supply, said connector including tubular means projecting through said stopper and having barb means underlying said stopper for preventing withdrawal of said connector from said stopper and for suspending said bottle from said connector, a gas supply tube in said tubular means and being in communication with said inlet, said gas supply tube lying below the liquid level and having a pointed end for piercing a hole in said stopper, said tubular means being of a cross-sectional size adjacent to said barb means that is larger than that of said gas supply tube so that the tubular means enlarges the hole pierced by said pointed end upon mounting of the connector onto the stopper, and means for conveying humidified gas through said connector to a nasal cannula, said conveying means including a conduit extending laterally of said tubular means and having a decreasing diameter in a direction away from said tubular member for telescopically receiving the nasal cannula.

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