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Cornett, III et al.

[11] **3,806,100**

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[54] **RESERVOIR FOR ULTRASONICALLY OPERATED NEBULIZER**

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

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[21] Appl. No.: **286,750**

[52] **U.S. Cl.** **261/1,** 128/186, 128/194, 261/119, 261/DIG. 48

[51] **Int. Cl.** **B01f 3/04**

[58] **Field of Search** ..... 128/188, 186, 194, 232, 128/272; 261/119, 1, DIG. 48; 239/308, 327; 259/DIG. 43, DIG. 44

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Assistant Examiner—W. R. Briggs
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[57] **ABSTRACT**

A container is disclosed which is a reservoir for water from which water is to be and can be atomized by ultrasonic means as in an ultrasonic nebulizer. The container is constructed of plastic. It is blow molded; prior to closing of the container, the water is introduced and the container is closed. A first port is provided for introduction of a gas, such as oxygen under pressure. A second port is provided for removal of atomized or mist of water in an oxygen medium for use by a patient requiring treatment.

The plastic container has a relatively thin bottom which may be suitably coupled to an ultrasonic energy producing means. Additionally, means is provided for breaking open the two ports to provide access to the inside of the container.

The container is also provided, in one embodiment with a continuous feeder so that additional water may be added, whereby the container is useful as a reservoir. The additional water is provided by means of a "chicken feeder" which is insertable through a breachable port located off-center on the top of the container.

6 Claims, 11 Drawing Figures

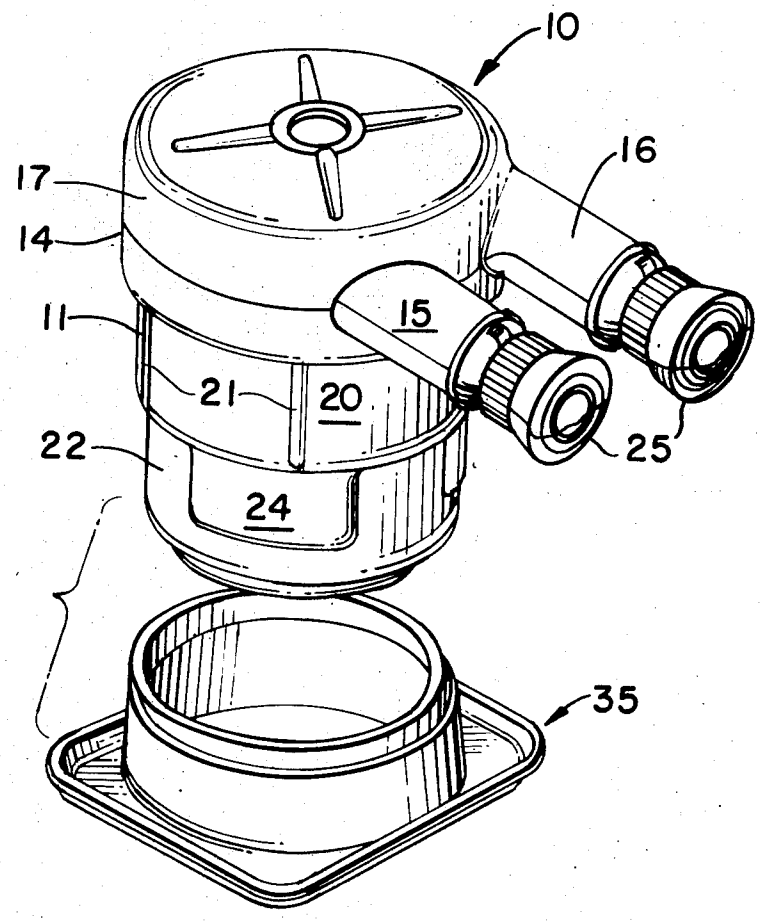

FIG. 1.

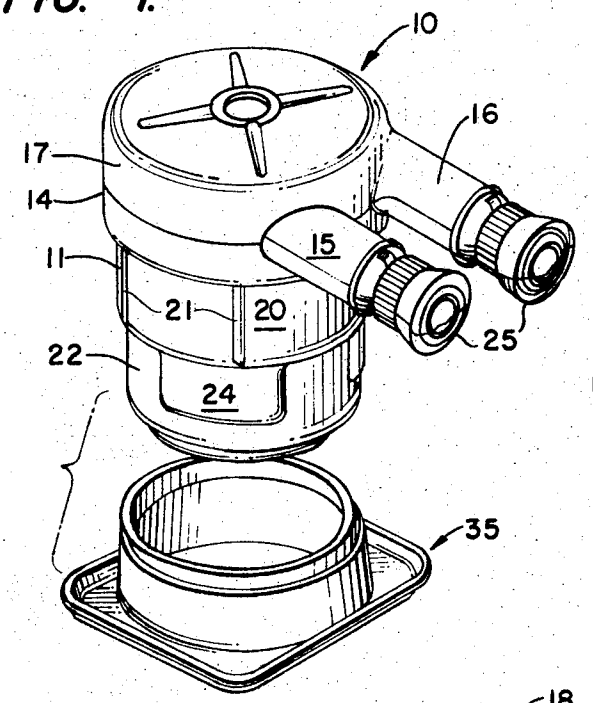

FIG. 2.

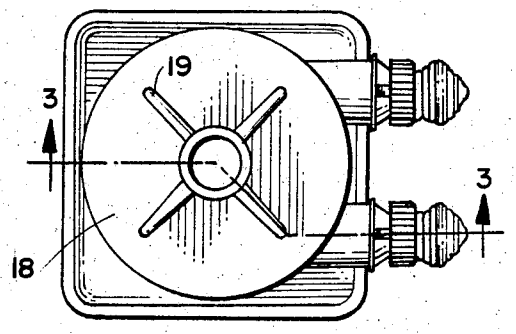

FIG. 3.

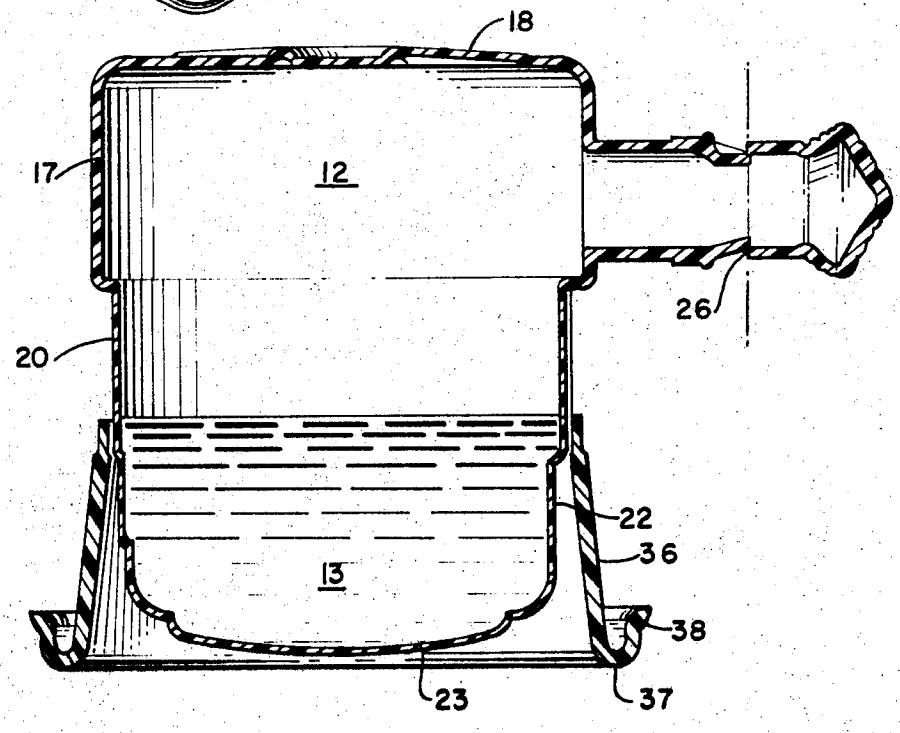

FIG. 4.

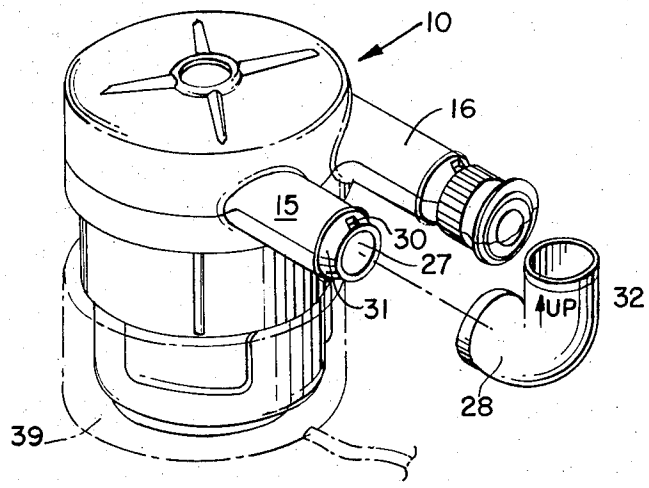

FIG. 5.

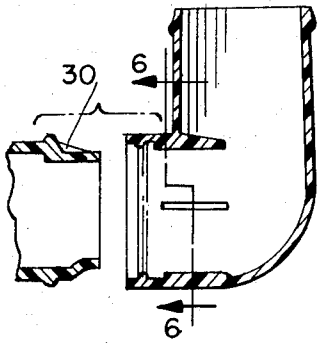

FIG. 6.

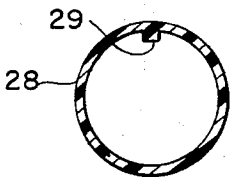

FIG. 7.

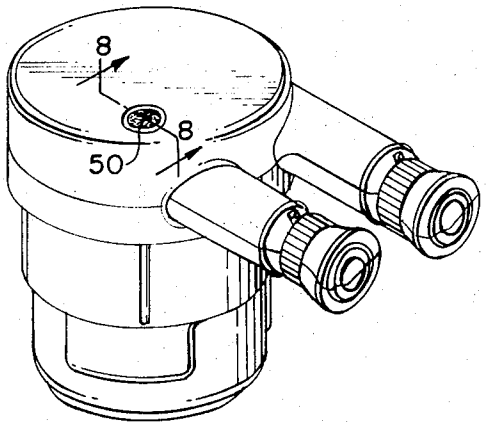

FIG. 8.

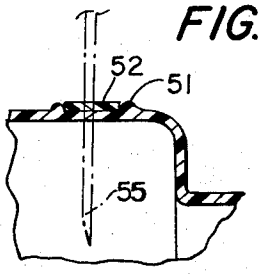

FIG. 9.

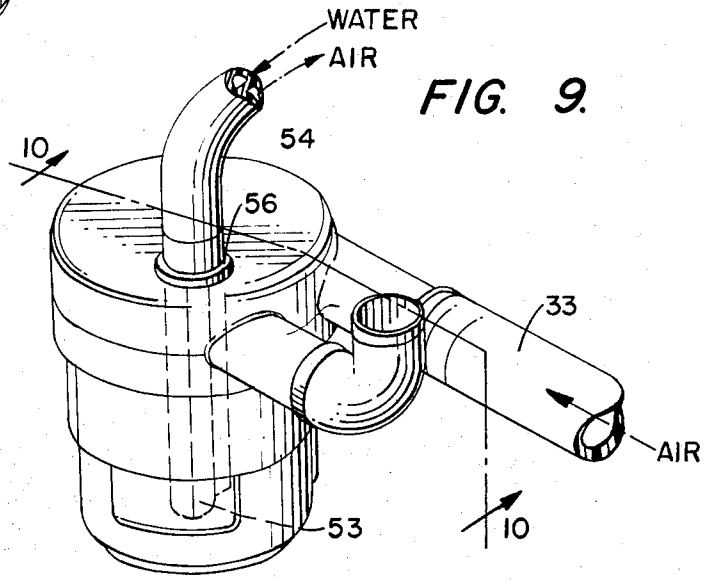

FIG. 10.

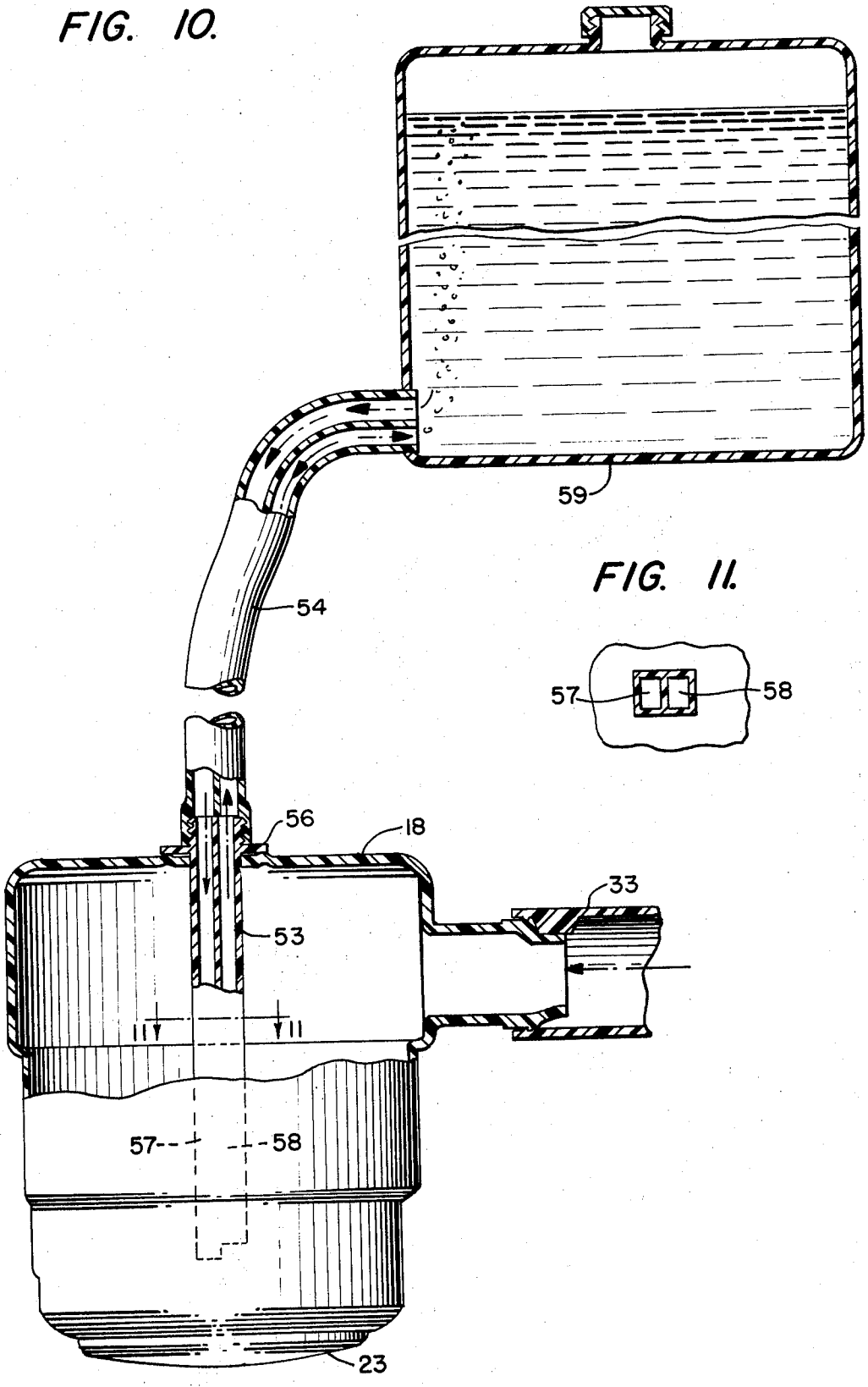

FIG. 11.

RESERVOIR FOR ULTRASONICALLY OPERATED NEBULIZER

FIELD OF THE INVENTION

The present disclosure relates to inhalation therapy. Particularly, it relates to a receptacle or container for ultrasonically operated nebulizers. Specifically, it concerns a container which is molded integral with a supply of water which may be atomized therefrom by coupling the container to a source of ultrasonic energy.

BACKGROUND OF THE INVENTION

Inhalation therapy is the medical art of treating with oxygen having a high moisture content. Several classes of devices, one of which comprises atomizers or nebulizers, are adapted for such treating. A heretofore known system for inhalation therapy comprises a container which acts as a reservoir for water. There beneath is positioned an ultrasonic device which agitates or acts upon the water in the container through a suitable coupling means to expel from the surface of the water tiny particles of water. The water is not in the form of discernible droplets. The particles or mist of water is dispersed in the ambient air or oxygen, if desired. The mixture is then provided to a patient for breathing purposes.

SUMMARY OF THE INVENTION

The device of the present invention comprises a sealed plastic container which is blow molded with a quantity of water included prior to completing the formation and sealing of the container. The bottom of the container is sufficiently thin whereby it is transparent to ultrasonic vibrations so that the ultrasonic energy may act on the water in the container. Sufficient head room above the water is provided. An ingress port and an egress port is provided so that air or oxygen may be introduced by means of one and may be removed by the other. While the gas is in the container it is charged with the mist formed of tiny particles of water expelled from the surface of the water when the water is subjected to ultrasonic vibrations. In another embodiment, the container functions as a reservoir which is continuously filled as needed from a source.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a perspective view of the device of the present invention exploded from an optional stand.

FIG. 2 is a top plan view of the device.

FIG. 3 is a vertical cross-sectional view of the device and the stand therefor.

FIG. 4 is a perspective view of the device positioned in means for producing ultrasonic energy.

FIG. 5 is a vertical cross-sectional view of the fragmentary portion of one of the ports and 90° elbow exploded therefrom.

FIG. 6 is a cross-section taken along line 6—6 of FIG. 5.

FIG. 7 is a perspective view of another embodiment of the present invention wherein a breachable port is provided.

FIG. 8 is a cross-section taken along line 8—8 of FIG. 7.

FIG. 9 is a perspective view of the other embodiment in a mode of operation.

FIG. 10 is a partial vertical cross-sectional view of the mode of operation of the other embodiment, part of the cross-section being taken along line 10—10 of FIG. 9.

FIG. 11 is a cross-sectional view taken along line 11—11 of FIG. 10.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring now more particularly to the drawings, shown is a container of the present invention generally designated 10, which may be of semi-rigid fabrication and has a general vertical orientation. It is comprised of a body 11. The body 11 is blow molded to form a chamber 12 containing water 13. The body has, generally, a cylindrical configuration. The mold employed, not shown, has two parts so that the body has a part line. The body is molded in a manner so that no part line is at the bottom but the part line is shown at 14 so that it passes through somewhat tangentially extending first port means 15 and somewhat tangentially extending second port means 16. Both port means will be seen to include elongated tubular means.

In blow molding the same quantity of plastic material is provided to both sides of the mold. As one side of the mold will have a considerably larger cavity the plastic when blown to fill the cavity will have to be distributed over a much wider area, as a result it will be much thinner. This can be readily seen from the cross-section of FIG. 3. In the instant matter it will be observed that the bottom is the thinnest portion. When coupled to a source of ultrasonic energy, this thin quality with respect to the bottom is an advantage as less ultrasonic energy is absorbed than would be the case otherwise.

The body 11 has three distinct sections with the first section 17 having the first and second port means and being uppermost. The top 18 will, of course, be integral and is the thickest portion. As can be seen from FIG. 1 and 2, especially, the top has radially disposed rib portions 19 to provide increased strength.

The next section is the second section 20 which is positioned directly below the first section. It is of slightly smaller diameter and is also a degree thinner in wall structure. Such Figures as FIGS. 1, 4 and 7 reveal the use of axially disposed longitudinal ribs 21 to provide a modicum of additional strength characteristics not otherwise available. The third section 22 is directly below the second section. Being the furthest from the mold part line it will be seen to comprise the thinnest section terminating in the bottom 23 which due to its thinness is highly flexible. The third section has a number of convoluted portions 24 to increase the rigidity to some extent of the rather thin third section.

The water 13 level in the body 11 is preferably at or near the junction of the second and third sections. More water than this results in poor atomization of the water as the body of water absorbs and dissipates too much of the ultrasonic energy without easily converting the water to fine particle form. The chamber 12 is thus provided with considerable head room for adequate gas distribution.

The first and second port means terminate in hollow caps 25 which have, of course, been blow molded integral with the container 10. In order to provide access to the interior of the container, that is, to the chamber 12, each of the caps 25 may be broken off along rela-

tively weak line **26,** as seen from the cross-section of FIG. **3.** Breaking off the left cap **25** on port means **15,** as seen in FIG. **4** will display a bevelled tubular opening **27** designed to have mated thereon one end of a 90° elbow **28.** The elbow **28,** as seen from FIGS. **5** and **6,** possesses internally a small protuberance **29** which is designed to mate with notch **30** on the uppermost side of the bevelled portion **31** of the port means **15.** The detent configuration thereby provided insures that the elbow **28** will always maintain an upwardly facing orientation, as shown in FIGS. **4, 5** and **9,** for instance. As port means **15** will carry away the nebulized mist of gas and water, the orientation of the elbow will provide a tortuous path so that any liquid water in droplet form will be caught by the inner surfaces of the elbow and flowed back to the body **11** by gravity through the port means **15.** The upwardly facing opening **32** is secured to a highly flexible tube (not shown) which distributes the nebulized water and gas to the patient.

The other port means **16** also has its cap removed. An air or oxygen supply conduit **33** is attached thereto as seen from FIG. **9** and **10.**

The container of the present invention is essentially designed to be utilized with a number of conventional commercially available ultrasonic devices. Usually the ultrasonic device has a piezoelectric crystal as the transducer to provide the desired ultrasonic vibrations. The transducer is usually positioned at the bottom of a cup to which is either added directly the liquid to be atomized or the liquid is used as a coupler between the transducer and the bottom and part of the sides of a container in which is the liquid, such as water which is to receive the full benefit of the ultrasonic vibrations. The coupling liquid should be relatively sealed between the container and the cup so that it is not atomized but merely acts as a carrying medium for the ultrasonic vibrations. Additionally, to accomplish efficient operation, no bubbles should be permitted to become lodged in the coupling medium at the interface of the medium and the bottom of the container. It will be noted that the bottom **23** is convex so that any bubbles will float away from the bottom.

In FIGS. **1** and **3,** it can be seen that the container **10** is designed to fit a support means **35.** The support means has an upstanding converging tubular wall **36** with an internal diameter slightly larger than that found at the junction of the second section **20** and third section **22.** The container **10** is thereby snugly fitted into the support means. The other end of the tubular wall **36** terminates in a squared off base portion **37** and an upturned outward folded portion **38.** In use the container is properly set up and disposed in its support means, which has previously been positioned in the ultrasonic device containing a quantity of coupling liquid which may be water, for instance.

FIG. **4** depicts the concept of employing an ultrasonic device having a cup **39,** shown in dotted lines, which can accommodate the container **10.** It will be noted that the container is supported at approximately the juncture of the second section and the third section as disclosed in the foregoing.

Attention is now directed to the embodiment portrayed by FIGS. **9** and **10.** As the container **10** does not contain a large quantity of water, due to the rather smallness of ultrasonic devices commercially available and due to inherent inefficiencies of such devices, the now here discussed embodiment is designed to off-set some of these disadvantages.

In the foregoing the container **10** acts as self-contained as it is already filled with a requisite quantity of water. The present embodiment looks to the use of the container with some modifications so that it can be used as a continuously operated device wherein the water nebulized therefrom is continuously replenished.

The top **18** of the container is modestly modified in that a breachable port **50** is positioned along the surface of the top. It will be noted from FIG. **7** that the port **50** is off-center. The port **50** comprises a raised annular ring **51** with a self-sealing disc **52** positioned concentrically therein. The port is designed to accept a sharpened double bored conduit **53** as in FIG. **9** which is attached to a double channeled tube **54** for continuous delivery of water. In FIG. **8,** the breaching tubular means **55,** shown in dotted lines, may be a conventional hypodermic needle so that medicament may be added to the supply of water.

The tube **53** may be of cylindrical construction or it may be rectangular. The tube has a flange means **56** secured to near one end. The flange means **56** is designed to lie in abutment on the top **18** so that the other end of the tube terminates above the bottom **23.** The tube has two conduits **57** and **58.** Conduit **57** is slightly longer than conduit **58.** The former is for the delivery of water from a reservoir **59,** the latter is for air to displace the delivered water in the said reservoir. The reservoir is a sealed receptacle and is positioned to provide hydrostatic pressure.

In this embodiment the container **10** can be used for a prolonged period as the water therein is continuously replenished. By controlling the point of termination with regard to tube **53,** the water level in the container may be set at a point where there is the most effecient occurrance of nebulization.

The material for fabrication of the container is either polypropylene or polyethylene. The fittings are of the same materials, but can be constructed of other plastics.

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 as illustrative only and not in a limiting sense.

What is claimed is:

1. A plastic container blow molded with a quantity of water included therein during the molding operation comprising a first section having a cylindrical configuration, said first section having ingress port means and egress port means, both of said port means having break-away cap means, said first section having a top, a second section having a cylindrical configuration integral with said first section, said second section being of a diameter smaller than said first section, a third section having a cylindrical configuration, integral with said second section, said third section having a diameter less than said second section, the third section having a convex bottom, the third section being constructed of thinner plastic than the second section, the second section being constructed of thinner plastic than the first section, at least the egress port means having a detent exposed when said break-away cap is removed whereby a conduit having a mating detent

when attached to the egress port means is prevented from rotating.

2. The container of claim **1** wherein the egress port means and the ingress port means include tubes radiating tangentially outwardly from said first section.

3. The container of claim **2** wherein the tubes terminate in a bevel when the break-away caps are broken away.

4. The container of claim **3** wherein the detent is a notch in the bevel.

5. The container of claim **1** wherein the said ingress port means and the said egress port means extend in the same direction.

6. The container of claim **1** wherein the top has a breachable membrane means off-center with respect thereto, the membrane means including means for self-sealing a breached opening.

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