March 5, 1946. G. B. ROBINSON 2,396,204

NEBULIZER

Filed March 6, 1944

FIG. 1.

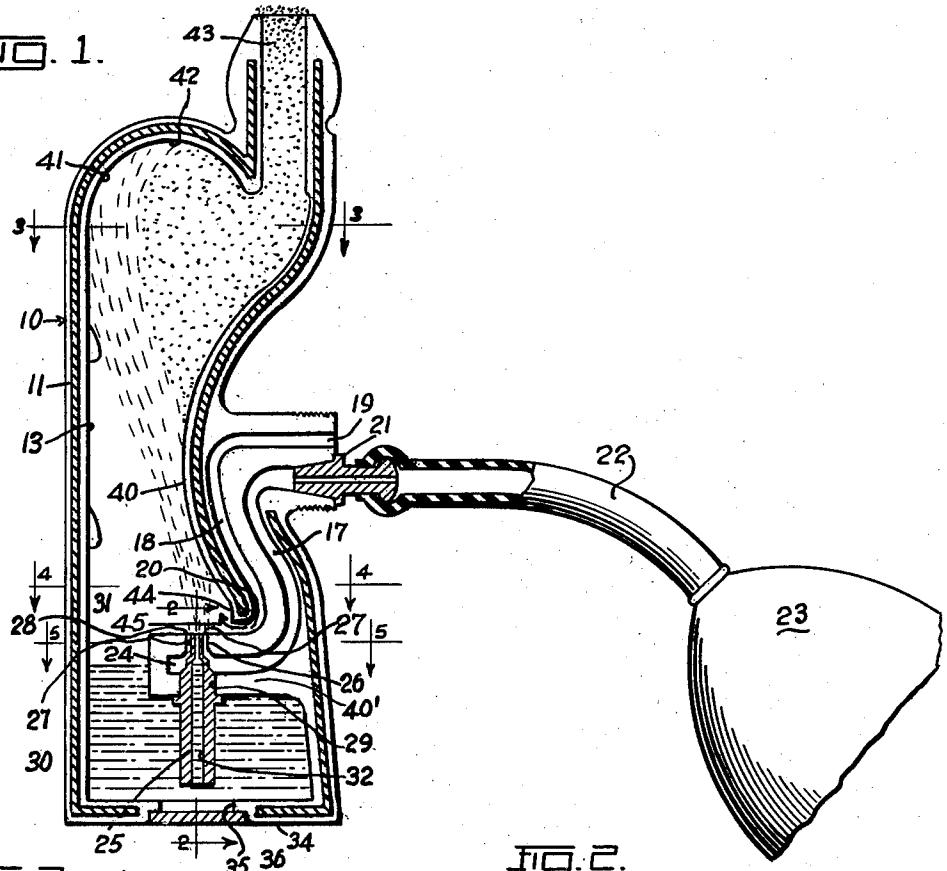


FIG. 2.

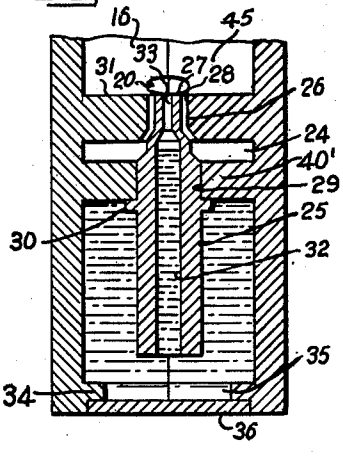


FIG. 3.

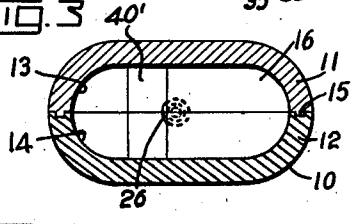


FIG. 4.

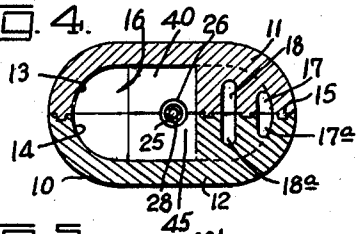
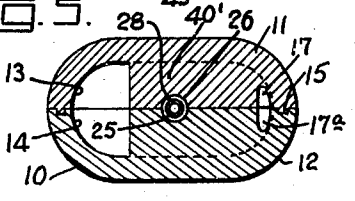


FIG. 5.



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Patented Mar. 5, 1946 2,396,204

UNITED STATES PATENT OFFICE

2,396,204

NEBULIZER

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Application March 6, 1944, Serial No. 525,135

6 Claims. (Cl. 299—88.5)

This invention relates to nebulizers or atomizers for producing a dry vapor that is used for medication of the respiratory organs.

An object of the invention is to provide a nebulizer or atomizer that has an internal chamber constructed and arranged in a manner that the heavy drops of vapor will be deflected from the discharge opening of the nebulizer so that only dry vapor will escape from the nebulizer chamber.

Still another object of the invention is to provide a nebulizer wherein the quantity of dry vapor that has discharged from the nebulizer chamber is substantially increased over that discharged from similar commercial products.

Still another object of the invention is to provide a nebulizer wherein the atomizing head is constructed and arranged in a manner that it will draw in a quantity of air for mixing with the atomized liquid whereby to increase the quantity of dry vapor that can be obtained from a given discharge of atomized vapor from the atomizing head.

Still another object of the invention is to provide a nebulizer wherein the atomizing head is constructed and arranged in a manner that the atomized vapor discharging from the atomizing head forms a low pressure area in the nebulizer, and wherein means is provided for connecting the low pressure area to the atmosphere to permit atmospheric air to be drawn into the nebulizer chamber for admixture with the discharging stream of atomized vapor to increase the quantity of dry vapor that is produced in the nebulizer chamber.

Further objects and advantages will become apparent from the drawing and the following description.

In the drawing:

Figure 1 is a vertical cross-sectional view of the nebulizer or atomizer of this invention.

Figure 2 is an enlarged cross-sectional view of the atomizing head taken along line 2—2 of Figure 1.

Figure 3 is a transverse cross-sectional view of the body of the nebulizer taken along line 3—3 of Figure 1.

Figure 4 is a transverse cross-sectional view of the body of the nebulizer taken along line 4—4 of Figure 1.

Figure 5 is a transverse cross-sectional view of the body of the nebulizer taken along line 5—5 of Figure 1.

In this invention the nebulizer or atomizer consists of a body 10 that is constructed in two parts, 11 and 12, these parts being identical halves. The body parts 11 and 12 are provided with identical recesses 13 and 14 respectively, that are adapted to be brought together on the parting line 15, whereby a chamber 16 is formed within the body 10. The parting line 15 is constructed in the form of a tongue and groove joint to align the two body parts 11 and 12 in proper assembled relationship. Additional recesses or channels 17, 17a, 18 and 18a are provided in the body parts 11 and 12 respectively, so that when the body parts are placed together, the channels 17, 17a, 18 and 18a will form passages for air to be supplied into the chamber 16 of the nebulizer body 10.

The passage 18 terminates at one end in an opening 19 that is open to the atmosphere, while the opposite end of the passage 18 terminates in an opening 20 that is open to the interior chamber 16. The passage 17 has one end thereof provided with a fitting 21 that receives a flexible rubber tube 22 connected to a pressure bulb 23 whereby air under pressure can be supplied through the passage 17 into the chamber 24 that surrounds the nozzle body 25. The chamber 24 is located within an inwardly projecting portion 40' of the wall 40.

An opening 26 is provided in the upper wall of the chamber 24 to receive the tip or discharge end 27 of the nozzle 25. The opening 26 is sufficiently large to provide a space 28 between the tip 27 and the wall of the opening 26 whereby air under pressure is discharged through the space 28 around the nozzle tip 27 when the bulb 23 is compressed.

The lower wall of the chamber 24 has an opening 29 that receives the body 25 of the nozzle to retain the same in assembled position. A flange 30 is provided around the body 25 of the nozzle to limit the upward movement thereof so as to position the surface of the nozzle tip 27 substantially parallel with the upper surface 31 of the upper wall of the chamber 24. The nozzle 25 is provided with a bore 32 therein that terminates in a nozzle orifice 33 whereby liquid in the lower part of the body 10 may be drawn upwardly through the nozzle orifice 33 when air under pressure passes through the space 28.

The lower wall 34 of the atomizer body 10 has an opening 35 through which the nozzle 25 may be inserted into engagement with the walls of the chamber 24 when assembling the atomizer, this opening being closed by a plug 36 that may be suitably cemented in place.

The body 10 of the atomizer is provided with a curved wall portion 40 that is disposed verti-

cally above the nozzle orifice 33 so that the jet of air discharging upwardly through the space 28 and aspirating liquid from the nozzle orifice 33 will impinge upon the curved wall 40, thereby deflecting the atomized liquid in a leftward direction as illustrated in Figure 1.

The wall portion 41 of the chamber 16 is provided with an arcuately shaped head portion 42. With the atomized liquid deflected in a leftward direction by the wall portion 40, as viewed in Figure 1, the heavy droplets of atomized fluid will tend to collect upon the wall 41 and the head portion 42 thereof and thereafter run down the wall 41 into the bottom of the chamber 16. It will be noted that the outlet 43 from the nebulizing chamber 16 is disposed on one side of the body 10, and particularly on the side of the body that is out of the direct path of the atomized fluid that is being directed upwardly by the air jet through the space 26. Thus, only light dry vapor will escape through the discharge opening 43 for inhalation into the respiratory organs.

The chamber 16 is generally of oval shape, as illustrated in Figure 3, but it will be noted in Figure 1 that there is a constricted portion in the chamber formed by the curved wall 40 thereof that expands into a relatively large volume in the upper portion of the chamber.

When air under pressure is forced by the bulb 23 through the passage 17 and the space 28, the air under pressure will aspirate liquid through the nozzle orifice 33, the jet thus formed being a mixture of air and liquid that is moving at relatively high speed to impinge against the wall 40. The jet thus produced causes a low pressure area in the space between the lower end portion 44 of the wall 40 and the jet moving vertically out of the discharge nozzle 25. This low pressure area 45 is connected to the atmosphere by means of the passage 18 so that atmospheric air will be drawn in through the passage 18 into the space 45 that will mix with the jet of air and liquid that is discharging from the atomizing head, thus supplying a relatively large quantity of additional air into the jet. This additional air will mix with the jet and cause an increased vaporization of the liquid because it also will impinge against the wall 40 with the result that there is a thorough admixture of all air and vapor particles which tend to break up the vapor into very fine droplets before it passes into the upper portion of the chamber 16. Actual tests of the arrangement disclosed shows that the quantity of dry vapor discharged through the discharge opening 43 will be increased from 50% to 100% over that discharged from a device of like character that is not provided with the atmospheric air passage 18.

The increased cross-sectional area of the chamber 16 at the top thereof permits the velocity of the atomized liquid to reduce in the chamber so that the heavier of the fine drops of atomized liquid may collect along the wall portion 41, and in the dome 42 of the chamber 16, whereby the heavy droplets will condense and drain back into the reservoir portion in the bottom of the chamber 16.

In constructing the atomizer or nebulizer of this invention, it has been found that the best operating conditions of the nebulizer have been obtained when the nozzle orifice 33 is of a diameter of .037 inch and a clearance around the tip 27, that is the space 28, is .006 inch. The air passage 18 shall be of a size that offers sufficient resistance to the flow of air through the passage so that the low pressure area 45 can be maintained for providing a pressure differential between opposite ends of the passage 18 for causing an inward flow of atmospheric air into the chamber 16.

While the apparatus described and disclosed herein constitutes a preferred form of the invention, yet it will be understood that the apparatus is capable of mechanical alteration without departing from the spirit of the invention, and that all modifications that fall within the scope of the appended claims are intended to be included herein.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An atomizer or nebulizer consisting of, a body having a chamber therein, an atomizing head disposed in the lower portion of said chamber for directing fluid under pressure upwardly through said chamber, wall means of said chamber disposed above and directly in the path of movement of the atomized liquid passing upwardly through said chamber against which the jet of atomized liquid impinges, said wall means extending to a position adjacent the discharge opening for said jet and being spaced therefrom whereby to provide a chamber area between the said wall means and said jet immediately adjacent the discharge opening of said jet that is a reduced pressure area as a result of the movement of the jet across said area, and means connecting the low pressure area with the atmosphere through which secondary atmospheric air is drawn to said low pressure area by the kinetic energy of the jet for intensive admixture with said jet to increase the vaporization of liquid in said jet.

2. An atomizer or nebulizer consisting of, a body having a chamber therein, an atomizing head in the lower portion of said body for directing atomized liquid upwardly through said chamber, a wall portion of said chamber extending inwardly into the same to reduce a cross-sectional area of the chamber and to dispose the wall portion above the discharged jet of atomized liquid to cause the wall portion to be engaged by the atomized liquid passing upwardly through said chamber whereby to deflect the atomized liquid against an opposite wall of said chamber to cause condensation of the heavy droplets of atomized liquid on the last mentioned wall, said first mentioned wall extending to adjacent the discharge point of said jet and being spaced therefrom whereby to form with said jet a low pressure area therebetween, means forming an air inlet passage for connecting the low pressure area with the atmosphere, and an outlet opening in said chamber positioned in the portion thereof that is most remote from the path of movement of the atomized liquid whereby to receive only dry vapor.

3. An atomizer or nebulizer that includes a body having a chamber therein, wall means in said body for constricting a portion of said chamber substantially midway between the top and bottom thereof whereby the lower portion of said chamber forms a liquid reservoir and the upper portion of said chamber forms a vapor separation chamber, wall means adjacent to and beneath said last mentioned wall means having an air chamber therein and provided with an air outlet, passage means connected to said cham-

ber for conducting air under pressure thereto, and liquid jet means traversing said air chamber and supported in said last mentioned wall means having the nozzle end thereof extending into said air outlet from said air chamber whereby to form an aspirator for drawing liquid from said reservoir portion of said body chamber.

4. An atomizer or nebulizer that includes a body having a chamber therein, wall means in said body for constricting a portion of said chamber substantially midway between the top and bottom thereof whereby the lower portion of said chamber forms a liquid reservoir and the upper portion of said chamber forms a vapor separation chamber, wall means adjacent to and beneath said last mentioned wall means having an air chamber therein and provided with an air outlet, passage means connected to said chamber for conducting air under pressure thereto, liquid jet means traversing said air chamber and supported in said last mentioned wall means having the nozzle end thereof extending into said air outlet from said air chamber whereby to form an aspirator for drawing liquid from said reservoir portion of said body chamber, said aspirator being disposed relative to said first mentioned wall means to direct vapor thereagainst, said first mentioned wall means forming with the vapor stream leaving said aspirator a low pressure area adjacent the discharge opening of the aspirator, and passage means connecting said low pressure area with the atmosphere whereby atmospheric air is drawn into the low pressure area for admixture with the vapor stream to increase the vaporization thereof.

5. An atomizer or nebulizer that includes a body having a chamber therein, wall means in said body for constricting a portion of said chamber substantially midway between the top and bottom thereof whereby the lower portion of said chamber forms a liquid reservoir and the upper portion of said chamber forms a vapor separation chamber, wall means adjacent to and beneath said last mentioned wall means having an air chamber therein and provided with an air outlet, passage means connected to said chamber for conducting air under pressure thereto and positioned in said first mentioned wall means, liquid jet means traversing said air chamber and supported in said last mentioned wall means having the nozzle end thereof extending to said air outlet from said air chamber whereby to form an aspirator for drawing liquid from said reservoir portion of said body chamber, said aspirator being disposed relative to said first mentioned wall means to direct vapor thereagainst, said first mentioned wall means forming with the vapor stream leaving said aspirator a low pressure area adjacent the discharge opening of the aspirator, and passage means in said first mentioned wall means connecting said low pressure area with the atmosphere whereby atmospheric air is drawn into the low pressure area for admixture with the vapor stream to increase the vaporization thereof.

6. An atomizer or nebulizer that includes a body having a chamber therein, wall means in said body for constricting a portion of said chamber substantially midway between the top and bottom thereof whereby the lower portion of said chamber forms a liquid reservoir and the upper portion of said chamber forms a vapor separation chamber, wall means adjacent to and beneath said last mentioned wall means having an air chamber therein and provided with an air outlet, passage means connected to said chamber for conducting air under pressure thereto and positioned in said first mentioned wall means, liquid jet means traversing said air chamber and supported in said last mentioned wall means having the nozzle end thereof extending to said air outlet from said air chamber whereby to form an aspirator for drawing liquid from said reservoir portion of said body chamber, said aspirator being disposed relative to said first mentioned wall means to direct vapor thereagainst, said first mentioned wall means forming with the vapor stream leaving said aspirator a low pressure area adjacent the discharge opening of the aspirator, and passage means in said first mentioned wall means connecting said low pressure area with the atmosphere and having the inlet opening thereof adjacent to the inlet opening of said first mentioned air passage whereby atmospheric air is drawn into the low pressure area for admixture with the vapor stream to increase the vaporization thereof.

GERARD B. ROBINSON.