June 24, 1958 J. W. DORSAK ET AL 2,840,417

NEBULIZING APPARATUS

Filed Feb. 12, 1957 3 Sheets-Sheet 1

Fig. 1

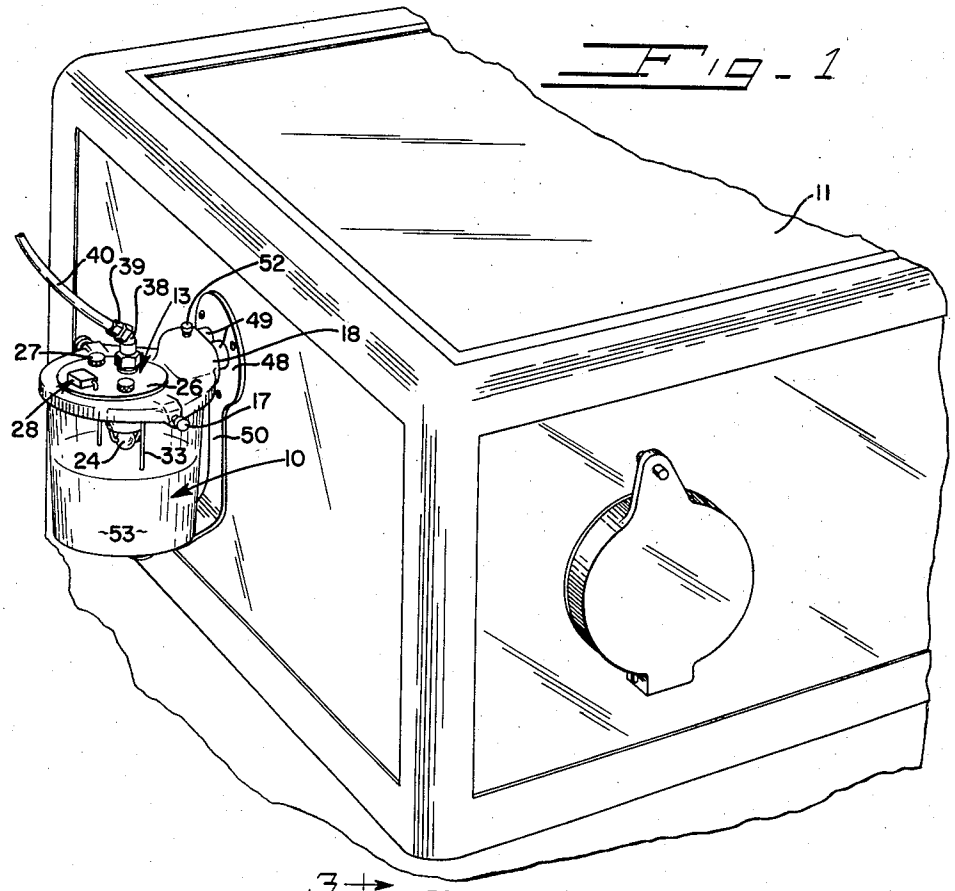
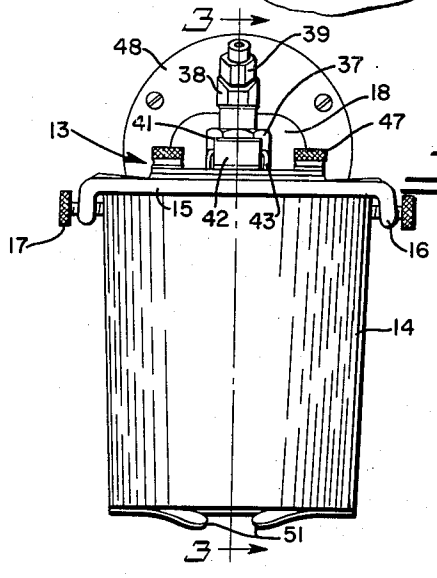


Fig. 2



INVENTOR.
JOHN W. DORSAK
THOMAS F. VAN DENBERG

BY
DES JARDINS AND ROBINSON

By Clarence R. Des Jardins

THEIR ATTORNEYS

June 24, 1958 J. W. DORSAK ET AL 2,840,417

NEBULIZING APPARATUS

Filed Feb. 12, 1957 3 Sheets-Sheet 2

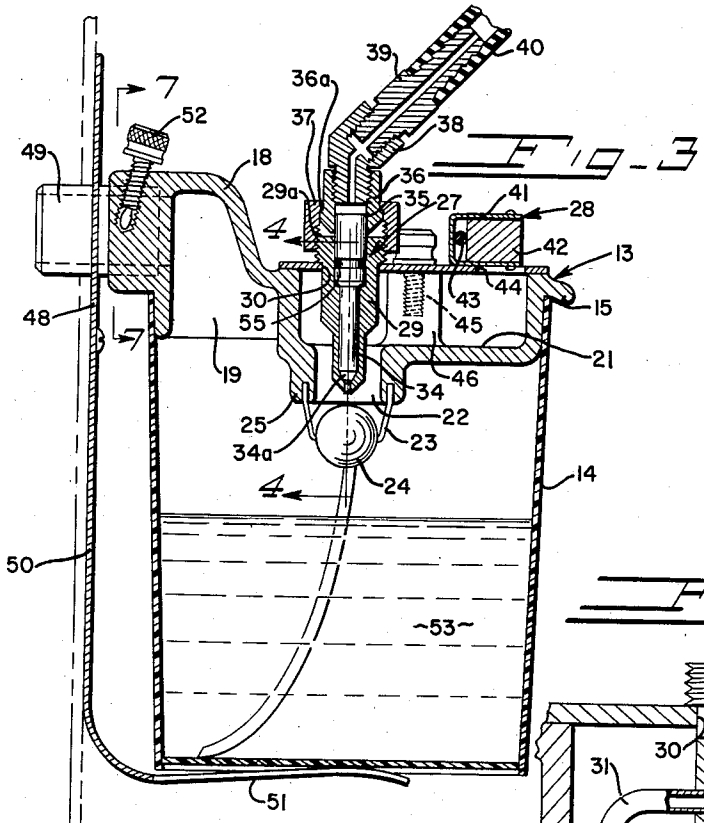


Fig. 3

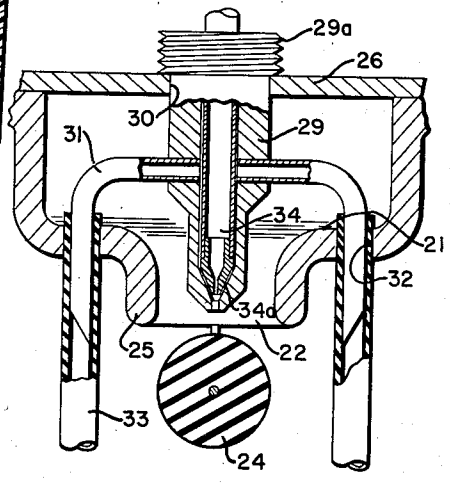


Fig. 4

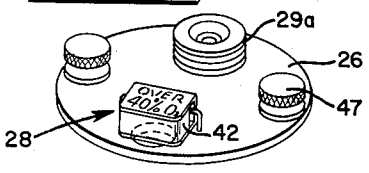


Fig. 5

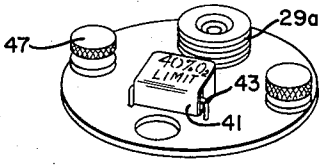


Fig. 6

INVENTOR.
JOHN W. DORSAK
THOMAS F. VAN DENBERG
BY
DES JARDINS AND ROBINSON
By Clarence B. Des Jardins
THEIR ATTORNEYS

June 24, 1958 J. W. DORSAK ET AL 2,840,417

NEBULIZING APPARATUS

Filed Feb. 12, 1957 3 Sheets-Sheet 3

Fig. 7

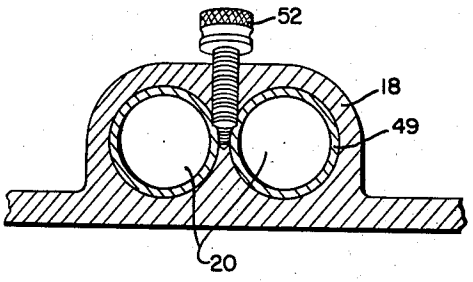


Fig. 8

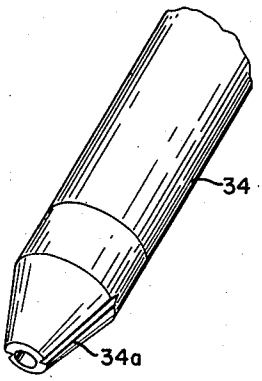
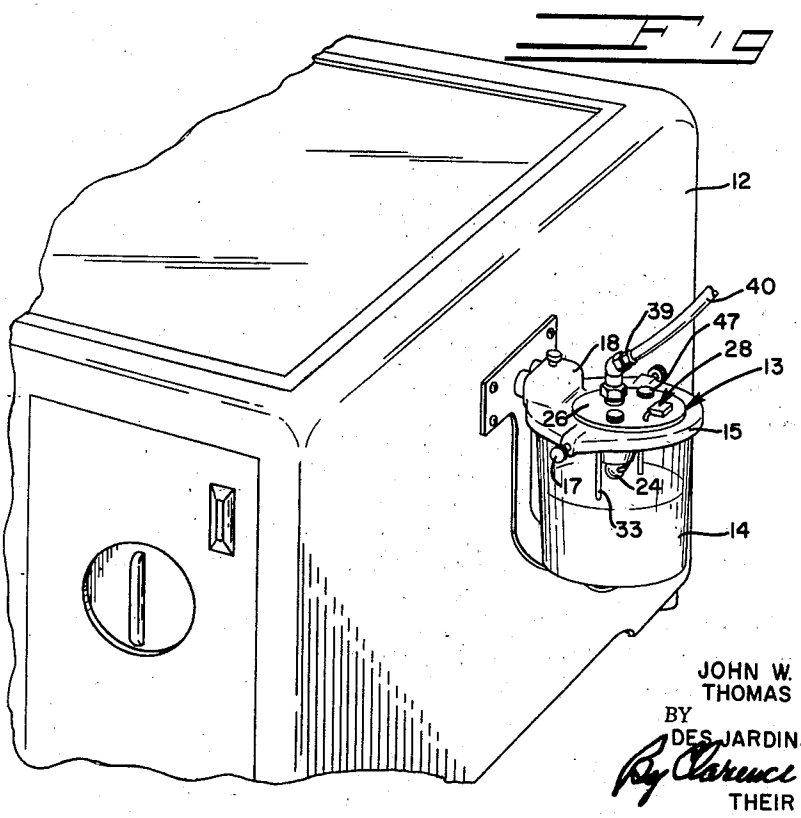


Fig. 9



INVENTOR.
JOHN W. DORSAK
THOMAS F. VAN DENBERG
BY
DES JARDINS AND ROBINSON
By Clarence R. Desjardins
THEIR ATTORNEYS

United States Patent Office 2,840,417 Patented June 24, 1958

2,840,417

NEBULIZING APPARATUS

John W. Dorsak, Lyndhurst, and Thomas F. Van Denberg, Chagrin Falls, Ohio, assignors to The Gordon Armstrong Company, Inc., Cleveland, Ohio, a corporation of Ohio

Application February 12, 1957, Serial No. 639,662

4 Claims. (Cl. 299—86)

The present invention relates to a nebulizing apparatus and, more particularly, to improvements in a nebulizer for introducing a fine liquid mist or spray into a gas being admitted to an incubator holding an infant.

Nebulizing means has been previously used for admixing a water spray with oxygen as it flows into an incubator, but none to our knowledge has the advantages of the present nebulizer. It is possible with the nebulizer of this invention to effect a separation between the finer or lighter globules or particles and the heavier particles of the nebulized mist, so that only the finer globules are entrained in the oxygen or other gas passing to the incubator. Additionally, the oxygen may be diluted with another gas in order that the amount of oxygen ultimately reaching the incubator may be varied.

The present nebulizing apparatus has simplified construction, the entire nebulizing mechanism bein carried on or forming part of a head assembly which thereby facilitates a quick assembly and disassembly of the entire nebulizing apparatus. Our nebulizing apparatus also has a safety provision to insure a continuous liquid supply for the nebulizing means, the failure of which might otherwise result in possible serious harm to an infant in the incubator. The present nebulizer does not require recirculation of the atmosphere of the incubator in order to obtain a desired composition of oxygen and/or water in the atmosphere. Further, the present nebulizer is adapted for secure, non-rotatable attachment to an incubator.

In one form, for example, our nebulizing apparatus includes a cup-shaped container having a detachable, nebulizing head assembly. The head assembly has an aspirating nozzle through which oxygen or another gas is discharged into the container. The action of the nozzle attracts a liquid from a reservoir in the container through a plurality of conduits to the nozzle to provide a nebulized or atomized spray. The same action may also induce a flow of air or other gas through a regulated opening in the head assembly to dilute the oxygen in the container as desired. In any event, the discharge of the nozzle impinges against a curved baffle to scatter the globules or particles of the nebulized mist throughout the container. The finer globules pass through an outlet in the nebulizer head assembly, and the heavier particles settle in the container to mix with the supply liquid in the reservoir.

The principal object of the present invention is to provide improved nebulizing apparatus.

A further object is to provide a nebulizer for an incubator which effects a separation between the lighter and heavier particles or globules in a nebulized mist.

A still further object is to provide nebulizing apparatus adapted to dilute the gas of the nebulized or atomized mist with a second gas by the nebulizing action itself.

A still further object is to provide nebulizing apparatus of simplified construction and easy assembly and disassembly by combining the entire nebulizing mechanism

on a head assembly which is adapted to seat in an open-ended container of generally cup-shaped construction.

Other objects and advantages of the invention are apparent from the following description which is directed to one embodiment of the invention and is not intended to limit the claims.

On the accompanying drawings:

Figure 1 is a perspective view of the present nebulizing apparatus attached to an incubator;

Figure 2 is a front elevational view of the nebulizing apparatus of Figure 1;

Figure 3 is a section of Figure 2 on the line 3—3;

Figure 4 is a section of Figure 3 on the line 4—4;

Figures 5 and 6 are perspective views of a plate cover of the head assembly and show a regulator in different positions in order to vary the admission of a diluting gas to the nebulizer;

Figure 7 is a section of Figure 3 on the line 7—7;

Figure 8 is a perspective view of a tube and tip used in an atomizer nozzle; and

Figure 9 is a perspective view of the nebulizing apparatus secured to another type of incubator.

Referring to the drawings, the nebulizing apparatus generally indicated at **10** may be secured to any type of incubator, such as the incubator **11** in Figure 1 or the incubator **12** in Figure 9. The nebulizing apparatus includes a nebulizing head assembly **13**, which contains the entire nebulizing mechanism, and an open-ended container or generally cup-shaped receptacle **14**. The head assembly **13** may be cast while the container **14** is preferably made of plastic such as polyethylene.

A rim **15** of the head assembly overlies the edge of the container **14** and has ears **16** (Figure 2) to receive knurled bolts **17** which bear against the sides of the container **14** and hold the head **13** and container **14** together. A raised portion **18** on the head assembly defines an outlet or exit **19** which preferably communicates with a pair of outlet openings **20** (Figure 7). The head assembly **13** also has a generally cylindrical recess **21** provided with a circular opening **22** which leads into the container **14**. A wire **23** extending through a rubber ball **24** has its ends turned and embedded in a circumferential rim **25** about the opening **22**.

A plate **26** covers the recess **21** and carries atomizing means generally indicated at **27** and a regulator **28** for controlling the admission of a second gas. The atomizing means **27** includes a tubular piece **29** which passes through an opening **30** in the plate **26** up to an enlarged threaded portion **29***a*. Rigid tubes **31** are bent to extend one leg through the sides of the tubular piece **29**, to which the leg may be soldered, so that the bore of the piece **29** is reached as shown in Figure 4. Just above the entry of the tubes **31** in the bore of the nozzle or tubular piece **29**, there is a round torus-shaped rubber seal or O ring **55** which rests within a suitable circumferential groove in the tube **34**. This ring seals the annular area between the nozzle **29** and the tube **34** against leaks in an upward direction as viewed in Figure 3. Any serious leak of gas at this upper end of the tubular piece **29** would affect the aspirating action and the proper suction and supply of the liquid to be nebulized. Since coupling nut **37** and flange **36***a* on the coupling **36** together with the threaded portion **29***a* do not usually form an airtight seal and as the bore of the nozzle **29** connects directly with this joint, omission of the O ring seal may adversely affect the aspiration of any liquid through the tubes **33** and **31** to the atomizing apparatus.

Flexible tubes **33** extend through openings **32** in the recess **21** on opposite sides of the main circular opening **22** to fit over the ends of the other legs of the rigid tubes **31**. This allows removal of the plate **26** from the casting without making it necessary to disconnect the two

flexible tubes 33. The latter are of sufficient length to reach the bottom of the container 14 upon assembly of the parts.

A tube 34 to which an aspirating tip 34*a* has been fixed as by soldering (Figure 8) fits concentrically within the tubular piece 29, leaving a slight spacing between the walls of the tube 34 and tubular piece 29 for the flow of a liquid aspirated to the atomizing means through the tubes 33 and 31. The tube 34 and a concentric bushing 35 are soldered to each other and to a coupling 36. A coupling nut 37 abuts against a flange 36*a* on the coupling 36 and has threads to engage the threaded portion 29*a* to hold the parts in assembly. Similarly, a threaded elbow 38 connects at one end to an internally threaded bore of the coupling 36 and is internally threaded itself at the other end to receive a hose connector 39 over which a flexible hose 40 fits.

The regulator 28 includes a metal strip 41 folded about and riveted to a plastic spacer block 42. A pivot pin 43 passes between the bight of the folded strip 41 and the block 42. The ends of the pin 43 are soldered or otherwise secured to the plate 26 adjacent an opening or inlet 44 in the plate which leads into the recess 21. In pivoting about the pin 43, the regulator 28 either exposes the opening 44 or covers it. In the latter instance, the opening 44 preferably is not completely covered, as indicated in Figure 3, so that at least some air is always admitted. The plate 26 has a pair of openings to pass a pair of knurled thumb screws 47 which screw into threaded openings in boss portions 46 in the recess 21 and thereby hold the plate 26 to the head assembly 13. The thumb screws 47 are held to the plate 26 by retaining rings to prevent the thumb screws from becoming lost.

In practice, an adaptor bracket secures the nebulizing apparatus to an incubator as illustrated in Figures 1 and 9. In each case, the bracket has an upper plate portion 48 in which two tubes 49 are fixed (Figure 3), a depending skirt portion 50, and two forked legs 51 which extend from the skirt portion to support the container 14 along its bottom. A knurled lock screw 52 passes through a threaded opening in the raised portion 18 of the head assembly to bear against the tubes 49 (Figure 7) and thereby secure the parts to each other. The use of the two tubes 49 prevents turning or other movement of the nebulizing apparatus relatively to an incubator.

A gas such as oxygen passes through the flexible hose 40 and the described coupling parts, through the tube 34, and then out the lower tip of the tubular piece 29. In accordance with known principles, the rarified atmosphere between the walls of the tubular piece 29 and the tube 34 causes a liquid 53 such as water to rise from a reservoir in the container 14 through the tubes 33 and 31 and to pass concurrently with the direction of the flow of oxygen around the tube 34 and out the lower tip of the tubular piece 29 as an atomized mist. The discharge of the atomizing means strikes the convexly curved surface of the baffle ball 24 which has the effect of nebulizing and scattering the globules or particles throughout the container 14, above the liquid level and below the outlet 19. The heavy particles gravitate or settle back to the liquid 53 to be renebulized, while the finer or lighter particles pass with the oxygen through the outlets 19 and 20 into an incubator. Placing the baffle 24 below the outlet 19 improves the nebulizing and the degree of separation between the lighter and heavier particles.

During this time, the opening 44 may be uncovered, that is, the regulator 28 may occupy the position shown in Figure 6. Accordingly, a second gas such as air may be induced into the container 14 by the described flow of oxygen so that the oxygen becomes diluted within the container. When a mixture of gas and atomized mist is discharged from the nozzle end of the tubular piece 29, the mixture entrains and propels particles of surrounding gas in the direction of discharge. This action is limited to gas passing through the opening 44 in plate 26 by locating the tubular piece or nozzle 29 in the opening 22 of the head assembly 13. This action is thus a secondary aspiration created by the discharge from the tubular piece 29 through the opening 22. The amount of aspiration is controlled mainly by the location of the convexly curved surface of the ball 24 with reference to the opening 22 and the discharging nozzle or tubular piece 29. Within limits aspiration efficiency may be increased by moving the ball 24 closer to the opening 22 and nozzle 29. The variation at this point is critical. Aspirating efficiency may also be increased within limits by reducing the opening 22 or opening 44 or by changing the location of the nozzle 29 with respect to the opening 22. Variations at these points are not critical as a large change is required to produce a very small change in aspirating efficiency. It is this secondary aspiration which is used and controlled to produce a proper dilution of the gas-mist mixture with a second gas. The apparatus is designed so that the dilution is within controllable limits, for example, a predetermined minimum of oxygen in the mist passed to the incubator may be set at 40 percent. One side of the plate 41 of the regulator 28 may be marked to show this value when the regulator is turned back as illustrated in Figure 6. For certain emergencies, however, it is necessary greatly to increase the oxygen content. In the present apparatus, the regulator 28 is merely flipped about the pin 43 to at least partially cover the opening 44 so that the admission of the diluting gas is decreased. The strip 41 may be marked with suitable indicia to indicate this position of operation as illustrated in Figure 5. In each case the efficiency of the present nebulizing apparatus is such that a single "one-pass" flow of oxygen through the nebulizer achieves the concentration of water and oxygen desired in the admixture which passes to the incubator. It is, therefore, not necessary to recirculate the atmosphere of the incubator to obtain desired concentrations.

If at any time a tube 33 conducting water to the nebulizing means becomes plugged, no emergency is created in the present nebulizer since the remaining tube 23 is of a sufficient capacity to provide enough liquid to insure a safe, continued supply of a nebulized mist for an incubator. Between periods of use, the nebulizer is easily disassembled by merely loosening the two bolts 17 and removing the head assembly 13. The container 14 is then just as easily cleaned, since all of the nebulizing elements are on the head assembly 13, and the apparatus quickly reassembled for further use.

The apparatus described herein is susceptible of considerable variation without departing from the spirit of our invention, and therefore the invention is claimed broadly as indicated by the appended claims.

Having thus described our invention, what we claim as new and useful and desire to secure by United States Letters Patent is:

1. Nebulizing apparatus including a substantially cup-shaped receptacle for containing a reservoir of liquid to be nebulized, a removable head assembly carrying the entire nebulizing mechanism and designed to fit in an open end of the cup-shaped receptacle, said head having an outlet opening, an aspirating nozzle carried by the head assembly pointed into the receptacle and having a passage for the travel of a first gas therethrough, means to conduct liquid from said reservoir to the aspirating nozzle under the action of said travel of the gas to discharge into the receptacle a nebulized stream of globules of the liquid in the gas, an inlet opening provided in the removable head assembly to admit a second gas induced into the receptacle by the action of the nozzle to dilute the first gas in the receptacle, and a baffle supported by said head assembly below the nozzle and in the path of said stream, said baffle having a spherical surface against which the stream impinges to distribute the nebulized globules throughout the container and allow the finer

globules to pass together with said first and second gases through the outlet opening of the head and to allow the heavier globules to gravitate back to the liquid reservoir to be renebulized.

2. Nebulizing apparatus as claimed in claim 1 wherein said means to conduct liquid from the reservoir to the aspirating nozzle includes a plurality of tubes so that clogging of one tube does not interfere with the continuous action of the nebulizer.

3. Nebulizing apparatus as claimed in claim 1 further including means to regulate the size of said inlet opening to vary the amount of dilution of the first gas by the second gas.

4. Nebulizing apparatus as claimed in claim 1 further including means to regulate the size of said inlet opening comprising a cover mounted on the head assembly for pivoting about an axis adjacent said inlet opening so that the cover may expose the entire inlet opening or at least partially overlie said opening to vary the amount of dilution of the first gas by the second gas.

References Cited in the file of this patent

UNITED STATES PATENTS

2,274,669	Curry	Mar. 3, 1942
2,709,577	Pohndorf et al.	May 31, 1955
2,720,387	Dorsak	Oct. 11, 1955