Feb. 19, 1957 S. C. SHADEGG 2,782,073

NEBULIZERS

Filed Oct. 30, 1953

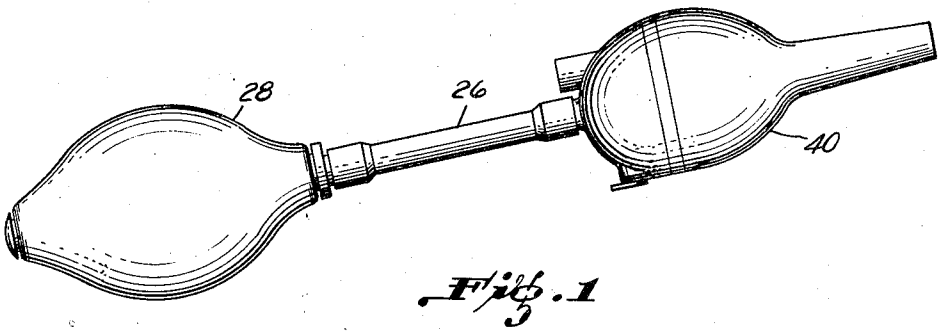


Fig. 1

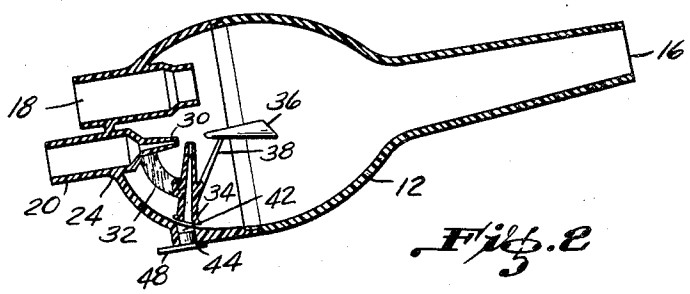


Fig. 2

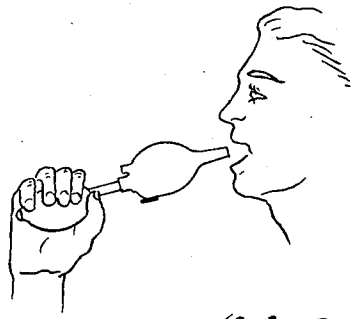


Fig. 3

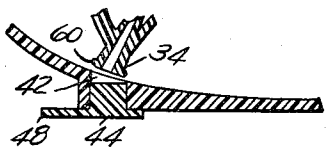


Fig. 4

INVENTOR

STEPHEN C. SHADEGG

BY

Munn, Liddy, Nathaniel & Mack

ATTORNEY

United States Patent Office 2,782,073 Patented Feb. 19, 1957

2,782,073

NEBULIZERS

Stephen C. Shadegg, Phoenix, Ariz.

Application October 30, 1953, Serial No. 389,254

4 Claims. (Cl. 299—88.5)

This invention relates to vaporizers or nebulizers used for the application of medication in the form of mist or spray, and in particular to a nebulizer for use in the administration of medication to relieve the symptoms of asthma.

Nebulizers commonly in use comprise a central flask varying in shape and dimension with a discharge nozzle at one extreme and a tube or bib for the attachment of a bulb or air delivery device at the opposite extreme.

The operating components invariably consist of a capillary, sometimes called liquid tube, and an air tube or jet nozzle.

The air tube or jet nozzle terminates directly over one end of the liquid tube and the stream of air from this jet nozzle passing over the capillary tube lifts the liquid from the bottom of the flask and projects it forward in a mist or spray. In some devices this mist or spray is projected against the side of the flask itself, which serves as a baffle to trap the larger droplets. In some devices the discharge nozzle is made on a radius and the bend in the discharge nozzle is employed as a baffle.

In other devices there is erected between the air stream where it comes across the top of the capillary tube and the discharge nozzle a physical baffie of various shape and design.

Nebulizers are intermittently used by the sufferer to inhale a small quantity of very fine mist or vapor. The medication usually used in such nebulizer is an epinephrine solution which, when inhaled, does provide some relief from the symptoms of bronchial asthma.

Most manufacturers provide corks or caps for any air vents or discharge nozzles since it is common practice to leave as mall amount of medication in the nebulizer flask and thus keep the nebulizer available for instant use when required.

Since only a small amount of medication is actually used to inhale at any one time, it is impossible for the user to measure the exact amount of medication needed. And to return left over solution to a bottle or other reservoir would result in contamination of the reservoir of medication.

In common practice, the individual keeps the solution to be inhaled in the vaporizer at all times, and thus there is apt to be some of the inhalant standing in the capillary tube for a considerable length of time in a more or less static condition.

Any vaporizer or nebulizer device comprising capillary tubes or nozzles having small diameter passages or holes (varying from .0015 to .0020 inside diameter) are apt to become clogged by even small amounts of foreign material or material in suspension or deposited out of the solution used.

Also, if solutions are used which tend to deposit "scale" over a length of time, the efficiency of the atomizer or nebulizer is gradually reduced until faulty action becomes more and more apparent.

Any blockage which reduces the inside diameter of the capillary or liquid tube by as much as $\frac{5}{1000}$ of an inch will materially affect the performance of the nebulizer.

Since many asthma sufferers are frequently symptom free for periods of from two weeks to sometimes thirty days, it is apparent that frequently the nebulizer which has been prepared by the introduction of medication for

this use is not actually used until a time sometimes two weeks to thirty days after the introduction of the medication. As a result of this intermittent use, the capillary or liquid tube frequently becomes plugged rendering the nebulizer inoperative and useless to the individual.

Various types of solutions have been recommended by various manufacturers for the cleaning of clogged nebulizers. Both chlorax and ammonia are widely recommended. But neither of these two solvents, nor any other solvent readily available to the individual, is universally effective in opening the clogged capillary tubes. Most manufacturers of nebulizers of this type offer to their purchasers a cleaning service which necessitates the return of the nebulizers to the factory. In the factory or laboratory, most manufacturers have available solvents of sufficient strength to attack the deposits in the capillary tube. Potassium dichromate acid is widely used for this purpose. But the delay and inconvenience to the individual is terrifying and disturbing. Frequently an individual possessing such a nebulizer suffers a violent appearance of the symptoms of asthma, prepares to use his nebulizer, which in the past has provided prompt means of checking the symptoms, and then discovers the liquid tube is clogged, the nebulizer is inoperative, and he has no means of counteracting or subduing or minimizing his attack.

The object of this invention is to provide a satisfactory nebulizer which can be easily cleaned at home by the average user; to provide a satisfactory nebulizer which can be quickly cleaned by the average user without resorting to strong acids or solvents.

It is understandable that the cleaning means provided must be of simple construction and contain few parts as well as be effective. If such is not the case, it will not be acceptable to the user, the cost of production will increase beyond reasonable limits, and the cleaning process will be too complicated for the average individual.

It is, accordingly, a further object of this invention to provide a nebulizer in which effective cleaning can be easily accomplished, in which the nebulizer cost is not considerably increased and in which there is little possibility for breakage or derangement of the parts.

A further object of this invention is to provide a reservoir or flask which will permit the introduction of smaller amounts of medication into the nebulizer than has heretofore been possible, and at the same time insure high operating efficiency in the hands of the average user. This obviously results in a saving in the amount of medication used and should reduce the tendency to clog.

Yet another object I might mention is to provide a nebulizer having means for facilitating and insuring thorough cleaning, as well as a means of insuring use of smaller than usual amounts of medicine, yet in which cost and maintenance problems are satisfactorily met. This is accomplished according to the invention by constructing a portion of the nebulizer so as to combine these desirable features.

These and other objects and advantages will become apparent from the following description and accompanying drawings, in which:

Figure 1 is a side elevational view of the nebulizer constructed in accordance with this invention.

Figure 2 is a sectional elevational view showing the internal construction of the nebulizer.

Figure 3 is a view showing the nebulizer as comfortably and normally held in operation by the average individual.

Figure 4 is an enlarged view showing a form of closure means or plug and cleanout opening constructed in accordance with the invention.

Similar references occur to represent similar parts of the several figures.

Referring now particularly to the drawing reference character **10** indicates the nebulizer flask which can be formed of any suitable plastic or glass material. The flask comprises a central chamber or reservoir **12**, a discharge nozzle **16**, an air inlet **18**, and a bib or nozzle for the attachment of bulb or air tube **20**, entering the nebulizer at **24**. An ordinary rubber bulb **28**, and a length of flexible rubber tubing **26** are provided in the embodiment shown.

The air nozzle **30** is connected to the inner end of the tube opening **20**. Support stem **32** depends from the nozzle and supports the capillary or liquid tube **34**. The baffle **36** is supported on tube **34** by means of bracket **38**. The baffle **36** is symmetrically conical in shape with the large end of the cone flat and tapering forward. The arrangement of capillary tube, nozzle and baffle is such that air is directed by nozzle **30** across the top of the capillary tube **34** and against the baffle **36**. Thus the liquid in the lower chamber of reservoir **12** is drawn upwardly through the capillary tube and blown against the baffle. The atomized medication is directed outwardly through discharge opening **16**. Air inlet tube **18** adds velocity to the discharged spray.

It will be noted that capillary tube **34** is not in a vertical plane but inclined backwardly at an angle of approximately twenty degrees with respect to the vertical axis of the flask. The angle of interception of the capillary tube and the air tube is less than ninety degrees by this approximate twenty degrees of inclination.

I show a clean-out opening **42**, circular in form in the lower section of the chamber **12**. The clean-out opening is formed with a shoulder on all sides, and the clean-out opening is directly below the bottom termination of the capillary tube **34**. The opening is normally closed by a plug or cover **44**. The body of the plug is held in opening **42** by friction. Flange **48** permits the user to remove the plug easily. The plug may be formed of any suitable material such as rubber or polyethylene. The interior diameter of capillary tube **34** tapers to a measured opening at the top end of approximately $^{18}/_{1000}$ inch. Stoppage usually occurs at this restricted point.

To clean the vaporizer the individual need only to fill the flask with water, turn the nebulizer upside down, remove plug **44** and insert in the bottom end of the capillary tube **34** a nylon straw of controlled diameter or a piece of stainless steel wire of controlled diameter. By applying gentle pressure to the clean-out wire, the accumulated residue can be forced through the top of the capillary tube **34** and the nebulizer made operable.

The clean-out hole being directly below the bottom end of the capillary tube **34** and being closed by a cork or plug somewhat shorter in length than the shoulder of the clean-out tube **50**, there is formed directly beneath the lower end of the capillary tube **34**, a small reservoir to trap and hold minute quantities of the medication, thus making it possible to atomize or nebulize the final drop of solution in the vaporizer and permitting the individual to introduce a smaller quantity of medication than would be necessary without this feature. Attention is called to Figure 3, which shows the vaporizer in normal operating position. It will be noted that the discharge end **16** is normally raised approximately twenty degrees above the horizontal, thus bringing the capillary or liquid tube **34** into an almost vertical position, resulting in all liquid inside the flask **10** collecting directly below the bottom end of the liquid tube **34**.

Attention is now called to the relationship between the bottom end of the liquid or capillary tube **34** and the radius of the flask. The shoulders **60** on the liquid tube **34** are tapered on either side and these shoulders rest approximately $^{5}/_{1000}$ inch above the interior of the flask. By keeping the clearance between the bottom of the liquid tube **34** and the flask or base of the reservoir to an absolute minimum, the nebulizer or vaporizer will function on the last visible drop or two of solution, and

it is claimed that by thus terminating the bottom of the liquid or capillary tube almost directly against the inner wall of the vaporizer, there is a marked improvement in operation and a marked saving to the individual as contrasted to those vaporizers wherein the liquid tube is terminated $^{20}/_{1000}$ to $^{75}/_{1000}$ inch short of the interior wall of the reservoir.

Attention is now called to tube **20**, which forms a connecting link between the air discharge nozzle and the source of air supply. This being in a straight line, it is possible for the user to remove the tube or bulb and insert the clean-out wire through the air nozzle in the event this nozzle becomes plugged or stopped.

As a result of this invention it will no longer be necessary to return the nebulizer to the factory to have the capillary tube cleaned. The cleaning can be accomplished easily and safely and quickly by the user at home.

While I have shown and described a preferred form of my invention, it will be understood that variations in details of form may be made without departure from the invention as defined in the appended claims.

I claim:

1. A nebulizer comprising a flask, said flask having a chamber for receiving liquid medication, a discharge nozzle at one side of said chamber, an air nozzle on the opposite side of said chamber and directed toward the said outlet, means for forcing air through said nozzle, a capillary tube having an upper outlet and positioned between said air nozzle and said outlet and positioned to intercept and be acted on by air emitted from said air nozzle, said tube having a lower end positioned adjacent the bottom of said chamber, and a baffle positioned intermediate said upper end of said capillary tube and said discharge outlet, and baffle comprising a cone having its apex facing said upper end of said capillary tube and positioned in close proximity thereto and having its base facing said discharge outlet.

2. The nebulizer of claim 1 in which said base is formed at an angle with respect to the main axis of said cone and inclined toward said upper end of said capillary tube.

3. A nebulizer comprising a hollow flask having a chamber for receiving liquid medication and a passage extending from said chamber through the bottom wall of the flask, a discharge nozzle at one side of said chamber, an air nozzle at the opposite side of said chamber from said discharge nozzle, a baffle positioned intermediate said nozzles, a capillary tube supported within said chamber and having an upper outlet end positioned between said air nozzle and said baffle to intercept and to be acted on by air emitted from said air nozzle, said tube having the lower end thereof positioned in close proximity to the bottom wall of said chamber and in alignment with said passage, a removable plug positioned in the exterior end of said passage to close the same, said plug being removable for cleaning of said capillary tube.

4. The nebulizer of claim 3 in which said plug is shorter in length than said passage to thereby define a reservoir for fluid in the chamber end of said passage when said plug is in operative position in said passage.

References Cited in the file of this patent

UNITED STATES PATENTS

1,169,301	Trask	Jan. 25, 1916
2,042,770	Chandler	June 2, 1936
2,131,455	Schutte	Sept. 27, 1938
2,274,669	Curry	Mar. 3, 1942
2,675,358	Fenley	Apr. 13, 1954

FOREIGN PATENTS

947,604	France	Jan. 17, 1949
1,011,397	France	Apr. 2, 1952
686,006	Great Britain	Jan. 14, 1953