

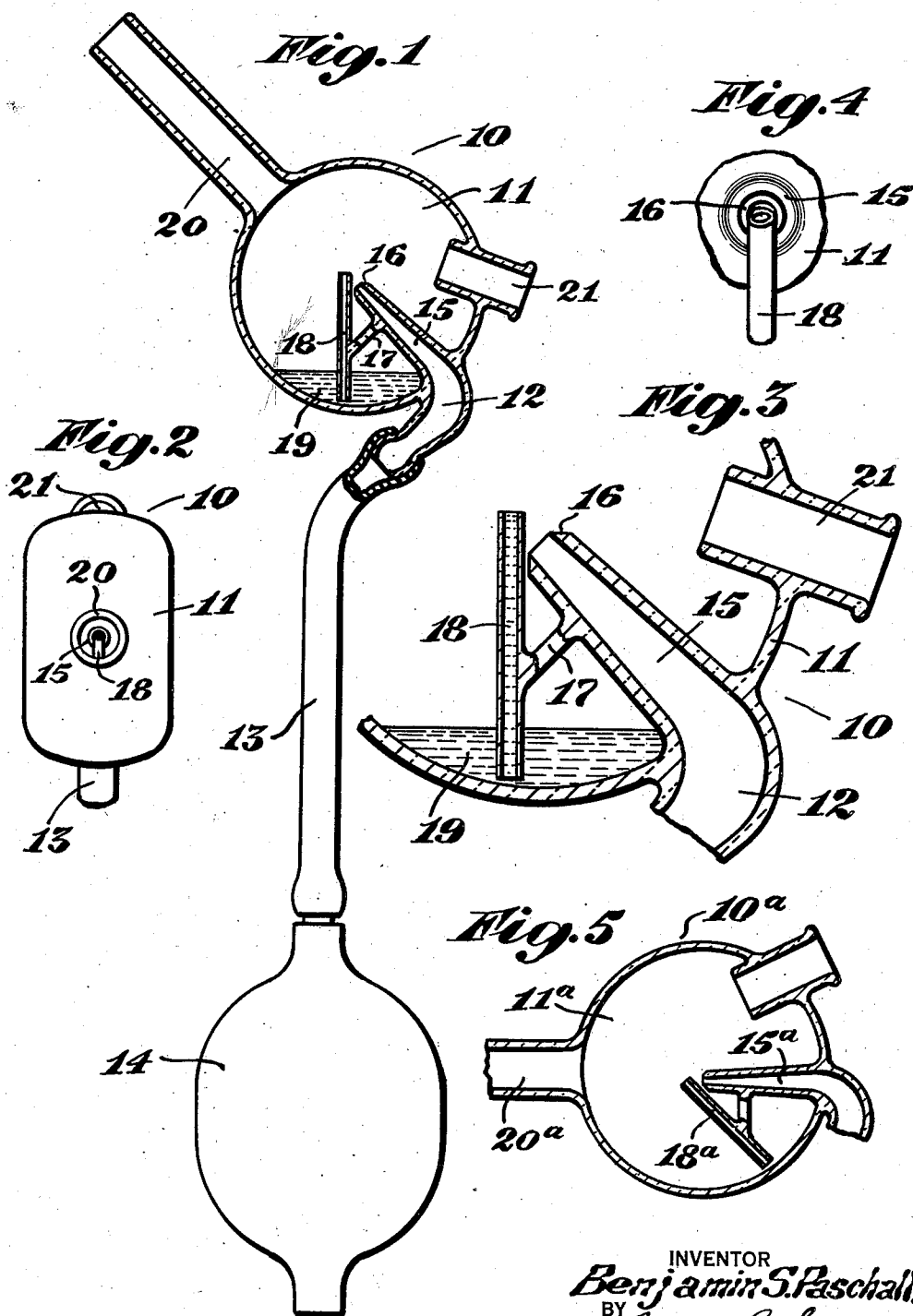
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NEBULIZER

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NEBULIZER

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This invention relates to improvements in nebulizers and aims primarily to provide a nebulizer especially designed and adapted for administering medicaments, or therapeutic substances to the bronchi, bronchioles, and alveoli of the lungs, as for example, in cases of persons suffering from asthma, hay fever and the like.

Broadly contemplated by the present invention is the provision of a nebulizer capable of producing a true vapor at ordinary room temperature from any suitable liquid medicament in adequate quantities and of such fineness of dispersion as to be rapidly and readily inhaled by a patient without any injurious amount thereof lodging in or being absorbed by the throat.

With the above in view, the invention is more particularly concerned in the provision of a novel and improved type of nebulizer embodying a flask or bulb having an air injection tube and discharge nozzle disposed in substantially coaxial relation; an angularly disposed capillary tube having its upper end disposed in close proximity to the outlet end of said air injection tube and substantially covering the orifice of same; an air intake angularly disposed in said flask in such a manner that the prolongation of the axis of same substantially intersects the juncture of the flask and inner end of said discharge nozzle, and means for supplying air pressure to said air injection tube with such velocity as to produce the greatest amount of vapor and the least amount of droplets, all of which are to be correlated in the broad aim of enhancing the efficiency of the present device.

The above, and additional objects which will hereinafter be more specifically treated are attained by such means as are shown in the accompanying drawing described in the following specification and then more clearly pointed out in the claims which are appended hereto and form part of this patent.

With reference to the drawing, in which there is illustrated several embodiments of the invention and throughout the various views of which like characters of reference designate similar parts:

Figure 1 is a vertical longitudinal medial section of a nebulizer comprehended by the present invention.

Fig. 2 is an elevation of the discharge end of same.

Fig. 3 is an enlarged fragmentary vertical medial section of the nebulizing means and air intake of the nebulizer.

Fig. 4 is an enlarged fragmentary end elevation of the air injection tube and capillary tube, and

Fig. 5 is a fragmentary vertical longitudinal

medial section of a slightly modified type of nebulizer.

It is the primary purpose of the present invention to provide a nebulizing device having a nebulizing chamber of such size to permit of the sudden expansion of the liquid medicament into a nebulized or vaporized state, and having an outlet tube or discharge nozzle of such calibre and length to permit the vapor to flow freely, whereby an adequate quantity of vapor, containing a sufficient concentration of the selected medicament, is produced at a suitable vapor pressure to obtain a maximum of relief in a minimum of time and with the least discomfort to the patient.

Beginning now the more detailed description of the invention by referring to the drawing, wherein the numeral 10 generally designates my novel and improved nebulizer, which in Fig. 1 is preferably illustrated as inclined substantially at the angle in which it would be used, said nebulizer being provided with a circular flask or bulb 11 forming the nebulizing or vaporizing chamber thereof, which flask, in the present instance is preferably provided with flattened sides, as shown in Fig. 2.

Exteriorly formed upon the flask 11 at one side thereof is an outwardly and downwardly extending nipple 12 to the outer end of which is connected one end of a rubber tube 13 having a conventional type of rubber bulb 14 at its opposite or outer end.

Extending within the flask 11 in axial alignment with the inner or upper end of the nipple 12 and communicating therewith, is an inwardly convergent air injection tube 15 which terminates approximately at the center of said flask, see Figs. 1 and 3, said tube having its tip or inner terminal 16 exteriorly bevelled or ground, as shown, and having a relatively small discharge orifice thereat. As above stated, the tip 16 should be located substantially in the center of the flask 11, for the reason that any material displacement of the same from the center, either in a horizontal or vertical plane will rapidly and proportionately diminish the production of vapor by the nebulizer. Exterior bevelling of the tip 16, as above described, is for the purpose of securing a better nebulizing effect and action for the device, as will be manifest and apparent to anyone skilled in the art.

Integrally connected, as by a stem 17, to the air injection tube 15, adjacent its inner end, and in downwardly inclined or angular relation thereto is a capillary tube 18, the inclination of said capillary tube relative to said air injection tube being such that the upper portion of the capillary tube is disposed substantially in slight spaced parallel relation to the bevelled face of the tip 16, as shown more clearly in Fig. 3, inas-

much, as any material variation of such relative inclination, or excessive spacing of the upper end portion of the capillary tube 18 from the tip 16, rapidly diminishes the nebulizing effect or action of the device and also causes droplets in the discharged vapor. The capillary tube 18 at its lower end is normally immersed in the liquid medicament, herein designated by the numeral 19, see Figs. 1 and 3. As now fabricated the upper end or tip of the capillary tube 18 is preferably ground square so as to produce a sharp or cutting edge thereat, this in order to secure smooth and uniform production of vapor. Further, the position or location of the tip of the capillary tube 18 in relation to the orifice of the tip 16 must be such that the upper peripheral portion or rim of the capillary tube allows the upper portion of said orifice to be seen as a crescent, when looking straight through the discharge nozzle 20, see Fig. 4. It is important and essential that the minute bore through the capillary tube 18 be uniform throughout its length for the reason that any narrowing of its orifice or other part results in obstruction caused by an accumulation of atmospheric dust that is drawn into the liquid. A uniform bore makes this tube self cleaning and results in a maximum production of vapor.

Exteriorly formed upon the flask 11 substantially aligned to the air injection tube 15 and extending radially from said flask is a discharge nozzle or outlet tube 20, said nozzle being of relatively large calibre to offset or reduce any back pressure built up within the flask 11 during operation of the nebulizer 10, and thereby insure of a large vapor output for the latter. The length of the nozzle 20 is such as to insure of the interception of droplets therein and their return to the flask 11, and should not be less than the diameter of the flask.

Formed upon and extending through the upper peripheral portion of the flask 11 in spaced superposed relation to and in the vertical plane of the air injection tube 15 is an angularly disposed air intake tube 21, the latter being inclined at such an angle, that a prolongation of the axis of the same will substantially intersect the juncture of the discharge nozzle 20 with the flask 11 see Fig. 1, this in order to cause the air passing inwardly through the tube 21 to intermingle with and function to drive the vapor out of the flask after it has been formed by the nebulizing means therein. In this connection I desire to state that such air intermingles with the vapor at a point substantially above its point of formation. It being here noted that any increase of downward inclination of the tube 21 over that stated above progressively and materially diminishes or decreases nebulizing action, in other words, if the inclination of the tube 21, was such as to direct the air passing inwardly therethrough to the point of vapor formation the latter is seriously diminished and droplets are carried through the nozzle. The position or location of the air intake tube 21 in relation to the nipple 12 should be such that the neck or protruding portion of said tube may be easily and readily held between the fore and middle fingers of the user, thus facilitating handling of the nebulizer. As will be observed, by referring to Figs. 1 and 3, the inner end or reentrant portion of the air intake tube 21 extends within the flask 11, this for the purpose of retaining the medicament 19 within the latter and obviating spilling of the same, in the event the nebulizer is invert-

ed, and also for the purpose of delivering incoming air into the vapor forming zone.

In the present instance the nebulizer 10 is preferably fabricated from glass because of the constructional advantages of such material, as well as its chemical inactivities and its convenience in use, however, I desire to have it understood that any other suitable material may be employed in the fabrication of my novel and improved device.

By fabricating the nebulizer 10 in the manner herein shown and described, the liquid medicament 19 is changed to a finely divided vapor and is ejected from the discharge nozzle 20 in the form of fog or smoke substantially free from any droplets, and in consequence, such fog or smoke is easily inhalable by the user without any choking sensation whatsoever and hence readily penetrates to the bronchi and the alveoli of the lungs.

In the slightly modified type of nebulizer 10a illustrated in Fig. 5, the numeral 11a designates the flask or bulb thereof having an air injection tube 15a extending therein slightly below the axial plane of the flask 11a, in which case the correlated capillary tube 18a thereof is proportionately shortened. The discharge nozzle 20a of said flask is located substantially in the plane of the flask axis, as shown. By disposing the axial planes of the air injection tube 15a and discharge nozzle 20a in slight spaced parallel relation as herein shown and described, a greater number of droplets are intercepted and retained within the flask 11a and nozzle 20a.

In the operation of the present nebulizer, the desired amount of liquid medicament 19 is poured into the flask 11 through the air intake tube 21, following which the user grasps the protruding neck of the latter between the fore and middle fingers of one hand and inserts the nozzle 20 in the mouth, preferably holding the nebulizer substantially at the angle indicated in Fig. 1, following which the user grasps the rubber bulb 14 with the other hand and vigorously and repeatedly squeezes same to produce and deliver air under pressure at the tip 16 of the air injection tube 15, which air as it emerges from said tip draws up the liquid medicament 19 within the capillary tube 18 causing ejection of such liquid therefrom in the form of a conical funnel or corona of vaporous spray, which impinges that portion of the inner walls of the flask 11 surrounding the discharge nozzle 20, whereby the maximum number of droplets are intercepted and retained within the flask 11, thus insuring of a comparatively droplet-free vapor being discharged from the nozzle 20. By locating the air injection tube 15 in substantially axially aligned relation with the nozzle 20, such conical funnel or corona of vaporous spray will impinge the inner walls of the flask 11 in substantially concentric relation to the adjacent end of the nozzle 20, as will be manifest and apparent. Lowering of the air injection tube, or its tip, within reasonable limits, as illustrated in Fig. 5, further decreases the number of droplets entering the discharge nozzle and in consequence progressively increases the amount of vapor discharged therefrom. The air pressure emerging from the air injection tube 15 draws in outside air through the air intake tube 21, which air converges or intermingles with the conical funnel or corona of vaporous spray emerging from the capillary tube 18 at a point substantially midway between

the tip of the latter and the opposing inner wall portion of the flask 11, surrounding the discharge nozzle 20, thus imparting a swirling effect to the vapor and materially increasing the volume of fog or smoke emerging from the discharge nozzle 20, which fog or smoke is inhaled by the user and delivered directly to the endothelial lining of the lungs whereby a therapeutic action is obtained in a relatively short time, which will afford the user relief for a relatively long period.

Manifestly, therefore, by constructing, combining and correlating the several elements or parts of the present device, in the manner herein disclosed, a highly efficient and balanced nebulizer is provided which gives the desired results. In this connection, I wish to state, that it is essential and necessary that the nebulizing means 15-18 must not be located either too near nor too far from the discharge nozzle 20, if the former too many droplets are discharged from the nebulizer and if the latter too small a quantity of vapor is discharged, this by reason of the fact, when the nebulizing means is too near the nozzle 20 the conical funnel or corona of vaporous spray containing droplets does not impinge the inner walls of the flask surrounding the nozzle 20, hence passes outwardly therethrough in its entirety, while when the nebulizing means is too far from the nozzle 20 the conical funnel or corona of vaporous spray is dissipated upon the inner walls of the flask 11. Further, as has hereinbefore been pointed out, the air intake tube 21 must be located on the flask 11 in such a position relative to said nebulizing means and nozzle so as not to diminish the quantity of vapor produced by the former and its discharge from the latter. Furthermore, by providing a circular flask or container 11 and locating the air intake tube 21 therein relative to the nebulizing means 15-18 and nozzle 20, in the manner herein described, the air entering or drawn through said air intake tube 21 imparts a swirling effect or centrifugal motion to the conical funnel or corona of vaporous spray produced by said nebulizing means, which swirling effect causes the droplets to adhere to the inner walls of the flask 11 without substantially impeding the discharge of the vapor through the nozzle 20. In the inhalation treatment of asthma and other kindred ailments it is desirable that the greatest amount of vapor be inhaled in the shortest time with the least expenditure of effort on the part of the patient, consequently, the present nebulizer has been designed to nebulize a relatively large quantity of medicament in a comparatively short time, with minimum effort.

The present nebulizer is especially effective in the treatment of the symptoms of asthma and other conditions in which there is difficult breathing, in which treatment epinephrin (adrenalin) is employed as the liquid medicament. The strength of the epinephrin solution preferably employed with the present nebulizer is approximately one part epinephrin to ninety nine parts of a normal salt solution.

While I have herein shown and described the invention with sufficient detail to enable those skilled in the art to which it pertains to understand the mode of construction and the principles involved, it is to be understood that there is no intentional limitation herein to the specific form and precise detail of construction shown and described, except as expressly defined by the

appended claims, and that various modifications of the same may be resorted to without departing from the spirit of the invention or the benefits derivable therefrom. It is also to be understood that certain features of the invention herein disclosed may be employed in and with other combinations than those shown and described.

What I claim as my invention and desire to secure by Letters of Patent is:—

1. A nebulizer comprising a circular flask, a diametral air injection tube extending within said flask and terminating in an exteriorly tapered tip substantially at the center of same, fluid pressure supply means connected to said tube, a capillary tube in said flask attached to said air injection tube in downwardly inclined relation to the axis thereof, said capillary tube having its upper end portion disposed in close spaced relation to the exteriorly tapered tip of said air injection tube, a discharge nozzle for said flask extending radially therefrom in axial alignment with said air injection tube, and an air intake tube extending into said flask above said air injection tube, said air intake tube being inclined so that its axis substantially intersects the juncture of the nozzle and flask.

2. A nebulizer comprising a circular flask, a diametral air injection tube extending within said flask and terminating in an exteriorly tapered tip substantially at the center of same, fluid pressure supply means connected to said tube, a capillary tube in said flask attached to said air injection tube in downwardly and rearwardly inclined relation to the axis thereof, said capillary tube having its tip ground square and its upper end portion disposed in slight spaced parallel relation to the exteriorly tapered tip of said air injection tube, a discharge nozzle for said flask extending radially therefrom substantially in the vertical plane of said air injection tube, and an air intake tube for said flask disposed above said air injection tube in inclined spaced relation thereto and substantially in the vertical plane thereof, said air intake tube being inclined so that a prolongation of its axis will substantially intersect the juncture of the nozzle and flask.

3. A nebulizer comprising a flask, a discharge nozzle radiating from the flask, an air injection tube extending into the flask and directed to point through the discharge nozzle, a capillary tube connected to said air injection tube in angular relation therewith and having its end portion disposed in contiguous relation with the discharge end of the air injection tube, and an air intake tube extending into the flask and directed at the opening into the discharge nozzle.

4. A nebulizer comprising a circular flask, an air injection tube extending radially into and terminating in a tapered tip substantially at the center of the flask, a capillary tube within the flask connected in angular relation to the air injection tube and being of uniform diameter throughout its length, said capillary tube having its tip ground square and disposed in the path of the air injection tube in contiguous relation with its tapered tip, a discharge nozzle extending radially from the flask and in the vertical plane of the air injection tube, said discharge nozzle having a relatively large uniform cross sectional area, an air intake tube extending into the flask and directed at the joinder of the discharge nozzle and flask, and said air intake tube projecting both into and outside the flask.

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