Feb. 2, 1937. R. F. MASSA 2,069,455

ATOMIZER

Filed Sept. 8, 1934

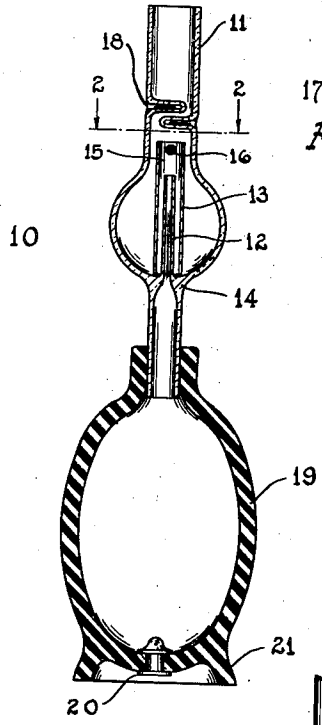


Fig.-1

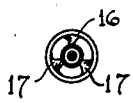


Fig-2

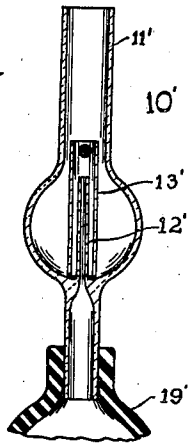


Fig.-3

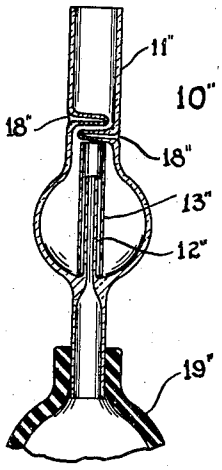


Fig.-4

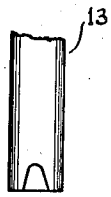


Fig.-8

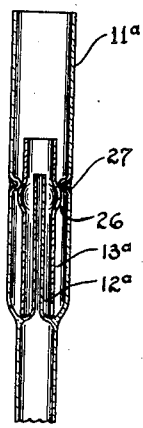


Fig.-6

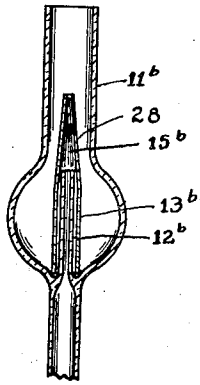


Fig.-7

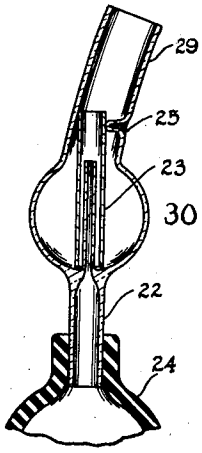


Fig.-5

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ATOMIZER

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Application September 8, 1934, Serial No. 743,245

15 Claims. (Cl. 299—88.5)

This invention relates to atomizers and more particularly to atomizers or sprays of the character used in atomizing or spraying medicinal liquids.

Atomizers or sprays to be best suited for present day use should be compact and small enough to be readily carried in a pocket or handbag of the user. They should be of rugged construction and so designed that they can successfully withstand considerable shock. They should be also constructed that they can be readily cleaned and sterilized. Furthermore, they should be made of material that will not be affected by the medicinal liquids used and will withstand the temperatures and temperature changes attendant upon their use and also upon cleaning and sterilization. In view of the fact that it is often desirable to obtain a warm spray of the medicinal liquid, the sprays or atomizers should also be such that an accessible portion thereof can be readily heated and when heated, retain enough heat to warm an appreciable quantity of spray.

The atomizers or sprays now available are generally too bulky to be carried about on the person and when made of glass are so delicate that they must be carefully handled to avoid breaking. Their construction is always such that they can only be cleaned with difficulty. The ones that are made of glass, because of their delicate and intricate construction, cannot successfully stand rapid temperature changes. Hence great care must be taken in sterilizing and heating them. This same construction renders them fragile under shock in handling. The ones made of other material are usually corroded by one or another of the medicinal liquids used in them and if for no other reason are always unsatisfactory. Furthermore, the present atomizers or sprays are so constructed that in order to produce a warm spray it is necessary to heat the whole of the atomizer or spray as by inserting it in a heated liquid.

This invention has for an object a small atomizer or spray of simple and rugged construction that can readily and safely be carried about in a pocket or handbag, that can be easily cleaned and/or sterilized, that can quickly be made to produce a warm spray and that can be easily and cheaply manufactured.

In accordance with my invention I form the atomizer or spray out of three concentric tubes. The tubes may be made out of any suitable material having the desired characteristics but for ease of manufacture as well as ruggedness in use of the finished atomizer or spray, I at present prefer to make the tubes of strong glass of very low coefficient of expansion. A glass such as the well known Pyrex glass is entirely suitable.

The outer spray directing tube is preferably, though not necessarily, formed with a spherical enlargement adjacent one end. Into this end of the outer tube is inserted the inner or air tube and welded thereto so that a portion of the air tube is within the outer tube. The portion of the air tube within the spray directing tube is of reduced diameter. Though the air tube may be formed by welding two tubes of different diameters, I preferably form it by reducing a portion of a tube of the larger diameter and weld this tube to the outer, or spray directing tube at the region where the reduction commences. The extremely light portion of the air tube within the spray directing tube is remarkably free from danger of breakage by reason of the manner in which it is supported and by reason of the fact, as will appear hereinafter, that it is not used to carry the weight of other parts.

The intermediate or liquid directing tube is loosely positioned concentrically of the air tube and extends from the joint of the air tube and the outer tube to a predetermined distance beyond the end of the air tube. The lower end of the liquid tube is cut at an angle or notched so as to assure a proper flow of liquid into and through it to the end of the air tube. The diameter of the liquid tube as well as the distance which it extends beyond the air tube is determined by the viscosity and density of the liquid to be sprayed as well as the character of the spray desired. The liquid tube at its discharge end is preferably centered on the air tube by one or more projections, formed in the walls of the outer tube, that touch the sides of the liquid tube. The liquid tube is positioned against substantial axial movement relative to the air tube by one or more projections formed in the walls of the outer tube which contact with the upper end of the liquid tube. When a very fine spray is desired the path of the spray through the outer tube may be baffled by one or more projections formed in the sides of the outer tube so that only the particles of liquid that are fine enough to be deflected past the projections by the air current can get out.

In another preferred form of my invention I bend the outer tube until it touches the upper edge of the liquid tube. In this form the walls of the outer tube in line with the outlet of the air tube and the liquid tube serve the purpose of the baffle projections and the portion of the walls of the outer tube that contact with

the liquid tube serve the purpose of the axial movement limiting projections as well as the purpose of one of the centering projections. However, I employ at least one separate centering projection to assure that the extremely light air tube has only itself to support and thereby keeping all strain away from the air tube.

In still another preferred form of my invention I provide a region of enlarged diameter intermediate the ends of the liquid tube and form a plurality of projections in the outer or spray directing tube that contact with the walls of the enlarged region. In this form I can obtain the centering and axial movement limiting functions by means of a single set of projections.

I may also modify any of the preferred embodiments mentioned by employing a liquid tube that has a tapering upper end in order to obtain, when desired, a further modification in the character of the atomization.

In all of the preferred embodiments as well as their modifications the end of the air tube that is outside of the outer tube is placed in the air outlet hole of an air bulb or pump. In forming the air bulb or pump I prefer to place the air inlet check valve in the bottom thereof and to make the bottom definitely convex. With the check valve in this position the appearance is better and there can be no interference with its normal operation by the user's hand. Also the life of the air bulb will be increased as the walls of the air bulb around the check valve will not be greatly flexed during operation and the tendency to force out the check valve will be a minimum. Since it is always desirable to be able to maintain the atomizer in an upright position when not in use, I provide a skirt around the bottom portion of the air bulb which will offer stable support.

The further objects and advantages of my invention will be apparent from a consideration of preferred embodiments thereof taken with the accompanying drawing, in which,

Fig. 1 is a part sectional front view of one preferred embodiment of my invention,

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1,

Figs. 3, 4 and 5 are views similar to Fig. 1 of other preferred embodiments, and

Figs. 6 and 7 are fragmentary views of modifications of the preferred embodiments of Figs. 1, 3, 4 and 5.

Fig. 8 is an enlarged fragmentary view of the intermediate or liquid directing tube of the preferred embodiments shown in Figures 1, 2, 3, 4 and 5.

The atomizer or spray 10 of Fig. 1 is made up of three generally concentric tubes, 11, 12 and 13. Tubes 11, 12 and 13 are preferably made of glass of very low coefficient of expansion such as the well known Pyrex glass. Tube 11, which is the outer or spray directing tube, may be of any diameter suited to the purpose to which atomizer 10 is to be put. While tube 11 may be of any length, I prefer, for reasons hereinafter pointed out, that it be about two or more inches in length. The lower end of tube 11 is expanded into the spherical or bulbous form so as to increase the liquid holding capacity of the lower end thereof. To obtain the desired strength and ruggedness I prefer to so manipulate the tube 11 in forming this bulb that its walls are approximately as thick as the walls of the straight portions of tube 11.

Tube 12, which is the inner or air tube, projects for a substantial distance into tube 11 and is welded intermediate its ends, as at 14, to said expanded end. Since the length of tube 12 in tube 11 determines the depth of the liquid that can be kept in the reservoir defined by the expanded end of tube 11, I prefer that the end of tube 12 extend to the top, or a little beyond the top, of the expanded end. Tube 12 may be made by welding two appropriately shaped tubes together but I prefer to form it by drawing a tube to the required shape.

Tube 13, which is the intermediate or liquid directing tube, is loosely centered on tube 12 and is long enough to extend from the region of weld 14 to beyond the end of tube 12. To assure a proper feed of the liquid the end of tube 13 adjacent the joint of tubes 11 and 12 is cut at an angle or is notched. A notched tube 13 is shown in Fig. 8. The portion of tube 13 beyond the end of tube 12 forms a mixing chamber 15 in which the liquid is broken up into a spray and mixed with the air. The length and diameter of mixing chamber 15 are dependent on the character of the liquid to be sprayed and are best arrived at by experiment since different pressure reductions will be required with liquids of different densities and viscosities. Tube 13 is substantially centered on tube 12 by providing one or more projections 16, one only being shown, in the walls of tube 11. Projections 16 are formed in the walls of tube 11 by heating an area thereof and pushing it in by means of a suitable tool. Projections 16 should be located near the discharge end of tube 13 and should touch or almost touch the walls thereof. If more than one projection is used they should be spaced around the periphery of tube 16 so as to best limit its motion, for instance, if two are used they should be 180° apart, if three are used they should be 120° apart, etc.

Tube 13 is positioned against substantial axial movement with reference to tube 12 by projections 17 which are formed in the same manner as projections 16. However, projections 17 should be so located that a portion of their surface contacts, or almost contacts, with the upper edge of tube 13. Any desired number of projections 17 may be used. If projections 17 are properly placed they may, in addition to performing their own function, also perform the function of projections 16. When projections 17 are used for this double purpose it is preferable to use three of them.

Projections 18, two of which are shown, are formed in the same manner as projections 16 and 17. However, they are located above the upper end of tube 13 and extend across substantially the full width of tube 13. These projections 18 act as baffles and separate from the stream of spray the coarser drops so that only a fine spray issues from the upper end of tube 11.

Tube 11 should extend a sufficient distance above the expanded portion to provide a mass of material having a heat retaining capacity sufficient to warm a substantial amount of the spray passing therethrough. As is evident tube 11 may be heated by placing it over a convenient flame such as a match, candle or the like.

The end of tube 12 outside of tube 11 fits into the air outlet aperture of air bulb or air pump 19. Air bulb 19 may be of any of the usual shapes and may be made of any resilient material such as rubber or the like. In the bottom of air bulb 19, which is made definitely convex, is located the usual check valve 20. A skirt 21 flares somewhat from the bottom portion of air bulb

19 and offers a stable support upon which the complete atomizer 10 may be rested. The expanded end of tube 11 is provided, in order to form a liquid reservoir of appreciable size without unduly lengthening tube 11. If a comparatively large size reservoir is not required the end of tube 11 need not be expanded as above described.

The atomizer 10' of Fig. 3 is substantially identical to that of Fig. 1 with the exception that the baffling projections 18 are omitted. Consequently a detailed description of this figure is not necessary as the parts thereof that correspond to the parts of atomizer 10 of Fig. 1 have been similarly numbered but the prime has been added.

The atomizer 10'' of Fig. 4 is also very similar to atomizer 10 of Fig. 1. In this case, however, centering projections 16 and positioning projections 17 have been omitted. Atomizer 10'' includes an outer tube 11'', an inner tube 12'' and an intermediate tube 13'' as well as an air pump 19''. The parts of atomizer 10'' just enumerated are in every way the same as the corresponding parts of atomizer 10 of Fig. 1. Above the end of tube 13'' are formed baffle projections 18''. One of these projections 18'' is so located that its under side either touches or almost touches the upper edge of tube 13''. Thus this baffle projection performs its ordinary baffling function and serves to limit the axial movement of tube 13'' on tube 12''. Atomizer 10'', though generally satisfactory, is not as desirable as atomizer 10 as tube 13'' is subject to more shock than tube 13 and, when tube 11 is large enough, tube 13'' may transmit shock to tube 12''.

Atomizer 30 of Fig. 5 is made up of three concentric tubes 29, 22 and 23 mounted on an air bulb or pump 24. Tubes 22 and 23 and air bulb 24 are identical with tubes 12 and 13 and air bulb 19 of Fig. 1. Tube 29 is formed with an enlarged lower end but is curved so that a portion of its walls contacts, or nearly contacts, with the upper edge of tube 23 and thus serves to limit the movement of tube 23 on tube 22 as well as to center tube 23 on tube 22. To center tube 23 and fix it in position in a way comparable to tube 13 an inwardly directed projection 25 is formed in the walls of tube 21 that contacts with the sides of tube 23 near the discharge end thereof. If desired, a plurality of spaced projections may be used. If one projection only is used it is located on the side of tube 21 opposite the portion that contacts with the upper edge of tube 23. In this modification of my invention the wall of tube 29 which lies over the outlet of tube 23 serves as a baffling means for separating out the coarse drops from the spray.

If desired, sprays or atomizers 10 and 10' of Figs. 1 and 3, respectively, and atomizer 30 of Fig. 5, may be modified as shown in Fig. 6. In Fig. 6 the outer or spray directing tube is denoted by the numeral 11^a, the inner or air tube by the numeral 12^a and the intermediate or liquid tube by the numeral 13^a. Tube 13^a is expanded intermediate its ends to form an enlarged portion 26. Enlarged portion 26 is preferably so located that it is below the upper end of tube 12^a. A plurality of projections 27, two being shown, are formed in the walls of tube 11 so that they contact, or almost contact, with the upper surface of enlarged portion 26. With this arrangement only one set of projections 27 are required to both center tube 13^a on tube 12^a and to limit the axial movement of tube 13^a relative to tube 12^a.

It is sometimes desirable, either because of the character of the liquid to be sprayed or because of the character of the atomization desired to have a greater control over the atomization conditions that can be exercised by the modification of the length of the mixing chamber formed between the end of the air tube and the liquid tube. When such is the case the preferred embodiments of Figs. 1, 3, 4, and 5 may be modified as shown in Fig. 7. In this latter figure the outer or spray directing tube is denoted by numeral 11^b, the intermediate or liquid tube by the numeral 13^b, and the inner or air tube by the numeral 12^b. Intermediate or liquid tube 13^b is so formed that it is tapered as at 28 for a substantial portion of its length so that its upper end that defines mixing chamber 15^b is frusto-conical in shape. Thus the atomization effect and the character of the spray produced can be varied not only by varying the length of the mixing chamber as before but also by varying the inside diameter of tube 13^b at the mixing chamber.

The taper of liquid tube 13^b can also serve a further useful function. It is sometimes necessary in order to obtain a spray of desired character with the embodiments shown in Figs. 1, 3, 4 and 5, to make the air tube and liquid tube of such relative size that the annular liquid passageway between them is so narrow that capillary attraction will cause the liquid to flow up to the top of the air tube even when air is not passed through the air tube. In such cases the liquid will, during use, wet the top of the air tube and thereafter flow down the air tube to the air bulb. By tapering liquid tube 13 this unwanted result is avoided as tubes 13^b and 12^b may be made of any relative size and yet by reason of taper 28 the liquid passageway below the top of tube 13^b may be made wide enough to prevent the raising of the liquid by capillary attraction. This result may also be obtained by forming the liquid tube as shown in Fig. 6. Enlargement 26 can easily be made large enough to prevent the liquid rising above it when the atomizer or spray is not in use.

In all of the embodiments of my invention and their variations shown in Figures 1–8 and above described, the intermediate tube is not in any way welded or otherwise permanently connected to the outer tube or to the inner tube. The intermediate tube merely rests on the joint of the outer and inner tubes. It is held against substantial lateral and/or axial movement by the projections formed in the outer tube. This expedient greatly simplifies the construction of the atomizers of my invention and enables their mass production to be carried out without the aid of expert glass blowers and/or accurate jigs and machinery.

In all of the preferred embodiments and modifications described the liquid or intermediate tube as well as the portion of the air or inner tube within the spray directing or outer tube are of very small mass. Also with the possible exception of the modification of Fig. 4 the intermediate or liquid tube while not welded to the outer tube is so fixed in position thereon that it cannot possibly injure the inner or air tube. While I have described a number of preferred embodiments and modifications thereof it is obvious that further embodiments and modifications may be formed by other combinations of the features disclosed.

I claim:

1. An atomizer comprising a spray directing

tube, an air tube joined to said spray directing tube having one end extending into said spray directing tube, an air bulb connected to the other end of said air tube, a liquid tube loosely positioned around said air tube with one end in aspirating relation with said one end of said air tube adapted to direct a liquid from the region of the connection of said spray directing tube and said air tube to said extending end of said air tube, and means formed on said spray directing tube engaging said liquid tube adjacent said one end thereof for preventing substantial movement of said liquid tube relative to said air tube.

2. An atomizer comprising an elongated spray directing tube having an enlarged end, an air tube joined to said enlarged end of said spray directing tube and having one end extending therein, an air bulb connected to the other end of said air tube, said enlarged end of said spray directing tube and said one end of said air tube defining between them a liquid reservoir, and a liquid tube surrounding said one end of said air tube and having one end in aspirating relation with said one end of said air tube adapted to direct a fluid from said reservoir to said one end of said air tube, said spray directing tube being shaped to engage said liquid tube adjacent said one end thereof to prevent substantial movement of said liquid tube on said air tube.

3. An atomizer comprising a spray directing tube, an air tube joined to said spray directing tube having one end extending into said spray directing tube, an air bulb connected to the other end of said air tube, and a liquid tube surrounding said one end of said air tube within said spray directing tube, said liquid tube having one end resting adjacent the joint of said spray directing tube and said air tube and the other end extending beyond said extending end of said air tube, and arranged in aspirating relation therewith, said spray directing tube being shaped to engage said liquid tube at and adjacent said other end of said liquid tube to substantially fixedly position said liquid tube relative to said air tube.

4. An atomizer comprising a spray directing tube, an air tube joined to said spray directing tube having one end extending into said spray directing tube, an air bulb connected to the other end of said air tube, and a liquid tube within said spray directing tube surrounding said air tube and extending from the joint of said spray directing tube and said air tube to beyond said one end of the air tube to provide a liquid passageway therethrough from said joint to said one end of said air tube, said liquid tube being enlarged adjacent said one end of said air tube to provide a liquid passageway of sufficient width at a substantial distance below said one end of said air tube to prevent liquid rising to said one end of said air tube by capillary attraction.

5. An atomizer comprising a spray directing tube, an air tube joined to said spray directing tube having one end extending into said spray directing tube, an air bulb connected to the other end of said air tube, and a liquid tube within said spray directing tube surrounding said air tube, said liquid tube having one end resting adjacent the joint of said spray directing tube and said air tube and the other end extending beyond said extending end of said air tube to provide a mixing chamber therebetween, said spray directing tube being so bent that a portion of its walls substantially touch said extending end of said liquid tube whereby said liquid tube is substantially fixedly positioned against substantial movement relative to said air tube.

6. An atomizer comprising an outer tube, an inner tube extending into said outer tube and joined intermediate its ends to one end of said outer tube, a third tube within said outer tube and surrounding said inner tube, said third tube having one end resting on the joint of said inner and outer tubes and the other end in aspirating relation with the end of said inner tube within said outer tube, an air bulb connected to the external end of said inner tube, and means on said outer tube positioning said third tube concentric with said inner tube.

7. An atomizer comprising an outer tube, an inner tube extending into said outer tube and joined intermediate its ends to one end of said outer tube, a third tube in said outer tube surrounding said inner tube, said third tube having one end resting on the joint of said inner and outer tubes and the other end in aspirating relation with the end of said inner tube within said outer tube, an air bulb connected to the external end of said inner tube, and means on said outer tube adjacent said other end of said third tube preventing substantial axial movement of said third tube relative to said inner tube.

8. An atomizer comprising an outer tube, an inner tube extending into said outer tube and joined intermediate its ends to one end of said outer tube, a third tube in said outer tube surrounding said inner tube, said third tube having one end resting on the joint of said inner and outer tubes and the other end in aspirating relation with the end of said inner tube within said outer tube, an air bulb connected to the external end of said inner tube, means on said outer tube above the joint of said inner and outer tubes positioning said third tube concentric with said inner tube, and means also on said outer tube preventing axial movement of said third tube relative to said inner tube.

9. An atomizer comprising an outer tube, an inner tube extending into said outer tube and joined intermediate its ends to one end of said outer tube, a third tube in said outer tube surrounding said inner tube, said third tube having one end resting on the joint of said inner and outer tubes and the other end in aspirating relation with the end of said inner tube within said outer tube, an air bulb connected to the external end of said inner tube, and inwardly directed projections on said outer tube above the joint of said inner and outer tubes contacting with said third tube to position said third tube concentric with said inner tube.

10. An atomizer comprising an outer tube, an inner tube joined intermediate its ends to one end of said outer tube, a third tube, said third tube being in said outer tube and surrounding said inner tube and having one end adjacent the joint of said inner and outer tubes and the other end extending for a substantial distance beyond the end of said inner tube within said outer tube, said third tube being of minimum diameter at said other end and of greater diameter between its ends, and projections on said outer tube contacting with the walls of said third tube between its minimum and maximum diameters.

11. An atomizer comprising an outer tube, an inner tube extending into said outer tube joined intermediate its ends to one end of said outer tube, an air bulb connected to the outside end of said inner tube, a third tube in said outer tube surrounding said inner tube and extending from

the joint of said outer and inner tubes to beyond the end of said inner tube, and baffle means formed in the walls of said outer tube positioned between the end of said third tube adjacent the end of said inner tube and the other end of said outer tube.

12. An atomizer comprising an outer tube, an inner tube joined intermediate its ends to one end of said outer tube, an air bulb connected to the outside end of said inner tube, a third tube in said outer tube surrounding said inner tube and extending from the joint of said outer and inner tubes to beyond the end of said inner tube, the walls of said outer tube being formed to provide a plurality of inwardly directed projections, at least one of said projections being located intermediate the ends of said third tube and substantially touching the walls of said third tube to position said third tube concentric of said inner tube, at least one of said projections substantially touching the end of said third tube adjacent the end of said inner tube, and at least one of said projections being above said end of said third tube and extending substantially thereacross whereby the spray issuing from said end of said third tube upon contacting said last mentioned projection has the coarse drops separated therefrom.

13. An atomizer comprising an elongated outer tube, an inner tube joined intermediate its ends to one end of said outer tube to provide a liquid reservoir, an air bulb connected to the outside end of said inner tube, a third tube in said outer tube surrounding said inner tube and extending from the joint of said inner and outer tubes to beyond the end of said inner tube in said outer tube, and means formed in the walls of said outer tube and positioned above the joint of said inner and outer tubes for centering said third tube on said inner tube and preventing movement of said third tube relative to said inner tube, said outer tube being elongated sufficiently to provide a mass of material beyond the end of said third tube having a substantial heat retaining capacity whereby by heating said mass a warm spray may be produced.

14. An atomizer comprising an outer tube; an inner tube coaxial therewith and united intermediate its ends to one end of said outer tube with one end extending into said outer tube; said outer and inner tubes providing a liquid reservoir between them; a liquid tube surrounding said inner tube defining a passageway for liquid from the region adjacent the joint of said inner and outer tubes to the end of the inner tube in said outer tube; means formed in the walls of said outer tube contacting with said liquid tube for centering said liquid tube on said inner tube and preventing axial movement of said liquid tube on said inner tube; and an air bulb having a top portion with a hole therethrough housing the end of said inner tube outside of said outer tube, a bottom portion with a check valve therein, and a skirt surrounding said bottom portion to form a stable base adapted to support said atomizer with the axis of said tubes in a vertical position.

15. An air bulb adapted to be used as an air pump for atomizers comprising a hollow body having a top portion and a bottom portion, said top portion having a hole therethrough for the outlet of air, said bottom portion having a check valve therein for the inlet of air, and a skirt surrounding said bottom portion and extending therefrom to form a stable support for said air bulb, said bottom portion being convex adjacent said valve whereby the walls of said bulb adjacent said valve will be deformed a minimum amount during use of said air bulb.

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