United States Patent

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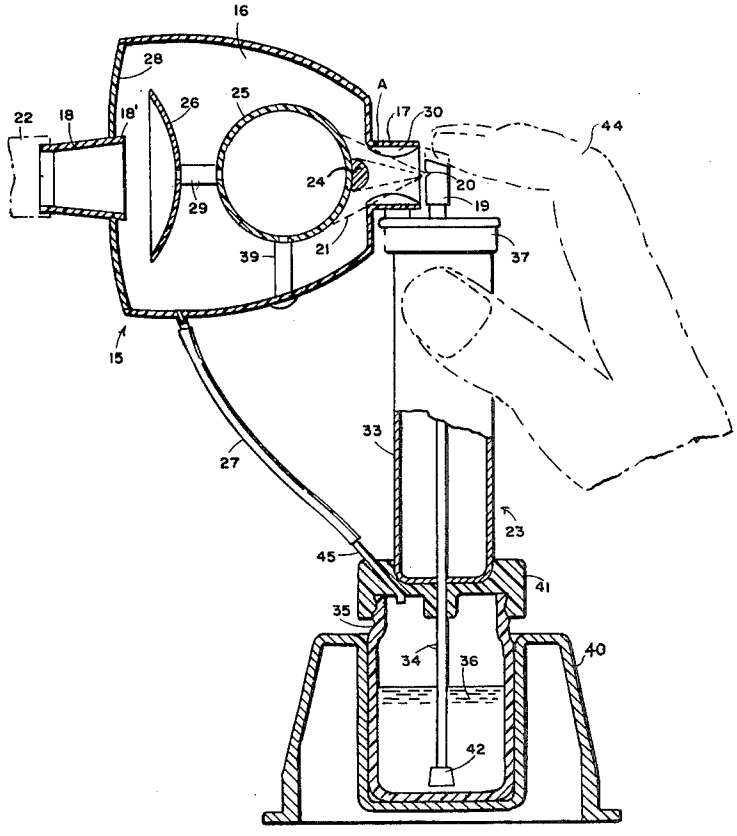
[54] **AEROSOL APPARATUS FOR INHALATION THERAPY**
10 Claims, 5 Drawing Figs.

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[51] Int. Cl. A61m 11/00
A61m 11/02, 11/06
[50] Field of Search 128/194, 186, 188, 197, 201, 195, 196, 198, 199, 173; 239/338, 307, 308

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ABSTRACT: A baffle-containing casing has an inlet nipple into which a nozzle discharges a liquid spray to be nebulized into a dry aerosol which is directed from the casing through an outlet nipple to the patient's mouth. The spray may be made by use of a power unit which is a spray maker operated by a compressed gas actuating an atomizer, all of which is a unitary structure whose operating member of its valve control is also the member which is the spray nozzle. The position of the nozzle is such when operating, that the particles of liquid issuing therefrom will impinge all around the inner surface of the intake nipple before entering the baffle chamber. This causes an automatic inrush of air through the intake nipple and into the baffle chamber, which crashes the larger particles of the spray against a relatively small semi-spherical baffle, causing nebulization thereof into an aerosol which is driven to the patient. Large spray particles remaining or caused into existence by bunching, are intercepted and drained back into the liquid supply which is being acted on by said spray-making gas-powered unit. The automatic inrush of air through the intake nipple which is caused by jet action, is strong enough to create proper dry aerosol though the spray flow is weak, is attainable because of the provision of a plurality of spaced, inward, radially extending fins in the intake nipple; such fins giving the nipple which may be of the venturi type, a shape which is sort of like an internal gear, whose teeth are of various shapes. Flow of air into the nipple at intake, is in straight lines and unbent from the free atmosphere.



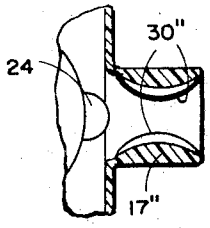


FIG. 5

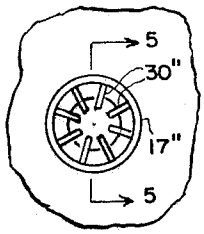


FIG. 4

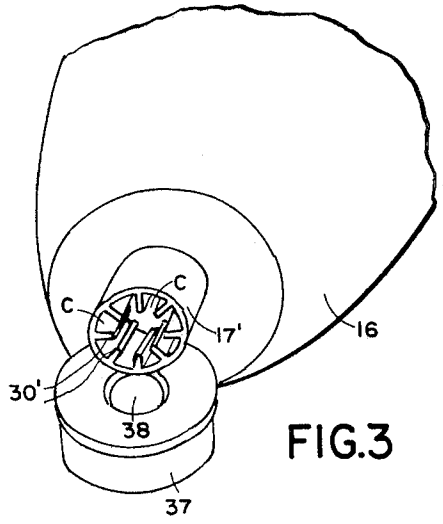


FIG. 3

FIG. 1

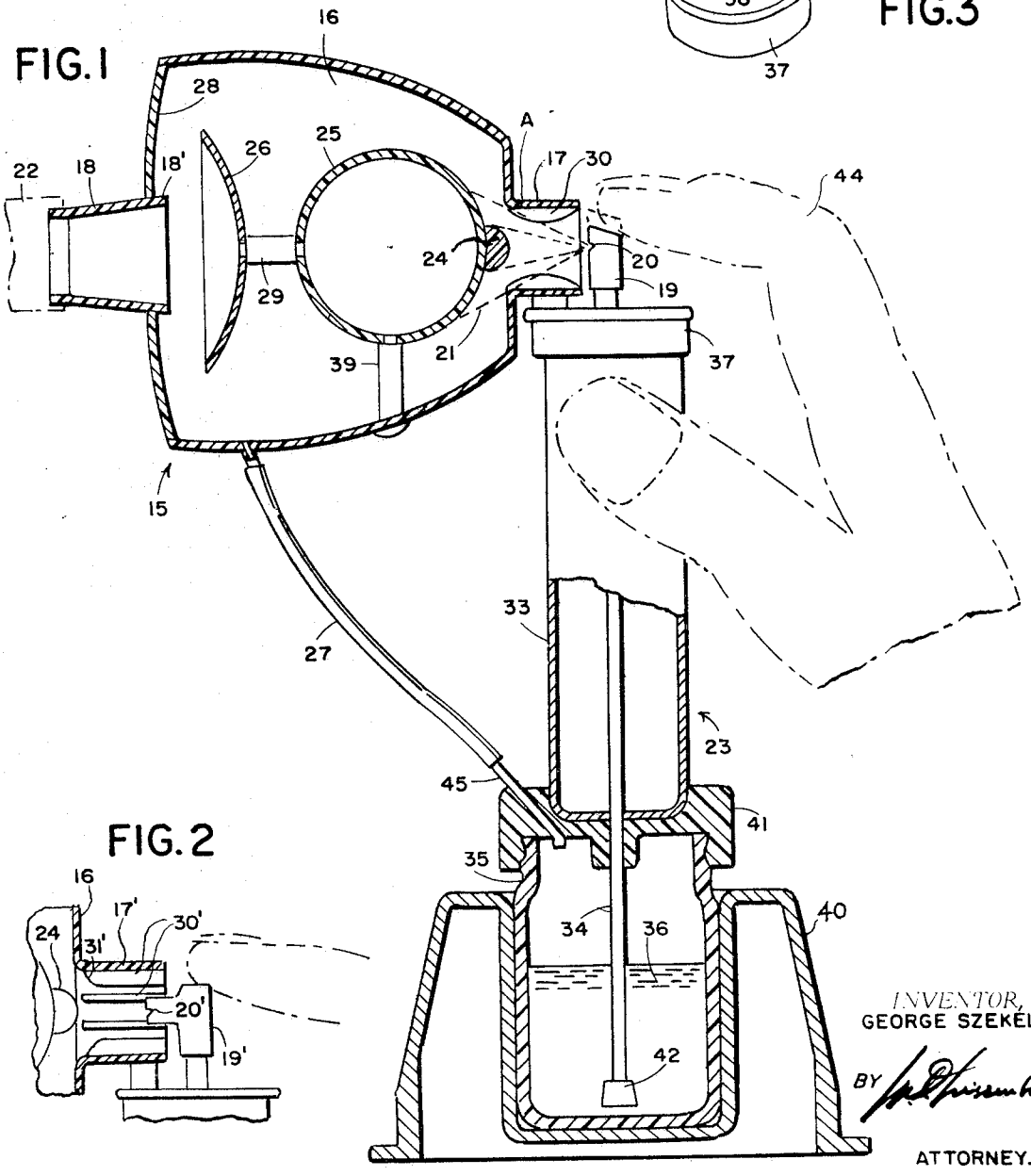


FIG. 2

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U.S. PATENT 3,522,806

AEROSOL APPARATUS FOR INHALATION THERAPY

The present invention relates to aerosol apparatus for inhalation therapy, which are devices utilizing teachings set forth in my Patent No. 3,302,374 and in my allowed patent application, Serial No. 610,967 filed January 23, 1967, which automatically produces a pressurized air flow by jet action, to act on an atomized liquid spray, and cause its propulsion and nebulization, that is, liquid in motion in a special way through a nipple intake, automatically creates an air gust through the nipple into an enlarged baffle chamber, affording a jet action which causes nebulization yielding proper aerosol generation and its propulsion to the patient.

My said prior devices contemplated that the supply of liquid in motion shall flow with appreciable force into the jet tube as a spray, in order to attain automatically a sufficiently pressurized air supply to accomplish proper propulsion and nebulization.

The principal object of the present invention is to provide a novel and improved nebulizer apparatus of the class mentioned, which will operate properly, though the force of the liquid flow is relatively weak, and also for use in my prior devices to improve their performance. In fact, my new construction is adapted for use with well known cartridge form gas-powered atomizer units, which essentially are spray makers operated by a push button valve. With such combination as afforded by my new nebulizer, an aerosol apparatus for general home use for short-duration treatments becomes very practical, and will be shown and explained. The said power unit, is a replaceable and reasonably cheap item. The whole apparatus is a one hand instrument, compact and portable. It is furthermore easy to clean and keep sterilized. The liquid spray issuing from a nozzle discharging into the nipple intake, is a conical beam comprising fine spray particles on the periphery, which may be proper aerosol but needs propulsion to reach the patient. The main body of the spray beam is composed of coarse particles to be acted on to make thereof proper aerosol suitable for inhalation therapy. It might be mentioned that entry of coarse particles into the respiratory tract may be harmful.

It is therefore another object of this invention that the intake nipple construction shall afford the creation of a stronger wind gust than was heretofore obtainable by any given liquid flow therethrough, and that the baffle structure shall specifically and effectively act on the coarse particles of the spray beam, to break them up into fine aerosol.

A further object thereof, is to provide that if any coarse particles are propelled through the device, or come into being in the baffle chamber because of bunching, that they shall be entrapped within the baffle chamber and thus be prevented from reaching the patient. Further provision is made that if any coarse particles are not broken up, that they shall be intercepted and drip down in the baffle chamber, to be drained off before they could reach the outlet, so the supply propelled to the patient, will be a continuous stream of dry aerosol.

A further object is to arrange that in the use of a gas-powered atomizer unit herein, of the type in which the nozzle is provided in the valve operating member which is a finger push button to be pressed down to open the valve, that at the operating position of said push button, the nozzle shall be in the most effective position in relation to the intake nipple.

A further object is to provide an aerosol apparatus of the character described to utilize a gas-powered spray maker of cartridge form to serve as the handle therefor besides its operating function to issue a spray into the intake nipple of the device; the nebulizer being of extremely simple construction and reasonably cheap to manufacture, and efficient in carrying out the purposes for which it is designed.

Other objects and advantages will become apparent as this disclosure proceeds.

For the practice of this invention, the aerosol apparatus consists of a casing serving as a baffle chamber; said casing having an inlet nipple into which a nozzle discharges a liquid spray, and an opposite outlet from which the aerosol supply is directed to the patient's mouth. The spray may be supplied by a cartridge form gas-powered atomizer whose discharge nozzle is on the push-button valve operating member which brings the atomizer into play. The position of the nozzle is such that particles of liquid issuing therefrom will impinge all around the inner surface of said nipple before entering the casing, where the inner part of the spray beam impinges a semi-spherical baffle to the diametrical plane of such baffle member, where the spray is met by a much larger spherical baffle, which either further breaks up any remaining large spray particles, or serves to collect them to drip off into the casing and is drained therefrom, back into the liquid supply. The liquid supply may be acted on by a cartridge form gas powered atomizing spray maker, which if used, also serves as the handle of the aerosol generating device. Entrance into the intake nipple of air from the free atmosphere is arranged that the air intake shall be straight into the nipple and not in any bent path to get thereinto. The nipple has a series of inward radial vanes free of the core of the spray beam, making canals or passages along the interior of the nipple, making the nipple somewhat in the form of an internal gear. The "teeth" of such gear form, meaning the vane shape may be of different construction, and may offer Venturi action. The spray flow into the nipple may be offered by pump or pressure flow action as explained in my prior inventions, to get the advantage of the present invention. The use of the gas-powered spray maker, is one of convenience and economy in this invention, and for other advantages it offers in the combination.

In the accompanying drawing forming part of this specification, similar characters of reference indicate corresponding parts in all the views.

FIGURE 1 is an elevational view partly in section, showing an aerosol apparatus embodying teachings of this invention.

FIGURE 2 is a fragmentary elevational view partly in section, of an aerosol apparatus of modified construction.

FIGURE 3 is a fragmentary perspective view as seen looking at an end of **FIGURE** 2.

FIGURE 4 is a fragmentary end view of another modified construction.

FIGURE 5 is a fragmentary section taken at line **5-5** in **FIGURE** 4.

In the drawing, the numeral **15** designates generally a held-in-hand aerosol apparatus, which is a preferred embodiment of this invention. It consists of a baffle chamber **16**, having an inlet tubular nipple **17**, and an outlet tubular nipple **18**, one at one end and one at the other end of said chamber. There is a spraying nozzle **19** having a minute discharge aperture **20**, so positioned that when this nozzle receives liquid under pressure, it discharges same as an atomized spray **21** of conical form, into the intake nipple **17**, and thence into the baffle chamber. The nozzle may be positioned that the discharge therefrom is at nipple entrance as shown in **FIGURE** 1 or the nozzle may extend a bit into the nipple as shown in **FIGURE** 2, where the entrance nipple is denoted by the numeral **17'** the discharge nozzle is indicated as **19'** and its discharge aperture is shown at **20'**. The aerosol supply generated, passes from the outlet nipple **18**, whence it is directed to the patient's mouth either directly by setting the outlet nipple at the lips, or thereto by means of a flexible hose **22**, or to a mask not shown, as is well known. The liquid flow may be brought on by a pump or other means as set forth in my said prior disclosures, or as specifically illustrated herein, such flow may be supplied by a gas-powered spray-making cartridge **23**, as will be explained. It is important to note, as taught by my said prior devices, that while a spray is issuing from the nozzle, a supply of air automatically forces itself from the atmosphere, into the intake nipple **17**, and rushes through the baffle chamber **16**, causing nebulization of the coarse particles of the spray **21**, by crashing them against the relatively small semi-spherical baffle

24, and then propelling the aerosol formed, through the chamber **16**, to the output nipple **18**. Much of the very fine spray particles of the spray's periphery, which is an extremely small part of the content of the spray **21**, is of course, also propelled to output by said automatically created wind caused by jet action. Whatever portion of the spray particles remain too large to constitute dry aerosol, collect on the inside surfaces of the walls of the baffle chamber **16**, and on the larger spherical baffle **25**, and on the baffle **26** which guards the entrance of the output nipple, from all of which such larger particles drip down and are drained off through a tube **27**. It is to be specially noted, that any run-off along the interior surface of the end wall **28**, is intercepted by the inwardly projecting end **18'** of the outlet nipple **18**, and thus prevented from entering same, and hence is kept from the patient. The mouth of the dished baffle **26**, faces and is close to the entrance of the output nipple **18**, but its convex surface is spaced from the spherical baffle member **25**, to which it is attached by an element **29**. The small semi-spherical baffle **24** is carried on said baffle **25**. All of said baffles and the input and output nipples are in axial alignment, and in the embodiment illustrated, such axis line is horizontal. The nozzle **19** is in such position that when it discharges, its discharge aperture **20** shall be in such line, and the mass of the inner content of the conical spray **21**, shall impinge against the small baffle **24**, whose size is chosen so as not to interfere with the peripheral spray particles of **21**, to avoid bunching them. However, the spray shall contact all around the interior of the intake nipple **17**, near the exit end thereof, as around the region A, in order to assure jet action. Such wetting of the inner wall of the intake nipple will be sinuous because of the series of inner vanes provided the intake nipple, to provide a series of longitudinal channels C, whose presence intensify the jet action, and so a spray **21** of weaker flow can be used through the nozzle and yet get proper jet action to accomplish nebulization and propulsion. Hence it is practical to use the commercially known gas-pressured spray maker cartridge **23** to provide the liquid flow. Also to be specially noted is that jet intensity is increased in the construction shown, because air from the free atmosphere to enter into the intake nipple **17**, can enter by a straight line movement, and need not bend its course to make such entrance which would deprive it of some energy, as was the case in my former devices. Here, the intake nipple **17** extends into the free atmosphere and is not confined by any structure.

The inwardly directed radial vanes **30**, **30'** and **30''** in the interior of the intake nipples **17**, **17'**, **17''** respectively, make the nipple structures in a form akin an internal gear; said vanes being the teeth thereof, running along the axis of the nipple. The tooth form **30'** in **FIGURE** 2 is substantially rectangular. The tooth form **30** in **FIGURE** 1, is the shape of the segment of a circle. The intake nipple **17''** in **FIGURE** 5 is of the Venturi type to gain its advantage, and the tooth form of **30''** is crescent-shape. Of course, the shape of the teeth, meaning the vanes, in each of the intake nipples shown, are identical respectively. The rounded rear end **31'** of the vanes **30'**, provide a sort of flared exit from the intake nipple **17'**, which eases the flow into the baffle chamber. The double-curved ends of the vanes **30** and **30''**, similarly provide flared entrances and exits for the flow into and out of the nipples **17** and **17''** respectively. The vanes **30** and **30''** also offer some Venturi action.

This jet action creates the aerosol, since the gas which emerges from the nozzle is immediately expanded and has little energy left in itself to act as propellent for the liquid particles of the spray.

The cartridge **23**, one suitable kind of which is the spray maker marketed as "Preval" power unit, consists of a container **33** filled with a gas under pressure, to operate an atomizer part whose suck-up tube **34** extends into the container **35** for holding the liquid **36** to be made into a spray which will issue forth from the discharge aperture **20** of a spray nozzle **19** which has been adopted for the embodiment of my invention shown in **FIGURE** 1. The operation of the atomizer of said power unit being controlled by a valve which is operated to open by pushing down the spray nozzle which also serves as the operating member of the valve. To mount the cartridge **23**, the baffle chamber **16** carries a ferrule **37** which fits onto the container **33**; the spray nozzle, extending through the hole **38** in the ferrule. Of importance is, that for efficient operation of the aerosol apparatus **15**, the spray nozzle **19** shall be so positioned that when pressed down to operate, the discharge orifice **20** will be on the axis line of the nipple **17** and the baffle assembly; said assembly of baffles being supported by the post element **39** in coaxial relation with said intake nipple. The numeral **40** denotes a weighted stand into which the container **35** securely fits. This stand serves as a base for the apparatus, as is obvious. The numeral **41** is a screw-on cap for the liquid supply container **35**; the power unit **23** being secured onto said cap. The drain tube **27** is preferably communicatively connected to the baffle-containing chamber **16**, and to the liquid supply container **35**, so all liquid not nebulized into aerosol, is returned for reworking; and often being expensive medication, is not wasted. The numeral **42** denotes a strainer means at the intake end of the atomizer's suction tube **34**.

Explanation already given herein, is believed sufficient as relates to the mode of operation of the apparatus, and I may further indicate that the apparatus can be held in hand, and when the finger **44** pushes the operating member **19** downwards, it will stop where the spray orifice **20** is in the axial line of the intake nipple **17**, and the spray **21** will be continuous, and so will the generated aerosol be a continuous flow to the patient, until the finger releases the member **19**, to rise, whereupon the power unit **23** is deactivated, and so the aerosol stops. The power unit being short-lived, its use with this apparatus is suitable for short treatments. When the unit **23** is spent, it is replaced. Its cost is relatively cheap.

The baffle system, its container **16** and the attaching ferrule **37**, may be of plastic. The container **35** is preferrably a glass bottle with a threaded neck for the screw cap **41**; the bottle being transparent so its contents are viewable. The manufacturer of the power unit **23**, would furnish the attached cap **41**, with a drain intake tube **45**, for connection to the flexible drain tube **27**.

A power unit of the kind mentioned, gives a continuous spray lasting about twenty minutes, which equals a bit more than **1000** individual brief inhalations. The nebulizer as shown in **FIGURE** 1, has a performance of **1 - 1.5** cu.cm. liquid per minute, and a dry aerosol of a finess of **0.1-0.05** microns. Supplementary air for breathing, is freely available through the inlet nipple **17**.

According to this invention, it is the main advantage to use a gas power unit which creates a suction action whereby there occurs no mixture of gas and liquid. By this manner, only a very small portion of gas from the power unit ever reaches the patient.

This invention is capable of numerous forms and various applications without departing from the essential features herein disclosed. It is therefore intended and desired that the embodiments shown herein shall be deemed merely illustrative and not restrictive and that the patent shall cover all patentable novelty herein set forth; reference being had to the following claims rather than to the specific showings and description herein, to indicate the scope of this invention.

I claim:

1. In an aerosol apparatus for inhalation therapy, of the type in which a casing housing a baffle structure, has an inlet nipple communicative with the atmosphere, a nozzle connected to said casing and directed at said inlet nipple for discharging substantially a conical spray into said nipple whereby the interior of said nipple is contacted all around by the spray before it enters said casing, thus automatically creating by jet action, a forceful flow of air through the intake nipple to impinge the spray particles against the baffle structure, to be nebulized and propelled through the casing and through an outlet therefrom to be directed to the patient, the improvement being that the

inlet nipple has a plurality of spaced longitudinally and radially inwardly directed vanes extending therealong within its interior.

2. An apparatus as defined in Claim 1, wherein the shape of each vane along the nipple is a segment of a circle.

3. An apparatus as defined in Claim 1, wherein said nipple is a Venturi structure and the shape of each vane therealong is a crescent.

4. An apparatus as defined in Claim 1, wherein the intake end of the inlet nipple is exposed in the free atmosphere whereby the direction of air flowing from the free atmosphere into said inlet nipple, is unbent and in direct straight lines.

5. An apparatus as defined in Claim 1, wherein the inlet nipple extends horizontally, and the baffle structure includes a first baffle presenting a substantially semispherical surface positioned in said casing, very near the inlet nipple, to be impinged upon by the particles constituting the inner content of the conical spray entering the casing, and a substantially larger second baffle adjacent the first baffle, presenting substantially a semispherical surface to be impinged upon by the spray particles inward of those which are of the periphery of the spray, but unintercepted by the first baffle.

6. An apparatus as defined in Claim 5, wherein the outlet is a nipple whose intake end projects horizontally into the casing, and including a third baffle positioned spaced from and between said second baffle and the outlet nipple, across and

overlapping the entrance end of the outlet nipple.

7. An apparatus as defined in Claim 6, including a drain pipe leading from substantially the lowest part of the casing.

8. An apparatus as defined in Claim 1, including a unitary cartridge of the type comprising a spray nozzle, a valve-controlled pressurized gas supply arranged to operate an atomizer whose suck-up tube extends into a container for a liquid supply to be atomized and discharged from the spray nozzle of said cartridge; said apparatus also including mounting means to associate said cartridge thereonto whereby the discharge of the nozzle of said cartridge is directed into the inlet nipple; the spray nozzle of said cartridge constituting the spray nozzle of said apparatus.

9. An apparatus as defined in Claim 8, wherein the spray nozzle is movably mounted on said cartridge, to serve also as the valve-operating member; said nozzle being normally at a position where the valve is closed, and is movable to a second position to open the valve; at said second position, the discharge orifice of the spray nozzle being in the longitudinal axis line of the inlet nipple; all baffles and the inlet nipple being coaxial.

10. An apparatus as defined in Claim 8, including a drain pipe leading from substantially the lowest part of the casing and communicatively connected with the liquid supply container; such container being below said casing.