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ABSTRACT

A liquid atomizer comprising a housing fitted with an inlet for connecting to a liquid supply line and a cavity being in flow communication with the inlet and having a longitudinal axis. The housing has one or more outlet nozzles for emitting atomized liquid. A vortex generating member is received within the housing and is formed with at lest one vortex generating path generates a liquid vortex about an axis transversally extending relative to the longitudinal axis of the housing and extending opposite a respective outlet nozzle. Each of the vortex generating paths is in flow communication with the cavity and extends opposite a respective outlet nozzle.

AUSTRALIA

Patents Act 1990

COMPLETE SPECIFICATION

STANDARD PATENT

Applicant(s):

DAN MAMTIRIM

Invention Title:

LIQUID ATOMIZER

The following statement is a full description of this invention, including the best method of performing it known to me/us:

LIQUID ATOMIZER

FIELD OF THE INVENTION

The present invention is generally in the field of liquid atomizers and in particular it is concerned with atomizers for agricultural and domestic use.

The term *"atomizer"* as used herein in the specification and claims refers collectively to a device capable of emitting a fine mist of liquid. Such devices are often referred to in the art also as foggers, sprayers, mist devices, humidifiers, etc.

BACKGROUND OF THE INVENTION

Atomizers used in agriculture and for domestic purposes serve for conditioning the environment both by increasing humidity such as in greenhouses and tropical gardens, for irrigation and for cooling. A variety of atomizers are known, referred to as rotary-cup atomizers, air blast/air assist etc. The present invention is concerned with pressure atomizers.

Cooling by atomized liquid is obtained by forcing a liquid, typically water, through specially designed nozzles so as to obtain a fog of ultra fine water droplets. The liquid droplets absorb heat energy of the environment and evaporate, whereby the energy (heat) consumed for converting the liquid into gas (vapor) is extracted from the environment, thus cooling the air.

The amount of moisture in the air divided by the maximum amount of moisture there could be absorbed at the same temperature (relative humidity) is a significant parameter in determining cooling potential. The lower the relative humidity, the more liquid can be vaporized, thus the more heat can be removed from the environment. Evaporative cooling can be used in most geographical zones owing to the fact that when temperature reaches its peak during day, relative

humidity is normally at its lowest. For this reason, evaporative cooling is commonly used in many zones over the world.

Liquid atomizers are at times, used also as frost protectors by creating a mist layer above the agricultural growth, thus preventing frost from damaging the crops.

Pressure atomizers are commonly in use and typically comprise a housing fitted with at least one outlet nozzle, a core member associated with each nozzle for generating a vortex (often referred to in the art as *"swirl"*) and a strainer/washer member packed together by screw coupling of the nozzle to the housing. The atomized spray is obtained by guiding a liquid jet through a path causing the jet to swirl and upon exiting through a fine outlet nozzle, an atomized spray is emitted.

Typically, each outlet nozzle is associated with a single housing and where covering a large area with mist is required, thus several such housing may be mounted on a splitting element, each such outlet nozzle being directed to a different direction and said splitting element being connected in turn to a liquid supply line.

It is an object of the present invention to provide a novel and improved liquid atomizer. The number of components, by one of its preferred embodiments, being reduced as compared with prior art such devices.

SUMMARY OF THE INVENTION

The present invention provides a liquid atomizer for use in agriculture and for domestic use and is aimed, by one of its preferred embodiments, at providing an atomizer comprising a reduced number of components. The liquid atomizer comprises a housing fitted with an inlet for connecting to a liquid supply line and a cavity being in flow communication with the inlet, said cavity having a longitudinal axis; the housing being formed with a plurality of outlet nozzles for emitting atomized liquid;

a vortex generating member, which is concentrically receivable within the housing with possibility for relative displacement with respect to the housing, said vortex generating member being provided with a plurality of depressions constituting at least one vortex generating path defined by a vortex generating

portion and by an inlet portion, the arrangement being such that when said vortex generating member is received within the housing the vortex generating portion is disposed opposite a respective outlet nozzle of the housing and the inlet portion is brought in flow communication with the cavity;

said inlet portion extending essentially along the longitudinal axis of the cavity and encountering said vortex generating portion essentially tangentially; and

each of at least one vortex generating path generates a liquid vortex about an axis transversally extending relative to the longitudinal axis of the cavity.

According to one embodiment, the peripheral member is integral with the housing and the vortex generating member is sealingly received within the cavity of the housing. According to another embodiment, the vortex generating member is integral with the housing and the peripheral member is mounted over the vortex generating member.

In accordance with another embodiment, the vortex generating member is coaxial with the housing and is sealingly received therewithin. By one embodiment it is radially fixable within the housing.

Typically one or more outlet nozzles are circular. However, they may also be or otherwise shaped nozzles so as to distribute a selected fog pattern.

By one preferred arrangement, the housing and the vortex generating member are cylindrical, wherein the vortex generating member is snapingly fixed to the housing and may be displaced into other functional positions. In accordance with a preferred design of this arrangement, peripheral walls of the vortex generating member sealingly bear against inner walls of the housing, thus preventing liquid flow between the walls of the vortex generating member and the housing. However, a sealing member may be introduced between the vortex generating member and the housing.

In accordance with one specific and preferred embodiment, the vortex generating path generates a liquid vortex about an axis substantially perpendicular to the longitudinal axis of the housing.

In accordance with one arrangement of the invention, the vortex generating path has an inlet extending parallel to the longitudinal axis and originating at an edge of the vortex generating member. In accordance with another design, the vortex generating member has a bore being in flow communication with the cavity and the vortex generating path has an outlet originating from the bore. This arrangement is in particular suitable for including a sealing member between the vortex generating member and the housing.

In accordance with one arrangement, the vortex generating path has an R or P like cross-section with the center of the round portion extending opposite the

respective outlet nozzle and wherein the respective leg portions of the R and P like shapes constitute the opening of the path. In accordance with a second arrangement, the vortex generating path has a cochlea-like (spiral) cross-section with the center thereof extending opposite the respective outlet nozzle.

According to a variation of the above embodiments, the vortex generating path is formed with two (or more) leg portions for increasing the flow rate, the leg portions extending from an edge of the vortex generating member which is in flow communication with the cavity, or have at least one leg being in flow communication with the cavity via a hollow formed in the vortex generating member which is in flow communication with the cavity.

In accordance with another variation of the invention, the vortex generating member comprises a plurality of vortex generating paths and the housing comprises a plurality of outlet nozzles; the vortex generating paths and the outlet nozzles being distributed at different angular divisions; the vortex generating member is fixable within the housing at different radial positions, each giving rise to cooperation of different outlet nozzles with respective vortex generating paths and to sealing of other outlet nozzles. This arrangement enables to determine the number of active nozzles within a single housing, allowing to increase or decrease the number of active nozzles so as to obtain different sectorial coverage of mist.

By another design, some of the vortex generating paths of the vortex generating member are axially offset and some of the outlet nozzles of the housing are offset in a corresponding manner, whereby axial or angular displacement of the vortex generating member with respect to the housing entails engagement of a different vortex path with a different outlet nozzle. In this way it is possible to select different fog patterns, outlet rate, etc. By a modification thereof, at least one outlet nozzle and at least one vortex generating member are axially offset.

The housing and vortex generating member are fitted with corresponding mating members for setting the vortex generating member at the different radial positions within the housing.

The arrangement of the liquid atomizer in accordance with the present invention reduces to minimum the number of components wherein each housing is fitted with a single vortex generating member whereby a single housing is required for several outlet nozzles.

By a different application of the invention, the inlet is in flow communication with a pressure threshold valve received before or after the inlet. By a preferred embodiment, the pressure threshold valve is received within the cavity of the liquid atomizer. In accordance with one such design, the pressure threshold valve comprises a closure member biased against the inlet of the housing.

In accordance with another embodiment, the pressure threshold valve is a leakage preventing device (**LPD**), wherein the closure member is spring biased against the inlet of the housing and has a piston rod connecting it with a piston, said piston being displaceable along a corresponding cylinder, which is in flow communication with the cavity. The LPD arrangement provides for opening of the closure member at a predetermined pressure threshold wherein the inlet is rapidly opened into a maximal open stage. This may be obtained by a structure in which the piston is sealingly displaceable within the cylinder and wherein liquid entering the cavity applies force on the piston in a direction entailing displacement of the closure member away from the inlet.

In accordance with such an embodiment, it is desired that the cylinder is vented to the atmosphere. In accordance with a modification of the invention, the piston is displaceable against a membrane fitted at an end of the cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

For better understanding, the invention will now be described, in a non-limiting example only, by way of example only, with reference to some accompanying drawings, in which:

Fig. 1A is an exploded isometric view illustrating the atomizer of the present invention, with replacement fog generating members;

Figs. 1B to **1E** illustrate different embodiments of vortex generating members;

Fig. 2 is a longitudinal sectional view of an atomizer in accordance with the present invention fitted with a leakage preventing device;

Fig. 3 is a longitudinal sectional view of an atomizer in accordance with the invention integrally fitted with a leakage preventing device;

Fig. 4 is a different embodiment of a liquid atomizer in accordance with the invention fitted with still a different leaking preventing device;

Fig. 5 is a longitudinal section of an atomizer in accordance with the present invention integrally fitted with a pressure threshold valve;

Fig. 6 is a perspective view of a sector-adjustable atomizer in accordance with the present invention;

Figs. 7A-7D are sectional views along line VII-VII in Fig. 6 referring to four consecutive positions suitable for emitting an atomized spray at four different sectorial positions;

Fig. 8 is a perspective exploded view of an atomizer according to still an embodiment of the invention;

Figs. 9A-9C are perspective views illustrating three different operative positions of the atomizer of Fig. 8;

Fig. 10 is an isometric, exploded view of a further embodiment of an atomizer in accordance with the present invention;

Fig. 11 is a cross-sectional view of the atomizer of Fig. 10, assembled;

Fig. 12 is an exploded view of an atomizer according to another embodiment of the invention; and

Fig. 13 is a longitudinal section of the atomizer of Figure 12, in an assembled state.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Attention is first directed to Fig. 1 of the drawings illustrating an atomizer generally designated **20** consisting of two principle components, namely a

housing **22** and a vortex generating member **24**. Housing **22** is cylindrical and comprises a cylindrical cavity **26** being in flow communication with an inlet **28** which may be attached by known means (press fit, screw threading, etc.) to a water supply line (not shown). It is clear that a cylindrical housing is only an example and any other shape is possible too.

Radially extending from the cavity **26** there are four outlet nozzles **32** (only three seen) extending from the cavity **26** to an external surface of the housing **22**. As can further be seen in Fig. 1A, the housing is fitted adjacent an upper edge thereof with an annular groove **38** for snapping and sealingly receiving a corresponding annular rim **40** formed at the vortex generating member **24**. If required, a suitable O-ring may be provided within a suitable groove.

The vortex generating member **24** is a plug-like member having a cylindric portion **44** adapted for tight and sealing engagement within the walls **46** of cavity **26** of the housing **22** essentially not leaving an interstice between the mating surfaces whereby liquid cannot flow between wall **46** and the cylindric portion **44** of the vortex generating member **24**.

Vortex generating member **24** is fitted, in the present example, with four vortex generating paths **50** (two seen in Fig. 1A) each having an R-like cross-section with an inlet portion **52** extending between the legs of the R-like shape at an edge **56** of the cylindric portion **44** with the center of the R-like portion **58** extending essentially opposite an opening of a corresponding nozzle **32** formed in the housing **22**.

In the assembled position, which can be seen in cross-section in Fig. 2, water enters the cavity **26** through the inlets **28** and is then forced to flow into the vortex generating paths **50** extending between the wall **46** of the cavity **26** and the path **50**, whereby the water enters through the widened inlet portion **52**, forced to spin within the R-like portion **58** and exits through the narrow outlet nozzle **32** after it is swirled, so as to emit a fine spray of atomized liquid.

It is noticed that the housing **22** is formed around the outlet nozzles **32** with a reflector-like indentation **60** in order not to interfere with the atomized water.

It will further be appreciated that the vortex generating member **24** is sealingly received within the housing **22** in a tight manner and in a manner in which it is angularly fixed therewithin, to ensure that the vortex generated at the round portion **58** of vortex generating portion **50** is axially aligned with the outlet nozzle **32** of the housing **22**. This may be, for example, by providing suitable projections and corresponding receiving recesses.

In Fig. 1B, there is illustrated a vortex generating member **61** which is similar to vortex generating member **24** in Fig. 1A, the different residing in the vortex generating path **62** which has an inlet portion **63** similar to inlet portion **52** and terminates at a vortex generating portion **64** having ~~a~~ cochlea-like pattern, ending opposite an outlet nozzle when assembled within a housing of the atomizer.

Fig. 1C is still a different embodiment of a vortex generating member **65**, having a P-like vortex generating path **66** formed with a bore **67** extending from a hollow of the vortex generating member (which is in flow communication with the cavity of the housing). The vortex generating path **66** has a round vortex generating portion **68** as explained in connection with Fig. 1A. The arrangement in accordance with the embodiment of Fig. 1C is that a suitable sealing member, e.g. an O-ring **69**, may be provided between the housing and the vortex generating member for improved sealing therebetween.

Figures 1D and 1E illustrate modifications of the vortex generating member. In Fig. 1D the vortex generating member **70** is formed with vortex generating paths **72** having two inlet portions **73** and **74** both extending from a bottom edge of the member **70** into a vortex generating portion **75** configured as a circular shaped well. This arrangement is useful for increasing flow rate.

The vortex generating member **76** (Fig. 1E) has a vortex generating path consisting of a vortex generating portion **77** shaped as a circular well into which extend one inlet portion **78** extending from a bottom edge (as in Fig. 1D) and a second inlet portion **79** communicating with a bore **80** (as in Fig. 1C).

As can further be noticed in the embodiment of Fig. 2, an inlet portion **83** of the housing **22** has venting openings **84** and is screw-fitted with a leakage

preventing device (LPD) **81** of a known type, available on the market. The purpose of such an LPD device is to prevent leakage of water from the atomizer by ensuring that water flow into the device is enabled only upon a minimal pressure at the liquid supply line. However, as long as the pressure remains below the predetermined pressure, the LPD device remains closed blocking water flow into the atomizer. Still another feature of the LPD is that once it opens to permit flow into the atomizer, it is fully opened, namely it rapidly displaces between its open and closed position.

In the embodiment of Fig. 3, the liquid atomizer **86** is substantially similar to the previous embodiments with the exception that it comprises an integral LPD **88**. The housing **90** is fitted with two side flaps **91** to facilitate fit connection with a fluid supply line (not shown). The inlet **92** into the cavity **93** has an upwardly projecting rim **94** for sealing engagement with a closure member, as will become apparent hereinafter.

The vortex generating member **96** comprises an annular wall **98** coaxial and parallel with cylindrical wall **100**, forming a cylinder **104** vented by means of venting aperture **106**. A closure plate **200** is formed with a sealing portion **202** opposite the rim **94** of inlet **92** and is typically made of a resilient material for improved sealing thereof. Extending from an opposite face thereof there is a piston rod **206** fitted at its opposite end with a piston **210** sealingly displaceable within cylinder **104** by means of O-ring **212**. The closure plate **200** is normally biased into sealing engagement of inlet **88** by means of a coiled spring **216** bearing at one end against closure member **200** and at an opposed end against a wall of the vortex generating member **96**.

The arrangement in accordance with the embodiment of Fig. 3 is such that as long as the water pressure within the supply line (not shown) does not exceed a minimal predetermined pressure, then the closure member **200** remains in its closed position, namely, sealing inlet **92**. However, as the water pressure within the supply line exceeds the predetermined pressure threshold to a pressure exceeding the biasing force of the spring **216**, the closure member **200** displaces away from the

rim **94** thereby opening inlet **92**, whereby water entering the cavity **220** enters into the cylinder **104** applying additional force on a bottom surface **222** of piston **210** assisting the displacement of the closure plate **200** from the inlet. Disengagement from the rim **94** i.e. opening of the inlet **92** is rapid since the piston **210** is exposed to atmospheric pressure via aperture **106.** When, however, the liquid pressure drops below the predetermined pressure threshold the closure member **200** sealingly engages the rim **94** of inlet **92** preventing further flow of water into a cavity **220**.

In Fig. 4, there is illustrated still another embodiment of a liquid atomizer **230** differing from the previous embodiments mainly in the design of the leaking preventing device. Housing **232**, in the present example is fitted with an external threading for connecting to a liquid supply line (not shown) and is formed with an inlet **234** extending into a cavity **236**. The vortex generating member **238** is formed with a shoulder **240**. In the assembled position there is a flexible closure member **242** sealingly bearing against the inlet **234** and being pliable, upon pressure rise of fluid at the inlet side thereof, to disengage from the inlet **234** allowing liquid to flow into the cavity **236** whereupon liquid pressure is applied on an increased area of the closure member **242** assisting its further deformation into disengagement from the inlet **234**. However, upon pressure drop of the fluid ingressing the cavity **236**, the closure member **242** reverts to its original position in which it sealingly bears against the inlet **234**. A space **243** at an opposite side of the closure member **242** is vented by means of opening **244** to allow fast deformation of the closure member.

In this embodiment there is provided an O-ring **239** sealing between the housing **232** and the vortex generating member **238.**

According to a modification of the embodiment of Fig. 4, there is provided a spring (not shown) for biasing the closure member **242,** at a predetermined force, towards the inlet opening of inlet **234.**

The embodiment of Fig. 5 resembles in a way the embodiment of Fig. 3. However, a space **260** is sealed by a flexible diaphragm **262** preventing ingress of water into the confined space **260** whereby a pressure threshold valve is obtained,

namely the closure member **264** remains in a sealing position against inlet **266** as long as the liquid inlet pressure does not reach a minimal predetermined threshold level and then only it begins to displace away from the inlet in correlation with the pressure change, namely, at a low pressure threshold the closure member **264** will only slightly displace whereas at the more significant pressure threshold the closure member will displace accordingly.

Figs. 6 and 7 are concerned with an embodiment of the invention wherein the housing **280** is similar to the housing in accordance with the previous embodiments and comprises four outlet nozzles **282A-282D** (only two seen in Fig. 6) and a visible position indicator **284**. The vortex generating member **288** is formed with ten vortex generating paths indexed **290A-290J** (Figs. 7) being angularly shifted from one another in a manner which at different angular settings of the vortex generating member **288** with respect to the housing **280** an atomized spray is emitted through either one, two, three or four respective outlet nozzles of the housing, as desired. This may be obtained by rotating the vortex generating member **288** within the housing **280** such that at each time one or more of the vortex generating paths face one or more corresponding outlet nozzles of the housing.

In accordance with this embodiment the liquid atomizer may be useful for emitting the atomized spray at a variety of sectors as may be required at different settings within a hothouse, etc.

It will be, however, appreciated that whilst in accordance with one embodiment the vortex generating member **288** is rotatable within the housing **280**, in accordance with another embodiment it may be fixed within the housing and the arrangement of a plurality of vortex generating paths as illustrated in Figs. 7A-7D is factory set. A further embodiment may of course be such that there exist an additional position in which all the outlet nozzles are blocked, namely, no atomized jet is emitted.

Figs. 8 and 9 illustrate still another embodiment in which the atomizer **300** is capable of distributing the atomized liquid at different sectors, varying outflows

and at different patterns. The atomizer **300** comprises a housing **302** and a mating vortex generating member **304**.

Housing 302 is principally similar to previous embodiments with the exception that it comprises a plurality of outlet nozzles: **306** having a respective large diameter; **308** having a smaller diameter; and **310** having an elongate shape. It is noted that the outlet nozzles are angularly shifted and furthermore that outlet nozzles **306** and **310** are formed at essentially the same level, wherein outlet nozzle **308** is formed at a lower level.

Vortex generating member **304** is formed, in the present example, with two vortex generating paths **314** and **316** axially extending above one another, where the former is in flow communication with the cavity via inlet portions **318** and the later is in flow communication with the cavity via inlet portions **320** and **321**, as explained hereinabove with reference to figures 1C-1E.

The arrangement is such that at an initial position (Fig. 9A) outlet nozzle **306** extends opposite vortex generating path 314, whilst outlet nozzles **308** and **310** are inoperable, namely do not extend opposite a corresponding vortex generating path. As seen in Figure 9A atomized liquid is distributed at circular pattern having a large diameter. Upon rotating the housing **302** in the direction of arrow **326** (or respectively the vortex generating member **304**, in a reversed direction), the outlet nozzle **308** comes to a position in which it is opposite the lower vortex generating path **316**, whereby a narrower circular pattern of atomized liquid is distributed. Upon further rotation of the housing in the same direction (arrow **326**) the longitudinal outlet nozzle **310** comes to a position in which it is in flow communication with the vortex generating path **314**, wherein the atomized liquid is emitted at a narrow, longitudinal pattern.

Figs. 10 and 11 illustrate a further embodiment of the fogger in accordance with the present invention generally designated **400** and comprising a housing member **402** formed with an inlet **404** extending into a cavity **406** having a rectangular cross-sectional head **410** (best seen in Fig. 10).

Head **410** is formed with four vortex generating paths **414** extending from cavity **406** through radial apertures **416** (Fig. 11), similar to the vortex generating paths disclosed in previous embodiments.

An atomizing cap **420** has a receptacle **422** snugly receiving the square head **410** whereby opposite at least one vortex generating path **414** there is formed an outlet nozzle **424**, similar to the disclosure of the previous embodiments. However, it would be appreciated that the number of outlet nozzles may be lesser than the number of vortex generating paths for irrigating at a selective zone only.

Cap **420** is formed with radial recesses **428** for snapingly receiving radial projections **430** formed in housing **402** and an O-ring **436** is provided for sealing any interstice between the cap **420** and the head **410** to prevent wetting at the surrounding of the atomizer.

In operation, water entering inlet **404** emerges through apertures **416** and then flows through vortex generating paths **414** where it is vortexed and emerges then through outlet nozzles **424** in an atomized form as explained hereinbefore.

In connection with the embodiments of Figs 8 and 9, the artisan will appreciate that the devices may be used to distribute the atomized liquid in any distribution pattern, also distribution along the longitudinal axis of the device.

Further attention is now directed to another embodiment of the invention illustrated in Figures 12 and 13. The atomizer generally designated **500** is constructed of a housing **502** and a vortex generating member **504** snugly receivable within a suitable cavity **505** formed in the housing **502** (seen in Figure 13). Similar to the previous embodiments, the housing **502** is formed with two outlet nozzles **506** extending from the cavity **505**, which is in flow communication with an inlet **508** attachable to a water supply. The vortex generating member **504** is adapted for press fitting within the cavity **505** and is formed with two formed with two vortex generating paths **510** (Figure 12), each extending between an inlet portion **512** and a vortex generating portion **514** , which at the assembled state of the device extends opposite a corresponding outlet nozzle **506** of the housing **502**.

The arrangement is such that liquid entering inlet **508** flows via inlet portions **512** into the vortex generating paths **510** such that it is forced to swivel within the vortex generating portion **514,** whereby as it leaves the outlets **506** it is in atomized form.

It is appreciated that the embodiment illustrated with reference to Figures 12 and 13 may be modified into different embodiments, some of which have been discussed in connection with previous embodiments herein before.

Whilst preferred embodiments have been shown and described, it is to be understood that it is not intended thereby to limit the disclosure of the invention, but rather it is intended to cover all modifications and arrangements falling within the spirit and the scope of the invention, *mutatis mutandis*.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A liquid atomizer comprising a housing fitted with an inlet for connecting to a liquid supply line and a cavity being in flow communication with the inlet, said cavity having a longitudinal axis;

the housing being formed with a plurality of outlet nozzles for emitting atomized liquid;

a vortex generating member, which is concentrically receivable within the housing with possibility for relative displacement with respect to the housing, said vortex generating member being provided with a plurality of depressions constituting at least one vortex generating path defined by a vortex generating portion and by an inlet portion, the arrangement being such that when said vortex generating member is received within the housing the vortex generating portion is disposed opposite a respective outlet nozzle of the housing and the inlet portion is brought in flow communication with the cavity; said inlet portion extending essentially along the longitudinal axis of the cavity and encountering said vortex generating portion essentially tangentially; and

each of at least one vortex generating path generates a liquid vortex about an axis transversally extending relative to the longitudinal axis of the cavity.

2. A liquid atomizer according to Claim 1, wherein the vortex generating member is radially fixable within the housing.

3. A liquid atomizer according to Claim 1, wherein the vortex generating member is coaxially and sealingly received within the housing.

4. A liquid atomizer according to Claim 3, wherein the vortex generating member is snapingly fixed to the housing.

5. A liquid atomizer according to Claim 3, wherein peripheral walls of the vortex generating member sealingly bear against inner walls of the housing.

6. A liquid atomizer according to Claim 3, wherein the housing and the vortex generating member are cylindrical.

7. A liquid atomizer according to Claim 1, wherein the vortex generating path generates a liquid vortex about an axis substantially perpendicular to the longitudinal axis of the housing.

8. A liquid atomizer according to Claim 5, wherein the vortex generating path has an inlet extending parallel to the longitudinal axis and originating at an edge of the vortex generating member.

9. A liquid atomizer according to Claim 5, wherein the vortex generating member has a hollow being in flow communication with the cavity and the vortex generating path has an inlet originating from the hollow.

10. A liquid atomizer according to Claim 1, wherein the vortex generating path has an R-like cross-section with the center of the round portion extending opposite the respective outlet nozzle.

11. A liquid atomizer according to Claim 1, wherein the vortex generating path has a cochlea-like cross-section with the center thereof extending opposite the respective outlet nozzle.

12. A liquid atomizer according to Claim 1, wherein the vortex generating member comprises a plurality of vortex generating paths and the housing comprises a plurality of outlet nozzles; the vortex generating paths and the outlet nozzles being distributed at different angular divisions; the vortex generating member is fixable within the housing at different radial positions, each giving rise to cooperation of different outlet nozzles with respective vortex generating paths and to sealing of other outlet nozzles.

13. A liquid atomizer according to Claim 12, wherein the housing and vortex generating member are fitted with corresponding mating members for setting the vortex generating member at the different radial positions within the housing.

14. A liquid atomizer according to Claim 1, wherein each housing is fitted with a single vortex generating member.

15. A liquid atomizer according to Claim 1, comprising only a single housing and a single vortex generating member.

16. A liquid atomizer according to Claim 1, wherein the inlet is in flow communication with a pressure threshold valve.

17. A liquid atomizer according to Claim 15, wherein the pressure threshold valve is received within the cavity.

18. A liquid atomizer according to Claim 16, wherein the pressure threshold valve comprises a closure member biased against the inlet of the housing.

19. A liquid atomizer according to Claim 16, wherein the pressure threshold valve is a leakage preventing device (LPD), and wherein the closure member is spring biased against the inlet of the housing and has a piston rod connecting it with

a piston, said piston being displaceable along a corresponding cylinder and being in flow communication with the cavity.

20. A liquid atomizer according to Claim 18, wherein the piston is sealingly displaceable within the cylinder and wherein liquid entering the cavity applies force on the piston in a direction entailing displacement of the closure member away from the inlet.

21. A liquid atomizer according to Claim 18, wherein the cylinder is vented.

22. A liquid atomizer according to Claim 17, wherein the piston is displaceable against a member fitted at an end of the cylinder.

23. A liquid atomizer according to Claim 17, wherein the inlet is sealed by a resilient sealing portion associated with the closure member.

24. A liquid atomizer according to Claim 12, wherein at least one outlet nozzle and at least one vortex generating member are axially offset.

25. A liquid atomizer according to Claim 1, wherein the vortex generating member is snugly received within a cavity formed in the housing.

26. A liquid atomizer, substantially as described herein with reference to and as illustrated in the accompanying drawings.

Dated this 9th day of May 2005

DAN MAMTIRIM

By their Patent Attorneys

GRIFFITH HACK

Fellows Institute of Patent and

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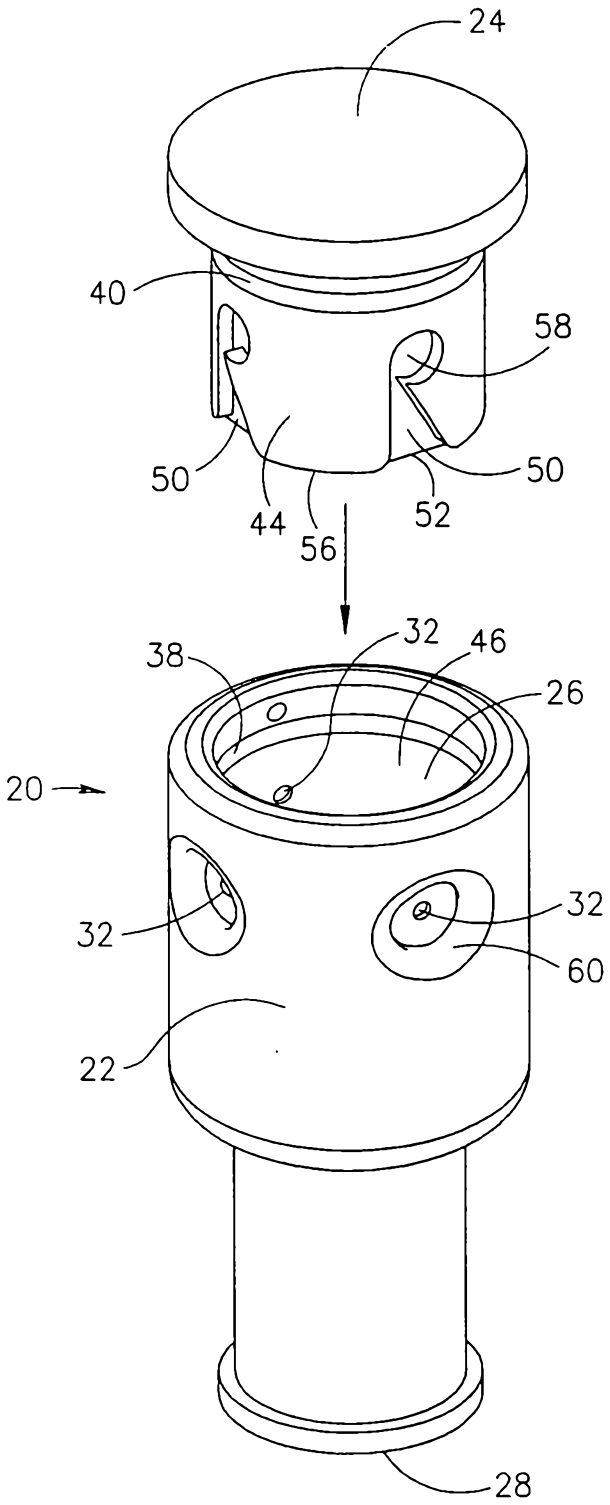

FIG.1A

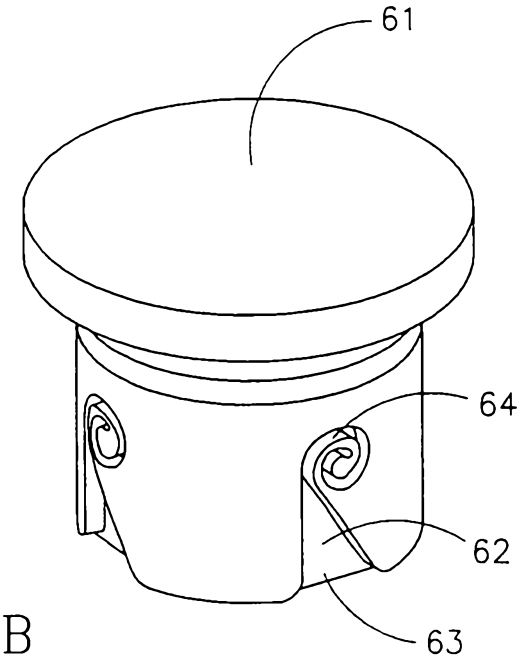

FIG.1B

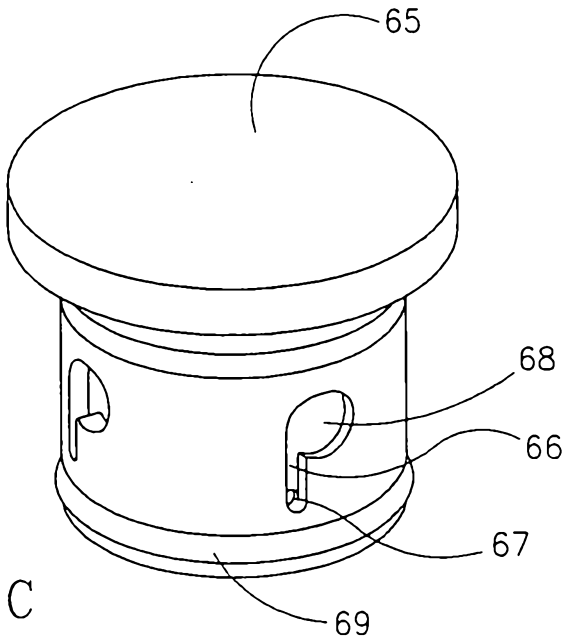

FIG.1C

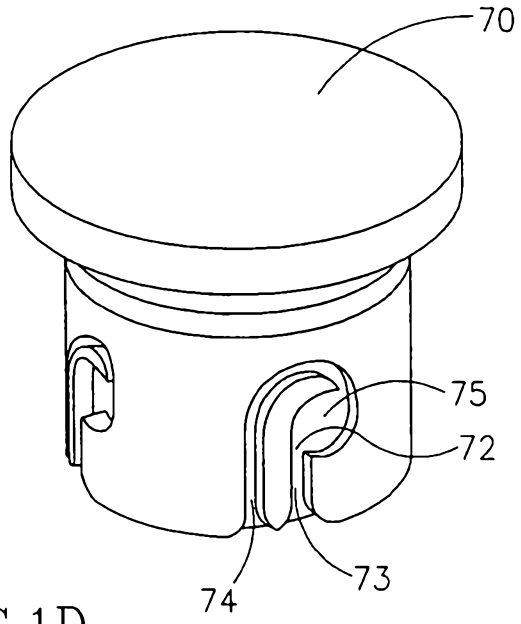

FIG.1D

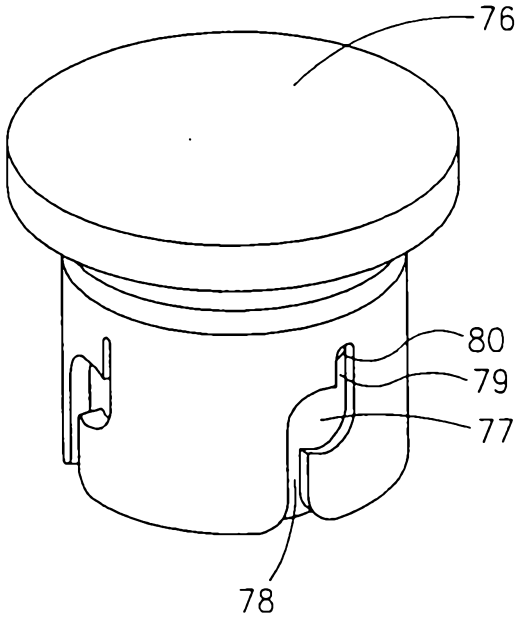

FIG.1E

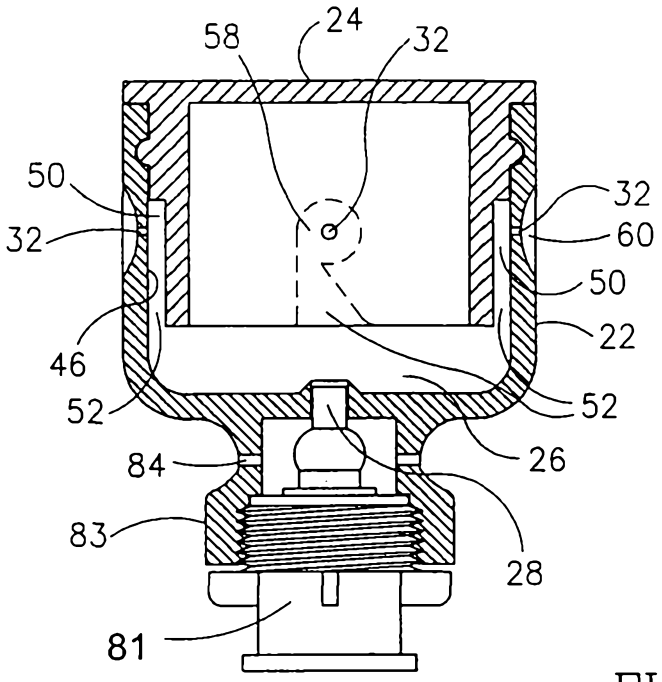
58
24
32
50
32
32
60
50
22
46
52
52
26
84
83
28
81

FIG.2

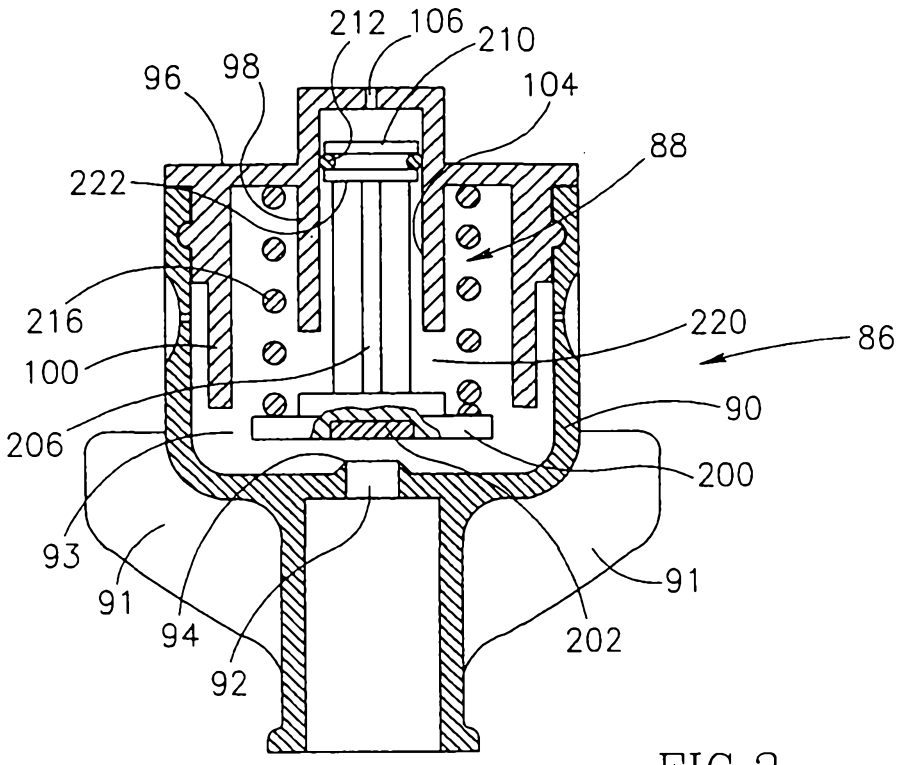
212
106
210
96
98
104
88
222
216
220
86
100
90
206
200
93
91
91
94
92
202

FIG.3

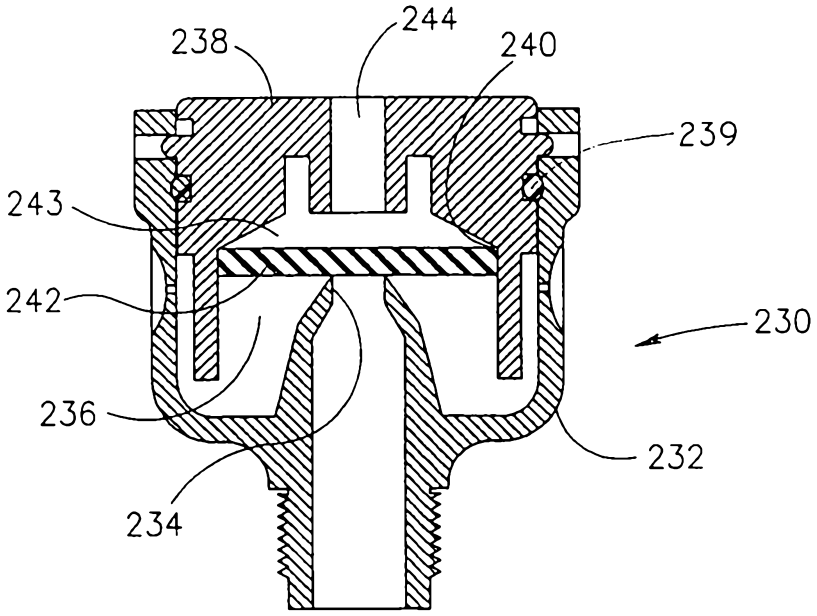

FIG.4

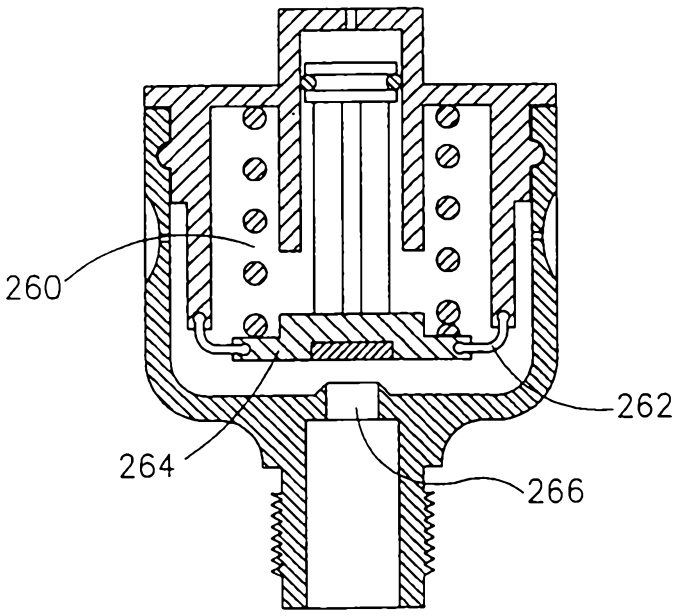

FIG.5

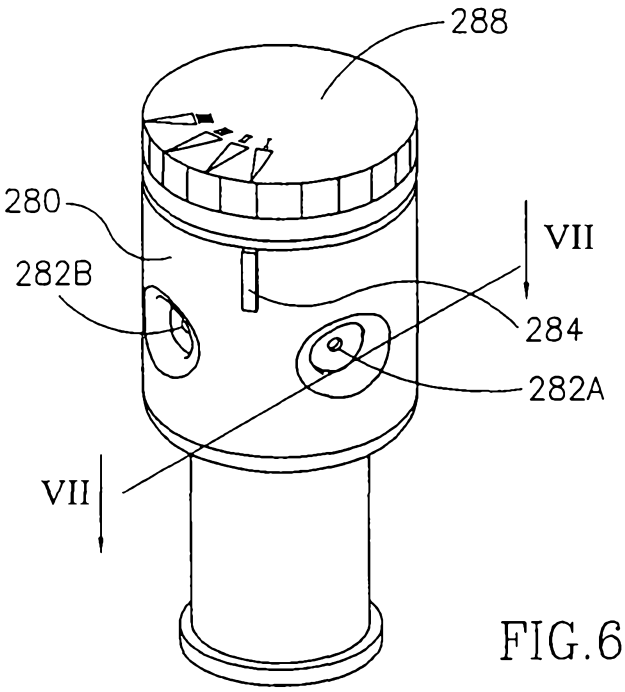
288
280
282B
VII
284
282A
VII

FIG.6

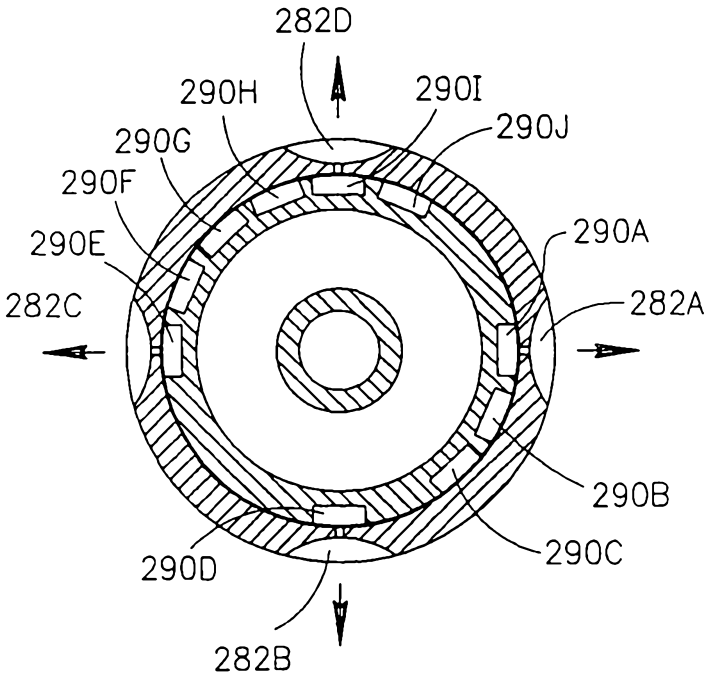
282D
290H
290I
290J
290G
290F
290E
290A
282C
282A
290B
290C
290D
282B

FIG.7A

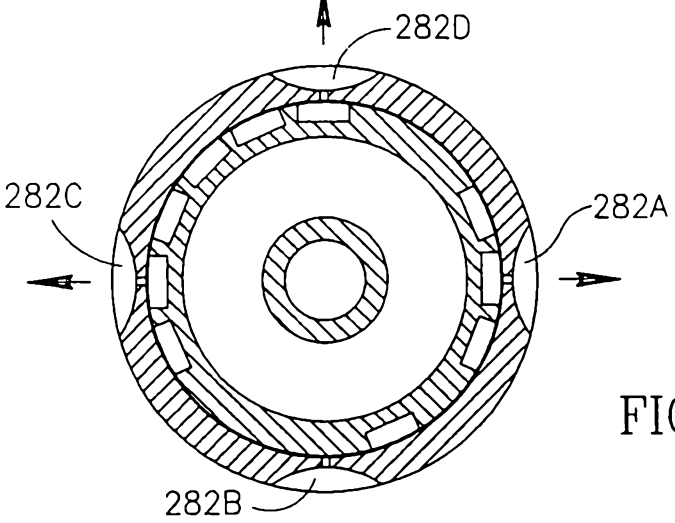

FIG.7B

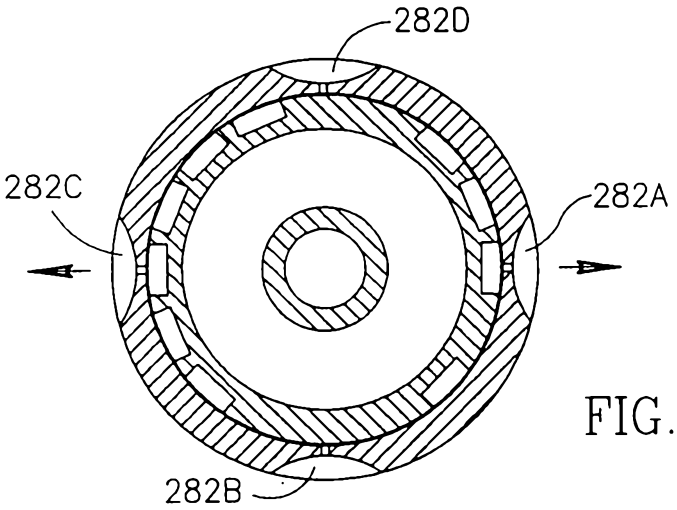

FIG.7C

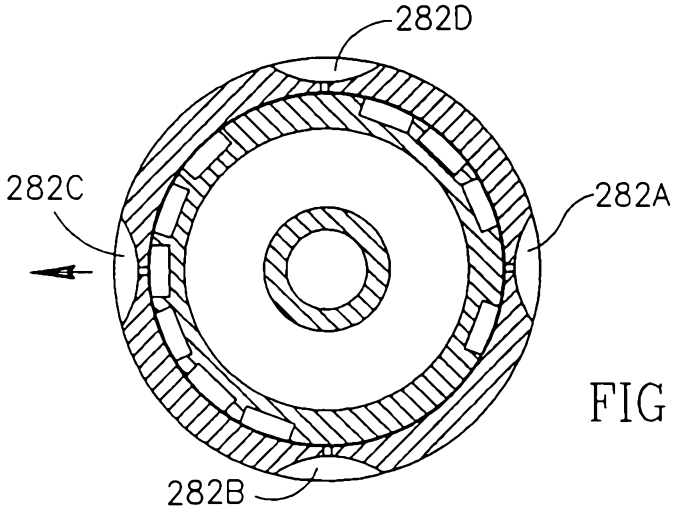

FIG.7D

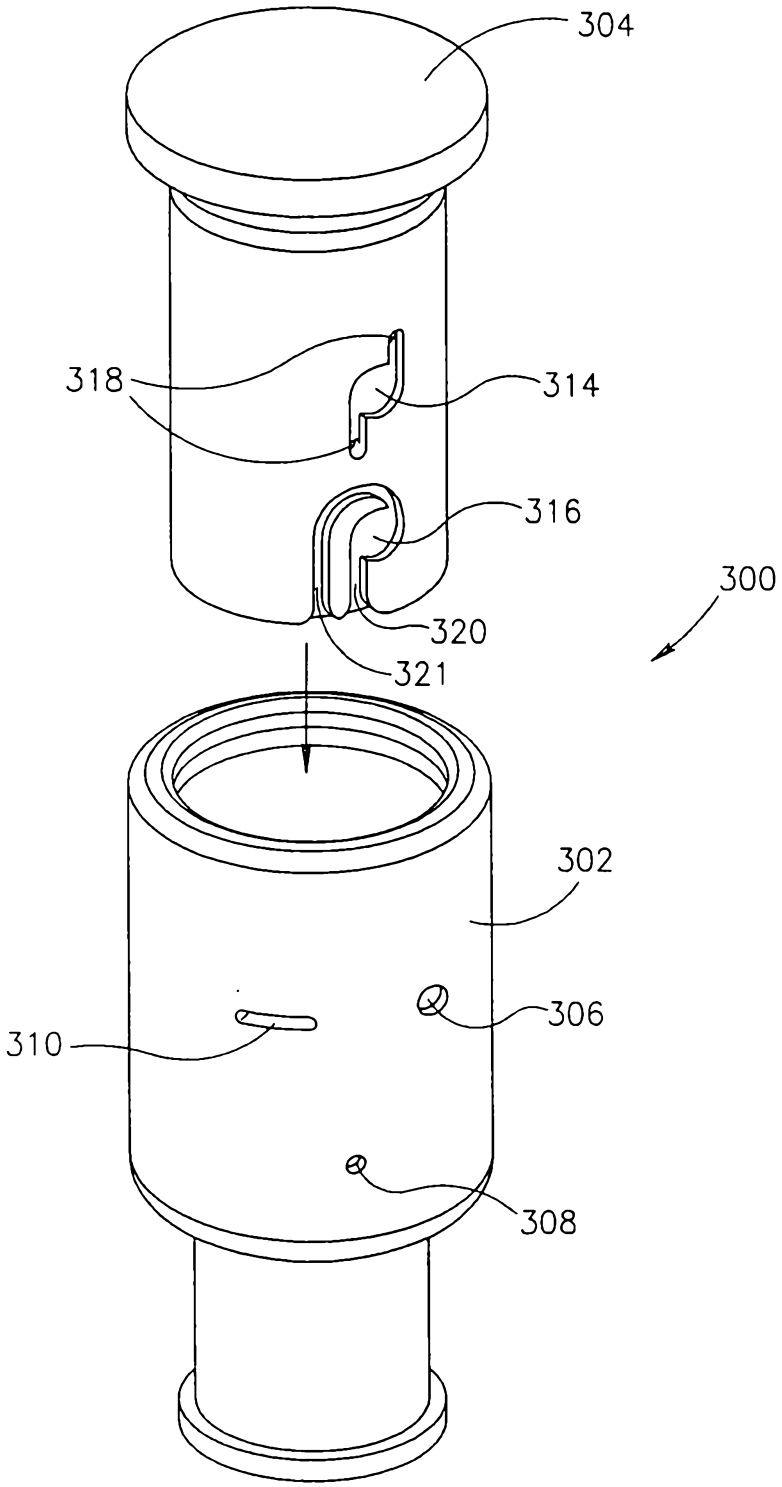

FIG.8

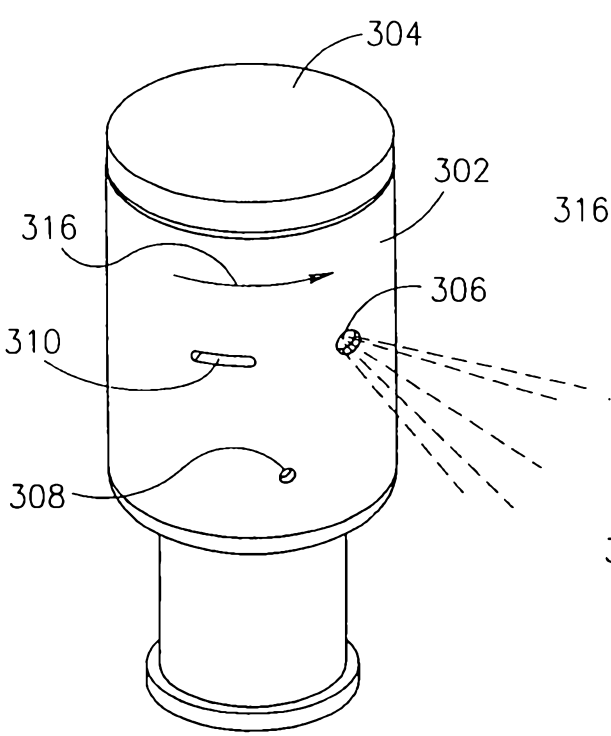

FIG.9A

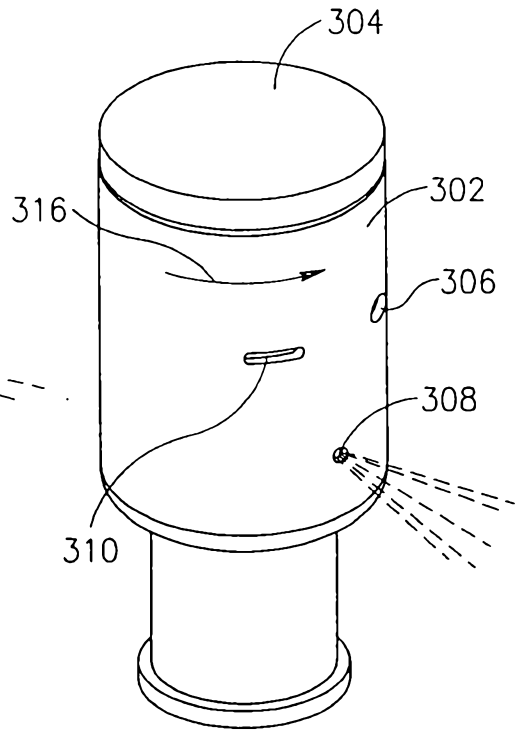

FIG.9B

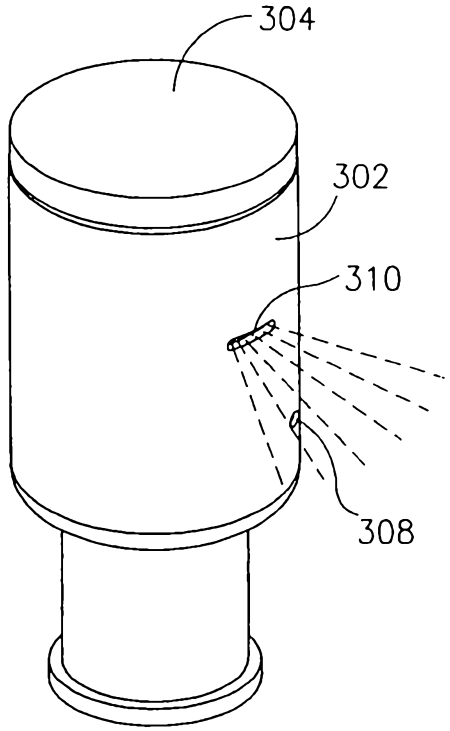

FIG.9C

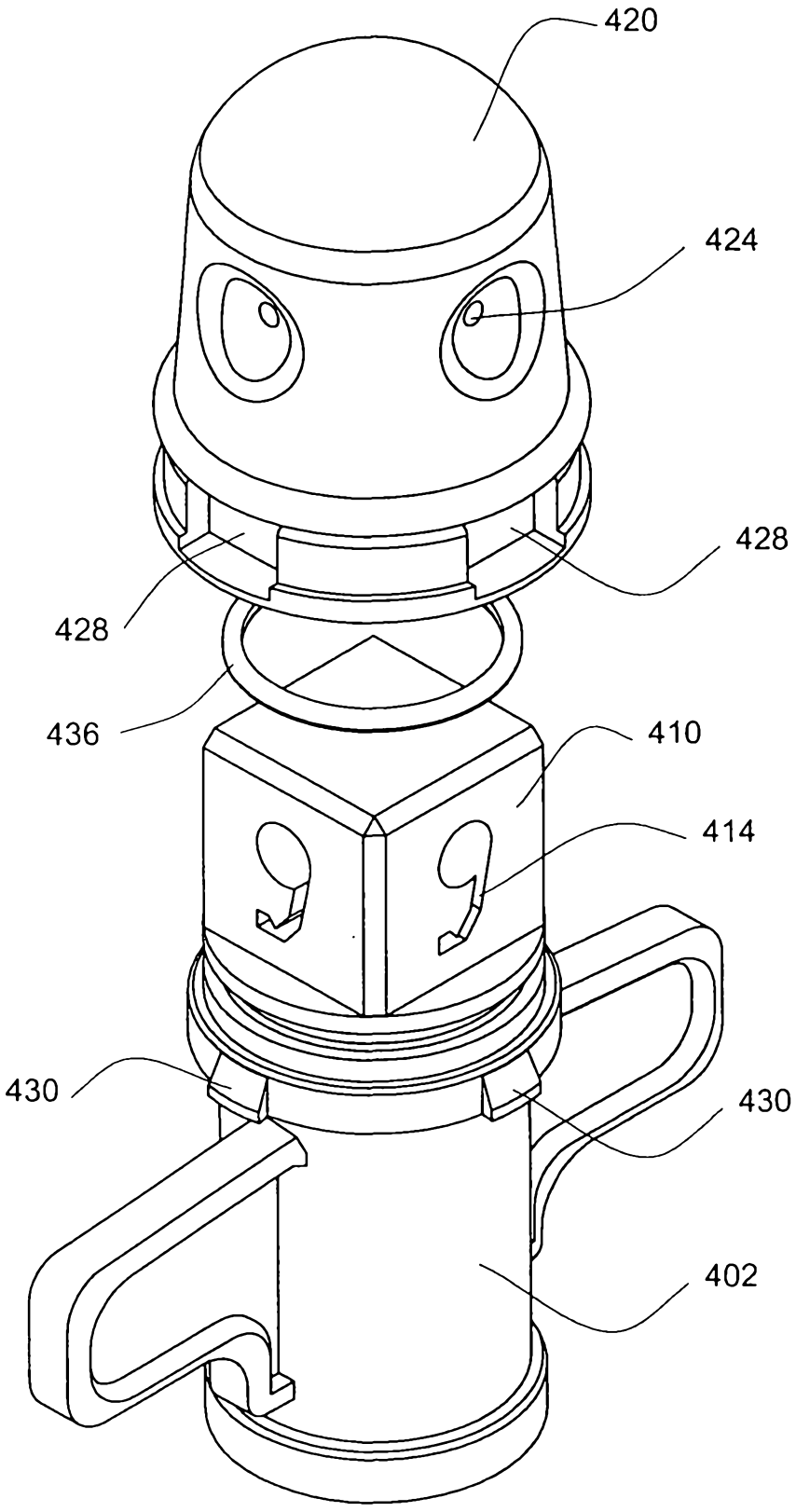

FIG. 10

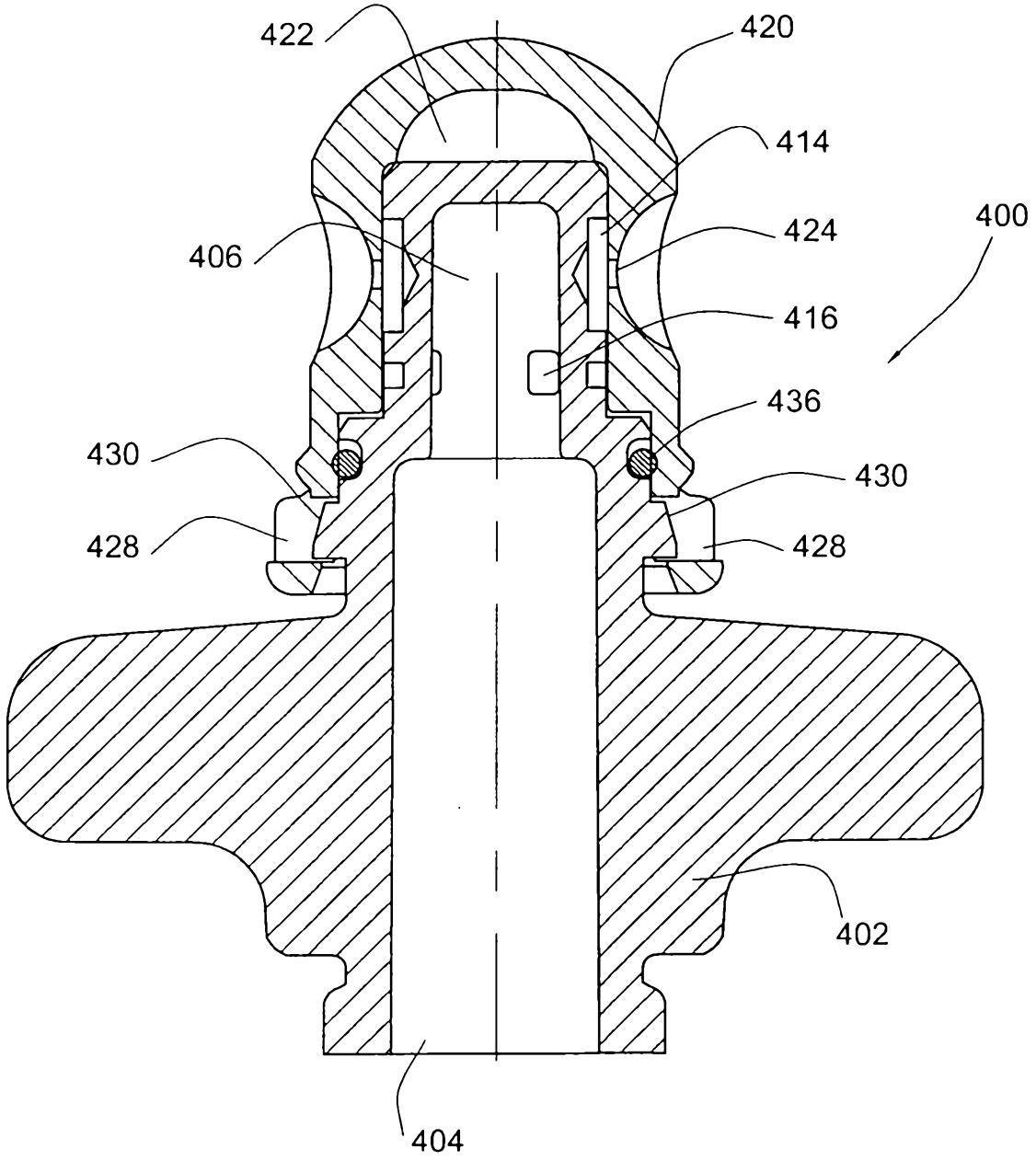

FIG. 11

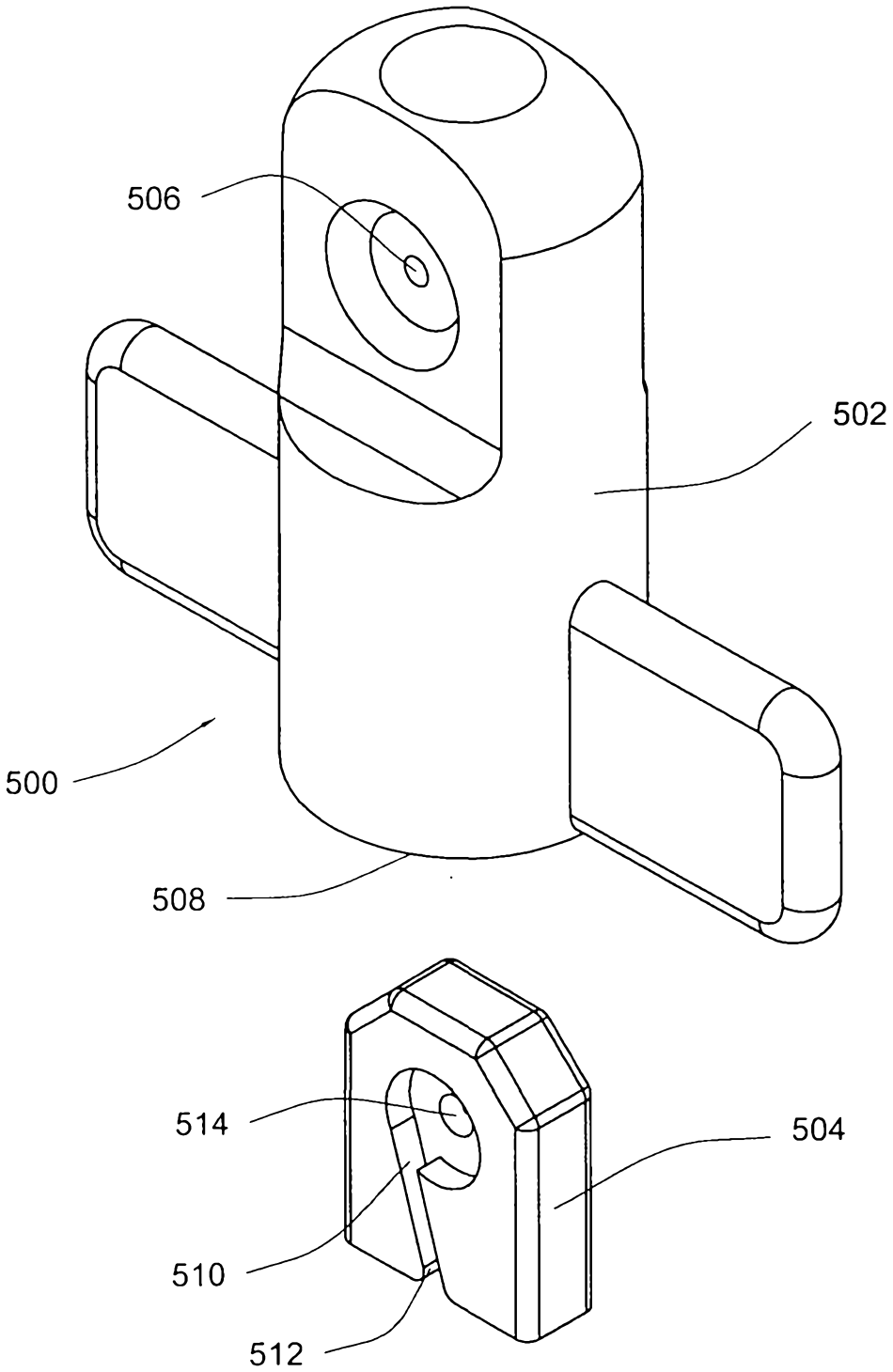

FIG. 12

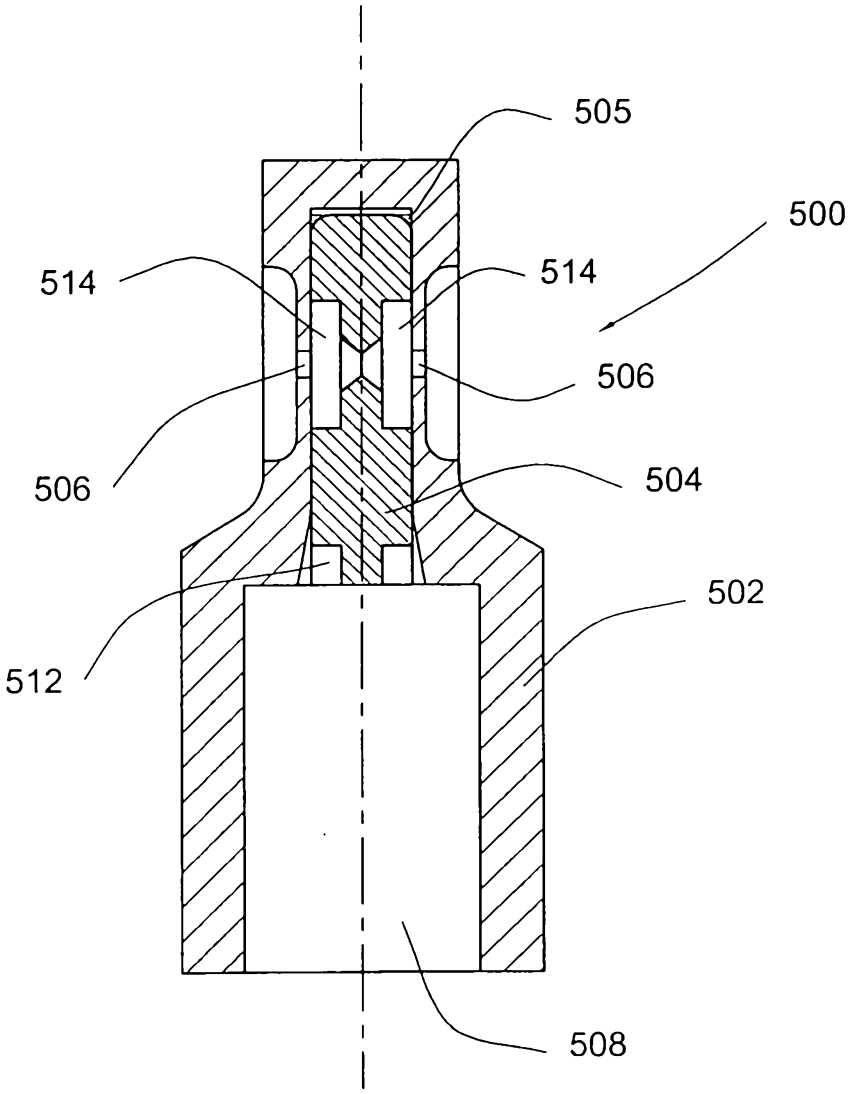

FIG. 13