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Albright

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[54] **SPRAY HEAD**

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[73] Assignee: **Advance Products Corporation,** Benton Harbor, Mich.

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[52] **U.S. Cl.** **239/412,** 239/414, 239/417.5

[51] **Int. Cl.** **B05b 7/00**

[58] **Field of Search** 239/407, 412, 414, 416.4, 239/417.5

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[57] **ABSTRACT**

A spray head comprises a body having air and liquid inlet passageways terminating adjacent to each other within the body. A single resilient diaphragm is disposed across the ends of the two passageways and sealed against a seat at the end of the liquid inlet passageway. The diaphragm is held against the seat by a spring biased piston, and the diaphragm is raised from the seat by air pressure in the air inlet line. The air and liquid are mixed in a mixing cavity immediately under the diaphragm, and the mixture is discharged through an outlet passageway to a spray nozzle. The spray nozzle may be a ball-shaped member formed with a variety of openings to provide various discharge patterns.

10 Claims, 10 Drawing Figures

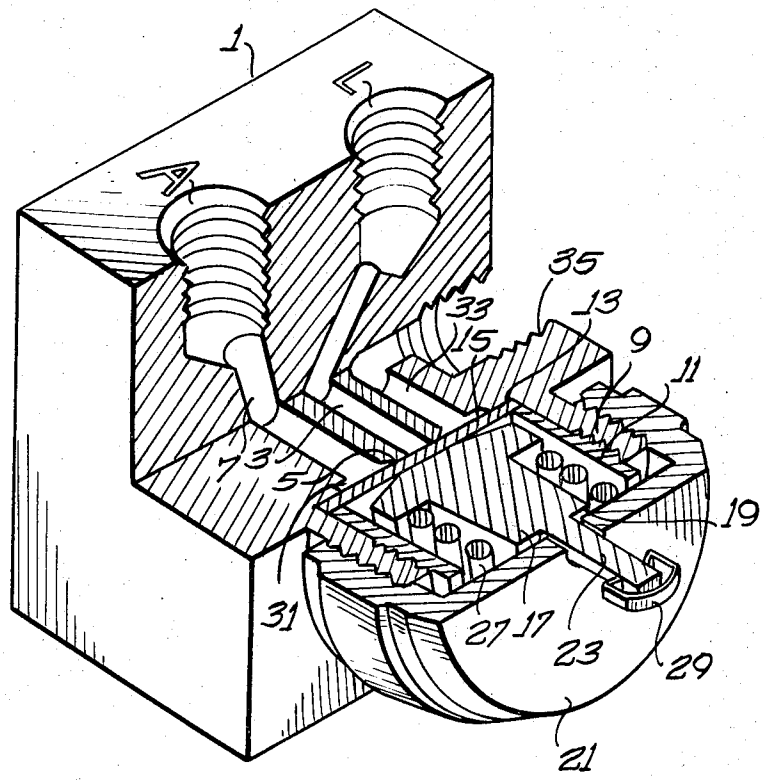

Fig. 1.

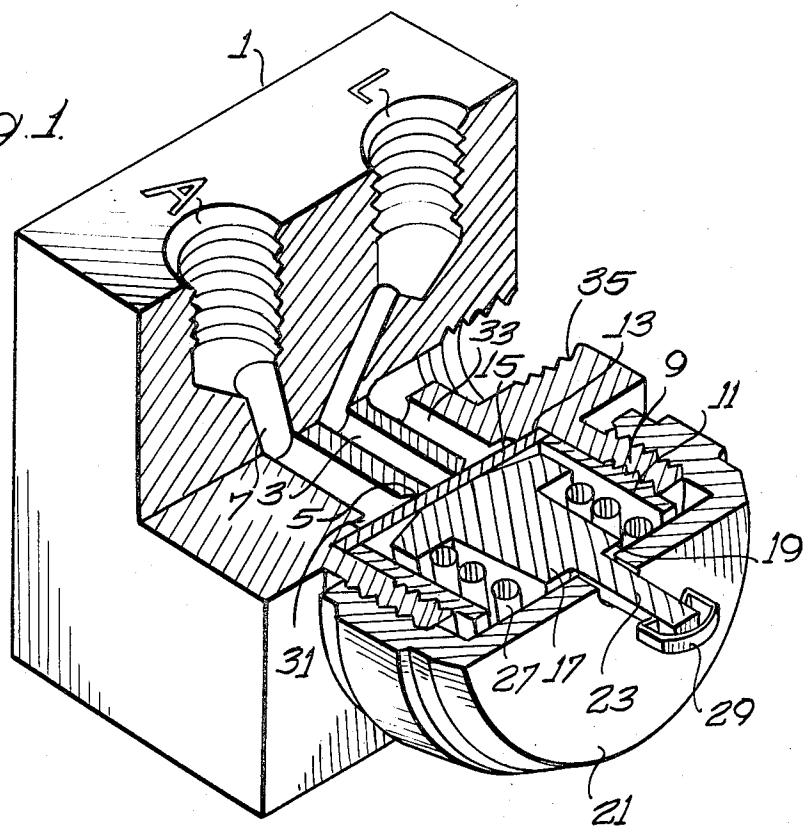
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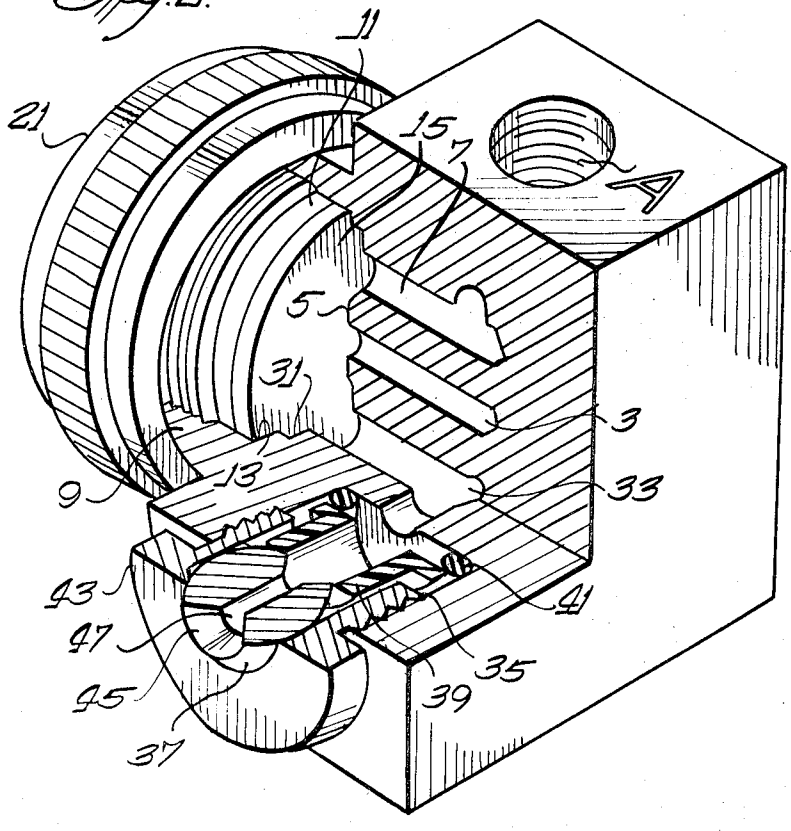
Fig. 2.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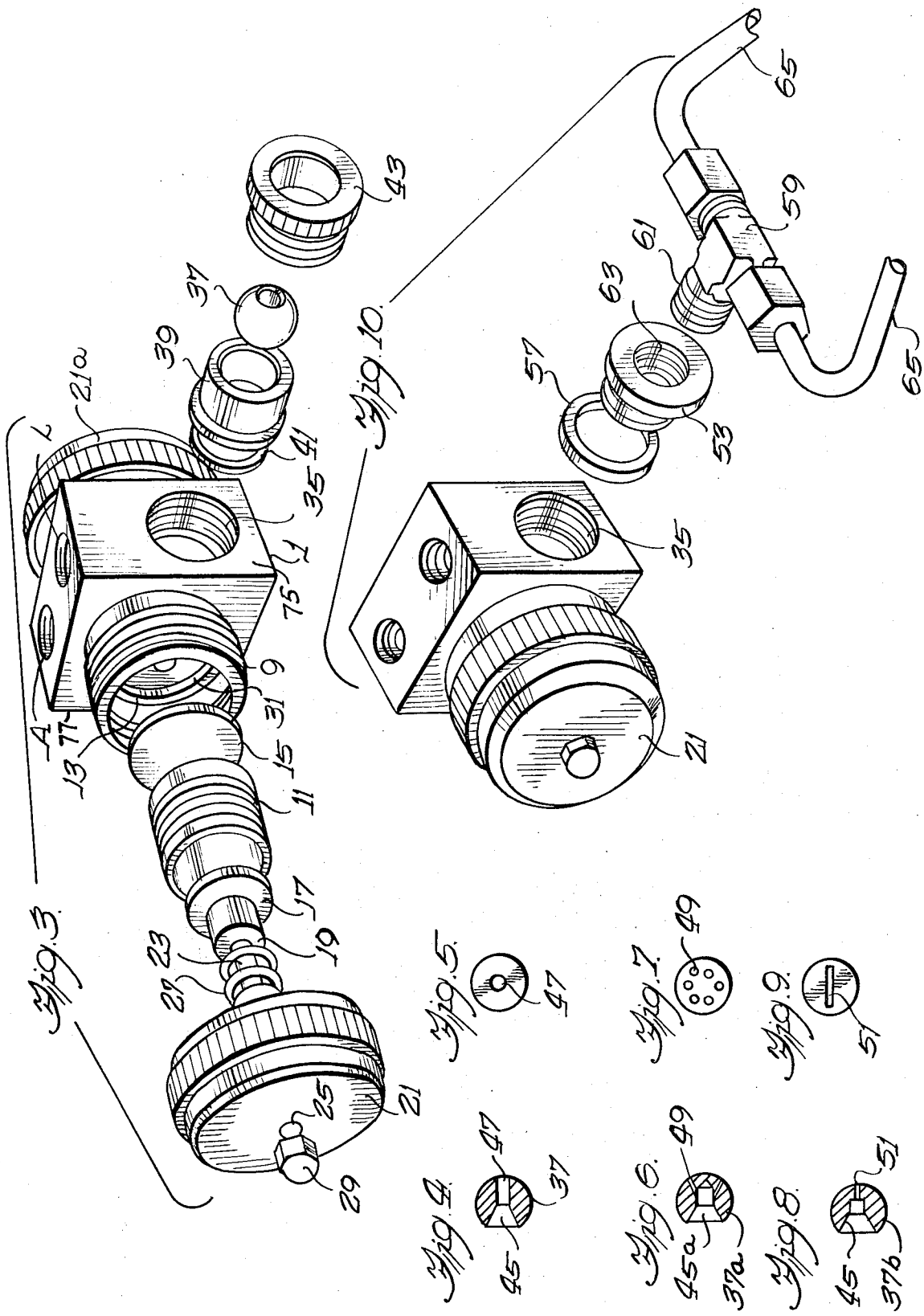
Fig. 3.
Fig. 10.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.

SPRAY HEAD

BACKGROUND OF THE INVENTION

This invention relates to improvements in spray heads.

The type of spray heads with which the present invention is concerned is that used for spraying lubricants or mold release agents into the cavities of casting dies. Spray heads of this type typically contain a body with air- and liquid-inlet lines, and suitable valving within the body to control the air, whereby the air pressure is used to deliver the liquid to a spray nozzle. The mixing of the air and liquid generally takes place in a discharge nozzle so that an atomized spray is discharged for impingement upon the surface to be lubricated. The aforesaid valving frequently consists of a ball check valve, needle valve or the like, all of which may be subject to deterioration and/or clogging during use. Furthermore, the spray nozzles themselves are often designed for only a fixed or predetermined spray pattern, which may not be satisfactory for all uses. If the nozzle is designed for various spray patterns, the adjustment features of the nozzle result in additional costs and complications.

OBJECTS AND SUMMARY OF THE INVENTION

An object of this invention is to provide a spray head of the type and for the purpose stated in which the air-inlet passageway and the liquid-inlet passageway extend into the body of the spray head, and wherein the sealing means across the end of the liquid-inlet passageway consists of a single resilient diaphragm. As a result, a reduction in cost and simplicity of design is provided.

A further and important object of this invention is to provide a spray head of the type stated in which the air and liquid are mixed in a mixing cavity defined in part by the diaphragm and immediately adjacent to the terminals of the air-inlet and liquid-inlet passageways. The mixed air/liquid is discharged through an outlet passageway downstream of the mixing cavity to a nozzle from which the spray is ultimately discharged. The design of the nozzle may be simplified and adapted to a wide variety of spray patterns since the nozzle is not depended upon for mixing.

An additional object of this invention is to provide a spray head of the type stated which may be disassembled for service without the need for tools, and wherein the diaphragm and its seat across the terminal of the liquid-inlet passageway are so designed that contaminants may flow through the spray head without immediately eroding the seal or preventing the seal from functioning, thereby reducing the need for frequent disassembly of the spray head for maintenance purposes.

A still further object of this invention is to provide a spray head of the type stated that utilizes a ball-swivel nozzle that can be rotated to various positions for discharging different spray patterns, such as a fine or wide conical pattern, a hollow conical pattern, fan shaped spray, or the like.

A still further object of this invention is to provide a spray head of the type stated in which the diapharagm mounting is such as to permit ready removal of the diaphragm so that it may be turned over in the event that the side of the diaphragm that is exposed to the flowing stream becomes partially eroded and tends to capture

particles. In effect this tends to double the life of the diaphragm before the need for replacement thereof.

In accordance with the foregoing objects the invention comprises a spray head having a body with air-inlet and liquid-inlet passageways terminating adjacent to each other within the body and with the end liquid-inlet passageway forming a metal seat. A flexible diaphragm is disposed across the seat, and a spring-biased piston imposes pressure upon the diaphragm to maintain the latter sealed against the seat until air of sufficient air pressure in the air-inlet passageway raises the diaphragm from the seat. A mixing chamber or cavity underlies the diaphragm and is thus defined in part by the diaphragm. The outlet passageway downstream of the mixing cavity conveys the air/liquid mixture from the mixing cavity to the spray nozzle.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a fragmentary view partially broken away and in section of a spray head constructed in accordance with and embodying the present invention;

FIG. 2 is another fragmentary perspective view partially broken away and in section of the spray head;

FIG. 3 is an exploded perspective view of the spray head, more particularly a dual-nozzle type spray head;

FIG. 4 is a sectional view through the central axis of one type of spray nozzle that forms part of the present invention;

FIG. 5 is an end view of the nozzle of FIG. 4;

FIG. 6 shows a sectional view of a modified form of spray nozzle;

FIG. 7 is an end view of the nozzle of FIG. 6;

FIG. 8 shows a sectional view of a still further form of spray nozzle;

FIG. 9 is an end view of the nozzle of FIG. 8; and

FIG. 10 is an exploded fragmentary perspective view of the spray head showing but still a further form of spray nozzle arrangement.

DETAILED DESCRIPTION

Referring now in more detail to the drawing, which illustrates a preferred embodiment of the present invention, there is shown a metal housing or body **1**, which is preferably of generally block-like form. At one surface of the body are air- and liquid-inlet openings marked A and L and into which conventional threaded fittings may be inserted whereby air and liquid under pressure may be supplied to the spray head. In communication with the recessed or bottom end of the liquid-inlet opening L is drilled passageway **3** that terminates within the body in a seat **5.** The lower or recessed end of the opening A is in communication with a drilled passageway **7** that terminates within the body **1** adjacent to but radially offset from the seat **5.**

Integral with the body **1** is a tubular cylindrical flange **9** that is coaxial with the axis of the drilled passageway **3** in the region of the seat **5.** The flange **9** is also large enough in internal diameter to embrace the terminal part of the passageway **7.** The flange **9** is internally threaded for receiving a cylindrical, externally threaded diaphragm retainer ring **11.** A resilient and flexible diaphragm **15** abuts a seat or shoulder **13** that is formed in the body **1.** The diaphragm **15** of circular shape has its peripheral portion seated on the shoulder **13.** The diaphragm is a resilient member and is preferably made from a fluorocarbon resin, which is chemi-

cally inert to many liquids. The diaphragm retainer **11** clinches the peripheral portion of the diaphragm **15** against the shoulder **13** to form a seal thereat. It is, therefore, apparent that the diaphragm **15** constitutes a membrane-like seal or barrier that prevents air and liquid from flowing therepast.

Axially slidable within the diaphragm retainer **11** is a piston **17** that presses against the diaphragm **15** to urge it into sealing position across the seat **5**, thereby normally closing off the end of the passageway **3**. The diaphragm is large as compared to the opening at the seat. The piston **7** has a machined shoulder **19** that receives the inside surface of a cap **21**, and the stem **23** of the piston **17** projects slidably through a central hole **25** in the cap **21**. The cap **21** has an external knurl to facilitate manual manipulation, and is internally threaded for threading onto the external thread of the flange **9**.

Within the cap **21** is a coil compression spring **27** which bears at one end against the inside of the end wall of the cap **21** and at its other end against the head of the piston **17**. The coil spring **27** surrounds the stem of the piston and, like the piston, is coaxial with the diaphragm **15**. Thus, the cap contains a subassembly comprising the piston **17** and the spring **7**. This subassembly is held together by a push nut **29** that frictionally fits over the end of the piston stem **23**. The amount of pressure on the piston **17** imposed by the spring **27** determines the maximum liquid holding pressure of the unit and the air pressure needed to lift the diaphragm **15** from across the seat **5**. The piston **17** has a limited axial movement in accordance with its setting. Thus, depending upon how far the cap **21** is threaded onto the flange **9**, the piston **17** can be set to provide controlled liquid flow or complete shut-off of the liquid. An annular machined cavity **31** underlies the diaphragm **15** and provides communication from the passageway **7** to the large underside of the diaphragm surrounding the seat **5**.

When sufficient air pressure is supplied to the passageway **7**, the diaphragm is lifted from the seat **5**. Air and liquid will then flow into the mixing chamber or cavity at **31**. This annular cavity **31** will, therefore, provide a chamber at which the air and liquid are mixed for subsequent flow to the spray nozzle. Typically, equal air and liquid pressures are used, but variations are possible within the scope of the invention.

The mixture of air and liquid in the mixing cavity underlying the diaphragm **15** is discharged through an outlet passageway **33** in the body **1**. This passageway **33** terminates in a threaded hole or exit port **35** at which a nozzle assembly is located. In the form of the invention shown in FIGS. **1–9**, the nozzle assembly comprises a ball-nozzle **37** that is supported by a tubular nozzle seat **39**. The nozzle seat **39** is sealed within the hole **35** by an O-ring **41**. An externally threaded nozzle retainer **43** receives the nozzle **37** whereby a portion of the nozzle projects outwardly therefrom for presentation to the die cavity or other surface to be sprayed. As shown, the nozzle retainer **43** has a knurled periphery to facilitate manual manipulation. When the nozzle retainer is threaded into the hole **35** so that the nozzle seat **39** bears against the O-ring **41** in sealing relation, the ball nozzle **37** is seated in place and the seal **41** prevents escape of the air-liquid mixture around the threads of the hole **35** and the nozzle retainer **43**. Because the ball nozzle **37** is nested within the retainer **43** and projects slightly forwardly therefrom, the nozzle **37** may be manually rotated for optional positioning without disassembling the nozzle assembly. To accomplish this the retainer **43** may be loosened slightly to permit movement of the nozzle **37** when it is desired to adjust its position.

FIGS. **4–9** show a variety of nozzles which may be used with the present invention. In the nozzle **37** shown in FIGS. **4** and **5** one end portion **45** of the nozzle is conical while the other portion **47** is cylindrical. In the nozzle **37***a* the conical portion **45***a* is somewhat wider than the conical portion **45**, and the opposite end of the bore of the nozzle **37a** has a series of circumferentially spaced small holes **49**. In the nozzle **37***b* the nozzle has a fan shaped slot **52** that is opposite to the conical portion **45**. Other nozzle outlet configurations may also be used. Thus, there is a wide variety of nozzles, any of which may be readily installed on the spray head, may be used to provide the desired spray pattern.

In a modified form of the invention shown in FIG. **10**, the nozzle comprises an adapter **53** that threads into the hole **35** and is retained by a locking ring **57**. A metal-to-metal seal may be provided by the adapter fitting **53** and the thread in the hole **35**. A T-fitting **59** has a stem **61** which is threaded into the internally threaded bore **63** of the adapter and forms a seal therewith. The T-fitting **59** has opposed tubes **65, 65** which may be positioned so as to direct sprays from each of the tubes into different portions of die cavities of relatively complex configuration. Such an arrangement tends to reduce the total number of spray heads used in some situations. It should be noted, however, that the T-fitting may be replaced by a single tube or other standard fittings such as a 45° fitting, a 90° fitting or a Y-type fitting. These are by the way of example only and not by way of limitation.

The principles of the present invention are also applicable to dual spray heads, namely those spray heads with the nozzle projecting outwardly from opposite sides of the body **1**. Rferring, for example, to FIG. **3**, it will be noted that a nozzle assembly projects from the body surface **75**. A like nozzle assembly within the scope of this invention may project from the opposite body surface **77**. Cap **21***a* represents the position of the piston, diaphragm, etc. of the second nozzle, all of which components are the same as those previously described. Both nozzles share the same Liquid and Air inlet lines as shown in the upper surface of the block as shown in FIG. **3**.

From the foregoing it will be seen that the diaphragm mechanism of the present invention provides effective metering as a result of the small diameter supply port at the seat **5** and the limited movement of the diaphragm **15**. The thin sheet-like flow of the liquid in the mixing chamber together with the turbulent air therethrough provides excellent atomizing even for relatively viscous fluids.

Furthermore, the flow rate provided by the limited axial movement of the diaphragm can be easily adjusted by the threaded setting of the cap **21** on the flange **9** to control the axial movement of the piston **17**. This setting establishes the distance between the shoulder **19** and the inside wall of the cap **21** and thus mechanically controls diaphragm movement. However, because the diaphragm movement is small, variations in air pressure above the minimum needed to lift the diaphragm from the seat **5** will have no significant ef-

fect on diaphragm movement. Such variations in pressure serve to control the degree of atomization and the velocity of the discharged liquid particles.

The invention is claimed as follows:

1. A spray head comprising a body having an air-inlet passageway terminating in said body, a liquid-inlet passageway also terminating in said body adjacent to the terminal of said air-inlet passageway, means forming a seat at the terminal of said liquid-inlet passageway, a resilient imperforate diaphragm disposed across said seat and the terminal of said air-inlet passageway, a spring-biased member imposing pressure on said diaphragm to maintain said diaphragm sealed against said seat in the absence of sufficient air pressure in the air-inlet passageway to raise the diaphragm from said seat, said liquid inlet passageway being free of said spring-biased member, a mixing cavity defined in part by said diaphragm and exposed to both of said passageway terminals upon sufficient air pressure being in said air-inlet passageway to raise said diaphragm from said seat, said diaphragm being secured around its entire periphery to constitute a membrane-like barrier preventing flow of liquid and air therepast from said mixing cavity, an outlet passageway downstream of said mixing cavity for conveying an air-liquid mixture from said mixing cavity, and a nozzle in communication with said outlet passageway for spraying the mixture conveyed thereto.

2. A spray head comprising a body having an air-inlet passageway terminating in said body, a liquid-inlet passageway also terminating in said body adjacent to the terminal of said air-inlet passageway, means forming a seat at the terminal of said liquid-inlet passageway, a resilient diaphragm disposed across said seat and the terminal of said air-inlet passageway, a spring-biased member imposing pressure on said diaphragm to maintain said diaphragm sealed against said seat in the absence of sufficient air pressure in the air-inlet passageway to raise the diaphragm from said seat, a mixing cavity defined in part by said diaphragm and exposed to both of said passageway terminals upon sufficient air pressure being in said air-inlet passageway to raise said diaphragm from said seat, an outlet passageway downstream of said mixing cavity for conveying an air-liquid mixture from said mixing cavity, and a nozzle in communication with said outlet passageway for spraying the mixture conveyed thereto; and in which said diaphragm is imperforate, said spring-biased member is a spring biased-piston, and said diaphragm is peripherally clamped to said body against a diaphragm seat therein.

3. A spray head according to claim **1** in which the terminal of the liquid-inlet passageway is small in cross-sectional area as compared to the cross-sectional area of the face of the diaphragm that is presented thereto.

4. A spray head according to claim **1** in which said nozzle comprises swivelly mounted ball member having an opening therethrough, one end portion of the opening being conical, and an opposite end portion being of different shape whereby the ball member may be optionally rotated to provide different spray patterns.

5. A spray head according to claim **1** in which said nozzle comprises a tube member.

6. A spray head comprising a body having an air-inlet passageway terminating in said body, a liquid-inlet passageway also terminating in said body adjacent to the terminal of said air-inlet passageway, means forming a seat at the terminal of said liquid-inlet passageway, a resilient diaphragm disposed across said seat and the terminal of said air-inlet passageway, a spring-biased member imposing pressure on said diaphragm to maintain said diaphragm sealed against said seat in the absence of sufficient air pressure in the air-inlet passageway to raise the diaphragm from said seat, a mixing cavity defined in part by said diaphragm and exposed to both of said passageway terminals upon sufficient air pressure being in said air-inlet passageway to raise said diaphragm from said seat, an outlet passageway downstream of said mixing cavity for conveying an air-liquid mixture from said mixing cavity, and a nozzle in communication with said outlet passageway for spraying the mixture conveyed thereto; and in which said body has a shoulder surrounding said passageway terminals, said diaphragm is peripherally supported on said shoulder, a tubular flange is on said body and surrounds said shoulder, a clamping ring is threaded into said flange and peripherally clinches said diaphragm against said shoulder, said spring-biased member is a piston in said clamping ring that is biased by a spring, and a cap is threaded onto said flange and provides an abutment for one end of the spring, the threaded position of said cap on said tubular flange determining the amount of axial movement permitted by said piston.

7. A spray head according to claim **6** in which said mixing cavity is of a shape to provide a sheet-like flow of liquid therethrough.

8. A spray head comprising a body having an air-inlet passageway terminating in said body, a liquid-inlet passageway also terminating in said body adjacent to the terminal of said air-inlet passageway, means forming a seat at the terminal of said liquid-inlet passageway, a resilient diaphragm disposed across said seat and the terminal of said air-inlet passageway, a spring-biased member imposing pressure on said diaphragm to maintain said diaphragm sealed against said seat in the absence of sufficient air pressure in the air-inlet passageway to raise the diaphragm from said seat, a diaphragm seat in said body and supporting the periphery of said diaphragm, a clamping ring removably secured to said body and imposing pressure against said diaphragm to seal the diaphragm in place on said seat, a mixing cavity defined in part by said diaphragm and exposed to both of said passageway terminals upon sufficient air pressure being in said air-inlet passageway to raise said diaphragm from said seat, an outlet passageway downstream of said mixing cavity for conveying an air-liquid mixture from said mixing cavity, and a nozzle in communication with said outlet passageway for spraying the mixture conveyed thereto.

9. A spray head according to claim **8** in which said spring-biased means is within said clamping ring.

10. A spray head comprising a body having an air-inlet passageway terminating in said body, a liquid-inlet passageway also terminating in said body adjacent to the terminal of said air-inlet passageway, means forming a seat at the terminal of said liquid-inlet passageway, a resilient diaphragm disposed across said seat and the terminal of said air-inlet passageway, a spring-biased member imposing pressure on said diaphragm to maintain said diaphragm sealed against said seat in the absence of sufficient air pressure in the air-inlet passageway to raise the diaphragm from said seat, a mixing cavity defined in part by said diaphragm and exposed

to both of said passageway terminals upon sufficient air pressure being in said air-inlet passageway to raise said diaphragm from said seat, said diaphragm being an imperforate member-like member having opposed sides of such configuration as to be operable when either side is exposed to the air-liquid mixture, means removably mounting said diaphragm in said body so that upon removal of said means the diaphragm may be selectively installed within said body with either side thereof presented to said mixture, an outlet passageway downstream of said mixing cavity for conveying an air-liquid mixture from said mixing cavity, and a nozzle in communication with said outlet passageway for spraying the mixture conveyed thereto.

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