MULTI-SPRAY DEVICE

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10 Claims

ABSTRACT OF THE DISCLOSURE

A method of dispersing a liquid in a multiplicity of fine mist spaced patterns is disclosed. The device consists of an inclined trough having a series of substantially inclined bulbous protrusions over which liquid is directed. An orifice is located at the apex of each protrusion through which fluid under pressure passes. A blast of gaseous fluid, for example air, is directed through the apertures thereby atomizing the film of liquid passing over the holes. By inclining the trough, liquid not dispersed by the uppermost bulbous protrusion is collected and directed by means of contoured channels to the next dome under gravity for subsequent atomization thereby. The unused liquid is then collected and circulated back to the liquid supply tank and thence into a weir at the top of the trough, thus completing the cycle. The device therefore provides a multiple spray atomizing unit from one source of liquid supply.

BACKGROUND OF THE INVENTION

Atomization of a liquid to produce a fine mist or fog is accomplished in the prior art in a number of ways. Notably, four patents issued to R. S. Babington et al., U.S. Patent Nos. 3,421,692; 3,421,693; 3,425,058; and 3,425,039, all disclose a means to produce a fog-like mist dispersing the liquid in extremely small particles of 5 microns or less.

The Babington et al. patents basically comprise passing a bulbous or curved surface which causes the liquid to "film out" or "stretch" if the liquid is applied to a surface which has adhesive properties. By stretching the film of liquid over a curved surface and passing the film over a small aperture near the apex of the curved surface and by directing a jet of gas or air under pressure through the aperture, the film of liquid is stretched to the point of rupture thereby atomizing the liquid into minuscule particles. The liquid atomization principle patented by Babington et al. can be utilized in a number of different areas of technology. A few examples include the following: humidifiers, gas cleaners for industry and fuel burners for both commercial and domestic applications.

The devices depicted in the foregoing patents however are limited to a single spray unit.

Therefore, it is an object of this invention to provide an improvement over the prior art in that a method is disclosed wherein multiple spray functions are provided from a single liquid source.

More particularly, it is an object of this invention to disclose a simplified method for providing multiple spray patterns from a single source of liquid utilizing, for example, a preformed stamped metal plate serving the multiple function of channeling liquid toward the bulbous injector elements on one side while the other side serves as an air chamber wherein air is directed to the elements having apertures therein.

DESCRIPTION OF THE DRAWINGS

The above noted objects and further advantages of the present invention will be more fully understood upon the study of the following detailed description in conjunction with the detailed drawings in which:

FIG. 1 is a semi-schematic view of the multi-spray device as utilized in the oil burner application;
FIG. 2 is a perspective view of one embodiment of the invention;
FIG. 3 is a fragmentary perspective view of still another embodiment of the invention;
FIG. 4 is a schematic view of the invention as utilized in the gas cleaning field;
FIG. 5 is a perspective view of an embodiment of the invention wherein multiple slots are utilized in each protrusion;
FIG. 6 is a top view taken along lines 6—6 of FIG. 5;
FIG. 7 is a front view of yet another embodiment of the invention wherein the plate is oriented vertically, and;
FIG. 8 is a side view taken along lines 8—8 of FIG. 7. Referring now to FIG. 1, the basic system consists of a liquid supply tank 12, an atomizing trough 14, a liquid circulating system 16 including pump 18 and a gas supply source 20.

In the oil burner application, fuel oil from supply tank 12 slowly flows into a depression or catch basin upstream of the weir 24 and the fluid spills over the weir's edge 26. The oil descends gravitationally down channel 28 and over a bulbous protrusion or dome 30. Each of the upwardly extending domes 30, 33 and 35 has at least one aperture 32 through the dome, located near the apex thereof. The oil is stretched over the dome containing
the aperture in part by means of surface tension forces. The blower 20 supplies a gaseous fluid (air) under pressure through conduit 22 into chamber 23. Since the pressure within chamber 23 is higher than the ambient pressure around the trough 14, the fluid escapes through the apertures 32 in the domes. Preferably, the pressure within chamber 23 is 4 to 10 p.s.i. above atmospheric pressure while 8 p.s.i. would be ideal. When this happens, the surface tension of the fuel oil across the aperture 32 is ruptured causing the oil to atomize into a mist or fog 36 above the trough 14. The mixture 36 is then ignited above trough 14 in an oil burner housing (not shown). The fuel oil that escapes atomization by the uppermost dome 30 is collected in basin 29 downstream of the dome 30 and directed via channel 28 to dome 33 where the atomization process previously described is repeated. The remaining unburned oil finally reaches catch basin 34 wherein it empties into conduit 16 and is pumped back to the liquid supply tank 12 by pump 18.

The inclination of the device as illustrated in FIGS. 1 through 6 can be very small, say, typically 2 to 8 degrees. In extreme cases the inclination may be as high as 12 degrees. Open channel steady flow theory indicates a velocity of channel flow of 4 inches/sec, for 5 degrees of inclination. A near horizontal position of the trough, in the oil burning application, would lend itself to easy construction by the conventional route of the oil burners, to the device of the present invention. The trough can be vertical or at any other inclination and still operate as disclosed; however, slightly different design provisions are needed for collecting and redirecting the excess liquid flow, namely, a closed funnel type collector instead of a simple open channel collector (number 28, FIGS. 1 and 2) as indicated and described in detail with reference to FIGS. 7 and 8.

Referencing now to FIG. 2, the trough 14 can be, for example, made up of two stamped metal plates comprising an outer half cylindrical shell 15 with an inner intricately formed plate 17 attached thereto. The inner plate 17 defines the weir 26, flow channel 28, upwardly extending domes 30, 33 and 35 and catch basin 34. The ends 19 and 21 of shell 15 provide liquid tight walls for basin 24 and catch basin 34 at opposite ends of trough 14. The cavity or fluid chamber 23 (FIG. 1) is defined by the inside shell 15, end plates 19, 21 (FIG. 2) and the bottom of stamped plate 17. Each of the domes have at least one aperture 32 near the top of the protrusion so that fluid under pressure can escape therethrough. The aperture can be an elongated slot in the dome; in fact, the aperture is preferably an elongated slot with its long axis parallel to the flow of the liquid. Typical aperture dimensions (32) are slots 0.003 to 0.005 inches wide and 0.010 to 0.200 inches long. Obviously, any number of dome-like protrusions or domes could be oriented on an inclined plate as seen in the fragmentary view of FIG. 3 and more than one plate could be utilized (not shown) in any suitable arrangement provided they are inclined to gravitationally flow liquid down the plate and over the protrusions.

In the oil burner application (FIG. 1) wherein fuel oil is a blend of a rate of 1 to 2 gallons/hr, the flow into a basin 24, would typically be at the rate of 5 to 12 gallons per hour and the trough is at an inclined angle of 3 to 8 degrees. The pressure in cavity 23 should typically be between 5 to 10 p.s.i. above atmospheric pressure to provide good atomization above the protruding domes. Fuel burning rate from 0.3 to 15 gallons per hour could be attained with a single bulbous slot.

Plate 40 (FIG. 3) has multiple protrusions 42 extending from the plate. Each of these domes has at least one orifice through the dome 100 and a series of channels 46 connecting each dome. The apertures 43 act as supplemental air holes to enhance oxidation or burning of the atomized fuel oil. The angle of inclination of plate 40 would depend upon the rate of flow of the liquid to be atomized, the number of upwardly extending protrusions, the viscosity of the liquid, plate adhesion properties, velocity of the gas flow through the apertures 44, etc.

An atomization plate of the fragmented configuration partially shown in FIG. 3 could be utilized in the gas scrubbing operation minus the supplemental air holes 43 shown therein. Scrubbers are used to remove solid and certain types of liquid and gaseous impurities from exhaust gas streams. They are used in many power station exhaust stacks, chemical mining, metallurgical and agricultural processes wherein it is desirable indeed, imperative that the various irritants and toxic exhaust properties be removed.

Turning now to the gas cleaning apparatus of FIG. 4, the scrubber generally designated as 60 comprises a liquid supply tank 62 which feeds liquid into a weir 63, the weir subsequently spills liquid onto the dimpled plate 64. The liquid not subjected to atomization eventually reaches catch basin 66. The liquid is recirculated back to tank 62 by conduit 68 and pump 70. Contaminated gas 72 under a slight pressure (4 or 5 p.s.i. above atmospheric pressure) is directed through apertures 75 in the domes 74 of plate 64, thereby rupturing the surface tension of the liquid. In the gas cleaning apparatus 60 it is preferable to have more than one slot (75) in each protrusion as shown in FIGS. 5 and 6. The liquid can be, for example, water, and the water passing over apertures 74 is atomized by the contaminated gas above the dimpled scrubber plate 64. When the liquid breaks up into minute particles, solid contaminants entrained in the gas are encaptured, i.e., entrapped or dissolved by the liquid, thus collecting the solid particles from the gas. The solid thus entrapped and scrubbed from the polluted gas has to have particle sizes considerably smaller than the openings in the dimples 74. Gaseous contaminants, such as carbon dioxide, can be dissolved in the liquid. Certain gaseous organic impurities such as phenols (as found in the waste gases from industrial processes) can be dissolved in various organic solvents. There is a great surface area of liquid exposed to the contaminated gases and this will augment the absorption of impurities from the gas as well as the entrainment of solid particles in the gas. The atomized liquid as well as the gas passes over dimple 76 following the path of the contaminant substance is directed downwardly by baffle 78 most of the entrapped contaminants tend to fall out or settle in well 80 while the remaining gas is directed over baffle 82 towards well 84 before finally escaping up exhaust stack 86. The entrapped contaminants are removed from wells 80 and 84 by conduits 88 towards a disposal source (not shown).

Turning now to FIG. 5, the plate designated as 90 comprises a slightly different method of channeling and directing liquid over the domes 92. Due to the design of the basin 96 around the base of the protrusions 93, the liquid being guided gravitationally down channel 94 tends to stay within the guide channels because of the walls 95 (FIG. 6). The liquid which tends to go around the protrusions will empty into the well 95 thereby collecting and directing liquid to the next dome downstream.

FIG. 6 more clearly illustrates the particular design of the liquid channeling. The multiple slots 98 in the dome-like protrusions are particularly effective in the gas cleaning operation previously described since the object is to entrap as many solid contaminating particles for encapsulation by the liquid as possible. The orientation of the slots 98 are designed so that their long axes are 90 degrees to the liquid as the liquid moves over the dome radially from the apex of the dome 92.

FIG. 7 is an embodiment of the invention wherein the dimpled plate there can be domed 100 is vertical or nearly so. A series of funnel-like catch basins 102 collect and direct liquid over the dimples 104. By collecting the liquid in this manner, the liquid flow rate can be controlled by the size of the opening 106 at the exit of the diverging funnel 102.
FIG. 8 is a side view of the vertical spray apparatus, particularly illustrating the depth of the liquid catching funnels 102 and their relationship to the domes 104.

Although embodiments have been chosen to best illustrate the advantages of this invention, it is to be understood that the scope of the invention is not to be limited thereby.

I claim:

1. In a spray atomization device of the type that passes a thin layer of liquid over the top of a curved surface and wherein a flow of a gaseous medium under pressure is directed through an orifice on the curved surface to rupture the liquid layer spanning said orifice thereby atomizing said liquid, the improvement which comprises:

   an inclined plate having a series of bulbous, discrete, unconfined curved surfaces thereon, each discrete surface having at least one orifice therein, extending outwardly from said plate,

   channel means formed in said inclined plate leading to and extending from succeeding ones of said discrete surfaces to direct the flow of liquid from adjacent an upper portion of said plate so that liquid is guided over each of said discrete surfaces of the plate while traversing said plate toward a lower portion of the plate,

   means to conduct gaseous fluid under pressure through said orifices in said plate from the side of the plate opposite that containing the flowing liquid to atomize the liquid in a multiplicity of spray patterns.

2. The invention of claim 1 wherein said liquid is combustible and is atomized in a multiplicity of spray patterns above said inclined plate, said atomized liquid being subsequently ignited to generate heat thereby.

3. The invention of claim 1 wherein said liquid passes over said inclined plate and a contaminated gas under pressure is conducted through said orifices in said plate whereby liquid contaminant entrained in the gas is ruptured by the liquid and caused to settle out of the gas for removal therewith prior to exhausting said gas into the atmosphere.

4. The invention of claim 1 wherein said bulbous surfaces on said inclined plate are substantially aligned parallel along the slope of said inclined plate.

5. The invention of claim 4 wherein said substantially aligned bulbous surfaces on said inclined plate are spaced between a first weir in said plate located at the uppermost edge of said plate and a second catch basin located at the lowest edge of said plate whereby liquid overflows said weir onto said plate and is collected in said basin at the lowestest edge of said plate after said liquid traverses said plate, said collected liquid being recirculated by circulation means back to said weir.

6. The invention of claim 1 wherein liquid from a liquid supply source empties into a weir at the top edge of said plate, said liquid traverses said plate gravitationally and is collected in a catch basin at the lowestest edge of said plate and wherein said liquid is circulated back to said liquid supply source by a circulation means.

7. In a spray atomization device of the type that passes a thin layer of liquid over the top of a curved surface and wherein a flow of a gaseous medium under pressure is directed through an orifice on the curved surface to rupture the liquid layer spanning said orifice thereby atomizing said liquid, the improvement which comprises:

   an inclined plate having a series of discrete, curved surfaces, each having at least one orifice therein, extending outwardly from said plate, said inclined plate being enclosed by a structure forming a trough, the interior of the trough being formed by the underside of the walls of the structure, said interior cavity forming a manifold for conducting said gaseous medium under pressure through said orifices in said plate.

means to flow liquid from adjacent one portion of said plate so that liquid flows over said discrete curved surfaces of the plate while traversing said plate toward another portion of the plate, and

means to conduct gaseous fluid under pressure through said orifices in said plate from the opposite side of the plate to atomize the liquid above said plate in a multiplicity of spray patterns.
the plate to atomize the liquid above said plate in a
multiplicity of spray patterns.

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