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[54] **LIQUID DIFFUSION SPRAYING MECHANISM**
17 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **239/8,** 239/216, 239/224
[51] **Int. Cl.** **A01n 17/02**
[50] **Field of Search** 239/7, 77, 78, 160, 162, 172, 176, 223, 224, 222, 567, 216, 8; 261/30, 88

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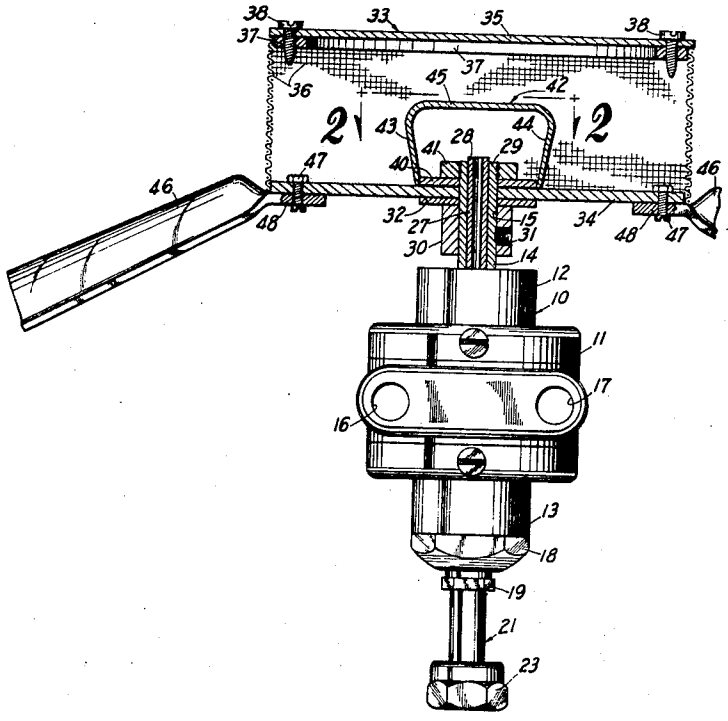
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ABSTRACT: A liquid diffusion-spraying mechanism having an air motor for driving a rotary cage or slinger which carries impeller blades outwardly of the cage. A nozzle, passing through the central portion of the air motor, discharges liquid against a central baffle which deflects the liquid outwardly. Thence, the liquid passes through a peripheral screen in the cage and is broken up in small particles which are slung into the path of air created by the impeller blades.

A group of the liquid diffusion-spraying mechanisms are readily arranged on a spray boom in spaced relationship, the axes of the mechanisms being parallel to each other. The air motors are arranged in series so that compressed air from a single source passes successively through the air motors for driving each of them. Valves are provided by which one or several of the mechanisms may be shut off.



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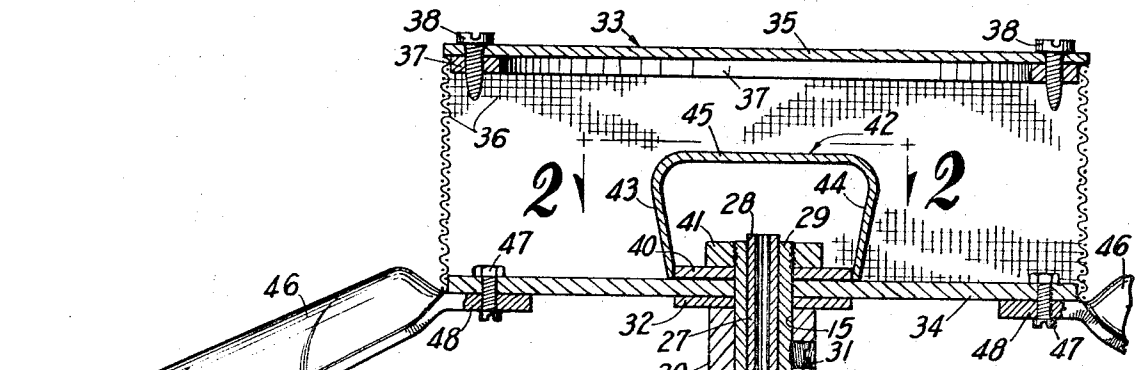


Fig. 1

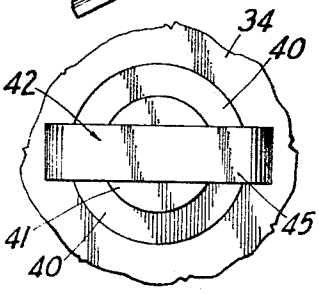


Fig. 2

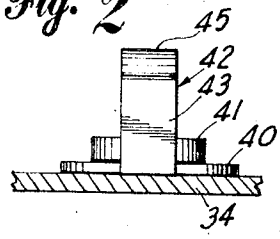


Fig. 3

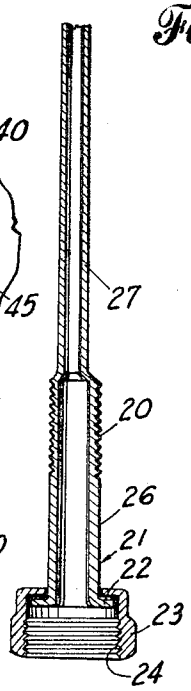
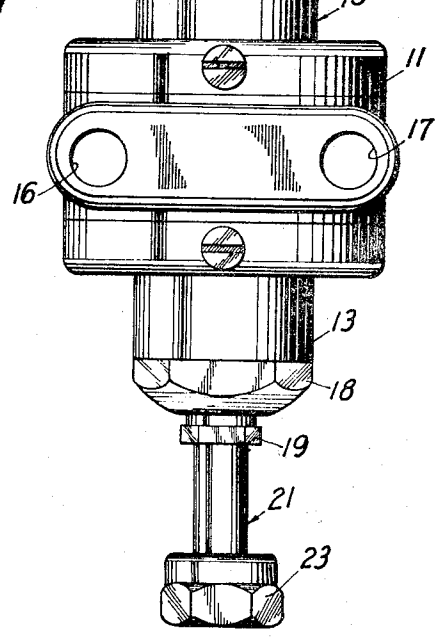


Fig. 4



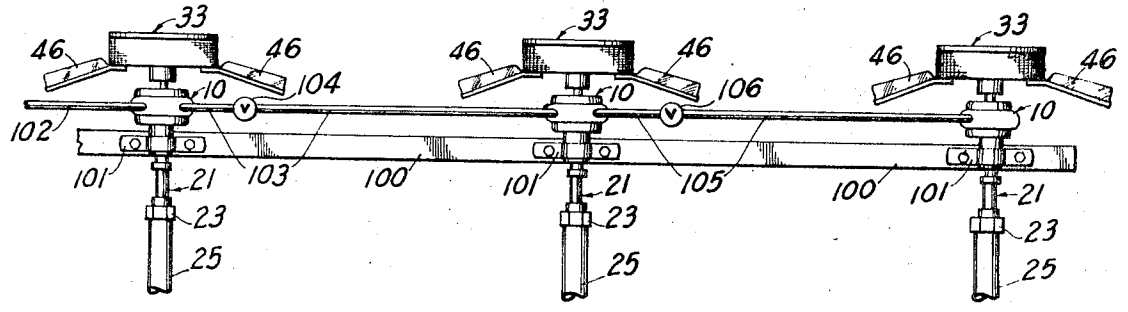


Fig. 5

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LIQUID DIFFUSION SPRAYING MECHANISM

SPECIFICATION

This invention relates to a liquid diffusion-spraying mechanism and is more particularly concerned with an agricultural instrument which will finely divide liquids, such as liquid pesticides, and distribute the finely divided liquid over a relatively large area.

In the past, various instruments have been devised for dividing liquids and for distributing the same over relatively wide areas. Such devices have found wide application in creating fogs for the destruction of various pests, such as mosquitoes, flies, bowl weevils, and various other insects, fungi, and bacteria. Such instruments may also be found useful in distributing liquid fertilizers.

The prior art devices have either distributed relatively large volumes of the liquid or have been relatively complicated and expensive. One such mechanism involves the generation of high temperature gasses which pass at high velocity through a nozzle and entrain the liquid so that the liquid is also discharged at a high velocity from the nozzle. Of course, in finely dividing the liquid and in subjecting it to relatively high temperatures, there may be a breakdown of the chemicals in the liquid to be dispensed. Therefore, while such mechanisms are quite effective in discharging relatively large volumes of liquid, their uses may be limited, especially when organic halogens are to be dispensed or where a small quantity of liquid per acre is to be dispensed.

Other types of prior art liquid-spraying mechanisms have been used, and some have attempted to discharge low and ultra low volumes of finely divided liquids. Such machines, known as the Fischer and Hahn machines, employ the carburetor principle using a large volume of compressed air at low pressure. Another type of machine is known as the John Blue machine and works on the principle of blowing a large volume of air across spray nozzles which discharge fine sprays into the blast of air.

Various liquids, such as liquid fertilizers, which may be dispensed with such mechanisms, are quite corrosive and, therefore, may attack the mechanisms, particularly where small orifices are involved. Therefore, maintenance of such prior art devices is a major factor and is, at times, expensive.

The present machine is different both in structure and method of operation from the prior art discussed above. It has a perforated annular web which, upon rotation, functions as a diffuser and a slinger for chopping the liquid into finely divided form and then slinging it radially outwardly for entrainment in a stream or blast of air.

Briefly described, the present invention, which is believed to obviate the problems described above, includes a motor, preferably an air motor, which rotates the slinger or cage. The slinger or cage is a cylindrical housing, the periphery of which is formed by a screen or perforated web. The liquid to be dispensed is passed by a central nozzle through the interior of the motor and is discharged into the central interior of the housing, as the housing is rotated about its axis. Circumferentially spaced blades project in radial directions from the housing so that, as the housing is rotated, the blades create an upwardly diverging conical discharge of air which passes over the peripheral surface of the screen. The liquid, upon being discharged into the interior of the housing, impinges upon a deflector or baffle which forms a primary diffuser and the liquid is directed thereby outwardly, passing eventually through the peripheral screen which forms a secondary diffuser and also acts as an accellerator which carries the liquid in an orbital path at such a velocity that the liquid, in fine droplet form, is slung by centrifugal force radially into the air blast. By controlling the speed of rotation, the particle size of the liquid is controlled and by controlling the amount of liquid passing through the nozzle, the volume discharged per acre may be varied as desired. Indeed, quite small volumes of liquid can be adequately entrained in quite large volumes of air and distributed over large areas.

Accordingly, it is an object of the present invention to provide a liquid diffusion spraying mechanism which is inexpensive to manufacture, durable in structure, and efficient in operation.

Another object and perhaps primary object of the invention is to provide a spraying machine which is capable of distributing a very, very small quantity of liquid over a large area.

Another object of the present invention is to provide a liquid-spraying machine in which the particle size of the sprayed liquid may be readily and easily varied.

Another object of the present invention is to provide a liquid-spraying mechanism which will evenly finely divide liquid and entrain it in a flow of air so that the liquid may be deposited over a relatively wide area.

Another object of the present invention is to provide a liquid-spraying mechanism which may be readily and easily arranged to be operated in conjunction with other similar mechanisms.

Another object of the present invention is to provide a liquid-spraying assembly which consists of a series of liquid-spraying mechanisms operated in conjunction with each other to discharge liquid in finely divided form over a relatively wide area.

Another object of the present invention is to provide a liquid-spraying mechanism in which both the particle size and the rate at which the liquid is sprayed may be varied independently of each other.

Another object of the present invention is to provide a liquid-spraying mechanism which may be readily and easily disassembled and reassembled for cleaning purposes.

Other objects, features and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings wherein like characters of reference designate corresponding parts throughout the several views and wherein:

FIG. 1 is a side elevational view, partially broken away, of the liquid diffusion-spraying mechanism of the present invention;

FIG. 2 is a cross-sectional view taken substantially along line 2–2 in FIG. 1;

FIG. 3 is a side elevational view of that portion of the mechanism shown in FIG. 2;

FIG. 4 is a vertical sectional view of the nozzle of the mechanism shown in FIG. 1; and

FIG. 5 is a schematic side elevational view, partially broken away, of a liquid-spraying assembly having three liquid-spraying mechanisms, such as illustrated in FIG. 1, arranged in spaced relationship on a spray boom.

Referring now in detail to the embodiments chosen for the purpose of illustrating the present invention, it being understood that in its broader aspects, the present invention is not limited to the exact details herein depicted, numeral **10** denotes, generally, a cylindrical air motor **10** having a body **11**, an upper bearing housing **12**, and a lower bearing housing **13**. An elongated cylindrical shaft **14** projects from the upper bearing housing **12**, upwardly along the axis of the motor **10**. The shaft **14** is provided with a hollow cylindrical bore **15** which communicated with the hollow interior of motor **10**. The vanes (not shown) of the air motor **10** are driven by air which is introduced through intake port **16** and is discharged through discharge port **17**. The vanes (not shown) in turn, rotate shaft **14** about its axis.

The lower bearing housing **13** of motor **10** threadedly receives a hexagonal cap **18**, the cap **18** being provided with the central bore aligned with the bore **15** of shaft **14**. The cap **18** is internally threaded along its bore and receives the external threads of a sleeve **19** which, in turn, is internally threaded to receive the external threads **20** on the shank **26** of a nozzle, denoted generally by numeral **21** and seen best in FIG. **4**. In more detail, the nozzle **21** is a hollow tubular member having a flared end flange **22**, at the lower end of shank **26** for rotatably retaining a coupling **23** thereon. The coupling **23** is provided with internal threads **24** which receive the external threads of

a coupling on the end of a flexible hose, such as one of the hoses **25**, seen in FIG. **5**. Hoses **25** lead from a source of liquid (not shown). At the opposite end of the shank **26** from the flange **22**, i.e., in the central portion of nozzle **21**, the shank **26** is integrally connected to straight cylindrical nozzle body **27** of smaller diameter than shank **26**, the nozzle body terminating at a discharge end **28**.

When the nozzle **21** is installed in the air motor **10**, as illustrated in FIG. **1**, it is disposed along the axis of motor **10** and shaft **14** so that the lower end portion of the nozzle **21** protrudes below the air motor **10** while the body **27** projects up through the bore **15** of shaft **14**, and projects a short distance above the outer end **29** of the shaft **14**. The diameter of nozzle body **27** is slightly less than the diameter of bore **15** and, therefore, does not interfere with the rotation of shaft **14**. It will also be seen that the nozzle **21** is disposed concentrically within the air motor **10** and its shaft **14**. The nozzle **21** does not rotate, nor does the body **11** or the bearing housings **12** or **13** of the air motor **10**.

Outwardly of housing **12**, the shaft **14** is provided with a collar **30** having a set screw **31** for retaining collar **30** in place on shaft **14**. Outwardly of the collar **30**, on shaft **14**, is a washer **32**.

The function of shaft **14** is to rotate a hollow cylindrical cage slinger or housing, denoted generally by the numeral **33**. This cylindrical slinger includes a disc-shaped or circular inner spin plate **34** and an opposed complimentary disc-shaped or circular top or outer spin plate **35**, which are disposed in spaced relationship, parallel to each other, being held apart by an annular diffusion member **36**. The diffusion member **36** is preferably a perforated web or wire screen which separates the liquid into finely divided form. Member **36** is affixed along its lower periphery to the outer periphery of spin plate **34** by means of braising or the like. The upper periphery of screen **36** is fixed to the outer periphery of an annular ring **37**, the upper surface of annular ring **37** abutting the peripheral lower surface area of the plate **35**. Bolts **38**, passing inwardly through the plate **35**, and into the ring **37**, removably retain plate **35** in place on diffusion member **36**. Thus, plate **35** further functions as an access plate.

Plate **34** is provided with a central hole through which projects shaft **14**, the plate **34** being received on the washer **32**, in abutting relationship. Within the interior of the slinger **33** is the outer washer **40** and the retaining nut **41**. The washer **40** is received over the end portion of shaft **14** and abuts the inner surface of the spin plate **34**. The nut **41** is threadedly received by the external threads at the end portion of the shaft **14**. With the nut **41** tightened, the plate **34** is clamped so as to extend radially from shaft **14** and be rotated upon rotation of shaft **14**.

A U-shaped strap **42** is disposed within the central portion of the slinger **33**, the ends of the arms **43** and **44** of the U-shaped strap being braised or otherwise affixed to diametrically opposed portions of the washer **40**. The upstanding arms **43** and **44** support a transversely extending body portion **45** parallel to and between plates **34** and **35**. The body **45** extends transversely across the axis of the shaft **14** and the axis of the body **27** of nozzle **21**. The body **45** is disposed in spaced relationship beyond the end **28** of nozzle **21**. Therefore, the liquid directed through nozzle **21** is discharged from the end **28** against the body **45** of strap **42**. Thence, the liquid is directed by the body **45** of strap **42** outwardly toward the annular diffusion member **36**.

As will be seen best in FIG. **1**, the plate **34** is provided with a plurality of circumferentially equally spaced impeller or fan blades **46**. These impeller blades **46** extend outwardly and downwardly from the periphery of plate **34**, being secured to the lower surface of plate **46**, by bolts **47** which pass through the bases **48** of the blades **46**. Thus, upon rotation of the plate **34**, the blades **46** will force air upwardly, as viewed in FIG. **1**, passing this air along the outer surface of the diffuser member **36**, and directing the air somewhat conically upwardly and outwardly.

The liquid which is received on the diffuser member **36** passed through the screen and, due to the centrifugal force created on it by being carried in an orbital path by the diffusion member **36**, the liquid, in finely divided form, is flung outwardly into the path of the blast of air created by the impeller blades **46**. Thence, the liquid in droplet or finely divided form is distributed by the conically diverging stream of air outwardly and upwardly so that eventually the droplets fall by gravity onto a relatively large area surrounding the mechanism.

Referring specifically to FIG. **5**, it will be seen that three of the mechanisms illustrated in FIG. **1** may be arranged along a spray boom **100**. While various means may be employed for attaching each of the fluid-dispensing mechanisms to the spray boom **100**, I prefer to use a simple bracket, such as the brackets **101**, which pass around the lower bearing housing **13** of the motor **10**. The straps **101** are retained in place by bolts or screws **102** which pass into the boom **100**. Thus, each of the fluid-dispensing mechanisms is supported with its axis disposed vertically. They are equally spaced from each other and aligned along the length of the boom **100**. An air hose **102** leads from a source of compressed air to the first of a series of the mechanisms, being connected to its port **16**. A flexible air hose **103** leads from the discharge port **17** via a cutoff valve **104** to the part **16** of the next adjacent mechanism. An air hose **105** leads through a valve **106** to the port **16** of the next subsequent air motor **10**. Thus, it is seen that the air motors **10** of the adjacent mechanisms are connected in series. By such an arrangement, quite efficient use of the compressed air is made in driving all of the air motors **10**. Also, any one or several of the air motors may be shut off by closing the valve **104** or **106**. It will be understood, of course, that when valve **104** or valve **106** is closed, it is open to atmosphere to permit the upstream air to discharge.

As is customary, the hoses **25** lead to a source of liquid (not shown).

From the foregoing description, the operation of the present device should be apparent. In operation, liquid is introduced through hose **25** into nozzle **21** and thence out of end **28** and against body **45**. The body **45** of strap **42** acts as a primary diffuser or deflector which directs the liquid outwardly as the cage or diffusion member **33** is rotated about its axis by motor **10** and shaft **14**.

When the liquid strikes the screen diffusion member **36**, it is carried with the members **36** in an orbital path whereby the centrifugal force urges the liquid through the member **36** and causes it to be flung outwardly in droplet form into the air blast created by the impeller blades **46** which are rotated with the slinger **33**.

If a screen is used for the diffusion member **36**, the liquid dispensed by the mechanisms heretofore described can have a particle size of from approximately 10 microns to approximately 50 microns, depending on the size of screen **36**, which is employed, and depending upon the speed of rotation of the screen **36**. Furthermore, the present mechanism is particularly suited for dispensing ultra-low volumes of fluid, for example, one-half gallon or less per acre.

Using the equipment of the present invention, as little as 8 ounces per acre may be evenly distributed. Also, the device of the present invention is suitable for applying conventional rates of fluid, such as 2 gallons per acre.

It will be understood by those skilled in the art that many various types of liquids may be dispensed utilizing the equipment of the present invention. Pesticide in liquid form is particularly suited for being dispensed with the present mechanism. Such pesticides are conventionally applied in dilute form in combination with various nonphytotoxic agricultural diluents, or carriers, in most cases, water. With the present invention, it is feasible to reduce the amount of diluent or carrier or, to do away with this carrier for most pesticide materials and discharge such materials in a concentrated form.

The present invention is also particularly suited for discharging slurries, as well as true solutions, since no small nozzles and high velocities of discharge are involved except insofar as the rotating screen slinger **36** is involved.

In the preferred embodiment of the present invention, the discs **34** and **35** are preferably 4½inches in diameter. The height of the member **36**, i.e., the distance between plates **34** and **35**, is approximately 3 inches. The member **36** is preferably a 40 mesh screen.

It will be obvious to those skilled in the art that many variations may be made in the embodiments here chosen for the purpose of illustrating the present invention without departing from the scope thereof, as defined by the appended claims.

I claim:

1. A liquid diffusion-spraying head comprising, an endless diffusion member, said diffusion member having a plurality of perforations therein for separating into finely divided form liquid passing therethrough, means for rotatably supporting said diffusion member, impellar means for producing a uniform blast of air axially in one direction along the outside surface of said diffusion member, and means for introducing a liquid into and against the inside surface of said diffusion member, said introducing means including means for passing said liquid along a path coaxial to the axis of rotation of said diffusion member and in said one direction.

2. The structure defined in claim **1** wherein said diffusion member is an annular screen.

3. The structure defined in claim **1** wherein said diffusion member is an annular perforated sheet, the surface of which is disposed axially with respect to said motor.

4. The structure defined in claim **1** wherein said means for introducing liquid against the interior surface of said diffusion member includes a nozzle passing axially through and into said diffusion member for directing liquid centrally of screen.

5. The structure defined in claim **1** wherein said impeller means directs a flow of air over the outer surface of said diffusion member for progressively entraining the finely divided liquid in the flow of air and for directing the entrained liquid axially away from said diffusion member.

6. The structure defined in claim **1** wherein said diffusion member includes a pair of spaced opposed parallel circular spin plates and an annular screen extending between the peripheries of said plates, one of said plates being provided with a hole through which said liquid is introduced into the interior within said plates and said diffusion member.

7. In a liquid diffusion-spraying means as defined in claim **1** further characterized in that said spraying means includes a boom-supporting structure, supporting a plurality of spraying heads in spaced-apart relationship.

8. The structure defined in claim **1** wherein said means for directing liquid against said diffusion member includes a nozzle projecting axially into said diffusion member.

9. The structure defined in claim **1** wherein said means for directing liquid against said diffusion member includes a nozzle projecting axially through said motor and terminating within the central portion of said diffusion member.

10. The structure defined in claim **1** wherein said impeller means is rotatable and mounted coaxially with said diffusion member.

11. In a liquid diffusion-spraying means as defined in claim **1** wherein said means for rotatably supporting said diffusion member comprises a support having a motor supported thereon and wherein said diffusion member is rotatably carried by said motor.

12. The structure defined in claim **11** wherein said motor includes a shaft for moving said diffusion member about its axis and said diffusion member including a spin plate mounted radially on said shaft for rotation therewith and wherein said diffusion member is a continuous screen extending axially from and carried by said spin plate adjacent the periphery of said spin plate and against which said liquid is directed.

13. The structure defined in claim **12** wherein said impeller means including a plurality of impeller blades mounted on said spin plate and extending outwardly beyond said screen for creating a flow of air directly over the outer periphery of said screen upon rotation of said spin plate.

14. A liquid diffusion-spraying mechanism including a slinger having a pair of spaced opposed parallel circular inner and outer spin plates radially disposed with respect to an axis, an annular screen concentrically disposed with respect to said axis and an annular ring, said screen being secured to the periphery of said inner spin plate and the periphery of said ring, said outer spin plate being removably secured to the outer surface of said ring, said inner spin plate being provided with a central hole, a motor, a shaft on said motor disposed along said axis and fixed to said inner spin plate for rotating said inner spin plate, said outer spin plate, said ring and said screen about said axis, a nozzle projecting through said shaft and terminating within the central portion of said slinger and means communicating with said nozzle for introducing liquid into said nozzle and thence into the interior of said slinger.

15. The structure defined in claim **14** including a liquid deflector strap in the interior of said slinger, said strap having a body portion extending approximately parallel to said plates and disposed therebetween, said strap having a portion thereof in a position to be struck by liquid directed by said nozzle into the interior of said slinger.

16. A method of spraying liquid comprising the steps of; rotating an annular perforated diffusion member, passing air axially in one direction along the outer surface of said diffusion member, directing fluid to be sprayed in said one direction and along a path coaxial to the axis of rotation of said diffusion member, and altering the direction of travel of said liquid within said diffusion member such that said liquid will be imparted by centrifugal force outwardly through openings in said perforated diffusion member and into the air stream moving axially over the surface of said diffusion member.

17. The structure defined in claim **11** wherein said motor is a fluid motor coaxially mounted with respect to said diffuser.