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Stewart

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[54] **SPRAYING NOZZLE**

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[52] **U.S. Cl.** **239/463;** 239/468; 239/599

[51] **Int. Cl.²** **B05B 1/34;** B05B 1/00

[58] **Field of Search** 239/463, 468, 469, 470, 239/597, 598, 399, 405, 1, 8, 142

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[57] **ABSTRACT**

A spray nozzle for e.g. urethane resins providing a fan-shaped spray pattern and method for the use thereof including fluid inlet means, fluid outlet means, a chamber for pressurizing the fluid and pressurizing gas inlet means tangential to the circular cross-section of the chamber.

10 Claims, 7 Drawing Figures

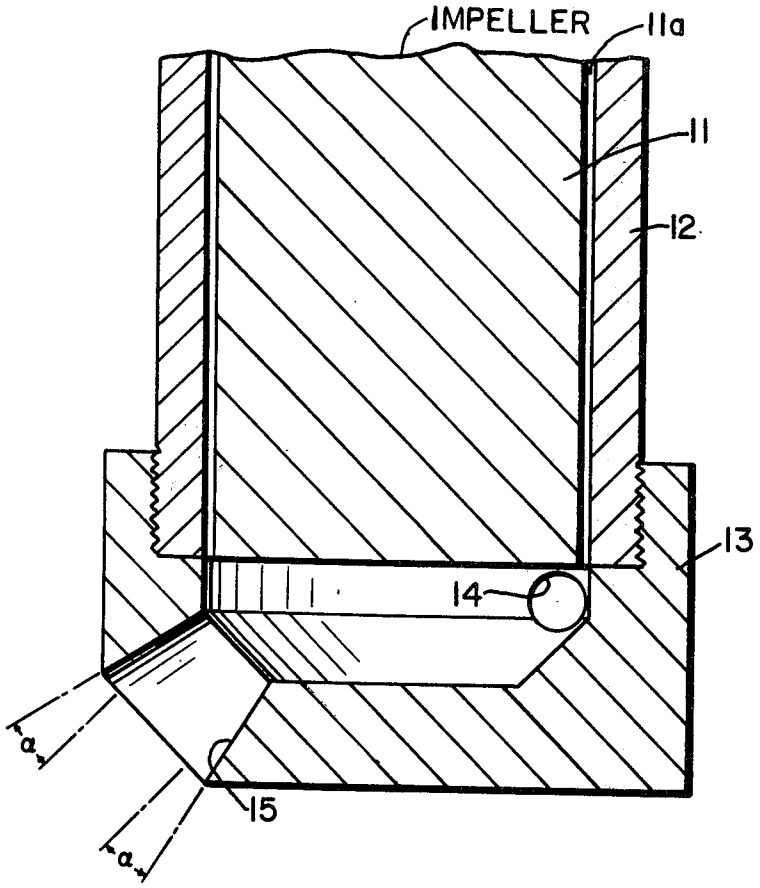


FIG. 1

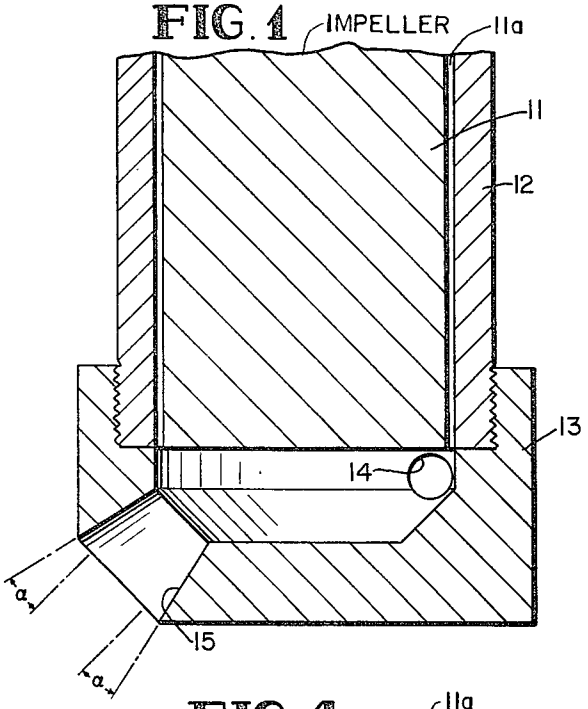
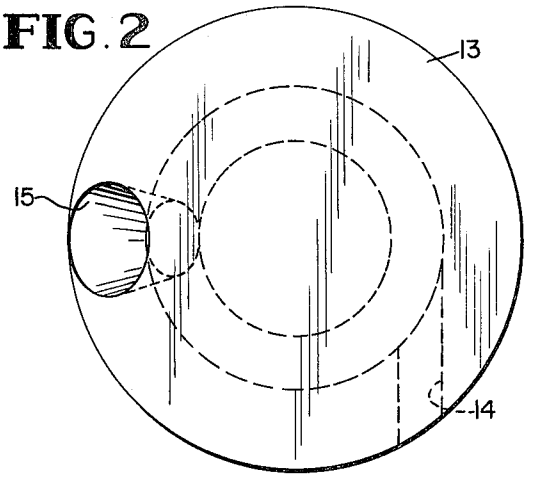


FIG. 2



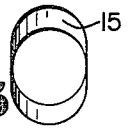


FIG. 3

FIG. 4

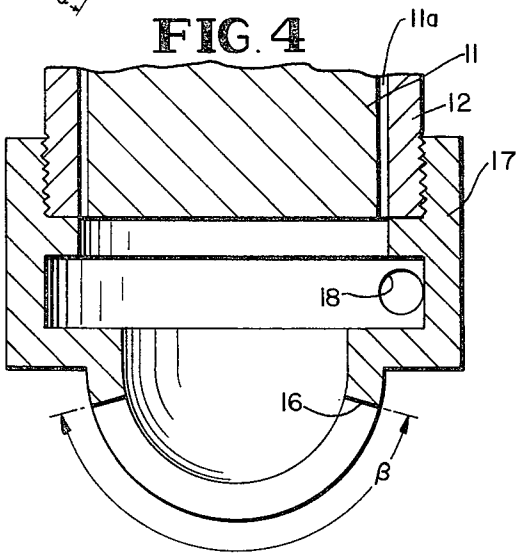


FIG. 6

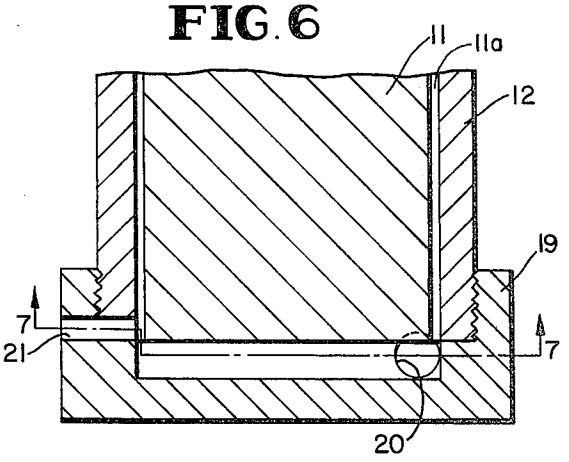


FIG. 5

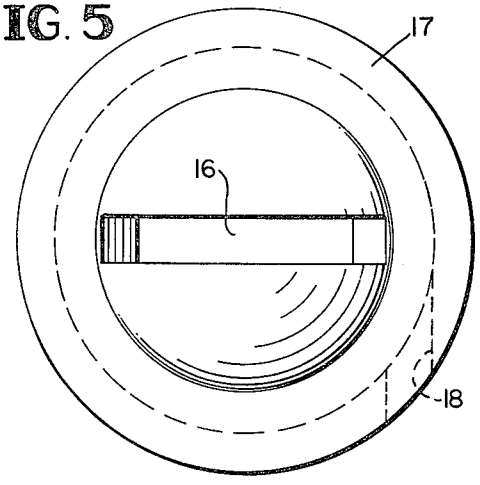
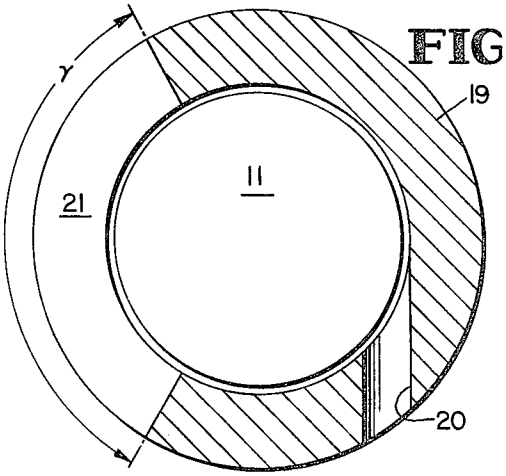


FIG. 7



SPRAYING NOZZLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to pressurized fluid spray nozzles wherein the pressure for the fluid is provided at the nozzle. More particularly, the present invention is directed to a spray nozzle and a method for using same which is particularly adapted to provide a fan-shaped spray pattern for coating with urethanes. The fan-shaped spray pattern is provided by the inclusion of tangential pressurizing gas feed to a chamber containing the fluid to be sprayed.

2. Description of the Prior Art

While many different orifice and feed designs for spray nozzles of many different characteristics have been disclosed, uniform spray in a fan-like design is not usually provided. That is, in much of the prior art, oval or circular spray patterns are provided. However, when it is desired to coat in an even manner with (preferably) a single pass over a surface, an ellipsoidal or circular pattern would provide for a concentration of the spray material along the central area. The present invention is directed to a means of overcoming this particular problem while utilizing a single nozzle.

Particularly, a very even coating is necessary when trying to provide e.g. even urethane coatings on surfaces such as wallboard, tiles, etc. Additionally, nozzles utilized to spray polymers often have a tendency to become clogged during spraying e.g. due to solidification of the heated resin or setting of the mixture of resin and cross-linking agent. One method of overcoming these particular problems has been to utilize calendering rollers which permit almost-even thickness layers or coatings. However, these particular operations have proved very difficult to control. A further possibility in this area is to calender a rising foam, but again sufficient control of thickness variations is very difficult and such a system would require tremendous expense for very large equipment. Finally, some urethane foam formulations have been provided which do spread very evenly in a cavity. However, these foams have the disadvantage of usually being deficient in dimensional stability. Thus there is a need in the art to provide a means for coating a surface with a very consistent, even thickness of a fluidized material.

This need is even more important in the areas of the use of the urethane foams as noted above since urethane foams are often provided with very thin coatings. Thus, variations therein are much more significant.

The present invention overcomes many of the above problems and provides a uniform, thin fan-shaped spray pattern. The spray thickness is only about 1 or 2 inches, depending on gas volume and it is very uniform. Such characteristics have not been achieved except in hydraulic pressure spray units, while the present invention allows an air atomized spray with the even-spray unit.

SUMMARY OF THE INVENTION

The present invention is directed to providing an apparatus and means for spraying urethane foams in a substantially flat, fan-like pattern which would provide very even coating of a substrate. This is accomplished by utilizing a spray nozzle having a mixing chamber for the urethane material, spray outlet means and pressurized gas inlet means which provides the means for the spray. By the provision of a circular cross-section mixing chamber having the pressurized gas inlet means positioned so that the pressurized gas enters the chamber tangentially thereto, it is possible to provide the fan-like outlet of the urethane mixture under pressure which allows for the coating of the substrate with a smooth and even surface.

Thus it is an object of the present invention to provide a spray nozzle having a spray pattern which is fan-like in shape and results in an even surface coating of a substrate.

A second object is the provision of a nozzle that is useful in spraying resins which have a tendency to clog the nozzle.

It is another object of the present invention to provide a urethane spray apparatus with tangential pressurizing gas inlet means.

It is an additional object of the present invention to provide a method of coating with a spray nozzle utilizing pressurized gases to provide a consistently even distribution of the sprayed fluid.

DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 show side and end views, respectively, of a nozzle in accord with the present invention.

FIG. 3 is an end view of the discharge orifice of the nozzle shown in FIG. 1.

FIGS. 4 and 5, respectively, show a side view in section and an end view of a second nozzle in accord with the present invention.

FIG. 6 and FIG. 7 show sectional side and end views of a third nozzle in accord with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the nozzles shown in FIGS. 1–3, mixing impeller 11 is provided in spray chamber housing 12 and is utilized to mix the fluent material to be sprayed from discharge orifice 15. The source of the material is, however, not shown. Mixed fluent material passes through annular space 11*a*, located between impeller 11 and housing 12. The spray cap 13 has discharge orifice 15 provided therein and tangential gas inlet 14 also. As shown in FIGS. 1 and 2, orifice 15 is directed at an angle away from chamber 12. As can be more easily seen in FIG. 2, the lower end of mixing chamber 12 is formed by spray cap 13 and is substantially circular in cross-section. Tangential gas inlet 14 provided in spray cap 13 produces a swirling motion in the pressurized gas which is preferably air (but may be any other suitable material), within the circular section of the mixing chamber. In this manner, a substantially fan-shaped discharge of the material sprayed (which in accord with the present invention may be any fluent material, but is preferably a urethane or urethane foam material) through discharge orifice 15. At the beginning of discharge orifice 15, as best shown in FIGS. 1 and 3, the orifice is circular in nature. However, at the outlet end thereof, the orifice is more ellipsoidal in nature. Preferably this ellipsoidal variation is produced by providing a 15° angle and the orifice (as indicated by alpha (α) in FIG. 1); however, this angle may vary from about 5° to 90°.

When the nozzle of FIGS. 1–3 is utilized, it is preferred that the ellipsoidal opening have an inner diameter of 0.5 inch at most, and an outer long diameter of about 0.75 inch; however, other sizes may be utilized

if desired. Additionally, the angle of impingement of the spray with the surface to be coated should be from about **30°** to about **60°**, preferably about **45°**.

In all of the nozzles of the present invention, the direction of introduction of the tangential pressurizing fluid supply should be the same as the direction of rotation of impeller **11**.

In the second embodiment disclosed in FIGS. **4** and **5**, the same mixing impeller **11**, mixing chamber housing **12** and circular cross-section mixing chamber are provided. However, in this embodiment, the spray orifice is provided by a hemispherical protrusion in spray cap **17** which, as in FIGS. **1–3**, also has tangential gas inlet **18'** required by the present invention. This second spray cap has a discharge slot **16** provided in the hemispherical section thereon which slot is from about **100°–180°** as indicated by angle beta (β), but is preferably about **150°**. This embodiment of the present invention provides a smoother, more even coating of a substrate when sprayed in accord with the method of the present invention.

FIGS. **6** and **7** again utilize mixing impeller **11**, mixing chamber housing **12** and a mixing chamber having a circular cross-section and spray cap **19**. In this case, spray cap **19** is provided with the same style tangential air or gas inlet **20** but discharge orifice **21** is provided above the tangential gas inlet and sprays the preferred urethane of the present invention at an angle perpendicular to the general direction of the nozzle chamber. In this spray system, angle gamma (γ) may vary dependent upon the factors such as the material to be sprayed, but is preferably from about **90°** to **150°** and most preferably **120°**.

As will be recognized by those skilled in the art, the angles used in the present nozzles may vary depending upon the distance between the nozzle and the unit to be coated and the width of the unit. For example, using a spray angle of **160°** and a distance of **14** inches between the nozzle and unit, a fan width of **54** inches is possible with high air volume, a width of **48** inches with moderate air volume and a width of **44** inches with low air volume. Thus, the actual angles used in the nozzles will vary with application, although we have noted the best known angles above since gravity, viscosity, etc. have an effect on the spray.

In the operation of the nozzles of the present invention, the components of the material are fed through the mixing chamber at the predetermined rate and mixed by the impeller. During operation, pressurized gas (preferably air or some other material which is inert in the present environment) is fed through tangential inlet **14, 18** or **20** to pressurize the material in the chamber, and force its discharge through the orifice. The pressurized discharge of the mixed material including the air is thus effected in a substantially fan-shaped pattern which provides for very even coating of a substrate with a single pass.

This tangential injection of air is most important to the present invention. The fan-like spray out of the nozzles of the present invention is provided, among other things, by subjecting all of the fluid in the nozzle to the same amount of drag. To ensure this, the wall thickness in the nozzle is the same for the entire length of the slot or passage for the fluid. Also, the introduction of the air or other gas into the annular ring of fluid at the atomizing end of the slot ensures even and complete atomizing around the full surface. The resulting circular or swirling motion in the atomizing area produces good dispersion of the liquids into small drops, and thus, the more uniform spray of the present invention results. Therefore, the nozzles of the present invention are particularly adapted to use in spray coating with high viscosity, high surface tension formulations and especially when such formulations are to be sprayed over wide surfaces.

The nozzles may be used in systems where there is relative movement between the work piece and the nozzle by either moving the nozzle or using a fixed nozzle and a conveyor. In both cases, the nozzle should spray perpendicular to the direction of this travel but it can be adjusted in the third axial direction by swinging the direction of spray along the fan pattern so that centered, right or left fan patterns are obtained. In this manner, the nozzle may be positioned anywhere over the work piece, depending on e.g. physical limitations and adjusted to spray from vertical to the left or right or to both sides.

The materials which may be sprayed in accordance with the process of the present invention include (but are not limited to) polyurethane resins and foams (including isocyanates and isocyanurates, as well as polyepoxides, polyepoxide foams and silicone resins). Additionally, the air atomization of the present invention can be used on materials that can be hydraulically sprayed only up to a certain point. These include oil and water based paints, insecticides, fungicides, herbicides, and even de-icing and chemical antifogging agents. However, polyurethanes are the preferred materials. The material feed rate varies with the size of the nozzle as well as the consistency of the material. For conventional system sizes, i.e. where the nozzle of the present invention is sized in accord with conventional practice, exemplary nozzle sizes include slot widths varying from about **1/16** to **¾** inch. With this size limit, flow rates of from about **0.5** to **300** lb/min, preferably **20** to **60** lb/min. are useful. The pressurizing gas is provided at pressures determined e.g. by the desired flow rates but is usually from about **5** to **100** psig, preferably about **20** to about **30** psig.

Thus it can be seen that the apparatus and method of the present invention provide for even coating of the substrate and particularly for even coating of urethane materials on substrates without significant variations in the thickness of the coating. The structures of the presently disclosed nozzles may be varied within the scope of the above disclosure and obvious improvements thereof may be made without being outside of the scope of the present invention.

What is claimed:

1. A fluid spray nozzle comprising:

a. spray fluid inlet means;

b. pressurized gas inlet means;

c. a chamber for receiving spray fluid from said spray fluid inlet means and pressurized gas from said pressurized gas inlet means; and

d. fluid outlet spray means having an unimpeded open channel connected to said chamber and directed at an angle away from the chamber, said spray means including an outlet orifice having a circular opening at one end thereof and an ellipsoidal opening at the other end thereof.

2. A fluid spray nozzle, as set forth in claim **1**, wherein said circular opening connects with said cham-

ber and said ellipsoidal opening connects with the atmosphere.

3. A fluid spray nozzle, as set forth in claim **1**, wherein said chamber is circular in cross-section and said gas inlet means is tangential to said circular cross-section.

4. A fluid spray nozzle comprising:

a. spray fluid inlet means,

b. pressurized gas inlet means,

c. a chamber for receiving spray fluid from said spray fluid inlet means and pressurized gas from said pressurized gas inlet means, said chamber having walls defining a right circular cylinder, and

d. fluid outlet spray means having an unimpeded open channel connected to said chamber and including a slot in said chamber walls lying in a plane which is perpendicular to the axis of said right circular cylinder.

5. A fluid spray nozzle as set forth in claim **4** wherein said slot extends over an arc between **90°** and **150°**.

6. A fluid spray nozzle comprising:

a. spray fluid inlet means,

b. pressurized gas inlet means,

c. a chamber for receiving spray fluid from said spray fluid inlet means and pressurized gas from said pressurised gas inlet means,

d. a rotatable mixing impeller in said chamber and positioned in the path of said spray fluid for mixing said spray fluid with said pressurized gas, and

e. fluid outlet spray means connected to said chamber for dispersing said mixture to the atmosphere.

7. A fluid spray nozzle, as set forth in claim **6**, wherein said chamber is circular in cross-section and said gas inlet means is tangential to said circular cross-section and provides gas flow in the direction of rotation of said impeller.

8. The nozzle of claim **1** wherein the walls of said outlet orifice are at an angle of about **15°** from the axis of a cylinder described by said circular beginning of said outlet orifice.

9. The nozzle of claim **3** wherein the diameter of the cross-section of said chamber adjacent said tangential inlet means is greater than the diameter of the remainder of said chamber.

10. In a fluid spray nozzle including spray fluid inlet means, a chamber, fluid outlet spray means, pressuring gas means, a rotatable impeller for said spray fluid and pressurizing gas inlet means providing gas flow in the direction of rotation of said impeller, the improvement wherein said chamber is circular in cross-section and said inlet means is tangential to the circular cross-section.

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