March 28, 1939. E. GUSTAFSSON ET AL 2,152,046

AIR NOZZLE FOR FLAT SPRAYING APPLIANCES

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Fig. 1.

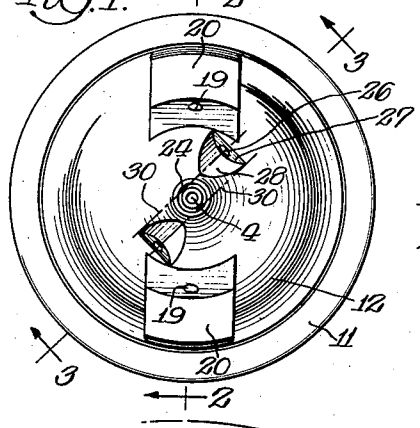


Fig. 2.

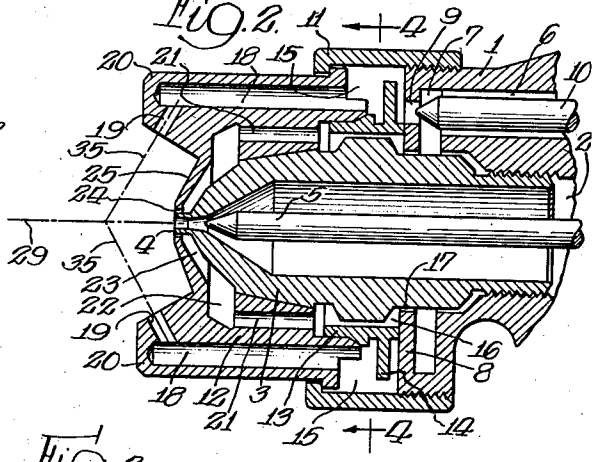


Fig. 3.

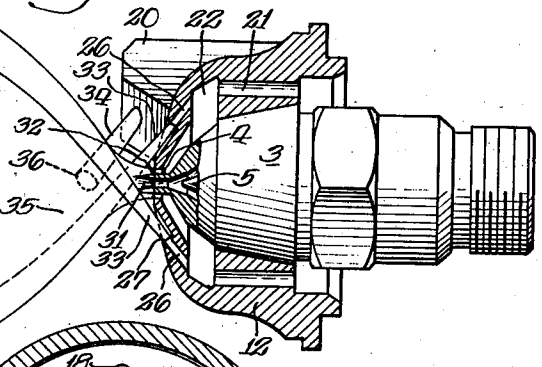


Fig. 4.

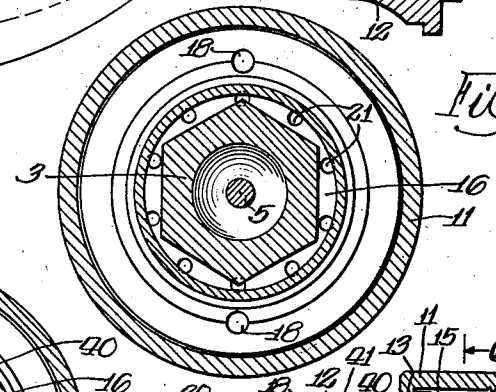


Fig. 6.

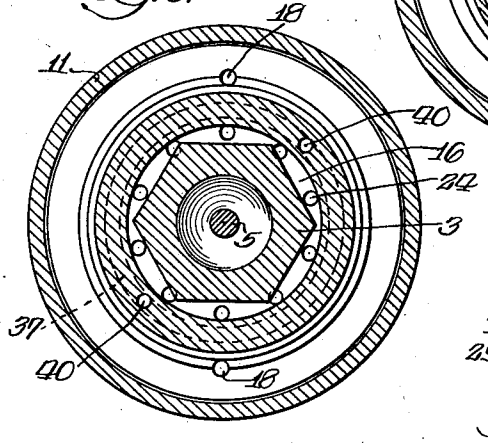
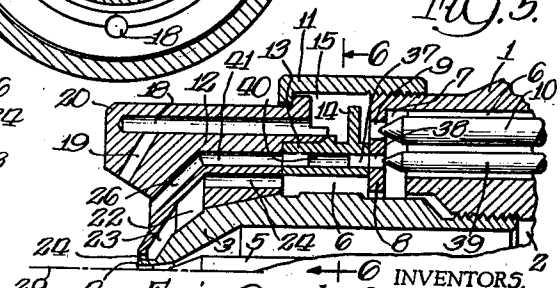


Fig. 5.



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Fig. 7.

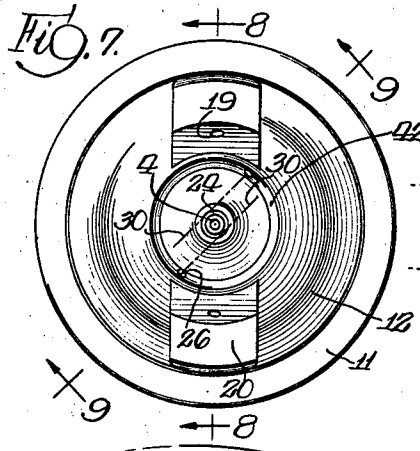


Fig. 8.

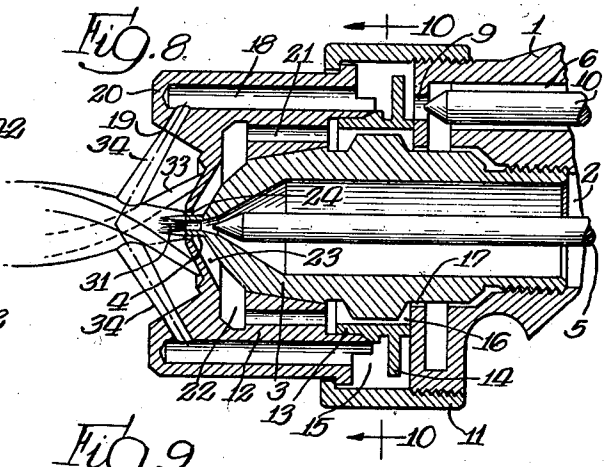


Fig. 9.

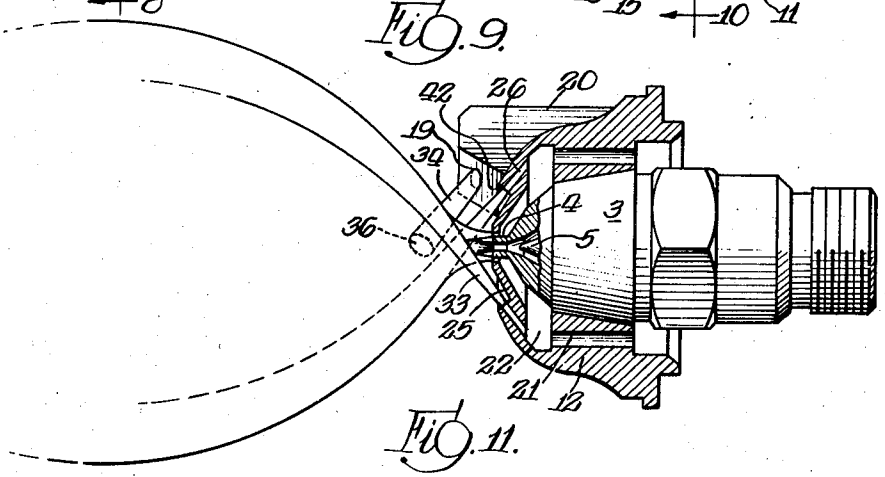


Fig. 11.

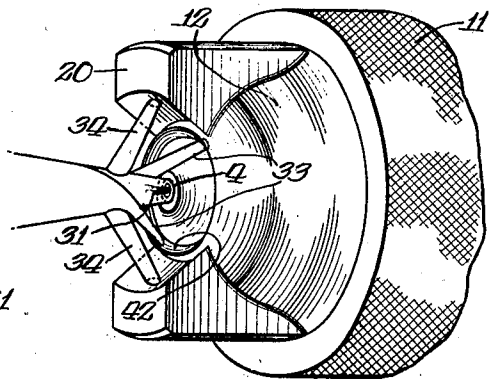
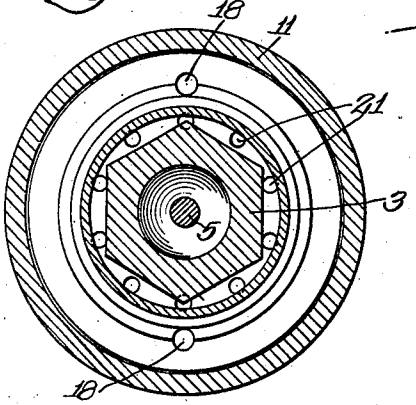


Fig. 10.



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Fig. 12.

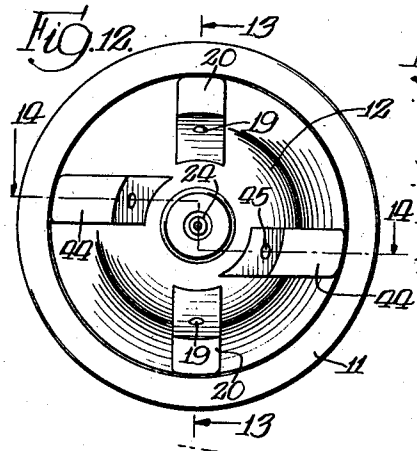


Fig. 13.

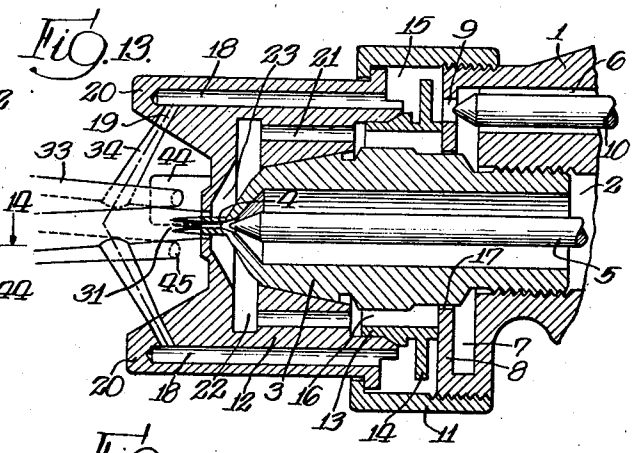


Fig. 14.

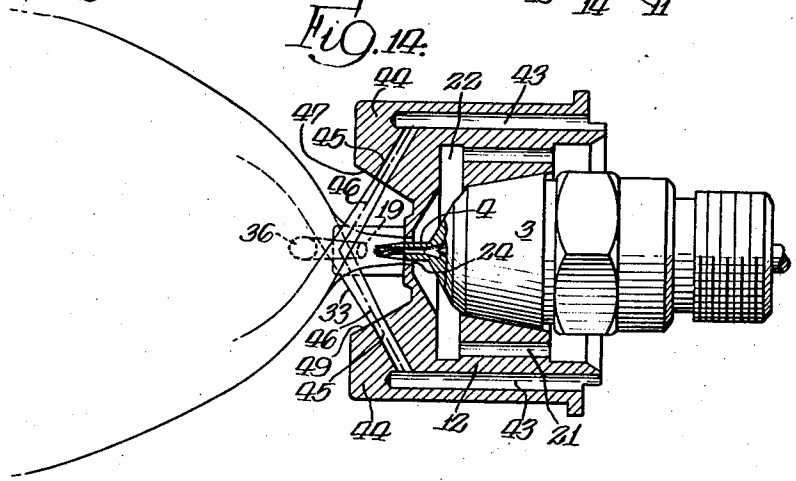
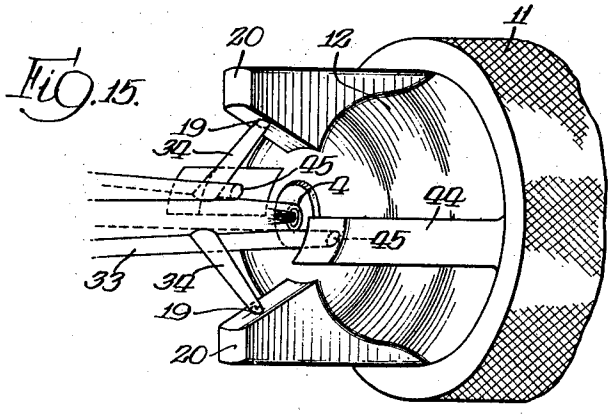


Fig. 15.



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Fig. 16.

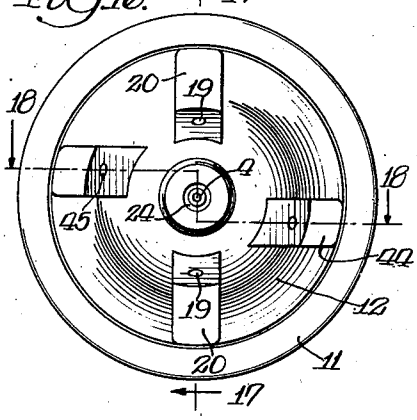


Fig. 17.

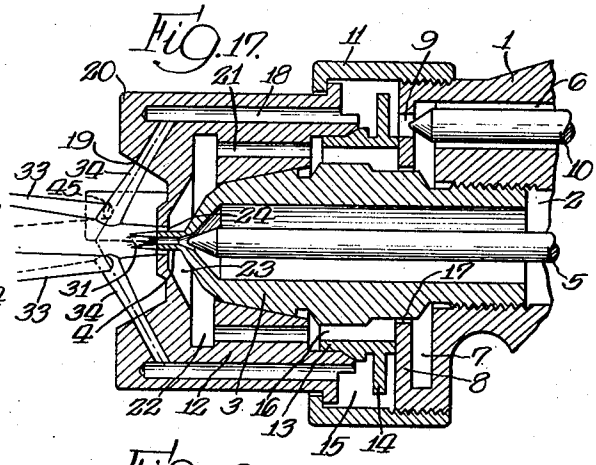


Fig. 18.

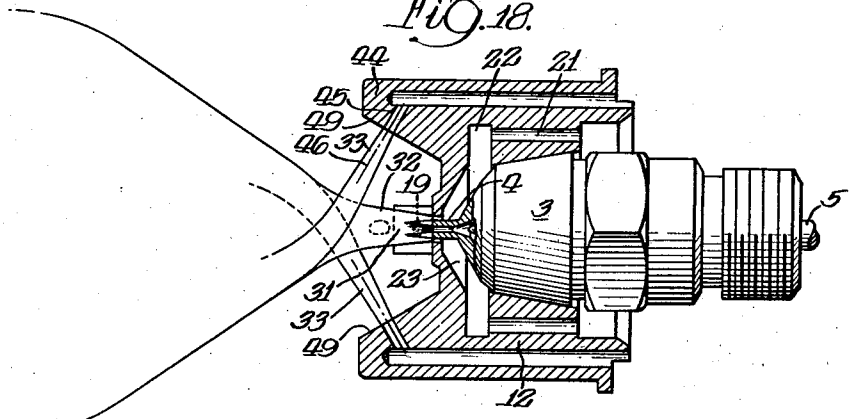
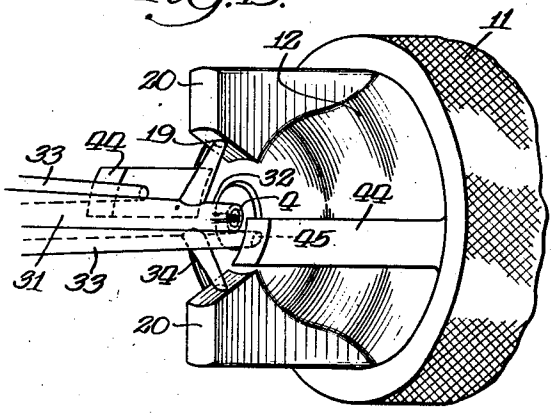


Fig. 19.



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UNITED STATES PATENT OFFICE

2,152,046

AIR NOZZLE FOR FLAT SPRAYING APPLIANCES

Eric Gustafsson and Harold L. Striegel, Chicago, Ill., assignors to Binks Manufacturing Company, Chicago, Ill., a corporation of Delaware

Application April 4, 1938, Serial No. 199,749

11 Claims. (Cl. 299—140.1)

The present invention relates to spraying devices; more particularly to the type for applying coating material, and especially to the type of devices wherein the liquid material stream is flattened by opposed fluid jets acting on the projected liquid stream.

As disclosed in the U. S. Patent No. 2,049,700, issued August 4, 1936, to Eric Gustafsson, for Air nozzle for flat spraying appliances, besides the use of the usual side jets for flattening the material stream (usually partly aerated) into the form of a fan-shaped spray with an elongated, substantially rectangular pattern (cross section), is shown the use of auxiliary air jets for controlling or maintaining the uniformity and clear definition of the pattern and preventing the forming of "off spray" or "straying" of the liquid particles, the auxiliary jets being projected in the plane of the fan-shaped spray and against the edges of the flattened spray at the shoulders thereof.

Large users of spray guns of this kind require that the spraying time be reduced as much as possible for spray coating of a given surface area, particularly when spraying quantity production articles, such as automobile bodies, railway car bodies, refrigerator cabinets, etc. This usually involves an increased rate of spraying and a handling of a greater quantity of coating material per unit of time with usually a greater consumption of compressed air. Varying the capacity of the gun, accordingly, has a tendency to distort the uniformity and well defined contour of the pattern. It is, therefore, an object of the present invention to provide a novel nozzle for a spraying appliance which will spray the material with a low range of pressures, both for the material itself and for the flattening medium, usually air under pressure, and with a wider fan-shaped flat spray whereby a wider coating for a given unit of time will result, while at the same time still maintaining the desired uniformity of the spray pattern on the surface being coated. Accordingly, the device of the present invention comprises the use of auxiliary fluid (air) jet means which will act to project air jets forwardly and convergently in separate spaced parallel planes, which are spaced from and parallel to the axis of the material stream. The planes of these auxiliary air jets are preferably at an angle to the plane of the flattened spray, or, expressed in another way, at an angle to the plane of the flattening jets. It has been found by experimentation that when the angular relation is at about 45° the more desirable result is obtained. However, this angular relation may be varied from zero degrees, that is, parallel to the plane of the flattened spray, to about 55°, or expressed with reference to the plane of the flattening jets and the central axis of the material stream, from 35° to 90°. Beyond this angle, the effect is not as satisfactory as would be desired.

The auxiliary air jets are projected forwardly along convergent axes at, preferably, an angle of from 50° to 60° to the central axis of the material stream, and the locations of the jet orifices or ports are such as to direct the auxiliary air jets to join with or impact the material stream either rearwardly or forwardly of the points or loci of joining or impacting of the side air jets for flattening the stream, it being preferred, however, to have the impact of the auxiliary jets take effect rearwardly of the points or loci of impact of the flattening jets, in which case the auxiliary jets give the material stream a preliminary flattening effect, while the main air jets complete the flattening effect to the desired uniform pattern. The main air jets also act to counteract any twisting effect which the auxiliary air jets would tend to produce because of the tangential or secantal relation of the auxiliary jets to the material stream. The points or loci of emission of the auxiliary jets may be radially inwardly or radially outwardly of the points or loci of emission of the main or flattening jets, and also such points of emission of the auxiliary jets may be rearwardly or forwardly of the points of emission of the flattening jets. The resultant of the flattening and twisting effects is a uniform and symmetrical pattern, with the advantage of a greatly increased width of the flattened spray, a much improved atomization of the material, a more uniform distribution of the particles whereby there is the same intensity throughout the pattern, and a clear and well defined border or edge contour of the pattern.

The invention also comprehends means for separately or independently controlling the air to the auxiliary air jet means, as desired, but is not limited thereto.

Other objects, advantages, capabilities, features and the like are comprehended by the invention, as will later appear and as are inherently possessed by the invention.

Referring to the drawings:

Fig. 1 is a front elevational view of one form of spray nozzle constructed in accordance with the invention;

Fig. 2 is a longitudinal section of the nozzle end of the spraying device and taken in a plane

represented by line 2—2 of Fig. 1 of the drawings;

Fig. 3 is a similar sectional view taken in a plane represented by line 3—3 of Fig. 1 of the drawings;

Fig. 4 is a transverse sectional view taken in a plane represented by line 4—4 in Fig. 2 of the drawings;

Fig. 5 is a fragmentary longitudinal sectional view of an alternative form showing the separate control for the air to the auxiliary air jet means;

Fig. 6 is a transverse sectional view of the structure shown in Fig. 5 and taken in a plane represented by line 6—6 of Fig. 5 of the drawings;

Fig. 7 is a front elevational view of another form of spray nozzle constructed in accordance with the invention;

Fig. 8 is a longitudinal sectional view taken in planes represented by lines 8—9—9—8 of Fig. 7 of the drawings;

Fig. 9 is a similar view taken in planes represented by line 9—9 of Fig. 7 of the drawings;

Fig. 10 is a transverse sectional view taken in a plane represented by line 10—10 of Fig. 8 of the drawings;

Fig. 11 is a perspective forward end view of the nozzle showing the paths of the material and air streams and of the main and auxiliary air jets.

Fig. 12 is a front elevational view of a further form of spraying device constructed in accordance with the invention.

Fig. 13 is a longitudinal sectional view of the same and taken in a plane represented by line 13—13 of Fig. 12 of the drawings;

Fig. 14 is a similar view taken in planes represented by line 14—14 in Fig. 12 of the drawings;

Fig. 15 is a perspective view of the forward portion of the nozzle showing the paths of the material and air streams and of the main and auxiliary air jets;

Fig. 16 is a front elevational view of a still further form of the device constructed in accordance with the invention.

Fig. 17 is a longitudinal sectional view thereof and taken in a plane represented by line 17—17 of Fig. 16 of the drawings;

Fig. 18 is a similar view taken in planes represented by line 18—18 in Fig. 16 of the drawings; and

Fig. 19 is a perspective view of the forward portion of the same showing the paths of the material and air streams and of the main and auxiliary air jets.

Referring in more detail to the drawings, the embodiments chosen to illustrate the invention are shown as comprising a spray gun body 1 having a central bore 2 for the passage of the coating material, such as paint or the like, to the forward end of which is secured a material nozzle 3 having a material tip 4 which is preferably of cylindrical form, the orifice or port of this tip being controlled by a needle valve 5. The body 1 also has an air passage 6 leading to an air chamber 7 located rearwardly of the front end wall 8 in which is provided an air port 9 controlled by an air valve 10. To the forward end of the body is connected a coupling ring 11 for holding an air nozzle 12 seated upon the forward tapered end portion of the material nozzle 3, and for holding a spacer or baffle ring 13 between the front wall 8 and the rear end of the air nozzle 12, the ring 13 having a baffling flange 14 extending in an annular air chamber 15, and being spaced around the body of the material nozzle 3 to provide an annular air chamber 16 communicating with the air chamber 7 by an annular passage 17.

The air nozzle 12 is provided with air passages 18 leading from the chamber 15 and communicating with forwardly directed convergent main air jet ports or orifices 19 in the horns 20. The air nozzle 12 also has a series of air passages 21 leading from the chamber 16 to an annular air chamber 22 which communicates with a conical air chamber 23 terminating in an annular air orifice 24 around the material tip 4 and which orifice is provided in the front wall 25 of the air nozzle 12.

The invention comprehends the provision in the front wall 25 of the air nozzle of forwardly converging auxiliary air jet ports or orifices 26 leading from the air chamber 22, these ports opening into the inclined faces 27 (see Figs. 1 and 3) made by milling, with an end milling tool, recesses 28 in the front wall 25 of the air nozzle and axially of the ports 26 at an angle of about 50° with the central axis 29 of the device, that is, of the tip 4, the axes of the ports 26 being designated by the reference character 30 in Fig. 1 of the drawings. The axes 30 are disposed in planes which are spaced from each other and which are parallel to and spaced from the central axis 29 of the device, so that the air jets projected from the orifices or ports 26 will unite with or impact the material stream tangentially or substantially so, the planes of the axes 30 being substantially in alinement with diametrically opposite portions of the annular air orifice 24 (see Fig. 1).

In operation the material stream 31 (see Fig. 3) issues from the tip 4 in a slightly divergent, more or less solid, round stream, with an annular stream 32 of air around it and issuing from the annular air orifice 24, the liquid or material stream becoming partly aerated by the surrounding stream 32. Air jets 33 are projected from the ports 26 along the axes 30 and unite with or impact the material and air stream 31—32 to give it a preliminary flattening with a tendency to give it a twist around the axis 29 of the material stream. At the same time air jets 34 are directed from the orifices 19 along the axes 35 to unite with or impact the material and air streams 31—32 at the spots or loci 36 to effect a flattening of the spray and to counteract the twisting tendency of the jets 33, with the result of obtaining a wide fan-shaped, flat spray in a plane at substantially right angles to the plane of the axes 35 of the main air jets 34.

Operating spray guns of this type at the increased capacity mentioned above and without the auxiliary jets described, there would be a distortion of the spray pattern so that the sides of the pattern instead of being straight and parallel would be bowed and frayed. By the use of the auxiliary jets of this invention, the pattern is maintained uniform and with the sides straight and clearly defined in outline, and a low range of pressures may be used while at the same time obtaining a much wider spray to cover more space per unit of time.

It will be noted in the form of device shown in Figs. 1 to 4, inclusive, the auxiliary jets 33 are projected to unite with or impact the material and air streams at loci rearwardly of the loci of uniting or impacting of the main air jets 34 with the material and air streams 31—32.

In the alternative form shown in Figs. 5 and 6, the spacer ring 13 has an annular air chamber 37 communicating with a second air port 38 provided in the front wall 8, which port is controlled by a second air valve 39 in the air chamber 6 of the body 1. The ring 13 has air passages 40 leading from the chamber 37 and communicating with air passages 41 provided in the air nozzle 12, independently of the air passages 21, and communicating with the auxiliary air jet orifices or ports 26. In this way the air to the auxiliary jet orifices may be separately and independently controlled for the effects desired to be produced.

In the form of device shown in Figs. 7 to 11, inclusive, the structure is identical with that shown in Figs. 1 to 4, inclusive, except that the auxiliary jet orifices 26 open into an annular bevelled surface 42 at opposite loci of such annular surface, this surface being made by machining, as in a lathe, a V-shaped annular groove or the like in the front wall of the air nozzle 12. The operation of the device is otherwise the same as described in connection with the structure shown in Figs. 1 to 4, inclusive. The air to the auxiliary jet orifices may also be separately and independently controlled in this device, as shown in Figs. 5 and 6. The section shown in Fig. 8 is so taken along lines 8—8 and 9—9 as to more clearly show the paths of the material and air streams 31—32, and of the auxiliary and main air jets 33 and 34, especially to show the passing of the auxiliary air jets 33 rearwardly of the main air jets 34; one on one side and the other on the other side. This is still more clearly shown in Fig. 11 which is a perspective view of the forward portion of the nozzle.

In the form of structure shown in Figs. 12 to 19, inclusive, the construction of the devices is in the main identical to those shown in Figs. 1 to 11, inclusive (the same reference characters being used to designate the same or corresponding parts) with the exception that the auxiliary air jets are projected from auxiliary horns and the passages to the auxiliary air jet orifices or ports lead from the air chamber 15 rather than from the air chamber 22 (compare Figs. 14 and 3), and the auxiliary air jet orifices open out into the inclined surfaces of the auxiliary horns instead of inclined surfaces formed in the front wall 25 of the air nozzle 12.

Referring to Figs. 12 to 15, inclusive, the air for the auxiliary air jets flows, under pressure, from the air chamber by way of auxiliary air passages 43 (see Fig. 14) provided in auxiliary horns 44, to auxiliary air jet orifices or ports 45 arranged on forwardly converging axes 46 which are disposed in spaced parallel planes which are spaced from and parallel to the central axis 29 of the device, that is, of the material nozzle tip 4. The orifices 45 open out in the inclined surfaces 47 of the auxiliary horns at loci further forward and radially more remote than the outlets of the orifices 26 in the structures shown in Figs. 1 to 11, inclusive. Accordingly, the axes 46 of the auxiliary jet orifices may be at an angle of 60° with the central axis 29 without imposing such resistance to the velocity of the material stream as to retard or diminish it, but the invention is not limited to the particular angular relation mentioned.

The operation of the device is the same as described above in connection with those shown in Figs. 1 to 11, inclusive, the auxiliary air jets uniting with or impacting the material and air streams 31—32 at loci rearwardly of the loci 36 of the uniting or impacting of the flattening main or air jets 34 with such streams, the auxiliary horns 44, as shown in Figs. 12 to 15, inclusive, being shorter than the main horns 20.

The device shown in Figs. 16 to 19, inclusive, is substantially identical with that shown in Figs. 12 to 15, inclusive, except that the auxiliary horns 44 are longer than the main horns 20 and the outlets of the auxiliary air jet orifices are still further forward and radially more remote so that the auxiliary air jets 33 unite with or impact the material and air streams 31—32 at loci in advance or forwardly of the loci of the uniting or impacting of the main flattening air jets 34 from the main horns 20. This produces a flat, fan-shaped spray of somewhat different contour or outline than in the case where the auxiliary air jets unite or impact rearwardly of the loci of uniting or impacting of the flattening main air jets, but substantially the same width of the spray is effected with substantially the same character of pattern as in the case of the other structures mentioned.

In the devices shown in Figs. 12 to 19, inclusive, the planes of the axes of the auxiliary jet orifices are disposed substantially at right angles to the plane of the axes of the flattening jet orifices, but it is to be understood such angular relation may be varied within the range mentioned above in connection with the embodiments illustrated in Figs. 1 to 11, inclusive.

While we have herein described and upon the drawings shown a few embodiments illustrating the invention, it is to be understood that the invention is not limited thereto but comprehends other constructions, details, arrangements of parts, features, and the like, without departing from the spirit of the invention.

Having thus disclosed the invention, we claim:

1. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream axially spaced from the loci of engagement of said flattening jets with said stream.

2. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream rearwardly of the loci of engagement of said flattening jets with said stream.

3. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream axially spaced from the loci of engagement of said flattening jets with said stream, and wherein the points of emission of the auxiliary jets from the orifices thereof are located

rearwardly of the points of emission of said flattening jets from the orifices thereof.

4. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream axially spaced from the loci of engagement of said flattening jets with said stream, and wherein the points of emission of the auxiliary jets from the orifices thereof are located rearwardly and radially inwardly of the points of emission of said flattening jets from the orifices thereof.

5. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream axially spaced from the loci of engagement of said flattening jets with said stream and wherein the points of emission of said auxiliary jets from the orifices thereof are located at a different radial distance from the axis of the stream than the points of emission of said flattening jets from the orifices thereof.

6. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream axially spaced from the loci of engagement of said flattening jets with said stream, said auxiliary orifices being so located as to have said planes of the axes thereof at an acute angle to the plane of the axes of said flattening jets.

7. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said streams axially spaced from the loci of engagement of said flattening jets with said stream, said auxiliary orifices being so located as to have said planes of the axes thereof at an angle within the range of from 35° to 90° to the plane of the axes of said flattening jets.

8. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream rearwardly of the loci of engagement of said flattening jets with said stream; and wherein the points of emission of the auxiliary jets from the orifices thereof are located rearwardly and radially inwardly of the points of emission of said flattening jets from the orifices thereof.

9. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream forwardly of the loci of engagement of said flattening jets with said stream.

10. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxiliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream forwardly of the loci of engagement of said flattening jets with said stream, and wherein the points of emission of the auxiliary jets from the orifices thereof are located forwardly of the points of emission of said flattening jets from the orifices thereof.

11. A spraying device having means for projecting a stream of material and means for projecting fluid jets against opposite sides of said stream to flatten said stream into a fan-shape and along a plane including the axis of said stream, comprising auxlliary fluid jet means provided with orifices for forwardly projecting converging jets along spaced parallel planes tangential to said stream and at loci of engagement with said stream forwardly of the loci of engagement of said flattening jets with said stream, and wherein the points of emission of the auxiliary jets from the orifices thereof are located forwardly and radially outwardly of the points of emission of said flattening jets from the orifices thereof.

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