June 13, 1950 B. W. MANTLE 2,511,356

SPRAY GUN NOZZLE

Filed May 24, 1946

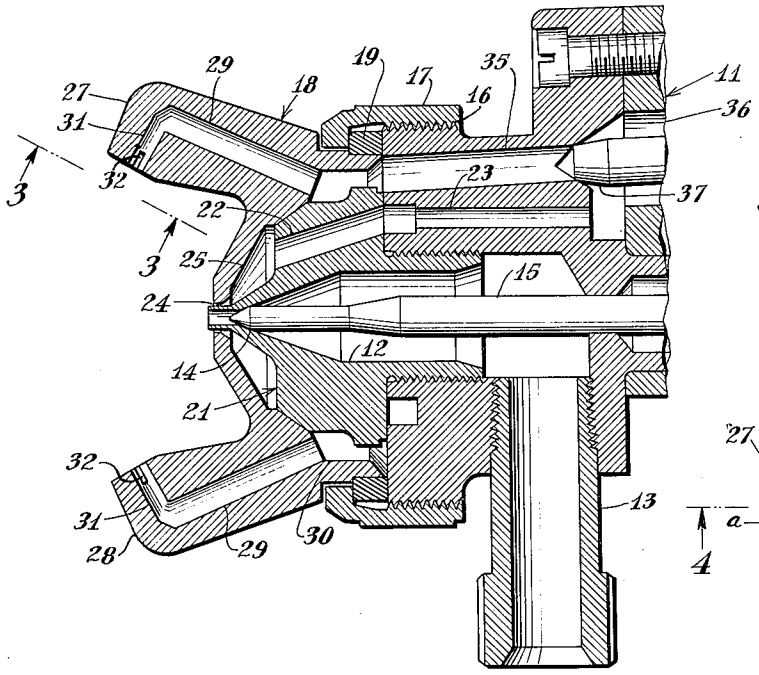


Fig. 1

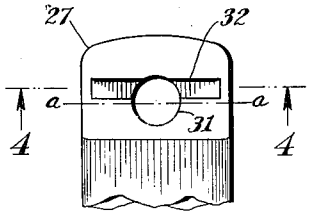
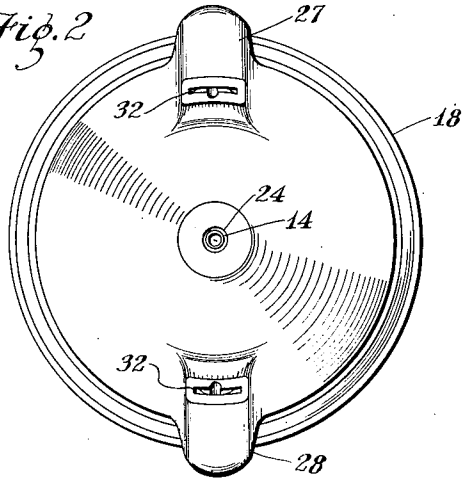


Fig. 3

Fig. 2



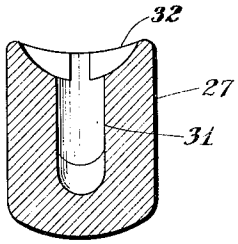


Fig. 4

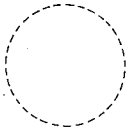


Fig. 5

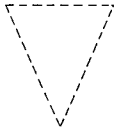


Fig. 6



Fig. 7

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SPRAY GUN NOZZLE

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This invention pertains to spraying equipment and more particularly to spray nozzles such as are used in apparatus employed for spraying coating compositions such as paint and the like.

It has been customary in the past to use air operated spray nozzles for atomizing and directing a stream of fine particles against a surface to be coated, as for example, in applying paint and similar materials to surfaces of various types. Efforts have been made in the past to provide nozzles of the type mentioned above which will so evenly distribute the paint or other coating material being sprayed as to provide uniform and efficient as well as rapid coverage of the surface being coated. Numerous attempts have been made to design equipment capable of giving such distribution of coating material by so arranging the elements of the nozzle that the spray is suitably spread and its pattern, as applied to a receiving surface, is reasonably uniform in width and in thickness of coating. These attempts have not been entirely successful, however, since the spray patterns produced by prior art devices do not consistently afford uniform coverage and unless the resulting coatings are skillfully filled in to equalize parts unequally coated, a streaked, unsightly, and generally unsatisfactory appearance may result.

Spray nozzles of the general type referred to hereinabove are usually provided with a central aperture controlled by a needle valve or the like through which coating material may be fed into an atomizing air jet. Usually atmospheric pressure is relied upon to feed the composition, a partial vacuum created by the expanding air jet causing such feed. In other words, and as well known in the art, paint or the like is fed or expelled by the positive pressure which may be applied to the paint container, or by the aspirating effect of a current of air which is released through an opening surrounding and concentric with the central opening through which coating composition is drawn. The rate of supply of coating material through the central aperture is dependent upon two factors, namely, the size of the opening or the flow permitted by the needle valve in said openings, and the effective pressure on the coating composition which may be either a directly applied pressure or a pressure differential due to the flow of air through the concentric opening which produces the suction or vacuum effect that permits atmospheric pressure to feed coating composition from a supply source. Nozzles utilizing only the elements mentioned are not satisfactory, however, because their spray

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pattern is round and the distribution of coating composition such as paint and the like is not uniform and is not spread to sufficient width. Hence, in the prior art, auxiliary means such as special nozzles or orifices have been used to impinge auxiliary or supplementary air jets on the sides of the main spray jet of coating composition, which main jet otherwise could be conical in form, that is to say, circular in cross section, to flatten such main or spray jet and thus obtain a wider spray and a better distribution. Such devices have been partially successful in that they have made it possible to spray over a wider path and thereby cover a surface more rapidly but they have not produced the uniformity in the spray pattern which is essential to produce the best results. Commonly, when auxiliary air jets are thus employed, they tend to produce a split or "fish-tail" spray jet and thus to produce a coating which is streaked and non-uniform. Although various types of auxiliary jets formed through slots, converging from circular openings, or from combination slotted and circular orifices have been used, none have produced the desired broad, flat, uniform spray stream which is highly desirable for efficient spraying.

An auxiliary or side jet, designed to impinge on a spray jet must be so directed and shaped that it will compress the otherwise conical or circular jet into a substantialy flat form without penetrating such jet or causing it to become broken up into separate parts to produce a split or "fish-tail" pattern. With prior art nozzles there is a particular tendency to produce such an effect when spray guns are operated at high pressures, such as are required for spraying certain synthetic paints and coating compositions.

Since an unmodified spray jet of the character mentioned above is widest in cross section at its central portion, it is apparent that the strongest part of the auxiliary jet must be directed at its center but it must not be unduly concentrated there. A nozzle for an auxiliary jet might be designed theoretically so as to produce almost any desired effect on a spray jet but such a nozzle, although perhaps ideal in shape, would not be practicable to produce commercially. Various arrangements of auxiliary jets have been tried in the prior art, using intersecting jets which modify each other before impinging on the spray or stream, for example, but such arrangements have not been satisfactory, particularly when operated at various pressures as required when various types of paints and coating compositions are sprayed. These arrangements, furthermore,

are complex, easily fouled, and expensive to produce.

Hence it is an object of my invention to design auxiliary nozzles for air jets which will approximate the ideal shape and thereby produce approximately ideal flattening jets and to accomplish this in a manner such that economical production of the equipment is feasible.

Another object of my invention is to design a spray nozzle of the general character described above, having a suitable nozzle or orifice for coating composition and for the usual air flow which feeds or draws the coating composition from a receptacle, in combination with modifying nozzles or orifices for auxiliary air jets which will cause air to shape the jet of coating material to provide substantially uniform distribution and coverage.

Another object of my invention is to design a spray nozzle having oppositely disposed air nozzles so designed as to afford suitable modifying air jets for spreading a jet of coating material to the desired width with substantially optimum distribution and uniformity. A further object of my invention is to design a nozzle having the aforesaid characteristics wherein the auxiliary air jet nozzles may be economically produced.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment and the principle thereof and what I now consider to be the best mode in which I have contemplated applying that principle. Other embodiments of the invention embodying the same or equivalent principle may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings,

Fig. 1 is a vertical sectional view of a nozzle and parts of a spray gun embodying my invention;

Fig. 2 is a front elevation view of my improved spray nozzle.

Fig. 3 is a view taken substantially on the line 3—3, Fig. 1, showing the orifice of one of the nozzles which provides a spray modifying air jet;

Fig. 4 is a sectional view of the parts shown in Fig. 3 taken along the line 4—4 of said figure;

Figs. 5, 6 and 7 are diagrammatic views illustrating comparative distribution of various air jets.

Referring first to Fig. 1 there are shown the forward elements of a spray gun which is indicated generally by the numeral 11. The spray gun per se is more or less conventional in design and forms no part of my invention except as it may be modified to accommodate the nozzle means which forms the substance of my invention. As shown in Fig. 1, the spray gun may comprise an inner nozzle member having a central bore 12 which is connected with the bore or passage of a coupling 13 through which material to be sprayed such as paint or the like may be drawn from any suitable supply source, not shown.

The forward end of the central bore 12 is constricted or tapered as indicated at 14 to form a small nozzle opening through which paint or other coating composition may be fed into an atomizing jet. A needle valve 15 of generally conventional design is provided for closing the orifice 14 or for restricting or controlling the flow

of coating composition as may be desired. Means such as screw threaded parts, not shown, may be provided for adjusting the needle valve as is known in the art.

The body of the spray gun 11 is threaded near its forward end, as indicated at 16, to receive an internally threaded coupling or collar 17 which is employed to secure the outer spray nozzle 18 to the gun. A suitable ring 19, which serves as an abutment for the coupling 17, is secured to nozzle 18 and located between the spray nozzle and the body of the gun to insure a fluid tight seal. The inner nozzle member of the gun which comprises the tapered opening 14 previously mentioned may be formed as a separate internal member, designated generally at 21, which is threaded into an internally threaded part of the body of the gun 11. As shown, in addition to the passage 12, this inner nozzle is provided with a bore or passage 22 for air which communicates with an air passage 23 formed in the body of the spray gun 11, the purpose of these passages being to provide air to an annular orifice which surrounds the central opening 14 through which the coating material emerges. The orifice just mentioned is indicated at 24 and is formed centrally of the outer or main spray nozzle 18 which, when the parts are assembled, is arranged to surround and be concentric with the tip of the inner nozzle 14. The nozzle 18 and the inner nozzle 21 are so designed that an annular space indicated at 25 is provided therebetween so that air supplied under pressure through the passages 23 and 22 may freely surround the tapered inner nozzle 14 and emerge through the annular opening 24 in such a manner as to be uniformly distributed about the inner nozzle.

When the spray gun is operated to permit the flow of air through the passages just described, the increase in velocity through the annular opening 24 causes a sharp reduction in pressure, below atmospheric pressure, at that point and atmospheric pressure acting on the coating material which is carried in a suitable container, not shown, forces such material through the inner nozzle 14. Upon emerging, the coating material is broken into a fine spray by the annular air jet from orifice 24, and this spray spreads into a generally conical pattern which is substantially circular at any cross section unless its shape is modified by externally applied forces.

In order to suitably modify the jet of paint or other coating material which is produced in the manner just described, two auxiliary nozzles for air jets are provided. These are indicated at 27 and 28 respectively as a pair of wing nozzles being diametrically opposed and equidistantly spaced from the central apertures mentioned above. Auxiliary air nozzles of the general character mentioned had been used in the prior art but I have substantially modified these nozzles in a novel manner to produce an entirely new result which will next be described.

Each of the auxiliary air nozzles is formed as an extended wing on the main nozzle member 18. As shown in Figs. 1 and 2 the two wings project a substantial distance beyond the main central nozzles 14, 24 and they are disposed so as to direct air jets at an angle which may approach the perpendicular to the main spray jet.

A particular feature of importance in the wing jets or auxiliary nozzles is the specific design of the orifice. Each of these nozzles is formed with a bore or passage 29 which communicates with an annular air chamber 30 inside the spray

gun provided between the inner nozzle member 21 and the outer nozzle 18. As shown, the passage 29 connects with a short terminal passage 31, both such passages being circular or substantially circular in cross section, so that they may be produced by simple and ordinary drilling operations. If the circular orifices 31 were not modified, air jets issuing therefrom and impinging on the spray jet would be directed very largely at the central part of the spray jet and would tend to separate it into two parts or at least to compress the central portion unduly so as to give the spray jet the general configuration in cross section of a figure 8. This has been a common fault in apparatus known to the prior art and has resulted in spray guns giving a split or "fish-tail" pattern of non-uniform thickness as previously mentioned.

In order to so modify the auxiliary air jets as to flatten but not cut into or separate the spray pattern it is necessary to so form the external orifices in nozzles 31 that the air issuing therefrom, while impinging most strongly and directly at the center of the spray jet will have its effect spread over the spray jet with diminishing force toward the edges thereof.

To accomplish this result, I provide a narrow slot 32 transversely of the face of the auxiliary nozzles 27 and 28, such slot being so located that its upper or outer edge is substantially tangent to the opening 31, the slot being of a width preferably of the order of a little less than half the diameter of the opening 31. The slot 32 is thus disposed entirely or substantially entirely to one side of a diametral center line *a—a*, indicated in Fig. 3, of the circular orifice 31 and is located on the side farthest from the spray nozzle 14, 24. This slot, as best shown in Figs. 3 and 4, may be provided by a milling operation using a suitable tool which cuts into the margin of the orifice 31 substantially parallel to the axis of such orifice.

The combination of a slot and a circular orifice, broadly, is known, but the effect of the construction just described is that air issuing from the orifice 31 is better distributed and concentrated than in any known prior art device, being somewhat concentrated in the lower part of the jet, the upper or outer part of the jet being spread out into the slot to form a jet which compresses the emerging spray jet most at its middle part but also distributes its effect thereon with diminishing force toward the sides of the spray jet.

Figs. 5, 6 and 7 illustrate diagrammatically the effects which various types of auxiliary jets may have on a spray jet. An ordinary circular orifice provides a substantially round jet of air, as indicated in Fig. 5, which, as previously noted, tends to compress the center of the spray jet. Two such jets tend to give the spray jet the general cross-sectional configuration of a figure 8.

It appears that an ideal jet would be one which, as represented diagrammatically in Fig. 6, impinges first at a central point, and spreads its effect like a letter V to the outer edges of the jet with its force diminishing as a straight line function. To produce such a jet would involve the formation of a carefully machined triangular orifice which would be a very expensive if not practically impossible operation.

Hence a highly satisfactory substitute jet is produced of substantially the form indicated in Fig. 7, and which has a rounded contour at its lower part, the radius of which is determined

by the radius of the lower or inner circular part 31 of the orifice, the outer part of this jet being broadened and applied with diminishing force toward the edges of the spray jet.

Air for the auxiliary wing jets may be supplied from a common source with that for orifice 24. As shown in Fig. 1, in the body of the spray gun a suitable bore or passage 35 leads from the annular passage 30 previously mentioned to any suitable source of air pressure. As indicated such a source may be lead to a valve chamber 36 which may be controlled by a valve 37 of any suitable design.

From the foregoing it will be apparent that I have provided a spray nozzle of relatively simple design which is easy to manufacture and which is effective to distribute paint, or the like, uniformly and efficiently. This affords a rapid means for the efficient coating or covering of surfaces to be sprayed or painted. It will be understood that conventional operating means are provided for the various valves and other operating mechanisms which have been mentioned but not described in detail. By designing the auxiliary air nozzle to give an approximately ideal jet formation, using a simple combination of a round orifice and a flat slot of specific construction and location, which may be machined readily and economically, I have thus made it possible to provide a highly efficient spray nozzle at relatively low cost. Although as indicated above many and various types of auxiliary air jets have been known and used in the prior art, they have not been entirely successful and experience has shown that my improved nozzle has numerous advantages thereover. The general arrangement of the elements of my improved nozzle and in particular the specific shape and arrangement of the auxiliary jet orifices contributes to this result, this nozzle affording a very excellent uniformity in coating with a very simple structure.

Thus, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alternations as fall within the purview of the following claims.

I claim:

1. In a device of the character described the combination of a central nozzle including an annular air orifice and a central fluid nozzle for producing a spray of coating material, and a pair of diametrically opposed auxiliary air nozzles extending forwardly of said central nozzle, each of said auxiliary nozzles being provided with an orifice for projecting air forwardly against such spray at an oblique angle thereto, each of said last mentioned orifices comprising a circular orifice modified by the provision of an elongated slot extending across a fractional part of the marginal portion of said circular orifice so as to spread, and reduce the intensity of, a portion of the air jet issuing from such auxiliary nozzle during operation thereof, another fractional part of the marginal portion of said circular orifice projecting transversely from said slot.

2. In apparatus of the character described a nozzle comprising a central spray orifice for coating material, an aspirating air nozzle associated with said orifice and adapted to draw coating material therefrom and to atomize said coating material to form a spray thereof, and a plu-

rality of auxiliary air nozzles, said air nozzles extending forwardly of said central nozzle and each being provided with an orifice directed forwardly toward the axis of said central spray orifice at an oblique angle thereto, said orifices in said auxiliary air nozzles each comprising a circular opening combined with an elongated slot so as to direct a jet of air against a side of said spray emerging from said central orifice to flatten and spread said spray into a uniform pattern, said elongated slot extending across said circular opening with the two ends of said slot projecting outwardly on opposite sides of said circular opening, one longitudinal side of said slot being disposed forwardly of, and parallel to, that diametrical center line of said circular opening which is positioned perpendicularly skew to said axis of said spray orifice, the other longitudinal side of said slot being disposed adjacent to said diametrical center line of said circular opening.

3. In a device of the character described the combination of means for producing an aspirating and atomizing air jet, a nozzle mounted in said means and operatively associated therewith for supplying material to be sprayed to said jet, and an auxiliary nozzle for directing an auxiliary air jet against a side of such a spray of coating material produced by said atomizing jet, said auxiliary nozzle projecting forwardly of said means and comprising an orifice having a portion of substantially circular configuration modified by an elongated slot extending lengthwise across said substantially circular portion, said slot being offset laterally relative to the axis of said circular portion of said orifice.

4. In a spray gun, an inner nozzle having an orifice therein for supplying a coating composition, an aspirating nozzle surrounding said orifice and effective to direct a jet of air forwardly past said orifice to thereby draw coating material through said orifice and form a spray thereof, and two diametrically opposed auxiliary nozzles mounted on said aspirating nozzle and projecting forwardly therefrom a predetermined distance, each of said auxiliary nozzles having an orifice formed therein for directing a stream of air forwardly against said jet at an oblique angle thereto during operation of the gun, each of said last mentioned orifices comprising a circular opening and an elongated slot extending longitudinally across said circular opening and at an oblique angle to the longitudinal axis of said spray, said slot having two longitudinal side walls disposed in substantially parallel relation to that diametrical center line of said circular opening disposed perpendicularly skew to the axis of said jet, both of said side walls being disposed on the opposite side of said diametrical center line from said aspirating nozzle.

5. In a spray gun, a nozzle for producing a spray of coating material and projecting the same forwardly of the gun, two diametrically opposed auxiliary air nozzles mounted on said first mentioned nozzle and projecting forwardly therefrom, each of said auxiliary air nozzles having an air orifice formed therein at a predetermined distance from said first mentioned nozzle, said air orifices being effective during operation of the gun, to direct a stream of air forwardly against said spray at an oblique angle thereto to thereby flatten the latter, each of said orifices comprising a circular opening having a straight elongated slot extending thereacross, one of the longitudinal side walls of said slot extending substantially tangentially across said circular opening parallel to that diametrical center line of said circular opening perpendicularly skew to said axis of said spray, and the other longitudinal side wall of said slot extending across said circular opening on the same side of said center line of said opening as said one side wall and in parallel relation to the latter, the portions of said circular opening disposed on the other side of said center line, projecting laterally from said slot toward said first mentioned nozzle.

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