Dec. 7, 1937. E. GUSTAFSSON 2,101,175

AIR NOZZLE FOR FLAT SPRAYING APPLIANCES

Filed Nov. 9, 1936

Fig. 1

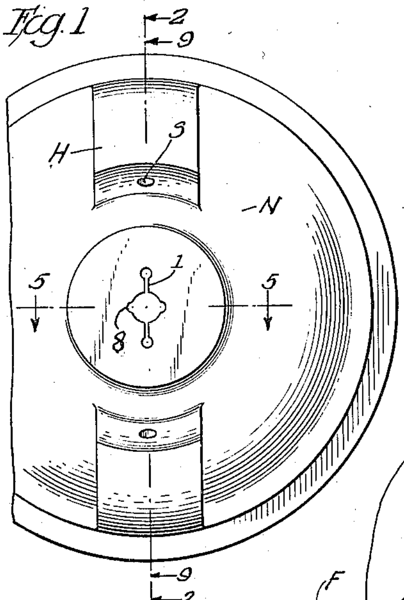


Fig. 4

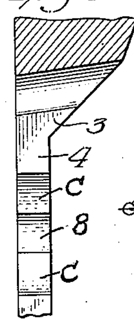


Fig. 2

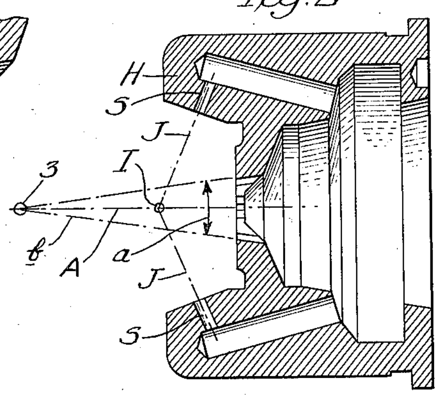


Fig. 3

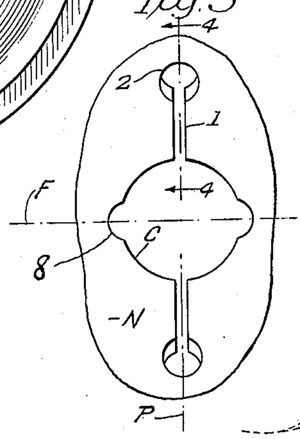


Fig. 6

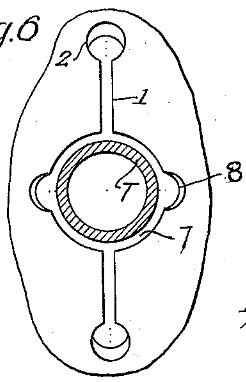


Fig. 9

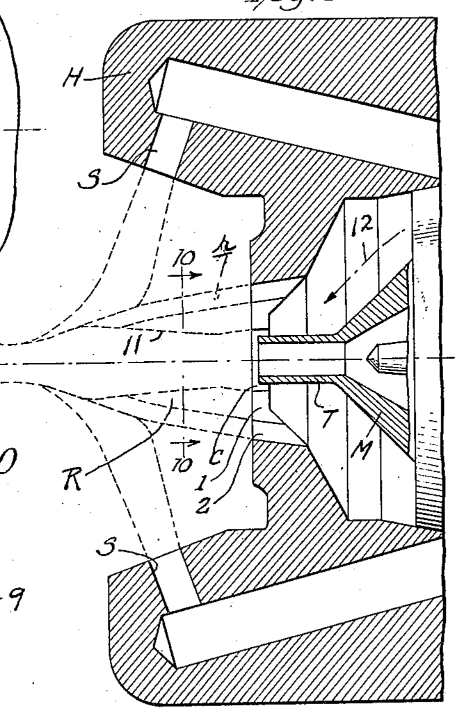


Fig. 8

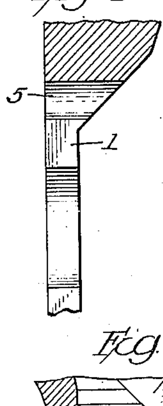


Fig. 10

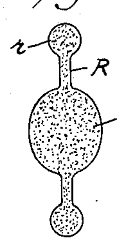


Fig. 7

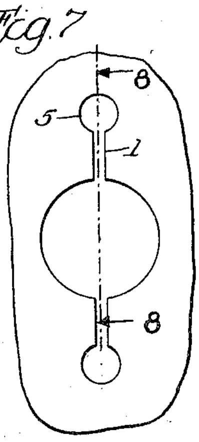
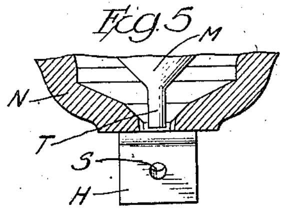


Fig. 5



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2,101,175

AIR NOZZLE FOR FLAT-SPRAYING APPLIANCES

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Application November 9, 1936, Serial No. 109,905

9 Claims. (Cl. 299—140.1)

My invention relates to an air nozzle of the type extensively used in spray guns and other flat-spraying appliances for emitting air around and in commingling as well as propelling relation to a projected stream of liquid (or at least generally liquid) material; and for also projecting forwardly converging jets of air symmetrically against opposite sides of the resulting stream of aerated material to transform this stream into a flattened spray.

When a spray gun including such an air nozzle is used for spray-coating a surface, it is highly desirable to produce a spray of a rectangular section corresponding substantially to the shape of an end of a flat paint brush, so that the resulting coating will be substantially uniform when the spray has been moved with respect to the said surface in a direction at right angles to the flattened sides of the spray. That is to say, the forwardly converging or so-called side jets of air should impact against the material with sufficient force to avoid having the sides of the spray bow either away from each other or toward each other, and these side jets should also supply sufficient air (supplementary to the air which initially aerates the stream) for insuring a fine atomization of the spray.

For rapid spray-coating, the velocity of the side air jets must be increased in suitable proportion to the velocity of the aerated stream of material, and with the side air jets at such higher velocities, the parts of these side jets nearest to the axes of these jets impinge more effectively against the said stream than the jet portions which are further from the said axes, so that the first mentioned or radially inner portions of the side air jets have an undue tendency to penetrate the stream.

This has heretofore been overcome to a considerable extent by forwardly projecting auxiliary air in merging relation to the said aerated stream along the two sides of this stream which respectively face the emission points of the side air jets, so that this auxiliary air produces longitudinal surface streams against which the side air jets respectively impact.

Thus my United States Patent #1,990,823 of February 12, 1935 disclosed an air nozzle in which such auxiliary air jets were produced either according to Fig. 2 by providing a single auxiliary port A adjacent to each of the sides of usually central air port of such a nozzle which face the side air ports, or according to Fig. 5 by providing a radially extending slot-like enlargement of the central air port at each of the same sides. So also, Figs. 9 and 7 of my United States Patent #2,029,423 of February 4, 1936 showed the providing of pluralities of auxiliary bored ports, arranged in tandem at each of the said sides of the central air port, in substitution for the simple slots shown in Fig. 5 of my Patent #1,990,823.

However, each of my said previously disclosed types of air nozzles has presented considerable manufacturing difficulties because of the small size permissible for an air nozzle of a commercial spray gun which must be sufficiently light as to be held in a hand of the user (who also has to support the weight of a considerable length of the air hose and the material hose, together with the weight of material in the latter) and manipulated for long periods of the time by the user without undue fatigue.

Owing to this size limitation, the diameter of each auxiliary circular air port of the air nozzle of Fig. 2 of my Patent #1,990,823, or with the plural auxiliary ports of my Patent #2,029,423, could not be more than about one-fortieth of an inch; and owing to the wear on both jigs and drills, such minute bores cannot be accurately positioned and bored, particularly in the already hardened tungsten steel required for making a durable nozzle, without an undesirably high expense both for labor, for replacement drills and for replacing jigs. Moreover, even with highly skilled labor, the waste due to occasional imperfect nozzles has been unduly large.

With the radial slots of Fig. 5 of my Patent #1,990,823, the narrow slot widths permissible in air nozzles for commercial spray guns made it highly difficult to remove the burrs, produced at the outer ends of the slots by the sawing, without both tedious additional labor and a considerable spoilage, thereby likewise increasing the manufacturing cost.

Each of my previously disclosed allied air nozzles has also been undesirably limited as to both the range of air and material pressures and the variety of materials with which it would operate efficiently. Consequently, anyone wanting to use the same spray gun with varying materials would require a corresponding assortment of air nozzles in which the auxiliary air-emitting provisions were respectively proportioned for the relatively different materals, and would also need to select and change to the appropriately formed nozzle of the same type when changing from one material to another. This not only involved added time for the user, but also has led to the production of imperfect coatings whenever a user erred in selecting the right nozzle.

My present invention aims to provide an air nozzle which will considerably reduce the above mentioned manufacturing difficulties and manufacturing expenses, and which will permit a single air nozzle to be used interchangeably with a much wider range of materials, and also a wider range of the pressures under which the material and air are projected, than my said earlier types; and which will further improve the uniformity of atomization of the resulting spray. In addition, my invention aims to provide a novel method for advantageously modifying the effect of the side air jets.

To obtain the just recited advantages, I modify each of the radial slots in Fig. 5 of my Patent # 1,990,823 by enlarging the outer end portion of the slot so that the stream rib produced by the air issuing through the slot will have a greatly thickened outer edge portion, and I preferably form each such slot enlargement so that the resulting stream rib will present a semi-cylindrical surface to the side air jet impacting against it. Moreover, I preferably form each such slot-end enlargement of a cross-sectional area greater than that of the parallel-walled slot leading to it, so that a major portion of the air supplied by each slot will form a stream rib part disposed against which a side air jet impacts. In addition, I so dispose the axis of each slot enlargement, with respect to the axis of the central air port, as to make the total air emitted by each such modified slot highly effective both for adding propelling power to the material stream and for enhancing the atomization of the resulting spray.

I also preferably produce each such slot-end enlargement by first forming a correspondingly disposed cylindrical bore in the forward end of the central part air nozzle and thereafter sawing each corresponding slot so that any resulting burr will be formed within the slot where it then can easily and speedily be removed by the use of an end reamer.

Illustrative of the manner in which I accomplish the above recited objects,

Fig. 1 is an enlarged fragmentary front elevation of an air nozzle embodying my invention, in which the bore portions of the two auxiliary port enlargements converge forwardly.

Fig. 2 is a central and longitudinal section taken through the same nozzle along the line 2—2 of Fig. 1 but drawn on a smaller scale.

Fig. 3 is an enlargement of the central portion of Fig. 1.

Fig. 4 is a still more enlarged fragmentary section taken along the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary section taken along the line 5—5 of Fig. 1 and including an elevation of a material nozzle associated with the air nozzle.

Fig. 6 is a rear elevation of the same central part of the air nozzle as Fig. 4.

Fig. 7 is a front elevation of the central part of another air nozzle embodying my invention in which the bore portions of the auxiliary port provisions have their axes parallel to the axis of the nozzle, and in which the nozzle does not have the arcuate central port enlargements of Figs. 1 and 4, drawn on the same scale as Figs. 3 and 6.

Fig. 8 is a fragmentary section taken along the line 8—8 of Fig. 7 through the air nozzle only.

Fig. 9 is an enlargement of the section of Fig. 2, taken also through the forward part of a material nozzle associated with the air nozzles and including lines indicating effect of the air nozzle of Fig. 1.

Fig. 10 is an enlarged section taken along the line 10—10 of Fig. 9 through the partially aerated stream of material issuing from the nozzle assembly of Fig. 9, before the side air jets impact on this stream.

In the embodiment of Figs. 1 to 7, designed for use in high speed spraying, the central air port C of my air nozzle N has a fundamentally cylindrical bore which has two counterpart and forwardly tapering arcuate enlargements 8 each extending symmetrically across the plane F (diametric and axial of the nozzle) as in the Long and Gustafsson Patent # 1,897,173, in which plane the material is to be flattened, this material being projected from the tip T of a material nozzle M (Fig. 5) which is coaxial with the air nozzle.

In addition, the central port of the air nozzle has two other opposed port enlargements of my present invention, each straddling the common plane P of the axes J of the side air ports S which are formed in the usual forwardly projecting horns H of the nozzle, which air jets converge forwardly at equal angles to the axis A of the air nozzle and intersect on this axis, the said plane P extending along the axis A and being at right angles to the said flattening plane F.

Each of the last mentioned central port enlargements comprises a slot 1 opening from the bore of the central port and having longitudinal walls parallel to, equally spaced from, and at opposite sides of the said side-jet axes plane J. Each such slot opens at its outer end into a bore 2 of circular section which is considerably larger in diameter than the width of the slot, and which bore has its axis in the said jet plane J. To form each of the just described central port enlargements accurately, I first form a cylindrical bore at the required spacing and axial inclination from the axis of the central port, and thereafter saw the parallel-walled slot leading to this bore. During this sawing, any resulting burrs will be projected into the interior of the said bore, where they can easily be removed by an end reamer slidably fitting that bore.

In practice, each such incompletely cylindrical slot-end portion 2 desirably has a diameter not exceeding about three-fifths that of one of the said side ports, each of which side ports usually has a diameter approximating (but not exceeding) about six-tenths that of the circularly arced fundamental portions of the central port, and the said slots desirably have a width somewhat less than one-third the diameter of the said slot-end portions 2. Moreover, the length of the parallel-walled slot portion at the forward face of the nozzle desirably is greater than the diameter of the said slot end portion, and the axis *b* of the two incompletely cylindrical slot end enlargements should intersect at a point 3 (Fig. 2) on the axis A of the central port considerably forward of the intersection I of the jet axes J.

For example, when the side ports S are located as in Fig. 2 and the side jet axes J converge at an angle of 140 degrees, the bored slot-end portions (for an air nozzle used in high-speed spraying) may advantageously have their axes converging at an angle *a* of 16 degrees, so that these bore axes *b* intersect approximately three times as far forward from the front face of the central portion of the air nozzle as the intersection I of side jet axes J.

To enhance the air-directing effect of the bored portions 2 of the just described central port enlargements, I preferably form these portions in the thickened frontal part 3 (Fig. 4) surrounding the flat part 4 contiguous to the main portions of the central port C, which flat part usually needs to be thin so as to expedite the flow of compressed air between the air nozzle and the tip T of the material nozzle to the space 7 (Fig. 6) between this tip and the main arcuate wall portions C of the said port.

The compressed air then flowing along the arrow line 12 of Fig. 9 issues partly also through each of the said slot and bore provisions to form longitudinal surface ribs R on the aerated material stream 11, approximately as shown in Fig. 10 each of which ribs straddles the plane P of the side jet axes and presents a cylindrical bead r at its outer edge for first receiving the impact of the side air emitted from the port S at the same side of the air nozzle. Thus each such slot and bore provision produces a rib having substantially the longitudinal section of a half-length of a dumb-bell, namely the axial and longitudinal section of a letter T having a circular head.

With the free edge of each such stream rib thus widened, the impact of the adjacent side air jet is distributed over a considerable portion of the width of that jet, so that the jet air portions adjacent to the axis of the jet do not unduly penetrate the main part of the aerate stream of material, while the relatively much smaller width of the slot portion of each such enlargement prevents the flat rib portion from unduly spreading circumferentially of the said main part of the stream.

Moreover, when the major part of the air issuing from such a slot enlargement forms the said widened edge bead r of the stream rib, this major portion of the air also commingles with the side jet air to a considerable extent before the side jet air reaches the aerated material stream, thereby effectively enhancing the atomization of the resulting spray.

In practice, I have found that convergence angle a of the bored portions of my novel central port enlargements can be varied from a maximum of about 20 degrees to about 12 degrees when my air nozzle is to be used for high-speed spraying, the preferable angle depending partly on the position of the side air ports with respect to the central air port and on the angle of convergence of the axes J of these side ports.

With a considerable convergence angle a of the bored port portions 2, such as the illustrated angle of 16 degrees, I have found that my here presented air nozzle can be used effectively with an unusually wide range of material pressures and air pressures, as for example with the material under pressures of from 5 to 40 pounds and the air at from 65 to 100 pounds, thus enabling a single one of my air nozzles to be used for the same variety of purposes which formerly required quite a number of different or at least differently proportioned air nozzles. I have also found that by suitably adjusting the proportions of the air and material pressure, a single such air nozzle can be used effectively with a quite large variety of materials, as for example with all commonly used lacquers (including the synthetic) as well as synthetic enamels.

However, for comparatively low spraying rates, the convergence angle a of my bored port portions may be further decreased all the way to a zero in which the axes of these bores are parallel to the axis A of the air nozzle. In that case I preferably dispose the outlets of the said bored port portions closer to the axis of the nozzle, as shown at 5 in Figs. 7 and 8, in comparison with Figs. 3 and 4.

When the bored or T-head-affording portions of my air nozzle converge, it also desirably has provisions for somewhat flattening the stream of aerated material, before the side air jets reach it, along the common plane P (Fig. 3) of the side air jets. For this purpose, I desirably use the opposed enlargements 8, formed according to the Long and Gustafsson Patent # 1,897,173 which cause the central stream portion 9 in Fig. 10 to be elliptical. However, I have not found these enlargements 8 needed, at least with some materials, when the bored portions 5 of my novel auxiliary ports have their axes parallel to the axis A of the air nozzle.

I claim as my invention:

1. The method of modifying the effect, upon a forwardly projected material stream, of two forwardly converging air jets which are directed against opposite sides of a portion of said stream and which jets have their axes in a common plane with the axis of the stream, so that said jets flatten the stream along a second plane diametric of the said axis and at right angles to the aforesaid plane, which method consists in providing the said stream with two counterpart longitudinal surface ribs at the stream sides respectively facing the said jets, each rib being symmetrical with respect to the said second plane and extending along the said stream from the point of emission of the stream and into merging relation with one of the said air jets, and each rib comprising a web portion extending radially outward from the said stream and a thickened free end portion disposed at the rib edge which faces the adjacent air jet.

2. The method of claim 1, in which each thus provided rib has the cross-sectional area of its said thickened free edge portion at least as large as that of its web portion.

3. The method of claim 1, in which each thus provided rib extends radially outward from the axis of the stream to a sufficient extent so that the said thickened rib edge engages a portion of the air jet which faces that rib before that jet impacts on the stream, whereby the said rib edge forwardly deflects the said portion of the air jet.

4. The method of claim 1, in which each thus provided rib has its thickened free edge portion cylindrical and of a diameter smaller than the initial diameter of one of the side air jets.

5. In a spray appliance of the class in which a stream of generally liquid material is forwardly projected through a material nozzle, and in which an air nozzle has both a central port through which air is forwardly projected around and in merging relation to the said material stream and two side air ports for projecting forwardly converging jets of air respectively against opposite sides of the said stream, and in which the axes of the said jets are in a plane diametric of the said central port, the said air nozzle characterized by also having the said central port provided with two counterpart enlargements respectively at opposite sides of the central air port; each of the said enlargements comprising a bore portion spaced from the said central port and a slot portion of less width than the said bore leading from the said bore to the said central port, the axis of the said bore portion and the medial plane between the longitudinal walls of the said slot portion being both in the afore-

said plane, the axis of the said bore portion being at an angle of between zero and ten degrees to the axis of the central port.

6. An air nozzle as per claim 5, in which the said bore portion of each central port enlargement has a diameter less than half the initial diameter of one of the said air jets.

7. An air nozzle as per claim 5, in which the said bore portion of each central port enlargement has a diameter less than half the initial diameter of one of the said air jets; and in which the length of the said slot portion of each central port enlargement is greater than the diameter of the bore portion of that port enlargement.

8. An air nozzle as per claim 5, in which the axes of the said bore portions of the two counterpart central port enlargements converge forwardly at an acute angle to each other.

9. The method of claim 1 in which the thickened portions of said two ribs converge forwardly.

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