Aug. 18, 1936. E. GUSTAFSSON 2,051,210

AIR NOZZLE FOR SPRAY APPLIANCES

Filed Sept. 13, 1935

Fig. 1

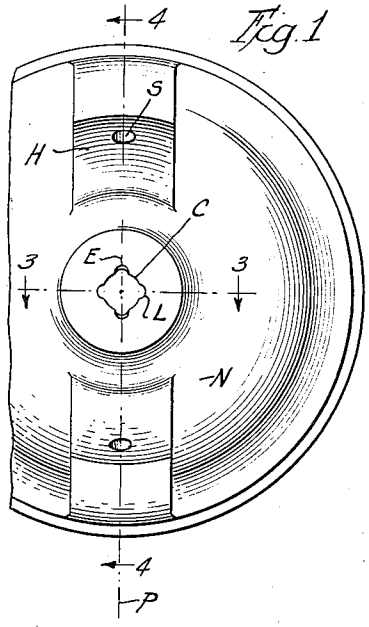


Fig. 2

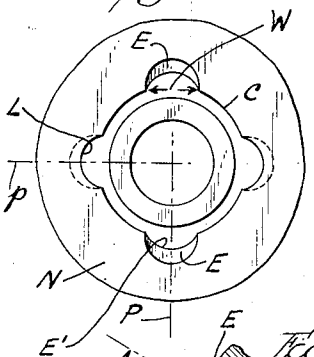


Fig. 3

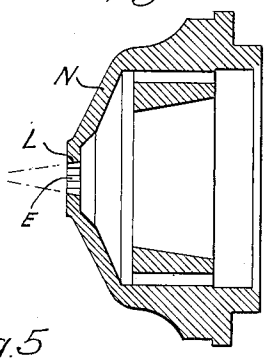


Fig. 5

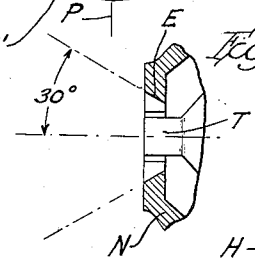


Fig. 4

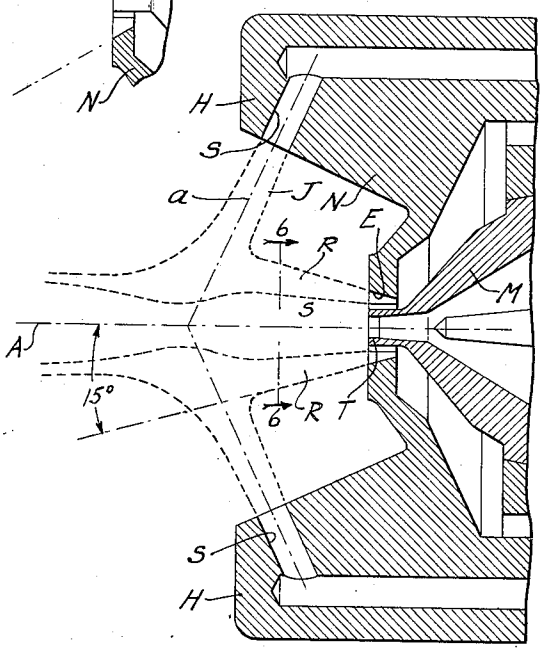


Fig. 6

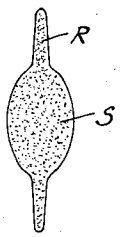


Fig. 7

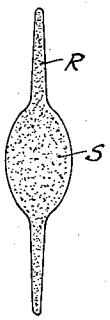
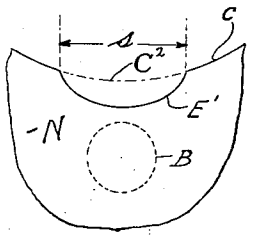


Fig. 8



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2,051,210

AIR NOZZLE FOR SPRAY APPLIANCES

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Application September 13, 1935, Serial No. 40,471

8 Claims. (Cl. 299—140.1)

My invention relates to the class of air nozzles used in spray guns and allied spraying appliances designed for converting a stream of material into a flattened and finely comminuted spray. In modern spray guns such an air nozzle is usually of a cap type having a central air port through which air is projected around and coaxial with the projected stream of material to aerate the stream, and the air nozzle also has two side air ports for projecting forwardly converging air jets against the said aerated stream to convert it into a flattened spray.

With many sprayable materials, a sufficient flat-wise spread of the spray for economical spray-coating can only be obtained by having the said converging air jets of such force that these jets would deform the cross-section of the spray to a so called figure 8 shape, or even to split the spray, if the central port of the air nozzle is of completely circular section. This difficulty has been overcome with some materials by providing the central air port with opposed enlargements (after the manner of the Long and Gustafsson Patent #1,897,173) so that the additional air issuing from these port enlargements will pre-flatten the aerated stream in a certain plane diametric of the stream, before the side air jets impact on this stream.

As a further improvement on the air nozzle of the said Patent #1,897,173, my United States Patent #1,990,824 also showed the providing of two auxiliary air ports, having their axes in the same plane, diametric of the projected material stream, with the axes of the two side air ports, these auxiliary ports being disposed so that the air jets issuing from them will merge with the aerated stream to produce longitudinal stream ribs against which the spray-flattening side air jets respectively impact.

Moreover, in my copending application #8,699 (filed February 28, 1935 on an Air nozzle for flat-spraying appliances) I disclosed the providing of pluralities of auxiliary air ports for increasing the width of the said air ribs radially of the aerated stream.

In practice, the diameter of each such auxiliary port in air nozzles of my last named patent and application must be limited, in proportion to that of the central air port and also of each side air port, in order to have the resulting stream ribs produce the proper stream stiffening effect without marring the uniformity of atomization of the spray.

Consequently, my said separately bored ports have not proven entirely adequate in air nozzles for spray guns when these guns are used for spraying some of the recently developed sluggish materials, as for example certain heavy synthetic enamels and heavy lacquers.

Furthermore, the boring of accurately positioned bored ports for the above recited purpose presents undesirable manufacturing difficulties in air nozzles for modern commercial spray guns, because of the exceedingly small diameter required for such ports—as for example one fortieth of an inch—and particularly so when such nozzles are drop-forged of bronze or even of still harder materials. Such a miniature diameter makes it difficult to dispose each bore with its axis in precisely the intended position—namely, with that axis exactly in the common plane of the axes of the side air ports and also at an exact predetermined spacing from the axis of the central air port. Consequently, in the commercial manufacturing of such air nozzles, many will have the auxiliary (stream-rib-producing) air ports sufficiently displaced so that the resulting spray is somewhat unsymmetrical, thereby causing irregularities in the resulting coating.

In addition, the auxiliary ports provided according to my Patent #1,990,824 and my application #8,699 for producing stiffening ribs on the aerated stream of material present this limitation: Since the air jets issuing from these ports are initially spaced from the air which is projected around and in merging relation to the material stream, these ports must have their axes either parallel to that of the central air port or converging slightly forward toward the latter, in order that these air jets will merge with the aerated material stream. Consequently, the width of each resulting stream rib (radial of the said aerated stream) cannot be much larger than the distance to which the corresponding auxiliary port reaches radially outward from the general circular section of the central air port.

My present invention aims to overcome the above recited difficulties by providing the central air port of the air nozzle with port enlargements which can be more easily made accurately, which will produce stream ribs of far greater resistance to the impact of the side air jets than those due to the bored air ports of my said patent and my said copending application, and which port enlargements can readily be varied in their size (even with the same tool used for their manufacture) to adapt the air nozzle for use in connection with the spraying of materials of considerably differing characteristics. Furthermore, my invention aims to provide port enlargements which will produce stream ribs of large width (radially of the stream) in proportion to the amount of compressed air required for that purpose, which stream ribs will increase forwardly in their said width to a material extent before the side air jets impact on them.

Illustrative of the manner in which I accomplish these objects, Fig. 1 is a front elevation of an air nozzle embodying my invention, including

both my novel central port enlargements and a pair of port enlargements disposed as in the said Long and Gustafsson Patent #1,897,173.

Fig. 2 is an enlargement of the central portion of Fig. 1.

Fig. 3 is an enlarged section taken along the line 3—3 of Fig. 1, drawn on a smaller scale.

Fig. 4 is an enlarged section taken along the line 4—4 of Fig. 1, including a portion of a material nozzle used with this air nozzle, and also including lines showing the outline of part of the resulting fluid streams.

Fig. 5 is a section similar to portion of Fig. 4, showing my novel port enlargements as formed for producing a greater width of stream ribs than those of Figs. 1, 2, and 4.

Fig. 6 is an enlarged section, taken along the line 6—6 of Fig. 4, through the ribbed material stream projected by the nozzle assembly of that figure, and Fig. 7 shows how the ribs are increased in section if the air nozzle of Fig. 5 is substituted for that of Figs. 1, 2, and 4.

Fig. 8 is an enlarged fragmentary view taken looking outwardly at an enlargement in the nozzle opening.

In the drawing, the air nozzle N has the usual (generally cylindrical) central air port C freely housing and coaxial with the cylindrical-tubular discharge tip T of a material nozzle M, and the usual horns H each provided with a side port S. These side ports have their axes *a* disposed in a common plane P diametric of the central air port and of the material nozzle tip, the said axes being at equal angles to the axis A of the said central port and intersecting at a common point on the central port axis A. Moreover, the side ports S are equal in diameter and considerably smaller than the main cylindrical portion of the central air port, as for example about three-fifths the diameter of the latter portion.

To accomplish the purposes of my invention, I provide the central air port with two diametrically opposed and counterpart enlargements E, each of which is a trough having a uniform width W considerably smaller than the diameter of one of the side air ports S—as for example four-sevenths of that diameter. Each such trough has as its trough bottom a semi-cylindrical surface of a diameter corresponding to the said uniform trough width, the axis of which surface slopes rearwardly of the nozzle at an acute angle toward the axis A of the central air port—as for example the 15 degree angle in Fig. 4—and desirably has its minimum depth (at the rear end of the trough) not much smaller than the radius of the said cylindrical surface.

In addition, I also usually (although not necessarily) provide the central air port with a pair of secondary and diametrically opposed arcuate enlargements L which have their axes in a plane *p* diametric of the central air port and at right angles to the common plane P of the side port axes *a*. These secondary port enlargements L, which may be of an arcuate section throughout their length, decrease in depth forwardly of the nozzle and in Fig. 2 the spread of each such enlargement (circumferentially of the said central port) is shown as equal to that of my novel port enlargements E, but this proportion may be varied somewhat according to the characteristics of the material which is to be sprayed.

When my nozzle assembly of Fig. 4 is in use, the material nozzle tip T projects the generally liquid material in a stream of initially circular section, with which the air issuing through the said central port around the material nozzle tip T speedily merges to form an aerated material stream. Owing to my novel port enlargements E, the air issuing through these enlargements instantly forms opposed longitudinal ribs R on the said aerated material stream, and owing to the slope of the trough bottoms of the said enlargements E, these ribs increase forwardly in their width (diametrically of the said stream, in the said medial plane of these enlargements) at an angle corresponding approximately to the angle at which the trough bottom of each such enlargement slopes forwardly away from the axis A of the central air port.

Consequently, my said port enlargements can readily produce stream ribs which increase to a considerable width before the air jets from the side ports S impact respectively on these ribs. When the air nozzle also has the secondary port enlargements L, the additional air projected through the latter enlargements in converging relation to the initially projected material stream acts (as more fully disclosed in the previously identified Long and Gustafsson Patent #1,897,173) for deforming the said stream to an elliptical section having its major axis in the plane P of the said air ports, thereby also spreading the stream in the same direction in which the ribs R (produced by my novel port enlargements E) project from the aerated material stream.

Consequently, my joint use of the above described two pairs of central port enlargements, even with the trough axes of the novel port enlargements E sloping at an angle of only 15 degrees to the axis of the central air port, enables me to produce stream ribs of many times greater width (radially of the stream) than the thickness of each such rib at its base,—as shown in Fig. 6.

With each such trough-like port enlargement, the resulting stream rib R has its edge sloping at approximately the same angle as the trough bottom—as for example 15 degrees with the air nozzle of Figs. 2 and 4, and 30 degrees with that of Fig. 5—since the air expands radially from the axis of the central air port while flowing forwardly through the port enlargement. Consequently, I can greatly vary the effective widths of the stream ribs produced by approximately the same amount of compressed air, by varying the slope angle within a range from about 12 degrees to about 45 degrees.

When each port enlargement is formed as a parallel-walled sloping trough having a trough bottom of semi-circular section, the rear end E^1 of the enlargement is approximately a longitudinal half of an ellipse, as shown on an enlarged scale in Fig. 8, thus providing a crescent-shaped area between this arcuate rear end and a continuation C^2 of the basic circular shape of the central air port. Owing to this crescent shape, the spread *s* of the inlet end of the enlargement is much greater than the diameter of a circle B of the same area as the said crescent, so that each such enlargement can readily be formed with a reamer of considerably larger diameter than the size of drill required for boring the corresponding circular auxiliary ports heretofore used for the same purpose.

Moreover, since this reaming operation can easily and speedily be done on a milling machine which permits the slope angle to be accurately adjusted, I can readily provide the central air port with the enlargements sloping at any desired angle, without requiring a variety of different

jigs. Consequently, I can easily vary my novel port enlargements according to the characteristics of the material which is to be sprayed; and I entirely avoid both the breakage of minute drills and the spoilage of nozzles encountered in the manufacture of air nozzles having separately bored ports for the same purpose.

Owing to the relatively large width of the stream ribs which I can obtain in this simple manner, I have found my here presented air nozzle completely satisfactory when used with heavy synthetic enamels and lacquers for which the heretofore used air nozzles were not adequate. In addition, I have found my novel port enlargements to effect a further improvement in the uniformity of atomization which substantially eliminates the so-called "orange peel" appearance of the coating produced with certain materials. This improvement I assume to be due to the fact that the additional air issuing from my novel port enlargements is integral with the rest of the air which issues from the central air port, so that the material stream can intermingle more uniformly with all of this air.

However, while I have illustrated my invention in connection with a particular type of now commercial air nozzle and as used in connection with the port enlargements of the Long and Gustafsson patent, and as including certain desirable proportions and shapings of parts, I do not wish to be limited in these respects, since my here presented drawing is merely illustrative of one embodiment.

I claim as my invention:

1. As a constituent for a spray gun, an air nozzle of the cap-like type having a generally circular central air port and also having two relatively smaller-diametered and forwardly converging side air ports, which side air ports have their axes in a common plane diametric of the said central air port and intersecting at common point on the axis of the said central port; the air nozzle being characterized by having its said central air port provided with two diametrically opposed and counterpart port enlargements both having their axes disposed in the said plane and each having its end wall sloping forwardly away from the axis of the central air port at an acute angle.

2. An air nozzle as per claim 1, in which the end wall of each port enlargement is concaved, in every section at right angles to the axis of the central air port, toward the axis of the central air port.

3. An air nozzle as per claim 1, in which the end wall of each port enlargement is concaved, in every section at right angles to the axis of the central air port, toward the axis of the central air port, and in which each port enlargement has its side walls parallel to the said plane.

4. As a constituent for a spray gun, an air nozzle of the cap-like type having a generally circular central air port and also having two relatively smaller-diametered and forwardly converging side air ports, which side air ports have their axes in a common plane diametric of the said central air port and intersecting at common point on the axis of the said central port; the air nozzle being characterized by having its said central air port provided with two diametrically opposed and counterpart port enlargements both having their axes disposed in the said plane and each having its end wall lying in a cylindrical surface the axis of which slopes forwardly away from the axis of the said central port.

5. As a constituent for a spray gun, an air nozzle of the cap-like type having a generally circular central air port and also having two relatively smaller-diametered and forwardly converging side air ports, which side air ports have their axes in a common plane diametric of the said central air port and intersecting at common point on the axis of the said central port; the air nozzle being characterized by having its said central air port provided with two pairs of diametrically opposed port enlargements, namely: a pair of counterpart enlargements each increasing forwardly in its length radially of the nozzle, and each straddling and symmetrical with respect to the said plane; and a second pair of counterpart enlargements each decreasing forwardly in its length radially of the nozzle, and each straddling and symmetrical with respect to a plane diametric of the central air port and at right angles to the aforesaid plane.

6. An air nozzle as per claim 1, in which the rear end of each port enlargement is semi-circular, and in which the forward end of each port enlargement is of a U-section presenting parallel U-shanks and having its U-bend substantially a counterpart of the semi-circular shape of the rear end of the said enlargement.

7. As a constituent for a spray gun, an air nozzle of the cap-like type having a generally circular central air port and also having two relatively smaller-diametered and forwardly converging side air ports, which side air ports have their axes in a common plane diametric of the said central air port and intersecting at common point on the axis of the said central port; the air nozzle being characterized by having its said central air port provided with two pairs of diametrically opposed port enlargements, namely: a pair of counterpart enlargements each increasing forwardly in its cross-sectional area, and each straddling and symmetrical with respect to the said plane; and a second pair of counterpart enlargements each decreasing forwardly in its cross-sectional area, and each straddling and symmetrical with respect to a plane diametric of the central air port and at right angles to the aforesaid plane.

8. In a spray appliance of the class in which material is forwardly projected through a cylindrical-tubular tip of a material nozzle, in which the said tip is freely housed by and coaxial with the central air port of an air nozzle, and in which the air nozzle also includes two side ports for forwardly projecting along axes which intersect at a common point on the axis of the said tip and which axes are in a common plane diametric of the axis of the said tip; the air nozzle having the major portions of the bore of its central air port formed as portions of a common cylindrical surface coaxial with the said tip axis, the said central port also having two diametrically opposite port enlargements each straddling and symmetrical with respect to the said plane and each increasing forwardly in its spread radially of the central air port; each such port enlargement being a slot presenting side walls parallel to the said plane and having a U-shaped forward end and a semi-elliptical rearward end.

ERIC GUSTAFSSON.