

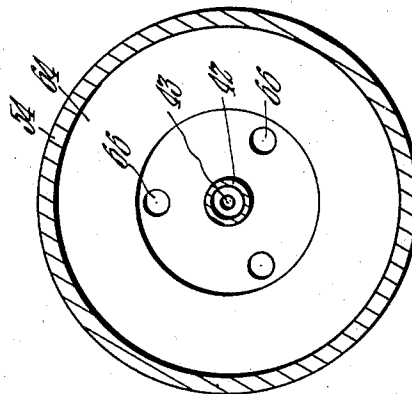
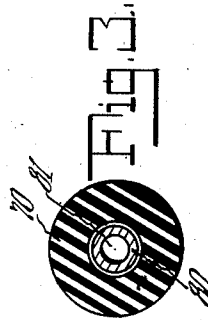
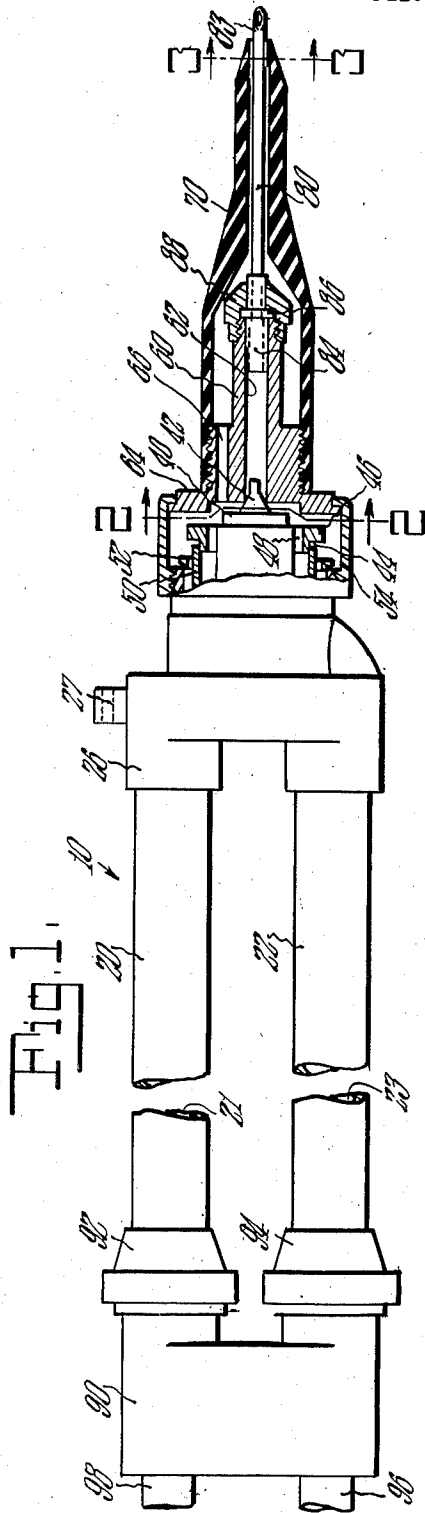
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SPRAY DEVICE FOR ELECTROSTATIC DEPOSITION OF A FLUID

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SPRAY DEVICE FOR ELECTROSTATIC DEPOSITION OF A FLUID

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This invention relates to the nebulizing of liquids and, more particularly, it relates to new and useful improvements in an apparatus for applying a liquid coating to an article or articles by electrostatically charging and depositing the comminuted coating material upon the article within an electrostatic field created between the article to be coated and the issuing source of the coating material.

That is to say, the invention relates to means for imparting an electrical charge to coating materials, which electrical charge is of such character that when the material is atomized, precipitated, and dispersed, the spraying charge is smoothly deposited upon the object toward which the atomized material is directed.

Means is provided whereby the liquid is readily and efficiently divided into minute particles by electrical force with the assistance of a moving air stream.

The principal object of the invention is directed to an apparatus and method for improving this dispersion and deposition of the atomized particles from a charged gun mechanism upon an oppositely charged article.

Same is accomplished by a means which provides greater stability to the projected spray or jet and imparts a sharper edge definition to its issuing pattern.

The invention envisions a paint spray gun mechanism wherein the forward atomizing and spray elements are isolated from the rear support and control elements and the structure is such as to permit the desired elimination of the possibility of a transmittal of an electrical charge in the forward area of the mechanism rearwardly to the rearward area thereof.

The rear portion of the mechanism is at ground potential for the convenience and safety of the operator while, at the same time, the forward portion thereof is adapted to receive a high electrical potential.

In applying coating materials to articles by means of known spray devices, the so called spray guns of the prior art, the art of employing compressed air as a means for atomizing or reducing the material into a fluid of fine comminuted particles and also as a carrying medium in spraying the same upon the surface of the articles being covered has been known. But such guns have been limited to a comparatively small field of dispersion. Also, they have caused the coating material to be discharged in non-uniform sized particles, as well as in variable patterns, whereby an uneven dispersion of the coating particles over the surface being coated results.

In certain prior art devices, the projected spray or jet is more or less unstable. That is, the axis of the spray or jet shifts erratically from one position to another. Expressed otherwise, the cross-sectional shape of the spray or jet pattern has been observed to vary during operation. Such instability results in an obviously objectionable irregular scattering of the coating material upon the surface of the article being coated.

In certain other prior art apparatus, a variable pattern of spray has been created and reproduced upon the surface being coated, the heavier coating particles being caused to impinge over one particular area and the more

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finely divided particles being caused to impinge over a different area. By reason of such variance, it often has been found advisable to arrange a plurality of spray guns in more or less of a bank, with particular regard to the variable pattern of each specific gun, which guns when properly arranged complement each other, all to the end that the pattern produced therewith is smoothed or evened out.

The inherent electrical effect in prior art guns of this general type causes the particles to repel each other more or less whereby lateral spreading thereof results. This spreading phenomenon is especially noticeable at the outer portions of the spray or jet area where an uneven, irregular and indistinct edge definition to the pattern of the coating material being deposited upon the article is normally observed.

By surrounding in close proximity the atomizing, projecting and depositing electrostatic field with an envelope of air, which is substantially coextensive longitudinally with the former, the projecting spray jet is stabilized, and is made more definite in shape and more constant in direction. The scattered spreading effect upon the particles, particularly at the outer portions of the jet, is materially reduced. This results in a deposited pattern which is more uniformly dense throughout and which has a desired sharp edge definition.

One of the objects of this invention is to provide a stabilizing area adjacent the electrostatic spray atomizing, projecting and depositing field, which area is effective to stabilize the jet produced by the latter, both in respect to direction and in respect to shape, and to give a resulting deposited pattern having a relatively sharper edge definition throughout its entire periphery and/or over one or more portions thereof.

The atomizing element of my apparatus consists essentially of a small head or nozzle having a sharply defined distributing or atomizing point or tip from which the coating material is metered at a predetermined rate in the form of atomized particles.

A source of electrostatic high potential, having one terminal grounded and its opposite terminal connected to the atomizing head creates a strong electrostatic field between the head and the article to be coated, which article is also grounded.

The force of this field transforms the coating material into a spray of fine, charged particles and creates an attraction which pulls the spray to the grounded article, thus accounting for complete electrostatic deposition.

I have determined, through considerable investigative effort, that optimum results are obtained where the mass of the atomizing point or tip is maintained as small as possible where as the mass of the article being coated is relatively larger. Such facilitates leakage of the atomized material from the high potential point or tip to the article. Otherwise expressed, the smaller the area at the high potential, the greater the leakage off to the mass of the article being coated.

Further, I have determined that by isolating the atomizing head and gun point or tip from the remainder of the gun, as by an insulated member or members, the desideratum of maintaining the smallest portion or area of the gun at a high potential is attained. In order to separate or isolate the atomizing head from the support or control elements of the gun, I have employed connections therebetween which are non-conductors of electricity, they being of rubber, glass, ceramic, plastic, or similar non-conducting material. By means thereof, the high voltage nozzle or head end of the gun apparatus is separated from the grounded support or control end in such manner that the support and control mechanisms, as well as the operator, are safeguarded against dangerous backfiring from the nozzle or head end.

It should be additionally mentioned here that in appa-

ratus employed for applying a liquid coating to articles, whether or not the coating material is electrostatically deposited, it is common to move the articles progressively through a coating zone in which the coating is applied to them. In this invention, it is anticipated that the articles to be coated may be moved past the apparatus of the invention, or conceivably, the apparatus can be reciprocated along a horizontal or vertical axis, or both, past the articles. In either event, the articles to be coated are usually supported in spaced relation to the discharge electrode, between which and the articles, a potential difference of sufficient magnitude is maintained so as to create an electrostatic field with an atomizing corona discharge in the region adjacent the discharge end of the discharge electrode.

Broadly speaking, the coating material is normally supplied to the discharge end and its region of corona discharge at a rate at which it can be electrically atomized by the corona discharge most efficiently and effectively, after which the charge particles are projected in spray form toward and deposited upon the oppositely charged article. Depending upon the viscosity and other characteristics of the material, the control of the supply is such as to permit the discharge of precisely the correct quantity and size of the particles so as to effect the greatest efficiency in coating a surface.

All of the above cited objects, I accomplish by means of such structure as will fully appear by a perusal of the description which follows and by various specific features which will be hereinafter set forth.

With the foregoing and various other and ancillary objects of my invention as will become more readily apparent as the description proceeds, my invention consists in certain features of novelty, in mode of operation, and in the combination and arrangements of parts as will be hereinafter more particularly pointed out in the claims hereunto annexed and more fully described and referred to in conjunction with the accompanying drawings wherein:

Fig. 1 is a side elevational view of the device of the invention parts being shown in section;

Fig. 2 is an enlarged sectional view on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged sectional view on the line 3—3 of Fig. 1.

In the accompanying drawing, I have illustrated a complete example of a physical embodiment of the invention in which the parts are combined and arranged in accordance with one mode which I have devised for the practical application of the principles of the invention. It will however be understood that changes and alterations are contemplated and may be made in these exemplifying drawings and mechanical structures, within the scope of the claims, without departing from the basic principles of the invention.

In the following description and claims, various details will be identified by specific names for convenience. These names however are intended to be as generic in their application as the art will permit.

Referring now to the drawing more in detail, in which similar characters of reference indicate corresponding parts in the several figures, and referring more particularly to the preferred form of my invention selected for illustrative purposes. I have shown an arrangement of apparatus which is suitable for coating articles (not shown) which are preferably moved along a path of article-movement through a coating zone which the device of the invention, fixed in location, projects.

Disposed at one side of the path of article-movement is a horizontally positioned atomizing head generally designated by the numeral 10, by means of which head the liquid coating material is electrostatically atomized.

Said atomizing head may be fixedly or adjustably mounted upon a suitable support, or it may be hand

manipulated by means of a handle, all as may be desired.

An elongated liquid spray material tube 20 made from glass, rubber, plastic, or similar material is provided with a longitudinal bore 21 extending therethrough. A coating material is adapted to be passed therethrough as will presently be observed.

Another elongated gas tube 22 extends parallel to the tube 20 and is spaced a distance away therefrom. Tube 22 is also provided with a longitudinal bore 23 extending therethrough. A gaseous material, such as air, is adapted to be passed therethrough, all as will hereinafter appear.

At the opposite extremities of the tubes 20 and 22, connecting means are provided.

At the nozzle end of the head, a nose piece 26 is provided and the tubes 20 and 22 may be threadedly or otherwise engaged therewith.

Interior passageways (not shown) within the nose piece 26 connect the respective tubes 20 and 22 with appropriate means at the forward face of the nose piece whereby the liquid and air may pass therethrough to forwardly disposed members shortly to be described.

The spray gun contemplated for use in this invention consists of a conventional main body portion which is disposed rearwardly of the apparatus of this invention. Same does not form a part of this invention and accordingly is not shown. It also includes a spray head similar to the type disclosed in U. S. Letters Patent #2,070,696, dated February 16, 1937.

The nose piece 26 is of such configuration as to be adapted to receive, in threaded engagement therewith the spray head of the above patent or of any other of the well known commercial types of atomizing spray guns using air for the atomizing medium.

The spray head comprises an inner fluid nozzle 40 formed with a forwardly disposed tip 42 having a central orifice 43 therethrough through which the coating material is emitted.

The inner fluid nozzle 40 is threadedly receivable in a sleeve 44 which is receivable in an appropriate opening in the forward face of the member 26.

An annular outer nozzle 46 surrounds the member 44 in spaced relation therewith so as to provide an annular opening 48 through which the air may be emitted.

The rear end portion of the member 44 is enlarged as shown at 50 and is connected in any suitable manner with the member 26.

The enlarged portion 50 of the member 44 is formed with a suitable annular seat 52 against which the forward end of nose 26 is held by a union nut 54 or other suitable means.

Forwardly of the member 40, an elongated connecting member 60 is provided having a central orifice 62 extending therethrough throughout the longitudinal length thereof.

The member 60 has an outwardly extending annular skirt portion 64 which is adapted to be engaged at its outer peripheral edge by the union nut 54 so as to hold the member 60 in extended coaxial relation to member 40 with the tip 42 extending into the opening 62 affording direct communication therebetween.

A sleeve 70 which may be made of metal or of insulating material such as rubber or the like as desired has a central opening extending longitudinally through the forward area thereof which is of reduced diameter, as shown. The forward opening leads into an enlarged opening within the sleeve member 70 at the rearward area thereof.

The rearmost portion of the inside wall of the member 70 is threadedly engaged with the member 60, as shown.

A needle 80 having an orifice 81 extending throughout the length thereof is extendable through the forward opening in the sleeve 70 so as to have a free outer

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end 83 extending therebeyond. If desired, the free outer end 83 may not be extended beyond the outer end of the bore.

The inner end 84 of the needle 80 is receivable in the opening 62 of the member 60 and affords direct communication therebetween. The inner end 84 has a shoulder 86 which abuts the outer end of the opening 62.

The needle 80 may be secured to the member 60 by means of a coupling 88, as shown.

The nose piece 26 and the other elements at the forward end of the gun are preferably made from electrical conducting material, the nose piece being connected to the ungrounded terminal of a high voltage source by means of a high voltage instrumentality 27. The potential source is electrically connected to the structure by a conductor associated with the connection 27 for raising the discharge edge to a sufficient high electrical potential for electrostatically atomizing liquid material supplied thereto as will presently be observed. The potential at the discharge edge approximates 100,000 volts. D. C.

The coating material passes through the tube 20 and appropriate conducting means in the nose piece 26 to the member 40 and out through the opening 43 thereof into the opening 62 of the member 60 and thence into and through the opening 81 of the needle 80.

The atomizing air is adapted to be supplied through the member 22 to the nose piece 26, then through the opening 48 and past the member 46, and thence through the openings 66 and into and through the opening in the sleeve 70 around the needle 80.

It will be appreciated that the needle 80 extends coaxially throughout the opening in the sleeve 70 and passes out therebeyond as a pointed metal rod electrode.

As the stream of liquid passes outwardly through the needle and as the stream of air passes outwardly around the surface of the needle, the same are subjected to the atomizing effect of the corona discharge from the rod electrode whereby the finely divided particles comprising the spray have each imparted thereto electrical charges of like polarity.

As previously stated, under certain conditions, the projected jet wavers erratically and continuously. This results in a scattered dispersion of the particles comprising the jet and thereby causes the deposited pattern upon the article to have irregularly disposed lakes. In addition, the mutual electrical repulsion of the particles due to their being charged to the same sign causes them to spread and scatter laterally, particularly at the outer portions of the jet. This makes a less sharply defined edge at the boundary of the deposited pattern.

To overcome these objectionable characteristics, I provide a gaseous field surrounding in close proximity the electrostatic atomizing field and coextensive in length with the latter. That is, it extends along the rod member with which it is substantially coaxial and terminates at the surface of the article to be coated.

In this manner, an air chamber is provided adjacent the outer periphery of the point of the needle 80 whereby a gaseous medium of any desired intensity may be introduced around the stream being dispersed through the needle so as to surround or envelop same.

Understandably, valve means (not shown) may be provided whereby the flow of liquid and air may be better controlled.

By means of this concentration of air around the liquid, the center of the area being sprayed receives as much of the sprayed material as the outer edges thereof, the air blast having the capability of directing the sprayed material inwardly toward said central area.

The insulated sleeve member 70 surrounds the needle 80 so as to insure against the discharge of coating material except along the free uncovered outermost portion of the needle.

The needle tip presents toward the articles to be coated a reduced or relatively sharp tip or discharge point from

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which the coating material may be withdrawn in the form of particles.

The inner extremities of the tubes 20 and 22 are threadedly engaged with a tail piece 90 by means of couplings 92 and 94 respectively.

The tail piece is connected to sources of supply of the coating material and air (not shown) by means of connections of any of the conventional designs.

In the drawing, a connection 96 is shown which may be connected to a source of air (not shown) and a connection 98 is shown which may be connected to a source of coating material (not shown).

The liquid and gaseous materials are supplied through their respective conduits to the nozzle assembly as previously described.

Without further analysis, the foregoing will fully reveal the gist of my invention whereby others can, by applying current knowledge, readily adapt it for various applications without omitting features which, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention. Such adaptations therefore should and are intended to be comprehended within the meaning and range of equivalence of the claims below:

What is desired to claim and secure by Letters Patent of the United States is:

1. In combination, an aero-electrostatic atomizing device attached to a spray gun for use in discharging an electrically charged air-supported stream of fluent coating material at high velocity, a dual motive agent-coating material atomizing nozzle comprising a combined coaxially disposed rearward connector and forward needle of electrically conductive material and having a fluent coating material bore extending longitudinally there-through, having the forward portion of uniform diameter and terminating at the forward end in an outer forwardly facing discharge orifice of the same diameter as that of the forward portion of said bore, said connector being engaged with the forward-extremity of the spray gun of electrically conductive material having means for connection to a high voltage source, an outer elongated sleeve of insulating material disposed forwardly of said spray gun and in axial alignment therewith and engaged with the rear connector, said sleeve having a motive agent longitudinal bore, the forward portion of which is of uniform diameter terminating at its outer end in a forwardly facing discharge orifice of the same diameter as that of said forward portion of said last-named bore, concentric with, rearwardly of, and disposed around the discharge orifice of the fluent coating material bore, all adapted and arranged whereby a motive agent discharged from the motive agent orifice impinges the electrically discharged particles of the fluent coating material discharged from the fluent coating material orifice in a plurality of points lengthwise thereof.

2. In combination, an aero-electrostatic atomizing device attached to a spray gun for use in discharging an electrically charged air-supported stream of fluent coating material at high velocity, a dual motive agent coating material atomizing nozzle member comprising a combined axially disposed rearward connector and forward needle having a fluent coating material longitudinal bore connecting at its forward end with discharge orifice means, said connector being of electrically conductive material and being connected with the forward extremity of the spray gun, said gun being of electrically conductive material and having thereon a high voltage instrumentality, an outer longitudinal sleeve member disposed forwardly of said spray gun in axial alignment therewith and connected with the rear end of the connector, said sleeve having a longitudinal motive agent bore communicating at its forward end with discharge orifice means disposed around and adjacent the coating material orifice means, one of said members being of electrically conductive material, whereby a motive agent discharged from the

motive agent orifice means impinges the electrically charged particles of the coating material discharged from the coating material orifice means.

3. In an aero-electrostatic atomizing device attached to a spray gun member of electrically conductive material for use in discharging an electrically-charged air-supported stream of fluent coating material at high issuing velocity, a dual motive agent-coating material atomizing nozzle comprising a combined coaxially disposed rearward connector and forward needle member of electrically conductive material, one of said members having a high voltage instrumentality thereon, the rearward extremity of the connector of said combined connector-needle member being engaged with the forward extremity of the spray gun, said combined connector-needle member being provided with a fluent coating material bore longitudinally and interiorly thereof and terminating in an outer forwardly facing discharge orifice at the forward extremity thereof, an outer elongated sleeve of electrically insulating material disposed forwardly of the spray gun and in axial alignment therewith, the rearward extremity of said sleeve being engaged with the rearward extremity of said combined connector-needle member, said sleeve being provided with a motive agent bore longitudinally and interiorly thereof and terminating in an outer forwardly-facing discharge orifice at the forward

extremity thereof concentric with and disposed around the discharge orifice of the fluent coating material bore, all adapted and arranged whereby a motive agent discharged from the motive agent bore impinges the electrically charged particles of the fluent coating material discharged from the fluent coating material bore in a multiplicity of points lengthwise thereof.

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