Sept. 9, 1958 J. SEDLACSIK 2,851,307

ELECTROSTATIC DEPOSITION APPARATUS

Filed Nov. 10, 1954

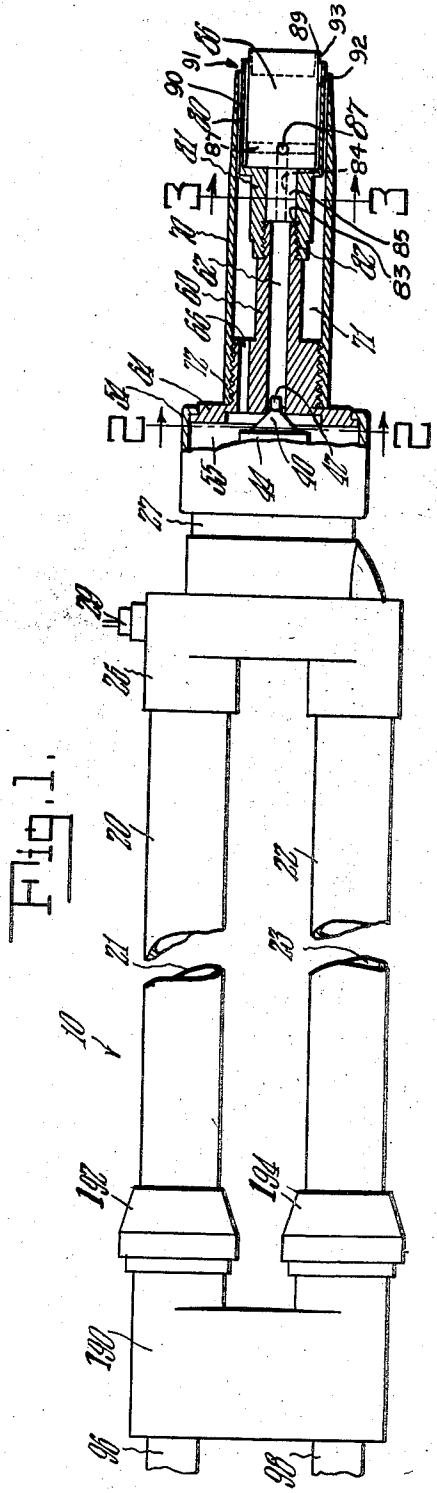


Fig. 1.

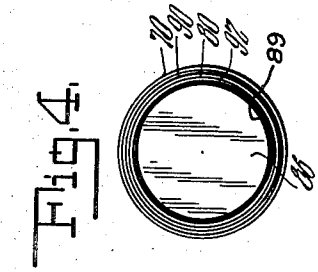


Fig. 4.

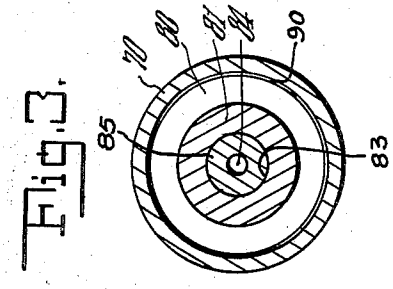


Fig. 3.

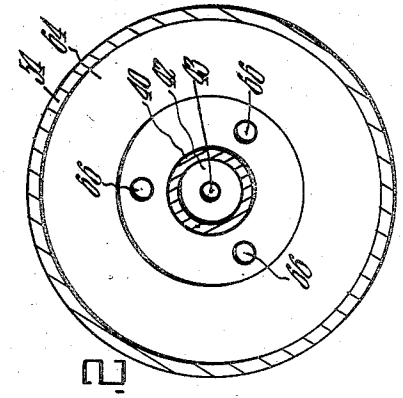


Fig. 2.

INVENTOR.
John Sedlacsik.
BY
Rossi Rossi
Atty's & Agents

United States Patent Office 2,851,307
Patented Sept. 9, 1958

2,851,307

ELECTROSTATIC DEPOSITION APPARATUS

John Sedlacsik, Garfield, N. J., assignor to Ionic Electrostatic Corporation, Garfield, N. J., a corporation of New Jersey

Application November 10, 1954, Serial No. 467,964

2 Claims. (Cl. 299—140)

My invention relates to improvements in an apparatus used in applying a liquid/gaseous coating material to an article by electrostatically charging and depositing the comminuted coating material upon the article within an electrostatic field created between the article and the issuing source of the coating material.

Means is provided whereby the liquid/gas may be readily and efficiently divided into minute particles by electrical force, without the assistance of moving air streams or other means commonly employed for this purpose.

As the coating material is electrostatically charged and projected from the apparatus, the electrical charge is directed toward and electrostatically deposited upon the articles to be coated.

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 with prior art spray guns, 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.

The inherent electrical effect in prior art guns causes the particles to repel each other more or less whereby lateral spreading thereof results.

This spreading phenomena 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

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

The atomizing element of the apparatus consists essentially of a small nozzle having a sharply defined annular shaped distributing or atomizing 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.

Optimum results are obtained where the mass of the atomizing tip is as small as possible whereas the mass of the article being coated is relatively larger. Such facilitates leakage of the atomized material from the high potential 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 or gun 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 backfiring from the nozzle or head end.

In apparatus 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. Here it is anticipated that the articles to be coated may be moved past the apparatus of the invention, or 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 charged 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 with parts being shown in section;

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

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

Fig. 4 is an end elevational view looking toward the atomizing tip of the gun as shown at the right in Fig. 1.

In the accompanying drawing, there is illustrated a complete example of a physical embodiment of the invention. Therein the parts are combined and arranged in accordance with one mode which has been devised for the practical application of the principles of the invention.

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.

The 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 head or nozzle end of the structure, a nose piece **26** is provided and 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**.

The member **44** is connected in any suitable manner with the member **26** and is surrounded by a union nut **54** which is threadedly engageable with the forward portion **27** of the nose piece **26**.

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 hollow outer housing **70** has a rearmost portion **72** threadedly engageable with the member **60**, as shown.

An air opening **66** extends through the member **60** as shown. A plurality of such openings may be provided, if desired, permitting air to move forwardly from the area **55** within the union **54** to the area **71** between the housing **70** and the member **60**.

A sleeve member **80** is generally cup shaped in its forward area and is provided with a neck portion **81** in its rearward area. The neck portion is threadedly engageable with the forward end portion of the member **60** at **82**.

A central bore or opening **83** extends longitudinally through the neck portion **81** and receives therein the shank **85** of a plug member **86**, the latter having a central passage or opening **84** having its rear end in direct communication with the opening **62** in the member **60**. The forward end of the opening **84** terminates in radially extending branches **87** each of which leads into the forward cup of the sleeve member **80**.

An annular air space **71** is provided between the outer housing **70** and the sleeve member **60**.

The plug member **86** is receivable within and spaced from the sleeve member **80** so as to provide an annular space **92** therearound between which and the sleeve member the liquid coating material passes. An annular air space **90** is provided between the housing **70** and the member **80** whereby air from the air space **71** may pass outwardly therefrom.

The forward end of the sleeve member **80** extends forwardly slightly beyond the forward end of the member **70** and the forward end of the plug member **86** extends forwardly slightly beyond the forward end of the sleeve member **80**. The forward end of the member **86** is formed with a sharp edge **89** to provide a corona discharge as hereinafter made apparent. Coating material is emitted outwardly from the space **92** through the orifice **93** at the forward end of the member **80**.

If desired, the forward end of the sleeve member **80** may extend inwardly of the outer end of the outer hous-

ing 70 and the forward end of the plug member 86 may be disposed inwardly of the outer end of the sleeve member 80.

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 (not shown) by means of a connection 29.

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 in the tip 42 thereof into the opening 62 of the member 60 and thence into and through the branches 87 of the member 86.

The atomizing air is adapted to be supplied through the member 22 to the nose piece 26, then through openings 66 and into area 71 and through the space around the sleeve 80 and then outwardly through the orifice 91 at the forward end of the housing or member 70.

As the stream of liquid passes outwardly through the member 40, 60 and 86 and as the stream of air passes outwardly around the outer surface of the sleeve member 80, the same are subjected to the atomizing effect of the corona discharge from the edge 89 of the member 86 whereby the finely divided particles comprising the spray have each imparted thereto electrical charges of like polarity.

With voltage applied directly to the spray head structure, a corona discharge is formed in the region around the nozzle and adjacent the outermost periphery thereof which is of an intensity sufficient to break up or to atomize into particled form the coating material being discharged from the nozzle and to project said coating material in spray form toward the surface of the article being coated.

A high electrical potential, from a suitable source, is applied to the nozle or head assembly while the material being atomized and the gas or air are delivered through the respective delivery tubes and connections to the nozzle or head assembly. This material, and the gas, issue from their respective orifices in the nozzle in the form of high velocity streams where they meet and mix with each other under pressure and are atomized and electrically charged passing outwardly into the field with high turbulence.

As aforesaid, 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 and around the sleeve member with which it is substantially coaxial and terminates at the surface of the article to be coated.

In this manner, an air envelope is provided adjacent the forward outer periphery of the member 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 envelope same.

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

By the use of this gaseous envelope outside of and surrounding the liquid, the paint or other material being sprayed with the apparatus may be better concentrated or dispersed over a given area of an article being coated.

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 inner extremities of the tubes 20 and 22 are threadedly engaged with a tailpiece 190 by means of couplings 192 and 194 respectively.

The tailpiece 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 or gas (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.

These materials issue from their respective orifices at the outermost free end of the nozzle in the form of streams where they mix with each other. The resulting mixture is directed outwardly with high turbulence in the form of a finely atomized stream as hereinbefore described.

In operation, an unidirectional electric potential is maintained at the high potential nozzle assembly and, as the thus formed stream is directed outwardly away from the nozzle, it is subjected to the ionizing effect of the corona discharge from the isolated nozzle whereby the finely divided particles comprising the spray have each imparted thereto electrical charges of like polarity and of substantially equal potential with respect to the atomizing point or tip.

The positively charged particles tend to repel one another and thus resist coalescence with the result that the electrified cloud of spray is attracted to surrounding grounded object desired to be sprayed and/or coated. The particles are attracted to and precipitate in a layer upon the nearest surface of the grounded article which is to be coated.

Coating material is urged forwardly to the discharge point or tip of atomization where it is electrostatically atomized and precipitated upon the article passing the head by the action of the electrostatic field which exists between the article and the head. That is the particles are electrostatically dispersed as they are formed or produced along the line of atomization and they are electrostatically deposited while still in the liquid state upon the article surface so as to form a finished coating.

As aforesaid, the applicator head is connected to a source of high voltage (not shown) through one terminal thereof. The other terminal of the source is grounded and through ground is connected with the article to be coated and/or the conveyor therefor.

Accordingly, the space or field between the applicator head and article is electrostatically charged by reason of the article being grounded and the applicator being at the high potential.

The effect thereof is to cause an electrical force to act on the coating material causing same to be broken up into finely divided or minute particles of coating material, such as to be attracted to the grounded article for deposition thereon. Thus, the grounded article may be referred to as a collecting electrode of one potential with the applicator head serving as a discharge electrode of a different potential.

The electrostatic force set up in the field between the electrodes is such as to develop and transmit finely divided particles of the coating material from one electrode to the other.

The same action will take place when the applicator head is grounded and the article is directly connected with the source of high voltage and is charged at a high potential.

The rate at which the coating material is supplied to the applicator head may be controlled by valves or the like (not shown) so as to insure that the apparatus will

not receive more coating material than can be atomized from its discharge edge.

If desired, the coating material may be circulated from the source of supply through the apparatus and may be then recirculated back to the source of supply again so as to aid in the maintenance of the desired degree of control.

With high voltage applied directly to the atomizing head structure, a corona discharge is formed in the region therearound and adjacent the outermost periphery thereof which is of an intensity sufficient to break up or to atomize into particled form the coating material and to project said coating material in a spray form toward the surface of the article being coated.

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

1. An aero-electrostatic atomizing apparatus adapted to be attached to a spray gun, a substantially cylindrical housing, spray gun attaching means adjacent an end thereof, a member in said one end having an eccentric bore through said member, said member having a reduced connecting member extending concentrically from said member and both of said members having an axial bore, a cylindrical sleeve extending from said connecting member, said sleeve being adjacent the second end of said housing and spaced therefrom, a cylindrical plug attached to said connecting member and having a bore in register with said connecting member bore and terminating laterally of said plug, said plug being spaced from said cylindrical sleeve, whereby material entering through said eccentric bore will issue between housing and said sleeve and material entering through said axial bore will issue between said sleeve and said plug.

2. An aero-electrostatic atomizing apparatus adapted to be attached to a spray gun having a high voltage instrumentality thereon, a substantially cylindrical housing, spray gun attaching means adjacent one end thereof, a member secured in said one end having an eccentric bore through said member, said member having a reduced connecting member extending concentrically from said member and both of said members having an axial bore, a cylindrical sleeve extending from said connecting member, said sleeve being adjacent and within the second end of said housing and spaced peripherally therefrom, a cylindrical plug attachd to said connecting member and having a bore in register with said connecting member bore and terminating laterally of said plug, said plug being within and spaced peripherally from said cylindrical sleeve, said plug having a peripheral knife edge at its outer end, whereby air entering through said eccentric bore will issue between said housing and said sleeve and fluent material entering through said axial bore will issue between said sleeve and said plug and be atomized at said knife edge.

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