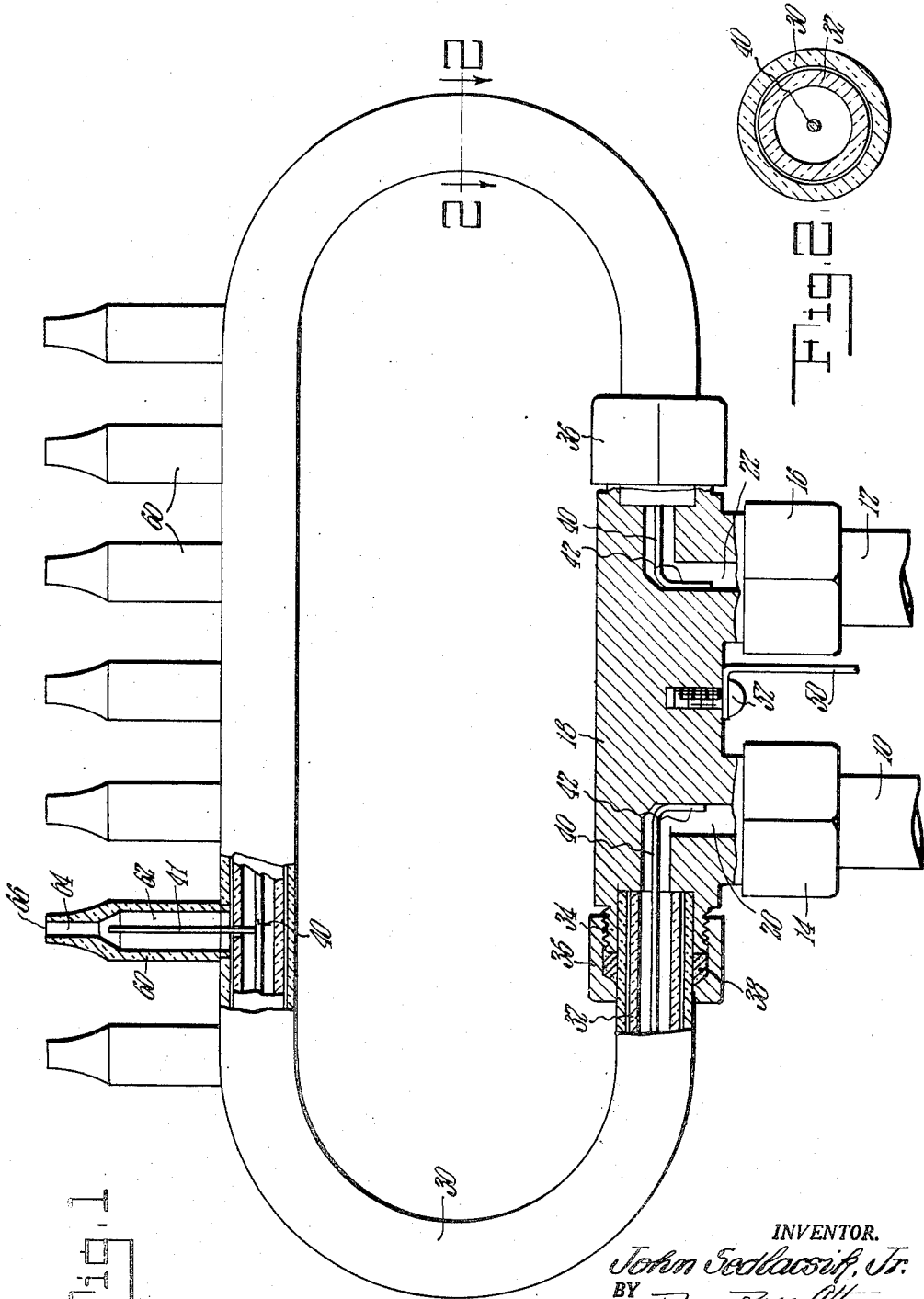


INVENTOR.
John Eckhardt, Jr.
BY *Thos. Pres. Atty.*



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2,855,245

ELECTROSTATIC DEPOSITION

John Sedlacsik, Jr., Garfield, N. J.

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9 Claims. (Cl. 299—1)

My invention relates to improvements in an apparatus for electrostatic coating comprising a pneumatic atomizing spraying head wherein air or the like as a motive agent and a liquid or the like as a coating agent are supplied separately to a plurality of relatively small discharge nozzles having sharply defined distributing mouths and arranged in a bank upon the so-called turret of the spraying head. The agents are supplied to the interior of the turret and are discharged simultaneously through the nozzles at a predetermined rate in a manner whereby the fluid agent is atomized and electrically charged.

In electrostatic coating systems of the present popular types, a field of electrostatic force is created which includes the article being coated and the atomized coating material particles in movement toward such article. In normal commercial practice, it is desirable to mount the article on a grounded conveyor and thus make it an electrode at ground potential. Another electrode at high potential is provided and same usually comprises the spraying head.

This invention contemplates the formation of a paint or similar spray from a liquid material, which material is capable of relatively rapid atomization and expulsion from the apparatus to which the liquid material is introduced in its liquid form. This is preferably done through the employment of the liquid coating material atomized by a motive agent and subjected to an electrostatic attraction of the atomized particles of the material and the subsequent dispersion thereof toward an oppositely charged article or target.

The principal object hereof is directed to a new and useful apparatus and method for improving this aforementioned dispersion of the atomized particles from the charging mechanism to the oppositely charged article or target. Same is accomplished by a means which provides greater stability to the projected spray or jet and imparts a sharper edge definition to the pattern thereof. That is to say, the comminuted coating material is charged and distributed within the electrostatic field created between the article and the issuing source of the coating material.

It is another object of the present invention to provide an improved method of and apparatus for coating in which electrostatic spray forming or atomization is utilized.

Another object of the present invention is to provide apparatus for coating by electrostatic means which is considerably simplified, more efficient in its use, and considerably cleaner in operation.

In prior art spraying devices utilizing air pressure to atomize the coating material, the spray mixture issuing from the spray nozzle spreads outwardly or expands uniformly taking the form of a generally conical mist-like stream. The sides of this stream travel outwardly in diverging paths in the general direction of the surfaces to be coated. Upon impact therewith, considerable of the coating material, entrained with the air, is deflected in a swirling action away from this surface and is dis-

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persed into the atmosphere. A great deal of the coating material, discharged from the nozzle, is thereby lost and, therefore, more material than actually needed is usually used to produce the desired coating.

This invention has for one of its purposes, the provision of an improved spray coating device which is capable of reducing this loss and waste of coating materials, of increasing the amount of effective coverage which may be obtained from a given quantity of coating material, and of generally improving the character of the coating produced by the spray device.

It will be understood that the general arrangement of the nozzles from which the coating material escapes can be materially altered and the efficiency of the apparatus can be materially increased or decreased.

More particularly, the invention contemplates a distributing apparatus and a method for applying a liquid coating to an article by electrostatically charging and depositing the comminuted coating material upon an article to be coated which is disposed within an electrostatic field created between the article and the issuing source of the coating material.

The invention includes means for imparting an electrical charge to the coating material, 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.

Broadly speaking, the invention relates to the formation of a paint or similar spray from a liquid material capable of relatively rapid atomization by expelling same from the container in which the material is held in the liquid form.

This is preferably done by means of air, in conjunction with an electrostatic attraction toward an adjacent target, as well as by the repulsion between the charged surface portions of the liquid and other adjacent parts of the mass.

For such purposes, it is essential that the liquid be sprayed in such a minutely or highly atomized condition that it will diffuse readily and uniformly throughout the surrounding atmosphere.

No completely satisfactory spraying device has yet been provided for this purpose. It is an object hereof to provide a spray head or spraying unit which is highly efficient and which insures uniform, widespread dispersion of the sprayed liquid throughout a large area in a non-precipitable state of atomization.

Other objects of the invention are: to provide a multiple nozzle atomizing unit or spray head of simple and compact construction which may be readily manufactured at low cost; to insure equalized distribution of air and liquid to all of the spray outlets; to construct the unit or spray head so that the parts thereof are readily accessible; and to provide a unit of the described character which is adaptable for permanent installation.

Still another object hereof is to provide means for improving the dispersion and deposition of the atomized particles from a charged gun mechanism upon an oppositely charged article, which means provides greater stability to the projected spray or jet and imparts a sharper edge definition to the issuing pattern.

This invention broadly envisions a paint spray apparatus mechanism wherein the forward atomizing and spray elements are isolated from the rearward support and control elements. The structure prevents the possibility of a transmittal of an electrical charge from the forward area of the apparatus rearwardly to the rearward area thereof, the rear portion of the mechanism being at ground potential for the convenience and safety of the operator and the forward portion of the mechanism being connected to the high electrical potential.

This invention is designed to be operable in combination with spray heads such as are shown and described in the patent of John Sedlacsik, #2,710,773, issued June 14, 1955.

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 distributing head or turret 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 toward and to the grounded article or target, thus accounting for complete electrostatic deposition.

The invention resides in the particular arrangement, construction and relationship of the various elements of the spray apparatus as disclosed in the accompanying specification in which the above and other objects of the invention will be apparent.

In the drawing:

Fig. 1 is a top plan view of the turret of the invention with certain parts broken away for purposes of clarification; and

Fig. 2 is a sectional view of the line 2—2 of Fig. 1.

The invention is not to be considered as limited in its application to the details of construction and arrangement of parts illustrated in these drawings, since the invention is capable of other embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

It will be further understood that forms of spraying devices other than the particular electrostatic atomizing device shown may be utilized and that other apparatus may be employed for accomplishing the purposes and for practicing the methods of the invention.

In the drawings, I have illustrated an example of one embodiment of the invention wherein 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 be understood however that changes and alterations are contemplated and may be made within the scope of the claims, without departing from the basic principles of the invention.

Referring now to the drawings more in detail 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) preferably moved along a path of article movement through a coating zone into which the device of the invention, normally fixed in location, is projected. It will be appreciated, however, that if desired, the apparatus of the invention could be reciprocated through this coating zone.

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

I have shown an apparatus wherein an air intake line 10 and a coating material intake line 12 are coupled by means of couplings 14 and 16 respectively to a support member 18, as shown, which support member is preferably formed from some electrical conducting material.

The support member 18 is provided with interior passageways 20 and 22 whereby communication with the lines 10 and 12 respectively is afforded.

Opposite ends of a pair of plastic tubes 30 and 32, one concentrically disposed within the other (as will be best observed by reference to Fig. 1), are received within spuds 34 at opposite sides of the support member 18 and are held relative thereto by means of couplings 36 in the conventional manner. Said tubes function as insulations as will hereinafter be observed.

A packing member 38 is seated within each coupling 36 adjacent the respective spud 34 so as to insure a tight

fit between the coupling and the respective adjacent end of the tubes.

The inner tube member 32 has a central orifice or passageway therethrough which is in communication with the passageways 20 and 22 of the member 18.

Disposed within the member 32 throughout the length thereof is a flexible rod-like member 40 formed of electrical conducting material, which member is protected by the tubes 30 and 32 disposed therearound.

Opposite free ends 42 of the member 40 are secured to the member 18 within the passageways 20 and 22 so as to establish electrical contact therewith for purposes as will shortly appear.

The member 18 is connected by means of a connection 50 fixed thereto by a screw 52 or equivalent means to one terminal or pole of a static machine or other source of high electric potential.

The members 30 and 32 are looped in a ring-like manner as shown and at the forward side thereof a plurality of forwardly disposed transversely extending nozzles 60 are provided.

Each nozzle 60 is made of a plastic similar to the material of member 30 and is seated over an opening in the side wall thereof as shown so that each nozzle communicates with the interior of the member 32.

Each nozzle 60 is provided with a hollow interior 62 having an outermost restricted throat 64 leading outwardly to and through the outer free end or mouth 66.

Extending upwardly into the opening 62 of each nozzle and terminating in an outer free end just short of the restricted throat 64 thereof is a needle-like member 41 which is fixed at its inner end to the member 40 and extends through a suitably aligned opening through the wall of the member 32, the opening being of suitable dimension so as to permit the escape of the motive agent and the fluid agent therethrough around the needle member 41.

The air or equivalent motive agent is introduced to the apparatus through the air intake line 10 and through the air passageway 20 of the member 18 and thence outwardly into the hollow passageway of the member 32.

The fluid coating material is similarly introduced to the apparatus through the coating material intake line 12 and through the coating material passageway 22 of the member 18 and thence outwardly into the hollow passageway of the member 32.

The motive agent and the fluid agent travel in opposite directions from the member 18 through the member 32 where they are mixed within the central orifice of the member 32 as they are brought together from the opposite ends thereof. Being under pressure from said opposite ends, the mixed materials are urged outwardly through the members 60 for discharge in a forward direction through the mouths 66 thereof.

As the stream of mixed air and liquid passes outwardly through the openings in the member 32 around the surfaces of the needles, the same are subjected to the atomizing effect of the corona discharge from the electrode whereby the finely divided particles comprising the sprays are each imparted electrical charges of like polarity.

With voltage applied directly to the rod member 40 of the spray head structure, a corona discharge is formed in the region around the member 40 and around the needles and adjacent the outermost peripheries of the needles. This discharge is of an intensity sufficient to complete the break up into particled form the coating material being discharged from the nozzles and to project said coating material in a spray form toward the surface of the article being coated.

That is to say, in actual operation, the electrical energy is maintained at the high potential nozzle spray assembly. The material being atomized and the gas are delivered through the respective openings to the nozzle or head assembly.

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The material being atomized and the gas are delivered through the respective delivery tubes and connections to the head assembly. The material and gas are released in the form of high velocity streams where they meet and mix with each other under pressure, are atomized and electrically charged, and pass outwardly with high turbulence.

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, within each of the nozzles.

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

The mixed materials issue from the orifices at the outermost free ends of the nozzles in the form of streams. The mixtures are directed outwardly with high turbulence in the form of finely atomized streams.

In operation, a 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 are each imparted electrical charges of like polarity and of substantially equal potential.

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 the grounded object 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.

As aforesaid, the spray 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 articles to be coated and/or the conveyor therefor.

Accordingly, the space of field between the spray head and article is electrostatically charged by reason of the article being grounded and the spray head 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 on 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 spray 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 spray 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.

With voltage applied directly to the spray head structure, a corona discharge is formed in the region around and adjacent each needle which is of an intensity suffi-

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cient 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.

By means hereof, the coating material is charged before the emission thereof from the nozzles 60 by means of the elongated charging surface of the needle like members 41 within the nozzles 60 and by means of the rod-like member extending through the passage of the member 32.

The coating material, by means hereof, absorbs a more complete charge within the spray device than has been heretofore possible with prior art systems where the electrical charges have been imparted to the particles subsequent to discharge from the mouth of the device in the area immediately forward thereof.

That is to say, in actual operation, the electrical energy is maintained at the high potential atomizing head assembly. The material being atomized is delivered through the delivery tube and connections to the head assembly.

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.

I claim:

1. Apparatus for electrostatic coating comprising, a support, an air intake line coupled to said support, or coating material intake line coupled to said support, an air passageway in said support communicating with said air intake line, a coating material passageway in said support communicating with said coating material intake line, a primary plastic tube communicating with said air passageway at one end thereof and with said coating material passageway at the opposite end thereof, a flexible electrical conducting member fixed to said support member at opposite ends thereof and extending through said tube, a plurality of nozzles connected to said tube and communicating with the interior of said tube, all adapted and arranged whereby air and coating material are mixed within said tube before passing outwardly through the nozzles of said plurality thereof.

2. In the apparatus of claim 1, each of the nozzles of said plurality thereof being provided with a needle-like member extending upwardly therethrough from said conducting member.

3. In a pneumatic spraying head comprising a high potential electrode to which a motive agent and a liquid coating agent are separately supplied comprising, a support connected to motive agent and liquid coating material intake lines and having separate motive agent and liquid coating material passages communicating therewith and extending therethrough, a turret of non-conducting material having a passageway therethrough having one extremity communicating with the motive agent passage of said support and having its opposite extremity communicating with the liquid coating material passage of said support, an elongated insert of electrical conductivity extending through the passageway of said turret and connected to the high potential source, a plurality of restricted discharge ports extending outwardly from said turret and communicating with the passageway thereof, and a plurality of discharge electrodes each being disposed within each of said discharge ports, each of said discharge electrodes being fixed to said insert.

4. Apparatus for use in an electrostatic coating system, said apparatus comprising a support having two separate passages therein, one passage being for air and the other passage being for a coating material, said support including intakes for each of said passages and having outlets disposed in line with each other but point-

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ing in opposite directions, a pair of concentric flexible tubes of electrically insulating material, one end of said concentric tubes being coupled to one outlet and the other end of said concentric tubes being coupled to the other outlet, a flexible electrical conductor disposed within the inner insulating tube and electrically connected to said support, a plurality of nozzles of insulating material carried by the outer tube and extending outwardly therefrom, said nozzles communicating with the interior of the outer tube by means of openings in the wall of the outer tube at the bases of said nozzles, said inner tube having openings through the wall thereof aligned with the outer wall openings for said nozzles, and a metallic member for each nozzle electrically connected to said conductor within the inner tube extending through the openings in the concentric tubes and into the nozzle, said flexible tubes being adapted to carry air and coating material in counterflow relation and said nozzles discharging said coating material in atomized form and said conducting member being adapted to charge said stream of atomized material as it issues from each nozzle.

5. An electrostatic coating means comprising a tubular loop like manifold, at least a part of the interior surface portion of said manifold being of insulating material having a source of air connected to one leg thereof and a source of coating material attached to the other leg thereof, an electrical conducting member in said manifold having attached thereto a source of electrical potential, and at least one nozzle extending from said tubular manifold.

6. An electrostatic coating means comprising a tubular loop like manifold as set forth in claim 5, and wherein said nozzle has disposed therein a branch conductor portion connected to the electrical conducting member.

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7. An electrical coating means comprising a tubular loop like manifold as set forth in claim 5, and wherein a multiplicity of nozzles extend from said tubular manifold and are spaced from one another, and with each of said nozzles having a conductor therein and with one end of each said conductor being connected to said electrical conducting member.

8. An electrical coating means comprising a tubular loop like means as set forth in claim 5, and wherein a plurality of nozzles extend from said tubular manifold with each of said nozzles having an outer portion of insulating material and an internal conductor portion connected at one end to said electrical conducting member and the other end thereof terminating within the confines of its respective nozzle.

9. An electrostatic coating means comprising a tubular loop like manifold of insulating material having a source of air connected to one leg thereof and a source of coating material attached to the other leg thereof, an electrical conducting member in said manifold having attached thereto a source of electrical potential, and at least one nozzle extending from said tubular manifold.

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