ELECTROSTATIC PAINTING APPARATUS FOR EXPLOSIVE ATMOSPHERES

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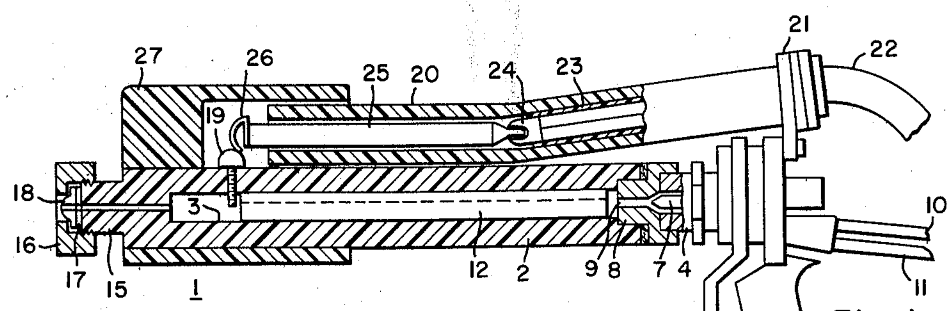

Fig. 1

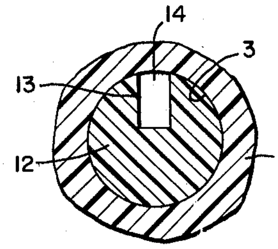

Fig. 2

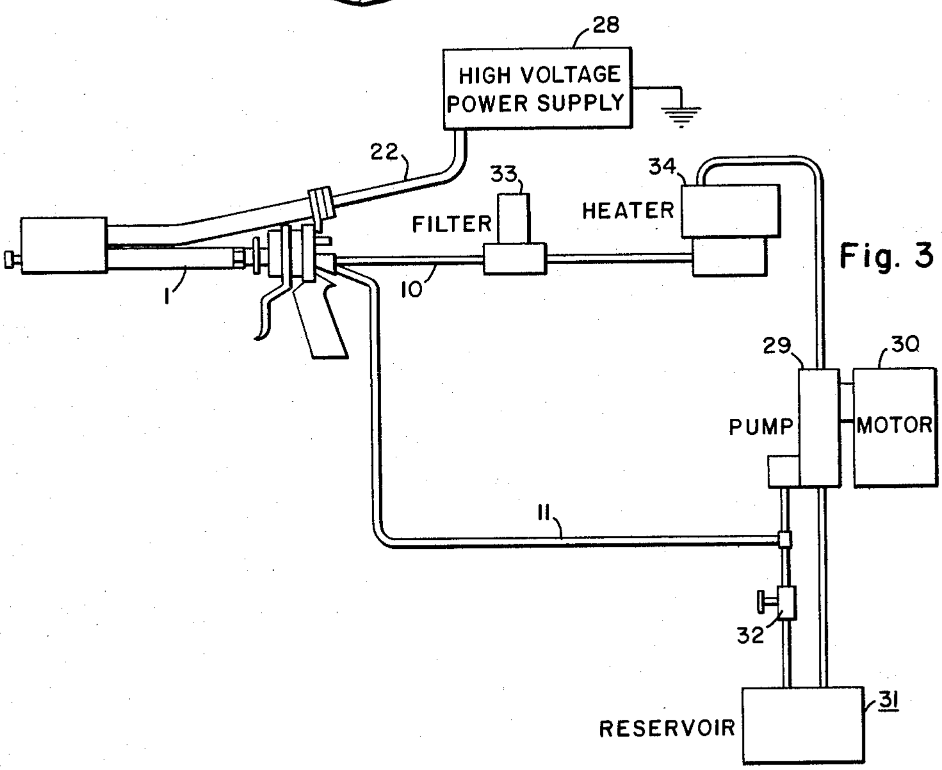

Fig. 3

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This invention relates in general to electrostatic painting apparatus and more particularly to an airless hydraulic spray gun incorporating high voltage means to electrostatically charge atomized coating particles with complete safety.

Conventional electrostatic spray apparatus, in the past, has included guns that rely on air or other gases to atomize the coating material, guns which feature the well known rotatable heads or electrostatic means to atomize the coating material. With guns which rely on a compressed air stream to atomize particles, a large proportion of the coating material is carried past the grounded article being coated by the force of the air stream. The air stream provides an impetus of such magnitude to some of the atomized particles that they are not attracted by the electrostatic force of the grounded article. When directed into corners and recesses of the article being coated, the air stream bounces back and carries a large portion of coated material back away from the grounded article. Reducing the force of the air stream is no solution, since the air stream must be sufficiently strong to atomize the coating particles. The phenomenon whereby electrostatic charges are built up on edges and corners further contributes to the lack of coating material in corners and recesses. The built up charge on edges, as compared to the charge in corners and recesses, results in an increased attraction for the charged particles of coating material literally robbing the recesses and corners of deposited particles.

The same phenomenon of electrostatic charge build up on the edges of the grounded article being coated contributes to the poor deposition of coating material in corners and recesses with guns that feature a rotating or centrifugal head and with apparatus employing electrostatic atomizing means. Coating particles atomized electrostatically or by a centrifugal head lack the necessary impetus or force to overcome the edge charge build up to reach corners and recesses. The annular spray pattern inherent in the centrifugal head is a further disadvantage that can be overcome only by such complex expedients as providing relative reciprocation between the head and the article being coated, or using a plurality of rotating heads. Such expedients are a particular disadvantage in guns adapted for hand operation.

In U.S. application Serial No. 178,478 filed March 8, 1962, assigned to the assignee of the present invention, an electrostatic, airless hydraulic spray gun, apparatus and method are disclosed and claimed which uniquely overcome the disadvantages heretofore described and which may be operated with increased safety and efficiency.

In the hereinabove mentioned application, the liquid coating material is atomized by a hydrostatic gun, without the aid of compressed air or other compressed gases. The hydraulic pressure on a column of substantially air and gas free liquid coating material, forces the coating material through an atomizing orifice into the atmosphere. The sudden expansion and volatilization of the solvent in the liquid coating material, as it enters the atmosphere, produces the atomization of the coating material.

The impetus imparted to the atomized liquid coating

particles by atomizing with the described airless hydraulic gun is uniquely sufficient to overcome the concentrated electrostatic charge on corners and edges of the article to be coated. The bounce-back normally associated with apparatus incorporating compressed air or gas for atomization is eliminated. When compared to systems which atomize the liquid coating material electrostatically or by means of air or centrifugal force, use of the described spray gun, apparatus and method results in a thorough and efficient deposition of coating material down in recesses and inside corners.

Electrostatic spray coating apparatus invariably makes use of a high voltage D.C. power supply of about 100 kv. with the negative terminal of the power supply affixed, through dropping resistors at the power supply, to the coating material atomizing means. The electrostatic airless hydraulic spraying apparatus disclosed in the application mentioned hereinabove was constructed with a high voltage connected to an atomizing nozzle through a resistor mounted on the spray gun. Mounting the high voltage resistor on the spray gun, or proximate thereto, reduces the possibility and intensity of hazardous sparking when accidentally grounded if the power supply output resistance is low, or if the gun to ground capacitance can be discharged through a low resistance path. The coaxial cables employed for high voltages act as capacitors and store electrical charges therein. The resistor prevents such discharges at high current rates.

This invention includes the advantages of the invention described in the application mentioned hereinabove. Even greater efficiency of operation, coating deposition and wrap-around as well as increased safety of operation is accomplished according to this inventon.

Modern technology has provided us with many coating materials. Compositions and properties of available coating materials vary considerably. Resistivity of paints, for example, will vary depending on the types and amounts of pigment, vehicle, solvent, etc. included in the composition. The viscosity and clogging characteristics of liquid coating materials can also vary, independent of changes in resistivity. For reasons which will become apparent hereinafter, it is advantageous and sometimes necessary to be able to vary the size of the liquid coating flow channel and the magnitude of the resistance of the liquid coating column in electrostatic spray guns.

Accordingly, it is the general object of this invention to provide a new and improved electrostatic airless hydraulic spray gun and system.

It is more particular object of this invention to provide a novel electrostatic airless hydraulic spray gun, adapted for simple manual or hand operation, with high charging efficiency and a further reduction in the possibility and intensity of hazardous sparking when accidently grounded.

Another object of this invention is to provide an electrostatic hydraulic spray gun with structural features which will provide means for the simple variation of the flow restriction and the electrical resistance of the liquid coating column with a minimum amount of disassembling and assembling.

A further object of this invention is to provide an electrostatic spray gun, apparatus and method of coating which provides for higher available charging voltages in the area of atomization.

Yet another object of this invention is to provide a spray gun having a minimum electrical capacitance and low leakage currents.

Briefly, the present invention accomplishes the above cited objects by providing structural features which either prevent accidental grounding or prevent a high flow rate of the stored charge in the event of accidental grounding. These novel structural features include locating a resistor on the gun, locating the charging electrode in the liquid coating material delivery channel, fabricating tubular members, shrouds and orifice assemblies from electrical insulating materials and providing for the simple insertion of a variety of grooved insulating rods in the liquid coating material delivery channel to permit easy variation of the flow channel.

Further objects and advantages of the invention will become apparent as the following description proceeds and features of novelty which characterize the invention will be pointed out in particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention reference may be had to the accompanying drawing, in which:

FIGURE 1 shows a side view of the electrostatic airless hydraulic spray gun, partially sectioned to illustrate certain interior details of the gun;

FIG. 2 is a partial section of FIG. 1, along line I—I, and illustrates in detail a longitudinally grooved insulating rod located in the liquid coating material delivery channel; and

FIG. 3 is a schematic illustration of an electrostatic spraying system employing the electrostatic airless hydraulic spray gun of FIG. 1.

Referring now to FIG. 1, there is illustrated, in detail, the structural features of an electrostatic hand spray gun **1**. A tubular member **2** defining a liquid supply channel **3** is secured to a valve body assembly **4**. A pistol grip **5** is mounted therewith so that the gun **1** may be conveniently held in the hand of an operator. A mechanical trigger **6** is conveniently located in close proximity to the pistol grip **5** so that it can be easily articulated by the operator. The trigger is connected to a needle valve stem **7**, normally biased by a spring, not shown in the drawing, in a closed position against valve seat **8**. Movement of the trigger **6** towards the pistol grip results in a movement of the valve stem which opens the flow aperture **9** and provides communication between a coating material feed line **10** and the channel **3**. The tubular member **2** is constructed from an electric insulating material such as phenolic laminates, extruded polyamide, polyfluoroethylene or the like. The reason for employing an insulating material with high dielectric strength for member **2** as well as other parts will be explained in detail hereinafter.

Liquid coating material is supplied to the gun through the flexible feed line **10** and returned to a pump through flexible line **11**. A continuous supply of coating material under pressure is available from the circulating system, the excess coating material being returned to the pump. Should the coating material be heated above room temperature, lines **10** and **11** may be insulated in order to minimize heat losses. Details such as pumps, reservoirs, etc. are discussed more fully in connection with FIGURE 3.

An elongated grooved rod **12** is fabricated from a material having good dielectric strength, as for example, the electrical insulating material employed in the fabrication of tubular member **2**. It will be apparent that the construction permits the rod **12** to be easily and conveniently inserted in and removed from the supply channel **3**. The rod is designed to fit snugly in the channel. The peripherally located groove **13**, which is illustrated more clearly in FIG. 2 as a cross-sectional detail, may run along the entire length of the rod. With the rod inserted in the channel, the open axial groove **13** and the wall or walls of the channel will cooperate to form a flow duct **14** having a cross-sectional area smaller than the channel **3**. It is preferred to have the flow duct **14** extend along a major portion of the length of the channel and thus leave a minor portion of the length of the channel so that a charging electrode, described hereinafter, may project into the minor portion of the channel. It is apparent that the flow duct **14** communicates with the minor portion of the channel and also with a source of liquid coating material through feed line **10**. It should be understood that the cross-sectional area of the flow dust may be easily varied by the use of rods having different sized grooves. It will also be understood that the grooves may vary in shape and location from that illustrated so long as the rods serve as a means for reducing and varying the size of the coating material flow area through the gun.

One part **15** of a nozzle adapter **15**, **16** is attached to the end of the tubular member **2**, as illustrated. A metallic nozzle element **17** is held to the end of the member by another part **16** of the nozzle adapter. The nozzle adapter is constructed from electrical insulating material, as for example the materials described for the tubular member **2**. The area of the metallic nozzle element is advantageously small, in the order of one-fourth to one-half square inch. The nozzle element has a small opening or orifice **18** extending therethrough, specifically designed for the airless hydraulic atomization of liquid coating materials. These nozzles and orifices are readily available items of commerce and known in the art. They are described, for example, in U.S. Patents 2,754,228 and 2,763,575.

A high voltage conductor or electrode **19** is inserted through the wall of the tube **2** so that it extends into the enlarged portion of the channel **3**. It should be noted that the insulating rod **12** is shorter in length than the member **2**. This permits the easy insertion of electrode **19** into the liquid flow channel. The electrode **19** may also function as a stop to hold the insulating rod **12** in position.

A second elongated tubular insulating member **20** is mounted adjacent to the tube **2** by means of bracket **21**. The tube **20** may be conveniently fabricated from insulating materials described heretofore. A portion of a coaxial high voltage cable **22** is passed into the tube **20**. An insulating potting compound **23**, as for example an epoxy resin catalyzed for a low temperature cure, is poured into the tube to surround the cable. The potting compound is cured in place so that the high voltage cable is rigidly fixed in the insulating tube **20** and is also additionally insulated. A connector element **24** is mounted on the high voltage cable so that a resistor **25** may be conveniently inserted into the insulating tube **20** and be easily connected to the high voltage cable. A spring type terminal **26** is connected to the opposite end of the resistor **25** and disposed in a manner to insure contact with the metal charging electrode **19**. Tubular members **2** and **20** are inserted into an insulating shroud **27** to form a unitary, rigid structure. Shroud **27** is constructed, for example, from heretofore disclosed insulating materials.

It is advantageous to fabricate the tubular members, insulating rod, nozzle adapter and shroud from electrical insulating materials. Similarly, it is advantageous to minimize the area of metallic parts such as the nozzle. These features or expedients minimize the charge storage of the parts in the high voltage field, because of their low electrical capacitance, thus insuring that an accidental grounding of the delivery end of the spray gun will not result in a current discharge to ground at a high flow rate.

The metallic charging electrode **19** should be proximately located to the nozzle or orifice to insure the existence of a uniform electrostatic field for charging the atomized particles of coating material. Preferably, the distance between the electrode **19** and nozzle **17** is at least one inch although distances from about one-half inch to about two and one-half inches may be employed. Additionally, its location provides a resistive column of coating material between it and points at which accidental grounding can take place. The charge stored on the electrode and on the conducting parts of the resistor in contact with the electrode cannot, therefore, be delivered at a high flow rate if the metallic nozzle **17** is accidentally grounded. It should be noted that the nozzle adapter may be designed to partially surround the metal nozzle and reduce the likelihood of accidental grounding.

The advantages of locating a resistor on the spray gun are described in U.S. application Serial No. 178,478 mentioned hereinabove. In the present invention additional advantages of squelching possible arcing result from the cooperation of the resistor with the resistive column of coating material between the electrode and nozzle element. The resistor **25** will preferably have a value of from about 100 to about 300 megohms, although values from 50 to 350 megohms will be advantageous. Improper use of conductive liquids in the spray gun will not result in dangerous spark discharges of the charge stored on the cable since the resistor and resistive column of coating material prevent discharges at high current levels.

It will be understood that the variable cross-sectional area of the liquid flow channel permits the maintenance of a high resistance, preferably not less than 10^{10} ohms, between the electrode and grounded metallic parts of the valve end of the liquid column even when low resistivity paints, e.g. 7.5 megohm-centimeter, are being sprayed. Of course, the cross-sectional area may be increased when higher resistivity paints, prone to clogging are being sprayed. The resistance of the column of liquid coating material between the electrode **19** and the grounded grip **5** minimizes leakage currents and contributes to a higher voltage at the charging electrode and point of atomization. It should be understood that it is desirable to keep the flow duct as small as possible, without clogging with the coating material, to provide a large resistance and low current drain between the electrode and the grip **5**. The lower voltage drop will cause a more effective charging of atomized coating particles.

Although leakage currents were considered to be necessary for the proper charging of atomized particles of coating material we have found it possible to insure a high voltage at the atomization area by reducing current flow or drain except that which is required for charging the liquid coating material. Leakage currents are minimized as previously indicated and by designing the parts with curved surfaces instead of sharp points. Corona currents may be reduced by applying a solvent-resistant corona grading coating to the interior walls of the shroud **27** and the tube **20** in the vicinity of the resistor **25**. To further reduce leakage currents the shroud **27** should be extended over the tubular member **20** for a minimum distance of about two inches and preferably three inches beyond the charging electrode **19**. With spray guns constructed according to this invention leakage currents may be easily limited to less than 20 microamperes and to less than 10 microamperes with reasonable adherence to the expedients disclosed. The length of the tubular members **2** and **20** should be a minimum of about 10 inches to minimize current drain.

Referring now to FIG. 3 there is illustrated the hydraulic airless spray gun, adapted for hand operation, heretofore desicribed and illustrated in FIG. 1. In addition to the hand gun **1**, the system includes a high voltage power supply **28** connected to the gun by means of the conductive sheathed cable **22**. The cable **22** is connected to the negative terminal of power supply **28**. The positive terminal of the power supply is grounded. Liquid coating material is circulated, under pressure, from a variable speed pump **29**, driven by, for example, motor **30** through the supply hose **10** to the spray gun **1**. The liquid coating material is returned from the gun to the pump through the hose **11**. Liquid coating material may be added to the circulating system from the reservoir **31** which may be controlled by valve **32**. Auxiliary equipment, as for example, the filter **33** and the coating material heater **34** may be optionally provided.

In operation, the hand spray gun is held by an operator in spaced relation to the article to be coated. The article is grounded so that it will attract charged particles. A space or distance of about 12 inches between the nozzle element and article is preferred. A high voltage, in the order of 50 to 150 kilovolts, is supplied

through the structural details described hereinabove, to the column of coating material at the charging electrode **19**. The liquid coating material is supplied to the gun under pressure. A pressure from about 250 to about 600 p.s.i.g. is ordinarily employed. A pressure of from about 300 to about 400 p.s.i.g. will satisfactorily atomize a paint having a low viscosity that has been reduced with a low boiling solvent. With higher viscosity paints or those employing higher boiling point solvents, satisfactory results may be obtained with pressures above 600 p.s.i.g. Pressures as high as 3000 p.s.i.g. may be employed for unusual coating materials. For most coating materials, the increased pressure merely produces finer atomized particles not essential to satisfactory electrostatic coating.

Coating materials employed in the system or apparatus may be heated, in a manner known to those skilled in the art. Heating the coating material is advantageous insofar as the heated material is more easily atomized. Coating materials are normally thinned or reduced with volatile solvents. In hydraulic airless spray guns, the sudden pressure drop on the coating material, as it emerges from the orifice, induces the liquid coating material to atomize into fine particles or droplets. Contributing to the atomization is the rapid evaporation or "bursting" of the solvent. The more volatile the solvent the easier it is to atomize the coating material.

It will be apparent to one skilled in the art, therefore, that the atomization is influenced by the amount and volatility of the solvent and the temperature and pressure imposed on the liquid coating material as well as viscosity of the material and the size of the orifice. The foregoing description of the operating conditions will be appropriate for commonly employed coating materials such as lacquers, enamels and the like. Conditions for unusual coating materials may be established by those skilled in the art by routine tests following the foregoing principles.

It is to be understood that the spray gun, apparatus and method of this invention preferably employs liquid coating materials which have some measure of conductivity to obtain the superior and surprisingly improved deposition and wrap-around on the grounded article being coated. While we do not wish to be held to any particular theory, it would appear that the location of the charging electrode according to this invention, requires materials which permit charge migration either in the liquid or on the atomized particle. Otherwise non-conductive liquid coating materials may be reduced with conductive or polar solvents to provide the required measure of conductivity. Examples of polar solvents which may be employed include ketones, alcohols and ethers. More specifically, the coating material may be reduced with methyl ethyl ketone, acetone, methyl or ethyl alcohol, for example. The coating material resistivity may vary from about 7.5 to about 250 megohm-centimeters with excellent results. The best disposition and wrap-around occurs with materials having resistivities in the range of from about 100 to about 250 megohm-centimeters.

As heretofore described the apparatus of this invention has as its chief novelties, high resistance and low capacitance to all intentionally grounded or accidentally groundable parts, low corona, use of the paint column as a spark suppressing means and a resistance to reduce current drain and a readily reducible flow duct area to accommodate variations in coating material resistivities. The apparatus of this invention has shown excellent paint wrap-around with various paints having resistivities ranging from about 7.5 to about 250 megohm-centimeters. The corona which exists when a grounded object is brought close to the orifice has repeatedly failed to detonate explosive mixtures of ethyl acetate readily detonated by one watt second sparks. Explosion hazards are therefore, virtually eliminated. It should be apparent and understood that some structural features of this invention may be advantageously employed in spray guns other than the one described.

While there have been shown and described what are at present considered to be the preferred embodiments of the invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention be limited to the specific arrangements shown and described and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

We claim as our invention:

1. An electrostatic spray gun for spraying atomized liquid coating material comprising, in combination, a tubular member defining a liquid supply channel, means for connecting a liquid supply line to one end of said channel, a nozzle element having an atomizing orifice extending therethrough, the element being connected to the tubular member so that the supply channel communicates with the orifice, valve means for controlling the flow of liquid through said channel, a metal electrode extending through said tubular member into said channel at a point proximately located to said nozzle, a resistance element having a value from about 50 to about 350 megohms located on the gun, one end of said resistance being electrically connected to the electrode and conductor means adapted for connection to a high voltage source connected to the other end of the resistance, whereby an electrostatic charge may be efficiently induced on the sprayed atomized coating material without the hazard of accidental electrical discharge.

2. An electrostatic spray gun for spraying liquid coating material comprising an elongated tubular member defining a channel, an elongated rod removably inserted into said channel to provide a liquid flow duct having a cross-sectional area smaller than said channel for at least a major portion of the length of said tubular member, means for connecting a liquid coating material supply line to an end of said channel, a nozzle element having an atomizing orifice extending through the element, the nozzle element being connected to the tubular member so that said channel and said feed duct communicate with the orifice, a metal electrode extending through said tubular member and projecting into the channel proximately located to the orifice, valve means for controlling the flow of liquid coating material through the feed duct, a resistance element having a value of from about 50 to 350 megohms located on the spray gun, one end of said resistance being electrically connected to the electrode and conductor means adapted for connection to a source of high voltage connected to the other end of the resistance, whereby an electrostatic charge may be efficiently induced on the sprayed atomized coating material without the hazards ordinarily attending accidental groundings of the gun.

3. An electrostatic spray gun for spraying liquid coating material comprising a member of electrical insulation having a wall defining an elongated channel, means inserted into said channel and cooperating with the wall to define a liquid flow duct along a major portion of the channel length, said inserted means adapted for easy removal from said channel, means for supplying a liquid coating material connected to one end of said channel, a nozzle element having an atomizing orifice extending through the element, the nozzle element connected to said member so that the orifice is in communication with the other end of said channel, an electrode extending through said tubular member and projecting into the channel in the minor portion unoccupied by said inserted means, valve means for controlling the flow of liquid coating material through the feed duct, a resistance element having a value of from about 50 to about 350 megohms located on the spray gun, one end of said resistance being electrically connected to the electrode and conductor means adapted for connection to a source of high voltage connected to the other end of the resistance, whereby an electrostatic charge may be efficiently induced on the sprayed atomized coating material without the hazards ordinarily attending accidental groundings of the gun.

4. An electrostatic spray gun for spraying liquid coating material comprising a first tube of electrical insulation having a channel extending therethrough, a rod of electrical insulation having an axial groove along at least a portion of its length, said rod adapted for slidable insertion into said channel and located within said channel to form a liquid flow duct defined by said channel and said axial groove, means for supplying a liquid coating material under pressure connected to one end of the channel, a nozzle element having an atomizing orifice extending through the element connected to said tube so that the other end of the channel communicates with the orifice, an electrode extending through said first tube and projecting into the channel at a distance of about one-half to two and one-half inches from the orifice, valve means for controlling the flow of liquid coating material through said duct, a second tube of insulation mounted adjacent to said first tube, a resistance element extending into one end of the second tube, the resistance element having a value of from about 50 to about 350 megohms, coaxial conductor means adapted at one end for connection to a high voltage source connected at the other end to the resistance element extending into the second tube, means electrically connecting the resistance element to the electrode so that a high voltage may be impressed upon the electrode through said coaxial conductor and resistance and electrical insulation shroud means surrounding said second tube whereby an electrostatic charge is efficiently induced on the sprayed atomized coating material without the hazards attending high energy discharges.

5. An electrostatic spray gun adapted for hand use comprising gripping means, means defining a length of an elongated supply channel, means inserted in said channel providing a flow duct having a cross-sectional area smaller than said channel for a major portion of said channel length, a minor portion of said channel length having a larger cross-sectional area than said flow duct and communicating therewith, means for connecting a coating material supply line to one end of said channel, valve means for controlling the flow of liquid through said duct and channel, said valve means being accessible to said gripping means, a nozzle element having an atomizing orifice extending therethrough, the nozzle element being connected to the other end of said channel so that the orifice communicates with the channel, a charging electrode projecting into said other portion of the channel proximate to said orifice, a resistance element having a value of from about 50 to about 350 megohms located on the gun, one end of said resistance being connected to the charging electrode, and conductor means adapted for connection to a source of high voltage connected to the other end of the resistance, whereby said gun may be operated to efficiently and thoroughly deposited coating material on articles without the danger of high energy discharges.

6. A system for spraying liquid coating materials onto an electrically grounded article of manufacture comprising a spray gun including a tubular member defining a liquid supply channel, a nozzle element having an atomizing orifice extending therethrough connected to one end of the tubular member so that the supply channel communicates with the orifice, means for supplying liquid coating material to said channel connected to the other end of said member, pressure means associated with said supply means for forcing substantially gas-free coating material through said orifice with sufficient force to produce atomized particles of the material, valve means for controlling the flow of liquid through said channel, a metal electrode extending through said tubular member into said channel at a point proximately located to said nozzle element, a resistance element having a value of from about 50 to about 350 megohms located on the gun, one end of

said resistance being electrically connected to the electrode, a high voltage source and means connecting the high voltage to the other end of said resistance, whereby the article may be efficiently and thoroughly coated without the danger of accidental high energy discharges.

7. A system for spraying liquid coating materials onto an electrically grounded article of manufacture comprising a member of electrical insulation having a wall defining an elongated channel, means inserted into said channel and cooperating with the wall to define a flow duct along a major portion of the channel length, said inserted means adapted for easy removal from said channel, a nozzle element having an atomizing orifice extending through the element, the nozzle element being connected to said member so that the orifice is in communication with one end of said channel, means for supplying liquid coating material to said flow duct connected to the other end of said channel, pressure means associated with said supply means for forcing substantially gas-free coating material through said orifice with sufficient force to produce atomized particles of the material, valve means for controlling the flow of liquid, an electrode extending through said tubular member and projecting into the minor portion of the channel unoccupied by said inserted means and located no less than about one-half inch and no more than about two and one-half inches from the orifice, a resistance element having a value of from about 50 to about 350 megohms located on the spray gun, one end of the resistance being electrically connected to the electrode, a high voltage source and conductor means connecting the high voltage source with the other end of the resistance whereby an electrostatic charge may be efficiently induced on the atomized coating material without the hazards ordinarily attending accidental groundings.

8. A spray gun for spraying liquid coating material comprising an alongated tubular member defining a liquid coating supply channel, an elongated rod adapted for insertion into the channel and having a peripherally located groove which extends along the length of the rod, said elongated rod being snugly fitted within said channel and cooperating therewith to form an elongated liquid feed duct having a cross-sectional area smaller than the channel, means for connecting a liquid coating material supply line to one end of said channel, a nozzle element having an atomizing orifice extending through the element, the

nozzle element being connected to the tubular member so that the orifice communicates, respectively, with said channel and said feed duct and valve means for controlling the flow of liquid coating material through the feed duct.

9. A system for spraying liquid coating materials onto an article of manufacture comprising an elongated tubular member defining a coating supply channel, an elongated rod having a peripherally located groove which extends along a length of the rod, the elongated rod being adapted for slidable insertion into the channel and being snugly fitted within said channel and cooperating there with to form an elongated feed duct, a nozzle element having an atomizing orifice extending through the element connected to one end of the tubular member so that the orifice communicates respectively with the channel and feed duct, means for supplying liquid coating material to said channel and flow duct connected to the other end of said member, pressure means associated with said supply means for forcing coating material through said orifice to produce atomized particles of the material and valve means for controlling the flow of coating material through said flow duct and channel.

10. A gun for spraying liquid coating material comprising a member having means defining an elongated coating supply channel, an elongated rod inserted into the channel, said rod having exterior surfaces designed to fit snugly into said channel and having an axial groove extending inwardly from an exterior surface to form an elongated feed duct in cooperation with a surface of the channel, means for connecting a liquid coating material supply line to one end of said channel, a nozzle element having an atomizing orifice extending therethrough, the nozzle element being connected to the tubular member so that the orifice communcates respectively with said channel and said feed duct and valve means for controlling the flow of liquid coating material through the feed duct.

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