

Dec. 11, 1956

L. J. LAMM

2,773,472

APPARATUS FOR ELECTROSTATIC SPRAY COATING

Filed Aug. 14, 1951

2 Sheets-Sheet 1

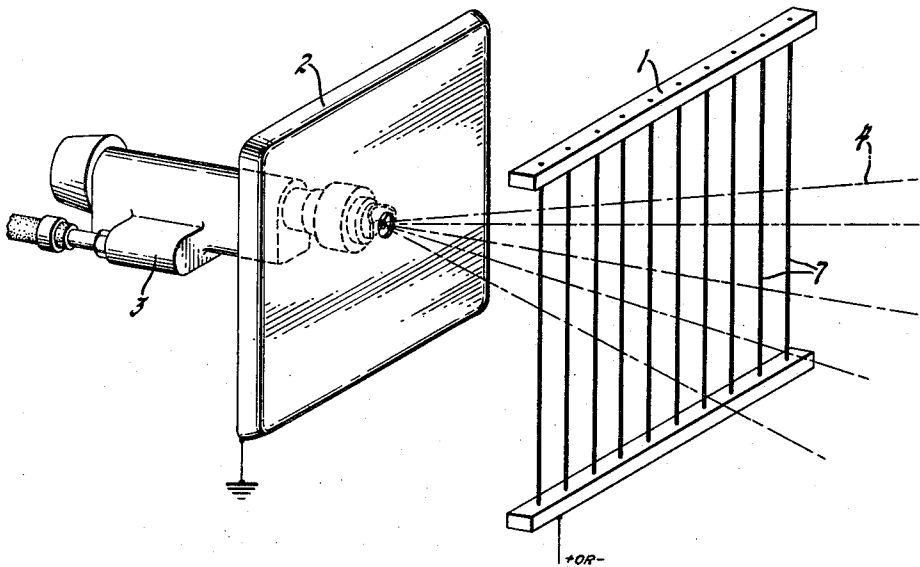


Fig. 1

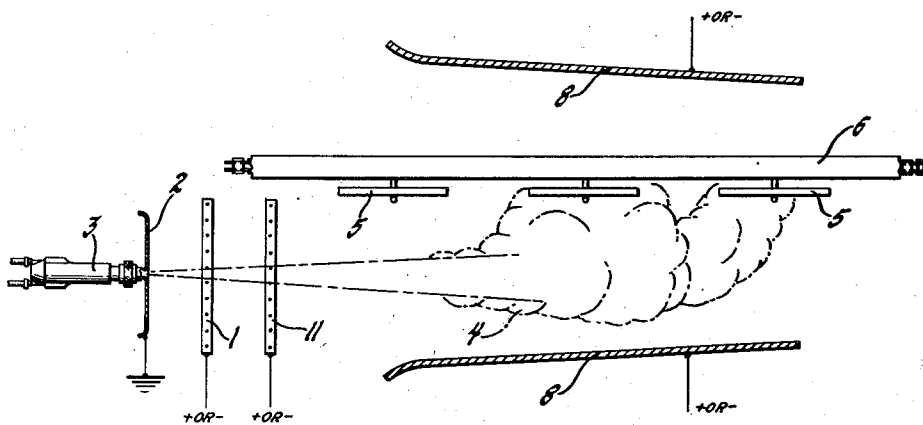


Fig. 2

Inventor

Lewis J. Lamm

By

Willits, Helwig & Baillio

Attorneys

Dec. 11, 1956

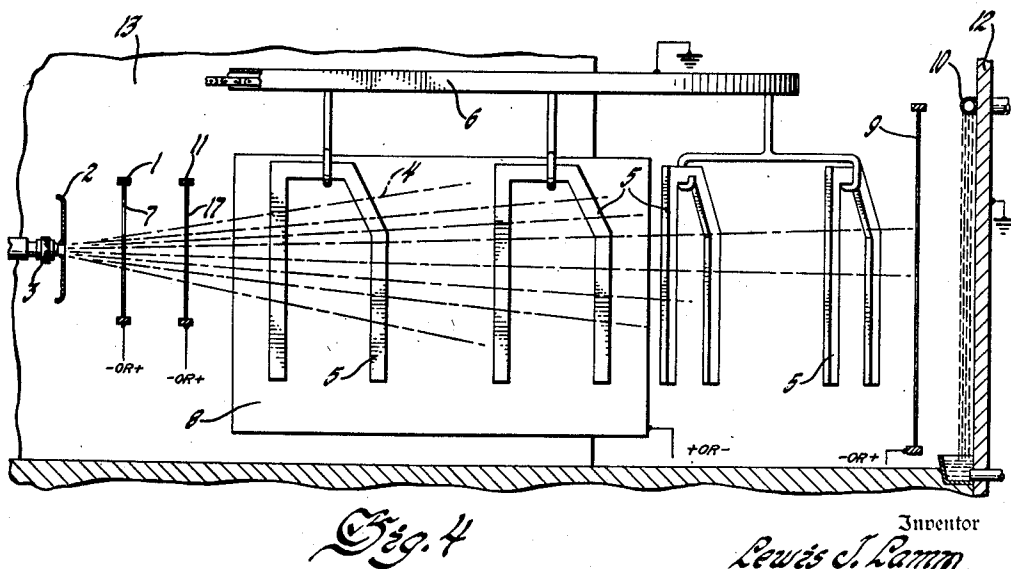
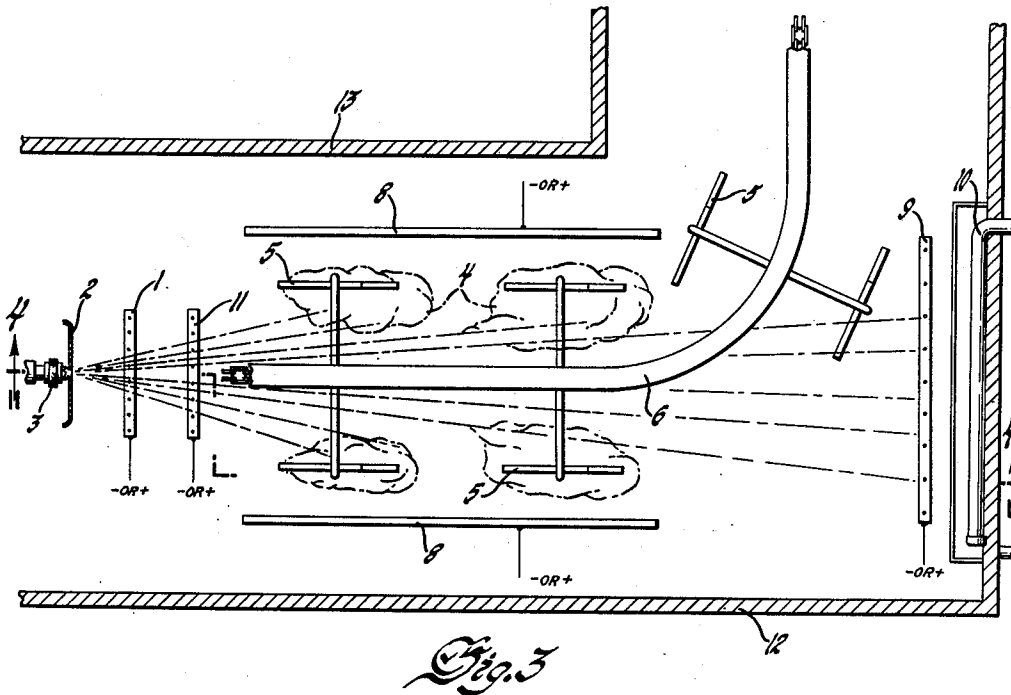
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Inventor
Lewis J. Lamm
By *Willits, Helwig & Bailley*
Attorneys

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APPARATUS FOR ELECTROSTATIC SPRAY COATING

Lewis J. Lamm, Washington, D. C., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application August 14, 1951, Serial No. 241,858

4 Claims. (Cl. 118—51)

The present invention relates to a method of and apparatus for electrostatic spray coating articles of manufacture. More particularly it relates to a method of coating articles of manufacture by initially placing an electrostatic charge on comminuted particles of coating material, and thereafter utilizing the electrostatic attraction between the charged particles and the article to be coated to perform the coating operation. This invention further relates to a method of controlling the flight of charged coating particles by electrostatic means that repel the charged particles towards the articles to be coated; to a means for charging the spray coating material by projecting the spray through an electrical discharge zone comprising a screen electrode, and to means for electrostatic recharging of the overspray of coating particles which were not attracted to the articles to be coated and collecting the recharged overspray.

Previous to the present invention, metallic air deflecting shields located in the space containing the articles to be coated were grounded, and the electrostatic attraction between the charged particles and the metallic shields influenced some of the particles to migrate to these shields and thereby coat them. This coating of the metallic air deflectors resulted in an overall reduced efficiency of the electrostatic spray coating apparatus. In the present invention the deflector electrodes are maintained at a suitable electrical potential of the same polarity as the charging electrodes. Thus these electrodes will function as electrostatic coating deflectors and repel the charged coating particles towards the articles to be coated to increase the overall efficiency of the apparatus. Moreover, these charged deflecting electrodes will substantially aid in controlling the flight of the charged particles.

Previously used methods of electrostatic spraying have employed electrodes consisting of parallel conductors as discharge elements with the conductors disposed approximately parallel to the path of the spray. In the present invention the discharge elements are made in the form of a pervious member disposed approximately normal to the spray path and through which the spray passes. The use of this electrode system produces an ionized atmosphere through which the coating particles pass and receive a surface charge as they are projected. This type of electrode enables the coating particles in the spray to become more uniformly charged.

In certain of the prior art, difficulty has been experienced with stray coating particles which were not attracted to the article to be coated due, in part at least, to the fact that these particles did not receive a sufficient charge from the charging electrode. The present invention seeks to overcome this difficulty by reducing the amount of coating material present in the discharge air from the coating zone, by providing means for recharging these stray coating particles. This recharging is performed by electrode means positioned in front of a water curtain to which the recharged stray coating particles are attracted, thereby increasing the efficiency of removal of the

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coating particles from the exhaust air, and minimizing overspray losses.

It is therefore an object of the present invention to provide a method of, and apparatus for, spray coating in which the coating material is projected through an electrical charging zone and thereafter electrically deflected towards the articles to be coated.

It is a further object of the invention to provide a method of and apparatus for producing electrostatic charges on particles of coating material by projecting particles in a direction normal to the plane of a charging electrode through an ionized atmosphere produced by a pervious electrode.

It is a further object of the present invention to provide a method of, and apparatus for, removing stray coating particles of overspray from the exhaust air by electrically recharging, and then collecting the stray coating particles.

Other objects of the present invention will be apparent upon reading the specification and inspection of the drawings, and will be particularly pointed out in the claims.

Referring to the drawings, Figure 1 is a perspective view of one form of charging electrode apparatus embodying the present invention.

Figure 2 is a plan view of one form of charging and deflecting apparatus useful in practicing the present invention.

Figure 3 is a plan view of a preferred form of apparatus, also embodying the present invention.

Figure 4 is a section taken on line 4—4 of Figure 3.

Referring more particularly to the drawings in which similar reference characters represent similar parts in each of the several views, 1 and 2 represent an electrode system made up of a charging electrode 1 and a grounded collector electrode 2. 3 is a spray gun, and 4 represents the spray of charged coating particles. The charging electrode 1 includes a plurality of spaced parallel fine wires 7 mounted in the same plane by suitable supports, and maintained at a sufficiently high positive or negative potential to produce corona discharge. The grounded collector electrode 2 is provided with rounded corners to prevent reverse corona discharge. This electrode system, 1 and 2, produces an ionized atmosphere around each of the wires 7 with an abundance of free charges capable of placing a uniform surface charge on each of the coating particles as it passes between the wires. The collector electrode 2, maintained at ground potential, permits the drift of current from the charging electrodes to this collector electrode, or vice versa, depending upon the relative polarities, thus expediting the electrical charging of the comminuted coating particles. The spray gun 3, which comminutes the coating material into fine particles, may be either attached to the collector electrode 2 or spaced therefrom. The spray of electrically charged comminuted coating particles 4 is propelled into the vicinity of the articles to be coated after they have been projected through the charging electrode 1.

In the apparatus shown in Figure 2 of the drawings, a charging electrode system having two charging screens, 1 and 11, is used. The charging screens 1 and 11 are constructed in the same manner as the charging screen 1 shown in Figure 1, consisting of a plurality of suitably supported spaced parallel fine wires 7. 2 is a grounded collector electrode similar to that of Figure 1. The articles to be coated are designated 5 and are moved through the vicinity of the electrically charged spray 4 by means of a mono-rail conveyor 6. The articles to be coated 5 are maintained at ground potential so that the electrically charged particles will be attracted to these articles, as a result of the electrical charge on the particles in the spray 4. 8 is a deflector electrode which is maintained at a suit-

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able potential of the same polarity as the electrodes 1 and 11. As shown in Figure 2 the deflector electrode system is made up of two electrodes 8, one on each side of the mono-rail conveyor 6 that moves the articles 5 to be coated through the zone of the charged particle spray 4. As the electrodes 8 are of the same polarity as the charging electrodes 1 and 11, they will also be of the same polarity as the charged coating particles in the spray 4, and will repel the charged particles towards the articles to be coated. The deflector electrodes need not be of the same potential as the charging electrodes 1 and 11, and they also can be maintained at different potentials with respect to each other. Moreover, the charging electrode 11 is of the same polarity as, but may differ in potential from that of charging electrode 1.

When charging electrode 1 is at a negative potential with respect to the grounded collector electrode 2, an electrostatic drift current takes place countercurrent to the direction of particle travel. The drift is, however, in the same direction as that of the particle travel when electrode 1 is positive with respect to electrode 2. With the arrangement shown in Fig. 2, therefore, the particles projected by gun 3 pass through two successive charging zones. These zones are, respectively, the ionized atmosphere between electrodes 1 and 2, and the single plane of corona discharge produced by the wires 7 of electrode 11.

The operation of the system shown in Figure 2 is as follows. The spray gun 3 projects the comminuted particles through a hole in the electrode 2 in a direction substantially normal to the planes of the wire screen charging electrodes 1 and 11, and through the two successive zones, so that these particles pass between the wires 7, and thereby become electrically charged to either a positive or negative potential, depending on the polarity selected for the charging electrodes. The particles, due to their inertia, are propelled through the wire screen electrodes 1 and 11 and into the vicinity of the articles 5 to be coated. The attractive force between a charged particle and the grounded articles to be coated is a function of the square of the distance between the particle in the spray 4 and the article 5 to be coated. Therefore, this attractive force becomes increasingly stronger as the particles in the spray approach the article. This attractive force between the particles in spray 4 and the articles 5 is implemented by the repelling effect of the deflector electrode system which is of the same polarity as the charged particles in the spray. Thus, the flight of the charged particles in the spray is controlled by the deflector electrodes 8 and as this attractive force increases, the particles are caused to deviate from their path and migrate to the articles to be coated, thereby coating the articles by electrostatic deposition.

In the preferred embodiment of the invention, as shown in Figures 3 and 4, 3 is a spray gun that comminutes the coating material into fine particles, and projects these particles through the charging electrode system made up of electrodes 1 and 11, and into the vicinity of the articles to be coated 5. The collector electrode 2 is maintained at ground potential. The charging electrodes are constructed in the same manner as has been previously shown and described in connection with Figures 1 and 2. The spray 4 of charged particles, and the articles 5 to be coated pass between the deflector electrodes 8 on a mono-rail conveyor 6 as in Figure 2. In this instance the grounded articles 5 are passed in a dual line between the deflector electrodes 8 while the charged particles are sprayed into the space between the paths traversed by these dual lines. The overspray may be collected by an electrode system made up of a recharging electrode 9 of similar construction to that of the charging electrodes 1 and 11 and a water curtain 10, preferably of the baffle type. 12 and 13 are the walls of the booth, shown here as being L-shaped and which is grounded to form a part of the electrode system. The conveyor 6 may move in either direction,

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and the booth may be provided with similar charging electrode systems at both the entrance and the exit thereof.

The charging electrodes 1 and 11 are of the same polarity but need not be of the same potential. Similarly, the deflector electrodes 8 are of the same polarity and this polarity is the same as that of charging electrodes 1 and 11, but the deflector electrodes may be of different potentials. The recharging electrode 9 is maintained at a suitable potential of the same polarity as the charging electrodes 1 and 11, and the charged particles in the spray 4. As much of the overspray consists of stray particles that did not receive a sufficient electrical charge to cause them to be attracted to the articles 5, or charged particles which have lost their charge due to leakage through the atmosphere, the recharging electrode 9 additionally charges or recharges these stray particles in the over-spray so that they will be attracted to the grounded water curtain 10, and thus minimize overspray. As a result the removal of coating material from the exhaust air is substantially complete. The fine particles in the overspray are the ones that are most efficiently charged or recharged by the electrode 9, because of their high area-to-mass ratio, and hence the charging or recharging of these particles assists in their removal. The coating particles collected by the water curtain may be recovered by any suitable means known in the art.

The operation of the preferred embodiment shown in Figures 3 and 4 is as follows. The spray gun 3 projects the comminuted coating particles through a hole in the collector electrode 2 in a direction substantially normal to the plane of the wire screen charging electrodes 1 and 11, so that these particles receive an electric charge. These charged particles are propelled into the path between the dual line of articles 5 which are carried on the conveyor 6. The charged particles in the spray 4 are deflected or repelled, due to the like polarity electrostatic charge on the deflector electrodes 8, towards the articles to be coated. Thus the deflector electrodes control the flight of the charged particles in the spray 4, and enable these particles to migrate towards and be attracted to the grounded articles.

The stray particles of coating material in spray 4 which are not attracted to the articles are defined as overspray. The stray particles in this overspray pass through the wire screen electrode 9 and are recharged. These recharged particles in the overspray are then attracted to the grounded water curtain 10 which collects and efficiently removes them from the exhaust air egressing from the spray booth or chamber.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof but I desire the invention to be interpreted as broadly as possible and that it be limited only as required by the prior art.

I claim:

1. Apparatus for electrostatic spray coating of articles to be coated including, in combination, means structurally supporting and conveying said articles in a given direction through a coating area; a spray gun projecting particles of coating material in a direction parallel to the direction of movement of said articles through said area; means charging said particles including a plurality of discharge electrodes disposed in a plane normal to the direction of the spray from the gun and in the path of the spray, a collector electrode spaced from said plane of discharge electrodes and located between the discharge electrodes and the gun, and a high potential power source connected to said discharge electrodes and said collector electrode and establishing a highly ionized current conducting atmosphere therebetween through which said particles are projected; a broad, flat deflecting electrode of large surface area relative to said discharge electrode disposed substantially parallel to and along the path of said spray particles pass-

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ing through said charging means within said coating area and means for electrically charging said deflecting electrode relative to said articles to a polarity similar to that of said particles, said flat deflecting electrode being substantially free of discharge points and providing an electrostatic repulsion zone of substantially uniform intensity to deflect the particles from the direction in which they are projected from said spray gun and in a direction toward said articles.

2. Apparatus for electrostatic spray coating of articles to be coated including, in combination, means structurally supporting and conveying said articles in a given direction through a coating area; a spray gun projecting particles of coating material in a direction parallel to the direction of movement of said articles through said area; means charging said particles including a plurality of discharge electrodes disposed in a plane normal to the direction of the spray from the gun and in the path of the spray, a collector electrode spaced from said plane of discharge electrodes and located between the discharge electrodes and the gun, and a high potential power source connected to said discharge electrodes and said collector electrode and establishing a highly ionized current conducting atmosphere therebetween through which said particles are projected; a broad, flat deflecting electrode of large surface area relative to said discharge electrode disposed substantially parallel to and along the path of said spray particles passing through said charging means within said coating area, means for electrically charging said deflecting electrode relative to said articles to a polarity similar to that of said particles, said flat deflecting electrode being substantially free of discharge points and providing an electrostatic repulsion zone of substantially uniform intensity to deflect the particles from the direction in which they are projected from said spray gun and in a direction toward said articles; and means for collecting the overspray particles which fail to adhere to said articles including a plurality of discharge electrodes disposed in the path of said overspray particles for recharging such overspray particles and a running water curtain spaced from said overspray charging discharge electrodes and charged electrically oppositely thereto to attract and carry away such charged overspray particles.

3. Apparatus for electrostatic spray coating of articles to be coated including, in combination, means structurally supporting and conveying said articles in a given direction through a coating area, a spray gun projecting particles of coating material in a direction parallel to the direction of movement of said articles through said area, a plurality of discharge electrodes disposed in a first plane normal to the direction of the spray from the gun, a collector electrode spaced from said plane of discharge electrodes and located between said discharge electrodes and said gun, means maintaining a high difference of potential between said discharge electrodes and said collector electrode and establishing a highly ionized current conducting atmosphere therebetween through which said particles are projected, a further plurality of discharge electrodes disposed in a second plane substantially parallel to and spaced forward of said first plane of discharge electrodes in the direction of the travel of the particle spray and means for

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maintaining said further plurality of discharge electrodes at a different potential relative to said collector electrode than said discharge electrodes disposed in said first plane, a broad, flat deflecting electrode of large surface area relative to said discharge electrodes disposed substantially parallel to and along the path of the spray particles passing through said first and second discharge electrodes within said coating area and means for electrically charging said deflecting electrode relative to said articles to a polarity similar to that of said particles, said flat deflecting electrode being substantially free of discharge points and providing an electrostatic repulsion zone of substantially uniform intensity to deflect the particles from the direction in which they are projected from said spray gun and in a direction toward said articles.

4. Apparatus for electrostatic spray coating of articles to be coated including, in combination, means structurally supporting and conveying said articles in a given direction through a coating area; a spray gun projecting particles of coating material in a direction parallel to the direction of movement of said articles through said area; means charging said particles including a plurality of spaced discharge wires disposed in a plane extending normal to the direction of the spray from the gun and located directly in the path thereof, a flat apertured collector electrode spaced from the plane of discharge wires and located between the plane of discharge wires and the gun, and a high potential power source connected to said discharge wires and said collector electrode and establishing a highly ionized current conducting atmosphere therebetween, said gun projecting particles of coating material through said apertured collector electrode and said conducting atmosphere between said charging means; a broad, flat deflecting electrode of large surface area relative to said discharge wires and disposed substantially parallel to and along the path of said spray particles passing through said charging means within said coating area, and means for electrically charging said deflecting electrode relative to said articles to a polarity similar to that of said particles, said flat deflecting electrode being substantially free of discharge points and providing an electrostatic repulsion zone of substantially uniform intensity to deflect said particles from the direction in which they are projected from said spray gun and in a direction toward said articles.

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