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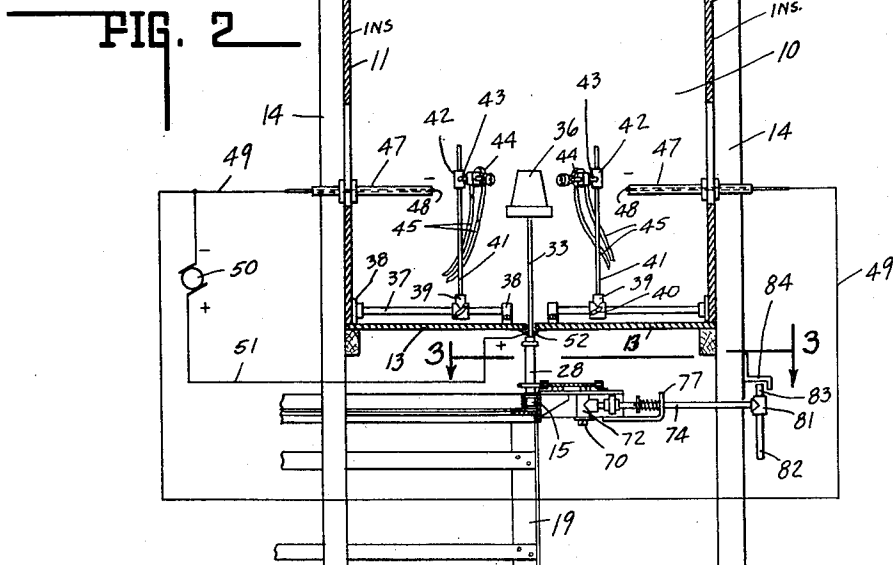
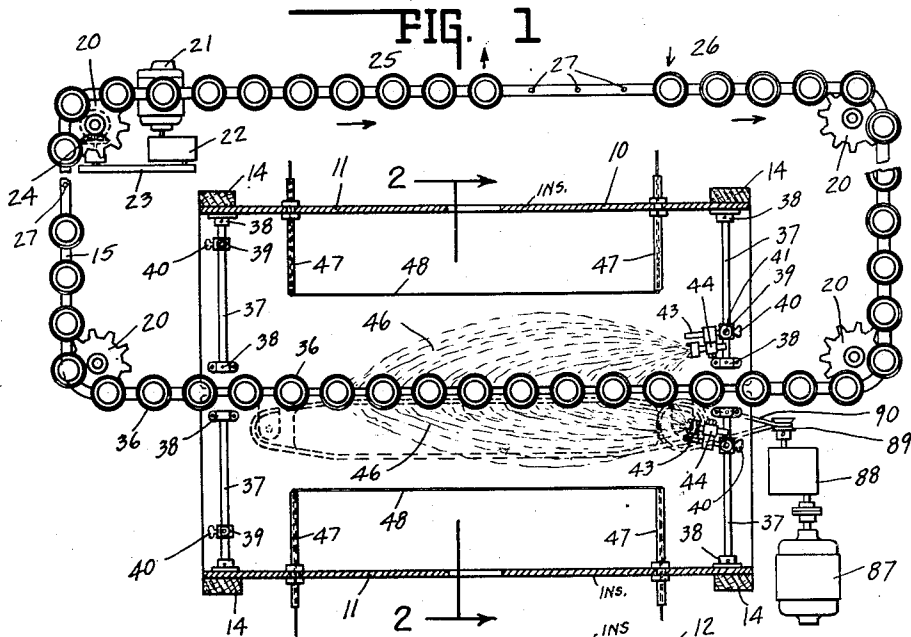
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2,334,648

METHOD OF SPRAY COATING ARTICLES

Original Filed June 29, 1939

2 Sheets-Sheet 1



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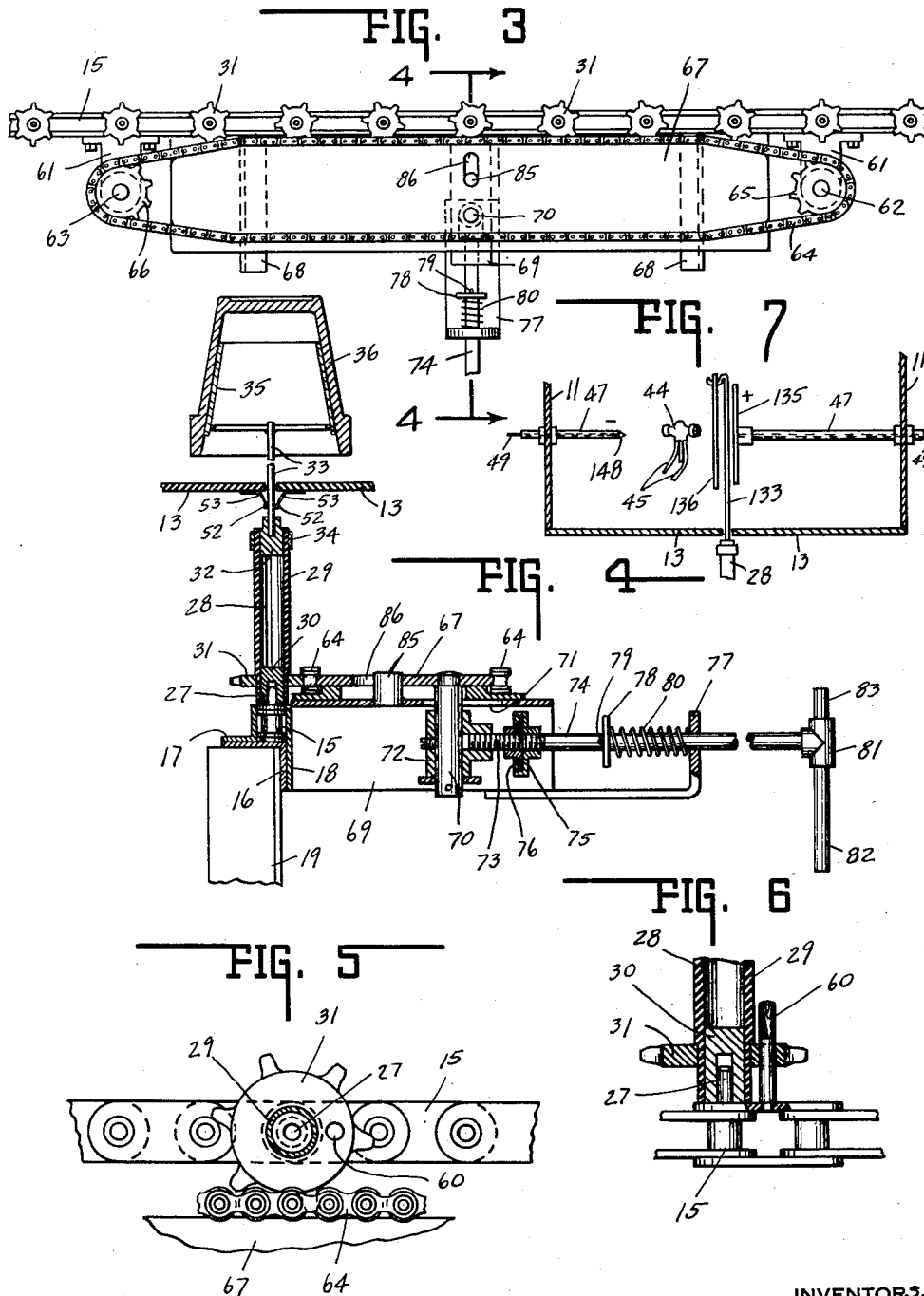
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2,334,648

METHOD OF SPRAY-COATING ARTICLES

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2 Claims. (Cl. 117—17)

This invention relates to a method of spray coating articles. The present application is a division of application Serial No. 281,766, filed June 29, 1939.

In spray coating methods involving the application of a siccative coat such as paint, varnish, lacquer, etc., to an article or surface to be treated, in which an electrostatic field is used it has heretofore been the practice to provide a collecting electrode and a discharge electrode between which an electrostatic field is set up. Usually the article to be coated is the collecting electrode and the discharge electrode is in the form of a spray gun or other device used to direct a spray of coating material into the electrostatic field. In some cases the discharge electrode has been an object placed near the spray gun or in the path of the spray from the gun rather than the gun itself. The whole has been enclosed in a metal cabinet maintained at the potential of the discharge electrode. The theory of operation of such apparatus has been that the spray particles in touching or passing near a positively charged discharge electrode, for example, pick up initial positive charges which cause them to be attracted to the negatively charged collecting electrode and to be repelled from the positively charged walls of the cabinet.

We have found, however, that spray particles do not behave in the manner to be expected from the application of this theory. Even though the gun itself is the discharge electrode and all particles of the spray may then be expected to be electrically charged, still the spray particles apparently move toward a positively charged electrode as readily as toward a negative one, other things being equal. The walls of the cabinet, even when charged at the same potential as the gun, have substantially the same attractive effect as when charged at the opposite potential. In cases where the discharge electrode is placed in the path of the spray said electrode apparently acts as a collector of spray particles.

One object of the present invention is generally to increase the efficiency of spray coating methods of the type described and particularly to reduce the amount of coating material lost by deposition on the walls of the cabinet and on the discharge electrode. This object is attained in part, first, by substituting a cabinet formed completely of insulating material for the metallic cabinet heretofore used; second, by placing the discharge electrode as completely as possible out of the path of the spray from the gun; and

third, by suitably proportioning the sizes of the discharge and collecting electrodes.

The substitution of an insulated cabinet for a metallic one in any given installation materially reduces the amount of spray material collected thereon. In some installations the deposition of spray material on the cabinet has been practically eliminated whereas with a metal cabinet a heavy coating of such material quickly appeared on the cabinet. Apparently only such particles as receive an initial velocity and direction from the gun such that they cannot be deflected by the electrostatic attraction of the electrodes can reach the walls of the insulated cabinet, whereas, with a metal cabinet, a large number of such particles are actually attracted to the cabinet irrespective of the potential at which the cabinet is maintained.

The behavior of the particles indicates that it is unnecessary to give them an initial charge by contact or proximity to an electrode charged in the opposite potential to the collecting electrode. Apparently particles discharged into an electrostatic field are attracted to either electrode. Other things being equal, the attractive effect of a positively charged electrode is considerably greater than that of a negatively charged electrode but the attractive effect of any electrode increases immensely with an increase in the size of electrode. These facts have made it possible to increase the efficiency of the apparatus by placing the discharge electrode out of the path of spray particles and by making the discharge electrode relatively small and the collecting electrode relatively large. For the coating of small objects the discharge electrode may be in the form of a point, while for a succession of articles moving on a conveyor the discharge electrode is preferably in the form of a fine wire or a series of points arranged parallel to the direction of travel.

Another object of the invention is to provide efficient means for coating articles having a surface area too small to comprise an efficient collecting electrode. This object is attained by grouping a plurality of such articles in such way as to cause all members of the group to be presented simultaneously to the discharge electrode in such manner that their aggregate area is much greater than that of the discharge electrode.

Another object of the invention is to coordinate the velocity and direction of the spray with the strength of the electric field and the position of the article to be coated in such manner that as

little as possible of the spray fails to reach the articles. In the ordinary spray gun used for paint spraying, particles of varying sizes are created and these particles lose their initial velocities at various distances from the gun, depending upon their size. In prior practice in the painting of small articles particularly, many of the larger particles reach the region of the articles to be coated with such a high velocity remaining that they cannot be pulled in by electrostatic attraction and are carried past the article. Small particles, on the other hand, lose their velocities before they can approach close enough to the articles to be attracted electrostatically. In the present invention, in one of its preferred forms, a series of articles to be coated is moved in a predetermined path adjacent to the spray gun. The gun is directed roughly parallel to the path or inclined at an acute angle to the path so that the articles successively pass close to the points at which the initial velocities of the particles of varying sizes are lost. Thus the particles of all sizes find themselves in the region of one of the articles at the time that their initial velocities have been sufficiently reduced to permit the same to be electrostatically attracted to the article. By this means a large percentage of the paint ordinarily lost because of the varying size and velocity of the spray particles actually reaches the articles.

Another object of the invention is to minimize the hazard of explosion in electrostatic spray painting with materials having inflammable solvents.

Another object of the invention is to provide an efficient method for electrostatic spray painting of articles formed of non-conducting materials.

Other objects and features of the invention will be understood from the accompanying drawings showing a preferred form of apparatus by means of which the invention may be practiced and from the following description and claims:

Fig. 1 is a plan view of a spray painting apparatus constructed in accordance with a preferred form of the invention and having the cabinet shown in section. Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1. Fig. 3 is a plan view of conveyor apparatus used with the invention and is taken substantially on the line 3—3 of Fig. 2. Fig. 4 is an elevational sectional view taken on the line 4—4 of Fig. 3. Fig. 5 is a plan view of a detail of the apparatus of Figs. 3 and 4. Fig. 6 is an elevational view of the same partly in section. Fig. 7 is an end elevational view showing an adaptation of the invention to the coating of a different type of object.

In the preferred form of the apparatus shown in the drawings there is provided a cabinet 10 consisting of side walls 11, top 12 and floor plates 13, all supported by vertical posts 14. The cabinet, including the vertical posts 14, is preferably constructed entirely of electrically non-conducting materials such as wood or Bakelite or other suitable plastics. Attention is called particularly to the use of non-conducting material for the supporting posts 14. Even though an insulated cabinet is used, if the supporting posts are of metal, an appreciable deposit of coating material is found on the inner wall of the cabinet in the region of the supporting posts. As will be apparent from the drawings, the cabinet is completely open to the atmosphere at both ends. It has been found that when the combined areas of the open ends of the cabinet measured in

square feet is at least equal to one-third of the total volume of the cabinet measured in cubic feet, there is no danger of explosion with electrostatic deposition of paints or enamels using ordinary commercial solvents. If the area of the open ends is less than this figure, the interior of the cabinet approaches too closely to a confined space in which an explosive mixture may be accumulated. In the cabinet illustrated in the drawings, the ratio of end area to volume is approximately one square foot to three cubic feet.

Beneath the floor of the cabinet there is provided a conveyor chain 15 supported on a trackway formed by an angle iron 16, an angle iron 17 and a plate 18 (Fig. 4). Said trackway is suitably supported by legs 19. The conveyor chain is trained about sprockets 20 and may be continuously driven by a motor 21 operating one of said sprockets through a reduction gear unit 22, a belt drive 23 and beveled gears 24. The path of the conveyor chain is best seen in Fig. 1 and leads from beneath the cabinet past an unloading station 25 and a loading station 26 and then again beneath the cabinet. At suitable intervals along the conveyor chain there are provided upwardly extending pins 27 each adapted to enter a mating opening in the lower end of a carrier unit 28. Each of said carrier units, as best seen in Fig. 4, includes a sleeve 29 preferably formed of insulating material and having in its lower end a plug 30 provided with an opening to receive the pin 27. A sprocket 31 is mounted near the lower end of the sleeve 29. A plug 32 is secured in the upper end of the sleeve 29 and is provided with a recess adapted to receive an upwardly extending rod 33. A collar 34 tightly secured about the upper end of the sleeve 29 prevents undesired displacement of the plug 32. The rod 33 extends upwardly through an opening between the two bottom plates 13 of the cabinet and carries at its upper end an electrode 35 herein shown as of frusto-conical shape formed of sheet metal and serving as a support for an article 36 to be coated. In the example shown herein the article is in the form of a flowerpot and may be of non-conducting material, such as ceramic ware.

At each end of the cabinet close to the floor there are mounted a pair of rods 37 suitably supported in fittings 38 and each having mounted thereon one or more slidable fittings 39. Said fittings 39 may be secured at any desired place along the rods 37 by means of thumb screws 40 and each of said fittings is adapted to receive a vertical rod 41. Fittings 42 are carried by the vertical rods 41 and are similar to the fittings 39. Said fittings 42 carry horizontal rods 43 adapted to support spray guns 44. Said spray guns may be of a well known commercial form and are connected by tubing 45 to a suitable source of a coating material of siccative nature such as paint, lacquer or enamel and a source of compressed air for atomization. By means of this construction the spray guns may be positioned as desired adjacent either end of the cabinet. In the arrangement shown in the drawing two such guns are used at one end of the cabinet and are located to direct a spray 46 of coating material in the general direction of the opposite end of the cabinet. One of said guns is positioned on each side of the path of movement of the articles 36 through the cabinet. Preferably all or a part of the supporting structure for the guns is formed of insulating material and the tubing 45 is also of non-conducting material. The guns are, therefore, isolated from the electrical apparatus

and do not impart any electrical charge to the spray particles nor tend to attract stray particles of the coating material.

On each of the side walls 11 of the cabinet there is mounted a pair of tubular insulating members 47 extending inwardly toward the path of travel of the articles 36. An electrode 48 in the form of a fine wire is strung between the inner ends of each of the insulators 47 and extends generally parallel to the path of travel of the articles. Each of said electrodes extends outwardly through one or both of the insulators 47 and is connected by a conductor 49 to one terminal of an electrical generating apparatus 50 shown diametrically in Fig. 2. The opposite terminal of said apparatus is connected by a conductor 51 to a pair of wires 52 (Fig. 4), which extend longitudinally beneath the floor of the cabinet and are supported on spring clips 53 carried by the cabinet floor. The wires 52 are adapted to engage the vertical rods 33 in their travel through the cabinet and thus serve to make an electrical connection between the generating apparatus 50 and each of the electrodes 35. Preferably the generating apparatus is adapted to supply direct current with a voltage of the order of 100,000 volts. The discharge electrodes 48 are preferably connected to the negative terminal and the collecting electrodes 35 to the positive terminal. By this means an electrostatic field of high intensity is set up between the discharge electrodes 48 and the collecting electrodes 35. Since the discharge electrodes 48 have an extremely small surface area as compared to the total surface area of the collecting electrodes 35 presented thereto, the last named electrodes exert a more powerful attractive effect on the spray particles than do the electrodes 48. The tendency of the discharge electrodes 48 to collect spray particles is further diminished by the fact that they are located at the extreme edge of the normal path of the spray from the guns 44 or completely out of said path.

By means of the arrangement of the spray guns just described, the path of the spray and the path of the articles 36 is such that both small and large spray particles lose their initial velocities at points adjacent to the path of travel of the article. Thus there is always an electrically charged article reasonably close to exert an attractive effect on each slowly moving particle. The efficiency of the paint collection is, therefore, immensely increased over that of any arrangement in which the spray is directed substantially at right angles to the path of travel of the articles. The velocity of spray is normally adjusted so that none of the spray particles pass beyond the confines of the cabinet. It is immaterial in which end of the cabinet the spray guns are mounted. In fact, one may be mounted in one end and the other in the opposite end. Such an arrangement is beneficial in certain installations. Where only one side of each article is to be coated only one gun and one discharge electrode may be required. In other cases, such as for larger objects, more than one gun may be required on each side of the conveyor.

It is to be noted particularly that the articles to be coated need not be electrical conductors. When said articles are so placed as to mask the collecting electrode so that the electrostatic field must pass through the article, the efficiency of the collecting electrode is not materially impaired. Paint which is attracted by the collecting electrode is then deposited on the outer sur-

face of the article. It is not necessary in all cases that the collecting electrodes be carried by the conveyor and act as supports for the articles. Where only one side of an article is to be coated it may be advantageous in some cases to mount a collecting electrode in a stationary position on the side of the conveyor opposite to the discharge electrode. Such an arrangement is illustrated in Fig. 7 in which an object 136 to be coated on one side only is in the form of a thin plate of non-conducting material. Said object is carried by a support 133 which may be mounted in the carrier 28 in the same manner as the rod 33 previously shown. The discharge electrode may be in the form of a metallic point 148 mounted on the end of one of the insulators 47. The collecting electrode is shown as a plate 135 carried on a similar support on the opposite side of the path of travel of the article 136. The spray gun 44 discharges the paint spray into the space between the discharge electrode and the object. In apparatus of this kind it is advantageous to move the conveyor intermittently, stopping each of the objects 136 between the electrodes for a sufficient length of time to receive a thorough coating of paint.

For objects not placed too closely together on the conveyor, the electrical attraction is sufficient to give a relatively uniform coating on all sides of the articles, even though the articles are not turned during their movement while subjected to the spray. For articles of this type and for other articles where the spray is to be applied to one side only, there is provided a construction as shown in Fig. 6 of the drawings. Each of the sprockets 31 is provided with a suitable opening in which there is inserted a pin 60, the lower end of which is received in an opening in the adjacent link of the chain 15. The pin, therefore, prevents the articles from turning during their travel through the cabinet.

When the articles on the conveyor are spaced relatively close together it is desirable that they be slowly rotated in their movement through the cabinet to insure uniform coating. For this purpose mechanism shown particularly in Figs. 3 and 4 is provided. In this construction there is provided a pair of brackets 61 secured to the plate 18, one of which brackets serves as a bearing for a vertical stub shaft 62 and the other for a similar stub shaft 63. A sprocket chain 64 is trained about a pair of sprockets 65 and 66 carried by said stub shafts. The chain 64 is of the proper pitch to mesh with the sprockets 31 carried by the carrier units 28. A plate 67 rests on brackets 68 and a bracket 69 secured to the plate 18. The edges of said plate 67 engage the inner and outer runs of the chain 64 which is preferably a roller chain adapted to run smoothly on said edges. By movement of the plate 67 toward or away from the conveyor 15 the chain 64 may be brought into and out of mesh with the sprockets 31.

The plate 67 has secured thereto a vertical pin 70 extending downwardly through a slotted opening 71 in the bracket 69 and having secured thereto a T-fitting 72. A stud 73 is threaded in the outlet of said T-fitting and is connected to a rod 74 by a pipe union 75. Said union is loosely adjusted so that the rod 74 may be rotated without rotating the stud 73 and the threaded connection 76 therein is soldered to prevent the union becoming unscrewed in its movement. The outer end of the rod 74 is guided in a bracket 77 secured to the bracket 69. A washer 78 is

carried by the rod 74 and is held in place thereon by a pin 79. A compression spring 80 is interposed between said washer and the bracket 77 and normally urges the rod 74 and associated parts to the left in Fig. 4 to keep the chain 64 in engagement with sprockets 31. The yielding pressure of the spring permits the chain to give slightly if the teeth of the sprockets do not initially engage the chain at the proper point.

The outer end of the rod 74 is provided with a T-fitting 81, in one run of which there is secured a downwardly extending handle 82 and the other of which carries a stud 83. A detent 84 is secured to a portion of the cabinet in position to engage the stud 83. A guide pin 85 secured to the bracket 69 operates in a slotted opening 86 in the plate 67 and serves to guide the movement of the same. By means of this construction, the spring 80 normally presses the plate 67 against the inner run of the chain 64 and holds said chain in engagement with the sprockets 31. By means of the handle 82 and the rod 74 may be rotated so that the stud 83 clears the detent 84, the rod may then be drawn to the right in Fig. 4 and the stud 83 returned to its vertical position outside of the detent 84. In this movement the plate 67 is moved to the right in Fig. 4 and disengages the chain 64 from the sprockets 31 and the detent 84 engages the stud 83 to retain the parts in this position.

A variable speed motor 87 is connected through a reduction gear unit 88, a pulley 89 and a belt 90 to a pulley mounted on the stub shaft 62 and thus serves to move the chain 64. When the motor 87 is run at the proper speed to operate the chain 64 at the same speed as the conveyor chain 15, no rotation of the articles on the conveyor is produced. By increasing the speed of the motor 87, rotation of the articles is effected in one direction, and by reducing the speed, the direction of rotation may be reversed. Any suitable speed of rotation of the articles may thus be produced by slight variations in the speed of motor 87. Of course when rotation of the articles is to be produced the pins 60 are withdrawn.

The foregoing specification describes the in-

vention in one of its preferred forms. It is apparent however that variations in one or more of the elements of the invention are necessary for the coating of articles of different sizes and shapes. Articles of conducting material serve as their own collecting electrodes and do not require additional collecting electrodes of large size, such as shown herein. With the high voltages used in the method, certain articles not ordinarily classed as conductors actually possess sufficient conducting power to be efficient electrodes in themselves. For example, small panels of wood have been successfully painted without the use of additional electrodes. Some articles are of such shape that they cannot be efficiently sprayed with the spray guns located as shown herein. With such articles it may even be necessary to direct the spray at right angles to their path of travel. However, even with such an arrangement of the guns other features of the invention specified in the claims are applicable.

The invention claimed is:

1. A method of coating articles, comprising the creation of an electrostatic field of definite length and breadth, continuously passing a series of the articles to be coated in spaced relation along the longitudinal center line of said field, and projecting a spray of siccative coating material from one end and exteriorly of said field into the latter roughly parallel and at an acute angle to the said longitudinal center line and with a force insufficient to project the spray beyond the opposite end of the field.

2. A method of coating articles, comprising the creation of an electrostatic field of definite length and breadth, continuously passing a series of the articles to be coated in spaced relation along the longitudinal center line of said field, and projecting a spray of siccative coating material from one end and exteriorly of said field into the latter roughly parallel and at an acute angle to the said longitudinal center line, the length of the field being greater than the projection of the spray.

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