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ELECTROSTATIC COATING METHOD AND APPARATUS

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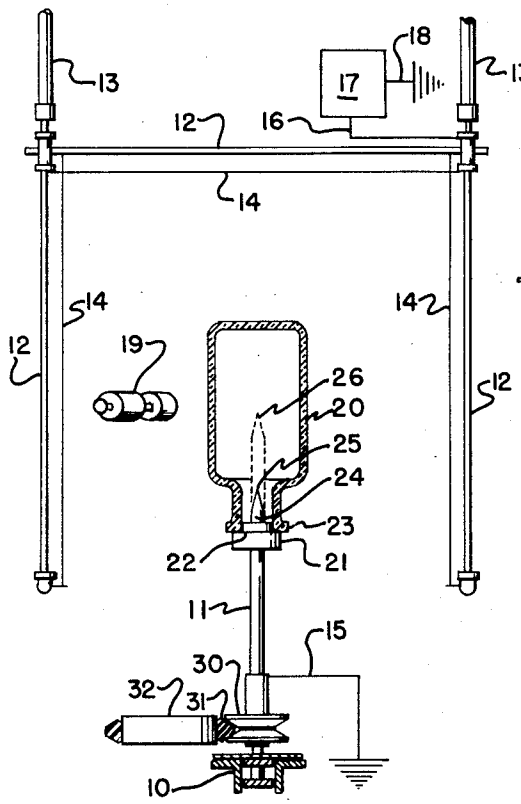


Fig. 1

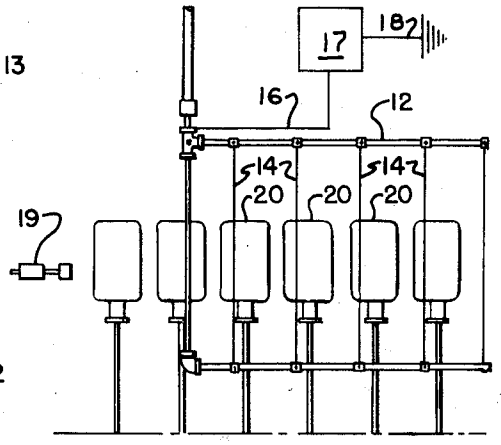


Fig. 2

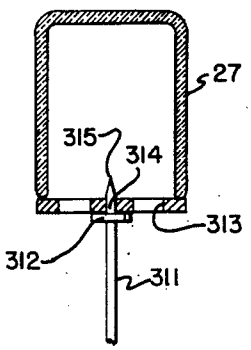


Fig. 3

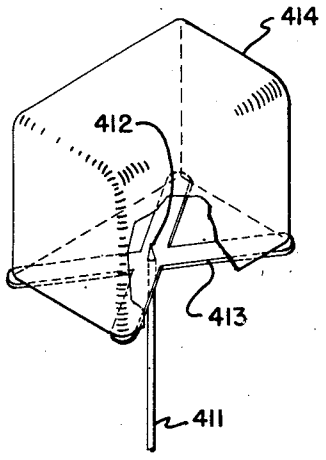


Fig. 4

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ELECTROSTATIC COATING METHOD AND APPARATUS

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6 Claims. (Cl. 117—93)

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This invention relates to coating articles and more particularly to improvements in an electrostatic method and apparatus for applying coatings to the exterior surfaces of hollow articles of dielectric or nonconductive material such as, for example, bottles, tumblers, plastic radio cabinets and the like.

I am aware that heretofore hollow articles have been coated with the aid of an electrostatic field. In such process and apparatus the articles are carried by a conveyor along a predetermined path spaced from a discharge or ionizing electrode. A high voltage source is associated with the discharge electrode for creating an electrostatic field to surround the articles. Finely divided coating material is introduced into the electrostatic field for deposition upon the articles. Where the hollow articles are of a dielectric material, in the past an extended backing electrode has been provided for the interior of each article being coated. U. S. Patent No. 2,247,963, issued to H. P. Ransburg and H. J. Green on July 1, 1941, illustrates one form of such extended backing electrode.

It is apparent that the necessity for providing a backing electrode fitting the interior surface of the article surfaces of such article or for electrical conformation, requires the fabrication of especially shaped backing electrodes for each form of article which it is desired to coat. In certain instances, as where the opening leading into the interior surface of the article is restricted as, for example, the neck of a bottle, such bottle-neck renders the use of the process impracticable because of the difficulty of introducing the backing electrode into the interior of the article.

In certain instances, even though the entrance opening of a particular article is of a size which would allow free and easy mounting or removal of the article over or from the backing electrode, such type of electrode frequently cannot be used because the highly irregular surface contour of the interior of the article renders it impracticable, if not impossible, to obtain the proper relationship between the article and the backing electrode.

An object of the present invention is to provide a method and apparatus for electrostatically coating the exterior surfaces of hollow articles of dieletric material in such manner that the operations may be simply and effectively carried out without necessitating the employment of any backing electrodes, especially shaped with respect to the articles to be coated and irrespective of the widely varying sizes and shapes of the articles or their entrance openings or the degree

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of irregularity possessed by their interior surfaces.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following specification taken in connection with the accompanying drawing, and the scope of the invention will be pointed out in the appended claims.

In the drawing:

Fig. 1 is an end elevation of an electrostatic coating apparatus of the general character with which my invention may be employed, and illustrates a typical use of the invention in the coating of glass bottles.

Fig. 2 is a side elevation thereof,

Fig. 3 is a detailed sectional view illustrating the use of the invention in the application of coating to a glass tumbler or the like, and

Fig. 4 is a detailed perspective view illustrating the use of the invention in conjunction with the coating of a plastic radio cabinet or the like.

The apparatus illustrated in Fig. 1 includes a conveyor 10 having spaced upstanding spindles 11 upon which articles are mounted. The conveyor 10 is arranged to travel between oppositely disposed, spaced electrodes 12, which are suitably supported by insulators 13 suitably affixed to a conventional coating booth (not shown). Electrodes 12 generally comprise rectangular frames across which are strung in vertical spaced relation a series of fine ionizing or discharge wires 14. Conveyor 10 and spindles 11 are connected through a conductor 15 to ground, whereas electrodes 12 and wires 14 are connected through a conductor 16 to one terminal of a high voltage source 17, the opposite terminal of which is connected by a conductor 18 to ground. It will be understood, of course, that if desired, the opposite terminal of the voltage source may be connected directly to the conveyor 10 and spindle 11 and the grounded connection thereby dispensed with, although generally the ground type of connection is preferred. Preferably, voltage source 17 is adapted to supply direct current with a voltage of the order of 100,000 volts, and the electrodes are arranged so that the distance between the wires 14 and the outer surface of the articles conveyed past them will be about ten inches.

In ordinary practice, that is, where articles of conductive material are mounted upon and electrically connected to the spindles 11, as such an article approaches the electrodes 12, an electrostatic field is created between the ionizing wires 14 and the surface of such article, the article

becoming during its movement past the electrodes 12 a complementary or collecting electrode in the system.

One or more spray guns 19 are suitably supported beyond the electrodes (see Fig. 2) and are directed so as to introduce the coating material from a supply source (not shown) in a direction generally parallel to the path of travel of the articles into the space between the articles and the electrodes. In this manner, the finely divided particles issuing from the spray gun become charged by the wires 14, and are thus attracted to the surfaces of the oppositely charged article.

Heretofore, when hollow articles of nonconductive material such as, for example, ceramic ware, glass or plastic were to be coated, it has been the practice to back the interior surface of the article with an extended metallic, form-fitting electrode supported upon and being electrically connected with the spindle 11. Such method and construction is satisfactory in certain instances, as where the opening leading into the interior of the article to be coated is of such size and shape with respect to its inner surface as will permit the article to be placed upon and removed from the conforming electrode. However, even in such cases, it is noted that variations in size and shape of the interior surfaces of varying articles call for correspondingly varying conforming plate electrodes. This naturally requires the maintenance of a large inventory of such electrodes in order to adapt the process and apparatus for use in connection with articles of varying size and shape. Moreover, with certain types of articles, such as, for example, bottles and the like, which generally have a narrow neck-opening leading into their interior surfaces, the prior art type of backing electrode cannot be used because the restricted opening prevents the mounting of such types of articles thereover.

By my invention, I have overcome such difficulties and have provided a method and apparatus for coating hollow articles which conveniently lends itself to applying a uniform application of the coating material to such articles without requiring the use of especially shaped electrodes. I have discovered that if an article with an opening which leads into its interior is placed at or adjacent an isolated, sharp ionizing point or points or a fine wire electrically connected with the spindle 11, an ionizing zone or zone of corona discharge is created within the interior of the article. Such discharge, in effect, establishes an intimate electrical contact with the entire interior surface of the article by virtue of which positive charges (assuming that the pointed electrode is charged positively) are distributed to every point on such surface. A possible explanation or theory of the operation in effecting a uniform coating is that the nonconductive or dielectric character of the article with ionizing zones or zones of corona discharge of opposite polarity located in spaced relation respectively, internally and exteriorly thereof, causes a polarization or electrical stress to take place in the nonconductive material so that the negatively charged particles of coating material are evenly and thoroughly attracted to and deposited upon the positively charged exterior surface of the article.

In explaining the theory of the operation of the apparatus and method, I do not wish to be confined to such theory in claiming my invention.

Referring again to Fig. 1 wherein is illustrated

the application of coating material to the exterior surface of a glass bottle 20, the spindle 11 is formed with an enlarged portion 21 which provides a shoulder 22 upon which the end of the inverted bottle 23 is seated. Extending upwardly and centrally of the enlarged portion 21 is a projection 24 which terminates in a sharp ionizing point 25. Projection 24 may be formed integrally with the spindle 11 or may constitute a fine ionizing wire suitably affixed on the spindle. Preferably, the pointed end 25 of the projection 24 terminates slightly within the neck of the bottle. It has been found by experimentation, however, that if the point extends into the bottle for a substantial portion beyond the bottle neck such as, for example, as indicated by dotted lines at 26, the application of the coating material will be more heavily applied to the exterior surfaces of the bottle lying in a plane above the point.

Referring to Fig. 3, wherein is illustrated the application of the improved process to the coating of a glass tumbler 27 or the like the spindle 311 is formed with a flange or shoulder 312 upon which rests a disk 313, preferably formed of insulating material. The upper end of the spindle projects centrally through an opening 314 provided in disk 313 and terminates in a sharpened point 315. The diameter of disk 313 is such that the edge of the inverted tumbler 27 is supported thereby.

Referring to Fig. 4 wherein is shown a modification for adapting the process and apparatus to the use of applying coatings to radio cabinets or the like, the spindle 411 has affixed thereto adjacent its pointed end 412 a spider 413, preferably of insulating material, the outwardly projecting arms of which are of sufficient length to engage and support the edges of the radio cabinet 414. Such radio cabinets are commonly made of electrically insulating or nonconducting materials.

In all of the illustrations, it is noted that the terminal point 25, 315 or 412 projects only slightly into the interior of the hollow article. It has been found in practice that the point may be so positioned that it is coplanar with or extends slightly below the plane of the edges defining the opening in the article, and that satisfactory coating results may be achieved when the ionizing point is so positioned.

The point or wire may even be formed so as to come in contact with the interior surface of the article when the article is mounted upon the spindle, the important requirement being that the point or wire be capable of creating an ionizing zone or zone of corona discharge within the interior of the article. Preferably, in carrying out the operations, the spindles 11, 311 or 411 are arranged to be rotated so as to impart rotation to the articles during their traverse of the coating zone. Such rotating mechanism may take the form of a pulley such as 30 (Fig. 1) affixed to the spindles and arranged to be engaged by a continuously driven belt 31 mounted over driving pulleys such as 32.

While the invention is herein shown and described in connection with an upstanding spindle type of conveyor, it is to be understood, of course, that it is equally adaptable for use in conjunction with any type of article support.

It is noted that by using such a method and apparatus as herein described, articles of nonconductive material and of varying sizes and shapes may be readily and easily accommodated

without particular regard to the sizes of their entrance openings to their interior shape or to the degree of irregularity possessed by their interior surface formations.

The requirement for especially shaped, extended backing electrodes is completely eliminated. In practicing the invention, the coating material is issued from the spray guns such as 19, in exactly the same manner as described in the foregoing. The establishment of an ionizing or corona discharge zone within the interior of the nonconductive article, which zone is of opposite polarity to the ionizing zones created by wires 14 in spaced relation from the exterior surface of the article, is effective to establish an electrical field between the electrodes. The finely divided material issuing from the guns 19 is deposited upon the exterior surface of the article by the precipitating action of such field.

It has been found in practice that a coating of satisfactory thickness and having a very high degree of uniformity can be obtained simply and efficiently by the use of this method and apparatus.

What I claim is:

1. Apparatus for electrostatically coating the exterior surface of a hollow article of non-conductive material having an opening leading into its interior, said apparatus comprising an ionizing discharge electrode, means for supporting the hollow article in spaced relation to said ionizing discharge electrode, said means being constructed and arranged relative to said ionizing discharge electrode whereby said ionizing discharge electrode is at the opening of the hollow article and within the lateral confines thereof, a second ionizing discharge electrode supported in spaced relation to the exterior surface of the article, means for establishing an electrostatic field between said electrodes of sufficient magnitude to create an ionizing zone about each, and means for introducing a spray of particled coating material into the field between the exterior surface of the article and said second discharge electrode for electrostatic deposition on the article.

2. An apparatus according to claim 1 wherein said first mentioned ionizing discharge electrode and the support for said article are formed integrally.

3. A method of coating an exterior surface of a hollow article of non-conductive material which comprises the steps of creating in spaced relation from and substantially within the boundaries of the interior surface of said article a localized zone of corona discharge of predetermined polarity to establish internally of the article and substantially throughout its confines a cloud of charged atmospheric particles, simultaneously creating in spaced relation from the exterior surface of the article an ionizing zone of corona discharge of opposite polarity to that of the atmospheric particles within said article, introducing a gaseous dispersion of particled coating material into the ionizing zone exterior of said article to form a cloud of coating material particles charged oppositely to the internal atmospheric particles, and establishing across the nonconducting walls of the article an electric field whereby the internal atmospheric particles will be attracted to the internal surfaces of the wall and the external coating material particles will be attracted to the external surfaces of the wall.

4. Apparatus for electrostatically coating the exterior surfaces of a series of hollow articles of nonconducting material, each of said articles having an opening leading into its interior, said apparatus, comprising a conveyor, a first discharge electrode spaced from said conveyor, a series of support members, each being carried by said conveyor and being adapted to support one of the hollow articles, a series of sharply pointed discharge electrodes, means for establishing an electrostatic field between said first discharge electrode and said pointed electrodes of sufficient strength to create an ionizing zone in the vicinity of each electrode, each of said pointed electrodes being disposed at an article-opening and in such position that atmospheric particles charged by it and attracted by said first electrode will be intercepted by the interior surface of the associated hollow article, and means for spraying coating material into the field between said first electrode and the articles for electrostatic deposition on the exterior surfaces of the articles.

5. A method of coating the surface of a hollow article of nonconducting material which comprises establishing between an ionizing electrode within the article and an ionizing electrode outside the article an electrostatic field of sufficient strength to establish internally of the article and substantially throughout its confines a cloud of charged atmospheric particles and externally of the article a surrounding ionized atmosphere of a polarity opposite to that of the internal cloud, and introducing a gaseous dispersion of particled coating material into said surrounding ionized atmosphere and into the field exterior of the article for electrostatic deposition on the article under the action of said field.

6. Apparatus for electrostatically coating the exterior surface of a hollow article of non-conducting material having an opening leading into its interior, a first discharge electrode spaced from said support, a sharply pointed discharge electrode, means for establishing between said two electrodes an electrostatic field of sufficient strength to create an ionizing zone in the vicinity of each electrode, said pointed electrode being disposed in alignment with the opening of an article on said support and sufficiently close to such article that atmospheric particles charged by it and attracted by said first electrode will impinge upon the interior surface of the article on the support to create a surface charge, and means for spraying coating material into the field between said first electrode and an article on the support for electrostatic deposition on the exterior surface of such article.

RICHARD E. HELMUTH.

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