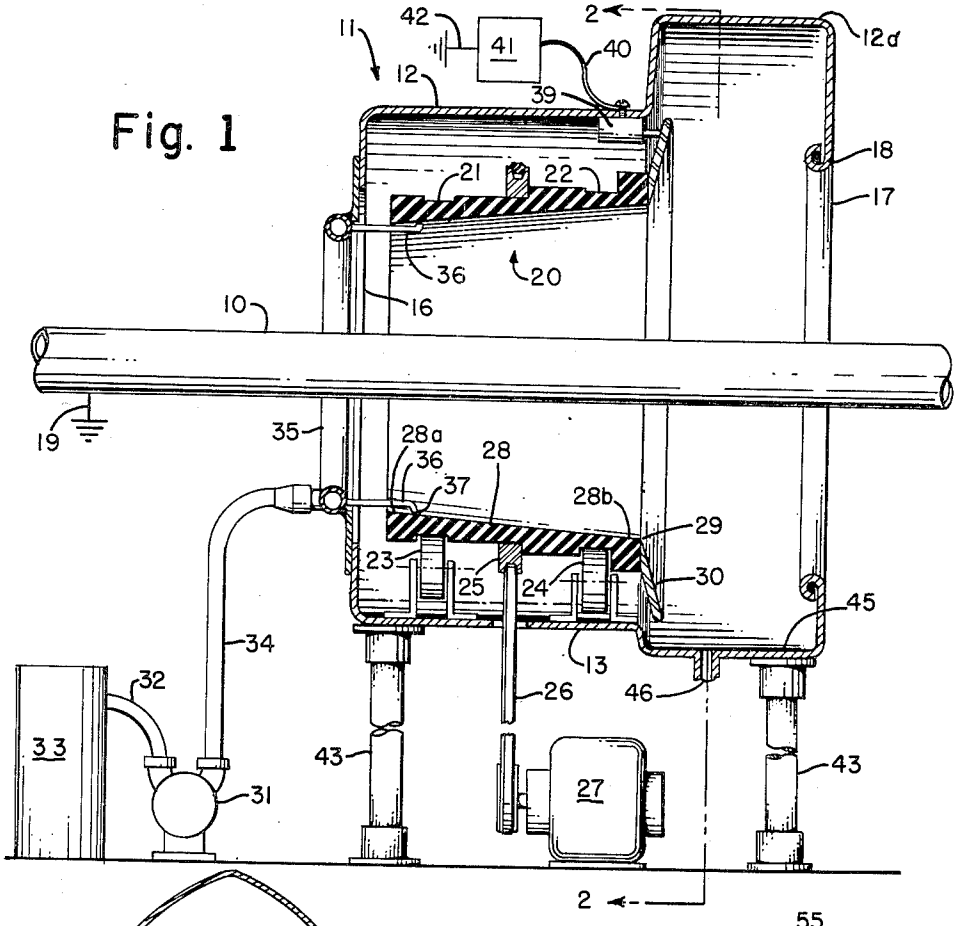
Feb. 12, 1957 M. R. MILLER 2,781,279

METHOD AND APPARATUS FOR SPRAY COATING OF ARTICLES

Filed Nov. 26, 1951

Fig. 1



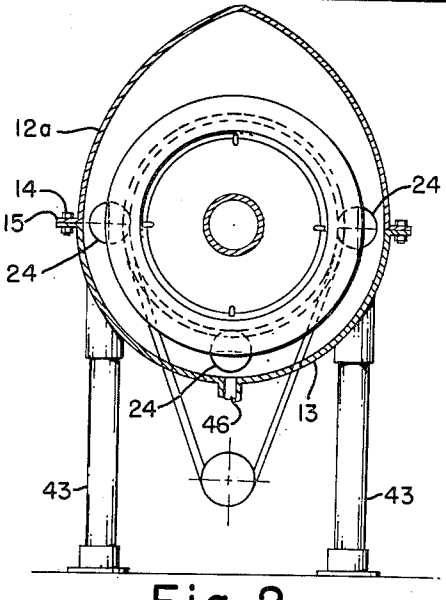


Fig. 2

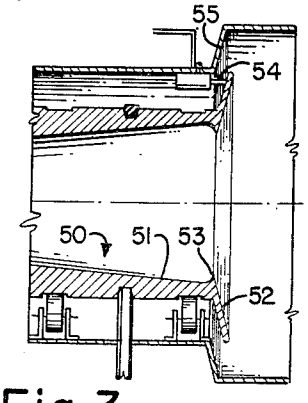


Fig. 3

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United States Patent Office 2,781,279 Patented Feb. 12, 1957

2,781,279

METHOD AND APPARATUS FOR SPRAY COATING OF ARTICLES

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Application November 26, 1951, Serial No. 258,213

10 Claims. (Cl. 117—93)

This invention relates to the spray coating of articles and more particularly to the electrostatic deposition of liquid coating material on articles.

When an article, particularly an elongated or extended article is exposed to the spray issuing from a spraying device in an electrostatic coating system where deposition of the coating material particles is primarily the result of electrostatic forces and where the particles are given an electric charge at the time they leave the spraying device or shortly thereafter, difficulty has been experienced in applying a uniform coating around the entire exposed surface of the article. This difficulty is particularly marked when coating the external surface of such elongated or extended articles as pipe, chain and cable.

Heretofore it has been the practice to coat such elongated articles by passing them through a housing in which are located either a slushing-type nozzle or a normal air atomizing nozzle. These nozzles are operated within the housing and the article passing therethrough receives a shower of the coating material. In the operation of the slushing method, considerable excess of coating material is flowed upon the article which excess is carried out of the housing on the article to drip on the floor or other areas surrounding the path of movement thereof. To insure sufficient coating on all areas of the article where air atomization is used, often an excess is applied to some areas, which excess gives rise to dripping as in the slushing method, and in any event the air introduced into the enclosure incident to the atomizing process is carried out of the enclosure by subsequently introduced air and such expelled air carries with it a considerable amount of coating material in atomized form which not only comprises waste, but also may necessitate expensive exhaust arrangements or the like.

The waste of coating material inherently incident to the operation of the processes just described can be considerably reduced by the use of an electrostatic coating system. In a majority of such electrostatic coating systems a field of electrostatic force is set up which includes the article being coated and the atomized coating material particles in movement towards such article. In normal commercial practice it has been found desirable to ground the article such as by carrying it on a grounded conveyor, and thus to make the article itself (if it is of conducting material), or electrodes within or immediately behind the articles, at ground potential; and to provide another electrode at a high electrical potential with respect to ground, this latter electrode sometimes being the spraying device and sometimes being a separate electrode near or past which the spray passes in its movement toward the article.

In coating elongated articles, particularly those of the type previously mentioned, by electrostatic deposition, waste of material is eliminated to a large extent but difficulty has been experienced in obtaining a uniform coating over the entire exposed surfaces of the article. Even where using the highly efficient atomizing head,

such as disclosed and claimed in the copending application of E. M. Ransburg filed in the United States Patent Office on February 13, 1950 as Serial No. 143,994, it has been found that the portions of the surface of the article to be coated nearest the coating head receive a heavier coating than those portions remote from the head.

This invention has as its object the provision of methods and apparatus for carrying out the methods which produce a cloud of atomized coating particles carrying an electrostatic charge relatively opposite to the charge of the article with the cloud having a substantially uniform concentration of atomized particles in the portion thereof near or immediately adjacent the article. Inasmuch as such atomized particles are deposited upon the article by the electrostatic forces employed, the provision of such a cloud of particles in substantially uniform concentration in an area completely surrounding the article results in a coating thereon of uniform thickness. Thus in the present invention the article to be coated is passed along a predetermined path and a multiplicity of atomizing zones are positioned to surround said path to produce at or near the center of the path a cloud of atomized particles of uniform concentration. Thus as the article is passed along that path it is passed through the cloud and receive a uniform coating thereon.

This and other features of the invention will be readily apparent from the following description and drawings, in which:

Fig. 1 is a vertical section through an apparatus embodying the invention;

Fig. 2 is a section taken along line 2—2 of Fig. 1; and

Fig. 3 is a view similar to Fig. 1 of a modified form of construction.

While two different forms of apparatus are illustrated in the accompanying drawings and will be described hereafter as providing means for practicing the present invention, it will be understood that these are representative embodiments only. It will also be understood that forms of spraying device other than the particular electrostatic atomizing device illustrated may be utilized and that other forms of apparatus may be employed; and it is to be understood that other embodiments may be utilized without departing from the contemplated scope of the present invention and that no limitations are to be implied from such specific description as shall now be provided.

Referring now to Figs. 1 and 2, there is shown one form of apparatus embodying the invention hereof which is illustrated as being employed in the coating of the outer surface of an elongated article such as the pipe **10**. The coating apparatus includes an elongated housing **11** formed of an upper section **12** and a lower section **13** secured together by bolts **14** passing through flanges **15** provided on each of the sections. The right-hand portion (as seen in Fig. 1) of each of the sections, which is the exit portion, is enlarged as illustrated with the upper section **12** being expanded to form an egg-shaped portion **12*a*** as shown in Fig. 2. The housing **11** is provided with aligned openings **16** and **17** at each end thereof with each opening being rounded as illustrated at **18** to provide a corona-free surface.

Conveyor means (not shown) are provided for passing the article to be coated, such as the pipe **10**, through the housing. The pipe section is grounded as indicated at **19**, which grounding may be achieved either by supporting the pipe section on a suitably grounded conveyor or by other well known means.

As it is the purpose of the apparatus electrostatically to deposit coating material on the outer surface of the pipe, means are provided within the housing for creating a cloud of atomized particles with each particle bearing an electrostatic charge relatively opposite to the charge

of the pipe and with the cloud containing a substantially uniform concentration of such atomized coating particles in an area near and extending around the pipe. To form such a cloud, there is provided in the apparatus illustrated a cylinder 20 of insulating material provided on its outer surface with a pair of bearing raceways 21 and 22 adapted to receive two series of supporting rollers 23 and 24. Three rollers are provided in each series with each roller being rotatably mounted on the inner surface of the housing section 13. Secured to the cylinder is a pulley 25 adapted to receive a rubber V-belt 26 driven by a suitable motor, such as the electric motor 27.

As will be noted from the drawings, the inner surface 28 of the cylinder 20 is tapered, having a relatively narrow portion 28*a* at one end and a wider portion 28*b* at the other end. Adjacent the wider portion of the interior surface there is provided a knife edge 29 of conducting material from which coating material is electrostatically atomized for deposition on the pipe. In the apparatus illustrated the discharge edge 29 which terminates flush with the inner surface 28*b* of the cylinder 20 is in the form of an annulus completely encircling the inner surface of the cylinder 20 and hence completely surrounds the pipe. The knife edge is formed at the inner edge of a rim 30 which flares outwardly within the enlarged portion at the right-hand end of the housing.

Means are provided for supplying liquid coating material to the narrower end 28*a* of the interior of the cylinder so that rotation of the cylinder operates centrifugally to flow the coating material uniformly to the discharge edge 29. For this purpose there is provided a pump 31 connected by a pipe 32 to a supply 33 of coating material and by a flexible rubber hose 34 to a manifold 35. The manifold is circular in shape and serves to feed coating material to a plurality of discharge nozzles 36 spaced around the interior surface of the narrow end of the cylinder, each nozzle terminating in a downwardly inclined portion 37 to direct coating material against the inner surface of the cylinder.

As the cylinder is rotated by the motor 27, coating material fed to the manifold and thence to the inner surface of the cylinder flows by the centrifugal force thus created toward the wider end 28*b*. Thus a flow of coating material is delivered substantially uniformly to the discharge edge. To supply the necessary electrostatic charge to the discharge edge 29 a brushing electrical contact 39 mounted on the housing 11 is connected by a lead 40 to one terminal of a high voltage supply 41 which has its other terminal connected to ground at 42 as illustrated. The entire housing is supported by a plurality of insulating supporting columns 43 and inasmuch as the V-belt 26 and hose 24 are of insulating material the entire housing can thus be maintained at a high potential with respect to the ground. No specific insulation is thus required between brush contact 39 and the housing 11.

A large proportion of the coating material supplied to the discharge edge 29 is atomized therefrom in the form of a spray of particles of coating material, each carrying an electrostatic charge and deposited by electrostatic force on the outer surface of the pipe 10. In the operation of a discharge edge, such as the edge 29, it has been noted that the coating material is not electrostatically atomized uniformly from every minute portion of the edge, but rather the coating material fed to the edge tends to form a multiplicity of cusps of coating material and the atomization takes place from these cusps. Thus the discharge edge produces a multiplicity of points, or sources, of atomization. By providing a continuous annular edge and by passing the pipe 10 through substantially the center of the annulus, this multiplicity of cusps or multiplicity of atomizing zones surrounding the article produces a cloud of atomized particles having a uniform concentration adjacent or near the pipe. As such a cloud has a uniform concentration and the particles constituting the cloud are thence electrostatically deposited on the pipe, a uniform coating results.

While, as noted, a large proportion of the coating material fed to the atomizing edge is atomized therefrom, some portion of the coating material may overflow the edge and is thence flowed outwardly by centrifugal force onto the lip 30 to be projected therefrom against the interior surface of the right-hand portion of the housing. The centrifugal force projects the excess coating material around the entire inner surface of the portion 12*a*. The fact that this portion is egg-shaped, coming to a relatively sharp peak at its top, insures that such excess material will run down the sides of the housing rather than drip onto the article. It will be noted that the lower portion of the housing at that end is shaped to provide a collecting well 45 having an outlet opening 46 therein so that unatomized coating material may be recovered for reuse. Thus the opening 46 can be connected by suitable means to the supply 33 or to some other type of collector.

The cloud of atomized particles just described may or may not be visible to the unaided eye depending upon many factors, such as the color or character of the coating material, the size of the area being coated, the rate of flow to the atomizing edge and the rate of atomization therefrom, and the amount of light available to illuminate the area immediately surrounding the article. Regardless of whether such cloud is visible, its creation by the provision of a multiplicity of atomizing points or sources surrounding the article assures the deposition on the article of a uniform coating.

It will be noted in the embodiment just described that the cylinder 20 is of insulating material and hence nonconducting. The major electrostatic field is thus created between the conducting edge 29 and the grounded article and material is thus atomized from this point toward the grounded pipe. Where the cylinder is made of conducting material other modifications in the apparatus are necessary.

In such event the modified form of apparatus shown in Fig. 3 may be employed. This apparatus is similar in substantially all respects to the apparatus previously described except that the cylinder 50 is formed of a conducting material and at its right-hand or wider end 51 is flared to form on its outer surface the rim 52. The inner surface of the cylinder 50 is turned inwardly to terminate in an annular discharge edge 53 to which coating material is fed and from which such material is atomized in the manner described for the edge 29. The discharge edge 53 as it extends inwardly of the cylindrical surface 51, acts in the nature of a dam to form a pool of coating material immediately ahead of the discharge edge. This pool is maintained about the cylinder by virtue of the rotation of the cylinder. Coating material is thus delivered substantially uniformly to the discharge edge for atomization therefrom. Material in excess of that which can be atomized overflows to the flange 52 and is centrifuged to the outer walls of the housing 12*a*. To conduct the electric charge to the discharge edge brushes 54 are provided which are secured to the upper portion of the housing and, as previously described, are given an electric charge. With the exception of the features just noted, the other portions of the apparatus shown in Fig. 3 are substantially identical to those described in connection with Figs. 1 and 2.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. The method of coating an article by electrostatic deposition which comprises atomizing coating material into quiescent air from an annular member forming a

substantially continuous atomizing zone extending substantially completely around the article while rotating the member in the plane of the annulus and while moving the article axially through the central portion of the zone, and creating an electrostatic charge differential between the atomized particles and the article of sufficient strength to move the particles through said quiescent air toward and to deposit them on said article.

2. The method of electrostatically coating the exterior surface of an article which comprises moving the article to be coated in a predetermined path, providing an atomizing source, feeding liquid coating material to said source, creating an electrostatic charge differential between the coating material at said source and the article of sufficient strength as to be capable of electrostatically atomizing said coating material and electrostatically depositing the atomized material and the article, and moving the source in a second and non-linear path extending at least a substantial distance around said article and generally following the shape of said surface.

3. The method of coating an article by electrostatic deposition which comprises centrifugally flowing coating material to a rotating annular atomizing zone, creating an electrostatic charge differential between the coating material at said zone and the article of sufficient strength as to be capable of electrostatically atomizing a portion of the coating material from the atomizing zone, moving the article through approximately the geometric center of the annular zone, centrifugally flowing the unatomized portion of the coating material to a confined area and collecting the unatomized portion from said area.

4. Apparatus for electrostatically coating an article comprising means for moving an article to be coated in a substantially linear path, a member provided with an atomizing edge extending substantially completely around said path with all portions of said edge being substantially equidistant therefrom, means for feeding coating material to said edge, a source of high electrical potential, and means electrically connecting said source to the edge and to the article to create therebetween an electrostatic charge differential of sufficient strength as to be capable of electrostatically atomizing coating material fed to said edge.

5. Apparatus for electrostatically coating an article comprising a rotatable atomizing head having an annular atomizing edge, a rim on the head flaring outwardly from the atomizing edge, a housing surrounding the rim, means for feeding coating material to the head at an area spaced closer to the axis of rotation of the head than said edge, and means for rotating the head centrifugally to flow coating material to said edge for electrostatic atomization therefrom and to cause any excess of coating material to flow to the rim to be projected therefrom to the surrounding housing.

6. Apparatus for electrostatically coating an article comprising a rotatably mounted substantially cylindrical atomizing head having an outwardly flaring inner surface, an annular atomizing edge at the larger outer end of said inner surface, means adjacent the smaller inner end of said inner surface for feeding coating material to said inner surface, a rim on the outer end of the head flaring outwardly from said atomizing edge, a housing surrounding the rim and provided with a collecting well, and means for rotating the head centrifugally to flow coating material along said inner surface to said atomizing edge a source of high electrical potential, means electrically connecting said source to the edge and to the article to create therebetween an electrostatic charge differential of sufficient strength as to be capable of electrostatically atomizing coating material at said edge and electrostatically depositing the atomized material on an article moved axially through the geometric center of the annular edge and to cause any excess of coating material fed to said inner surface to flow to the rim for projection therefrom to the surrounding housing to be collected in said well.

7. Apparatus for electrostatically coating an article comprising a housing having a substantially circular opening provided with rounded edges formed at opposite horizontally aligned ends and having a portion generally egg-shaped in vertical cross section near one of said openings, a substantially cylindrical atomizing head rotatably mounted in the housing with the axis of the head being aligned with said openings and with the head having an outwardly flaring inner surface, an atomizing edge at the larger outer end of said inner surface, means for feeding coating material to said inner surface adjacent the smaller inner end of said inner surface, means for rotating the head centrifugally to flow the coating material fed to the smaller end substantially uniformly to the atomizing edge, a flared rim on the cylinder at said larger end and located in said egg-shaped portion of the housing, said rim being adapted centrifugally to project coating material flowing beyond the atomizing edge to the interior surface of said egg-shaped portion with rotation of the cylinder, means forming a collecting well in the housing adjacent the flared rim to collect coating flowing down the interior surface of said egg-shaped portion, and means for moving an article to be coated from end to end through the housing along the axis of the cylinder.

8. Apparatus for electrostatically coating an article comprising a rotatable generally cylindrical member forming an open-ended housing, an inwardly-extending rim in said housing said rim having an edge providing an atomizing zone in the form of an annulus, means for feeding liquid coating material to the interior of said housing, means for rotating the housing to deliver coating material fed thereto to said atomizing zone, means for moving an article through said housing and axially through approximately the center of said rim, a source of high electrical potential connected to the housing, and means electrically connecting said housing to said rim and to the article to create therebetween an electrostatic charge differential of sufficient strength as to be capable of electrostatically atomizing coating material delivered to said atomizing zone and electrostatically depositing the atomized coating material particles on the article.

9. Apparatus for electrostatically coating an article comprising a rotatably mounted substantially cylindrical atomizing head having an outwardly flaring inner surface, a generally radially inwardly extending annular atomizing edge at the larger outer end of said inner surface, means adjacent the smaller inner end of said inner surface for feeding coating material to said inner surface, means for rotating the head centrifugally to flow coating material outwardly along said inner surface to said atomizing edge, a source of high electrical potential, means electrically connecting said source to the edge and to the article to create therebetween an electrostatic charge differential of sufficient strength as to be capable of electrostatically atomizing coating material at said edge and electrostatically depositing the atomized material on an article, and means for moving an article axially through said atomizing head and through approximately the geometric center of the annular edge.

10. The method of coating an article by electrostatic deposition which comprises atomizing coating material into quiescent air from a member having at least an annular portion from the edge of which said atomization occurs, and which member forms at least a portion of a substantially continuous atomizing zone extending substantially completely around the article while rotating the member substantially in the plane of the annulus and while moving the article axially through the central portion of the zone, and creating an electrostatic charge differential between the atomized particles and the article of sufficient strength to move the particles through said quiescent air toward and to deposit them on said article.

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