Sept. 18, 1951 W. W. CROUSE 2,568,611

COATING METHOD AND APPARATUS

Filed July 16, 1949

Fig. 1

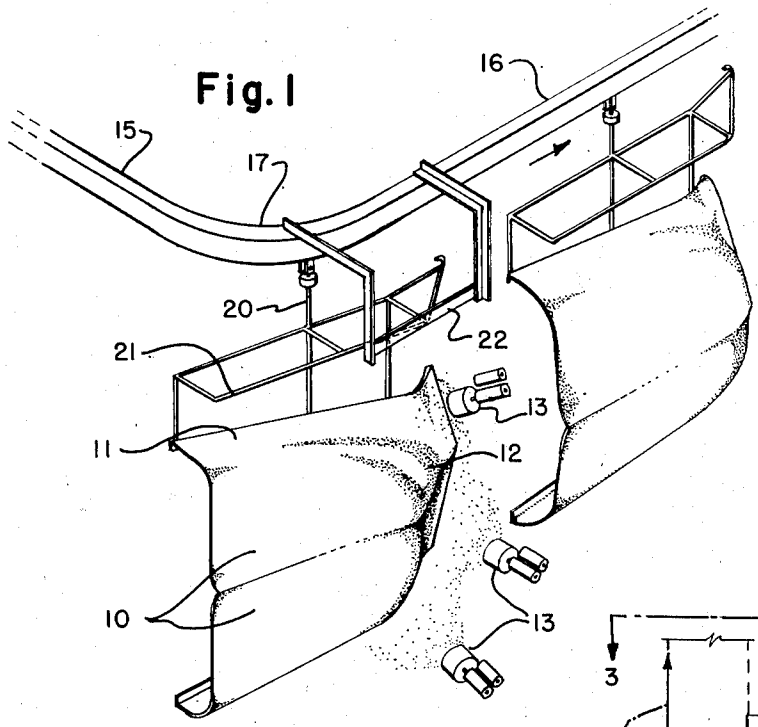
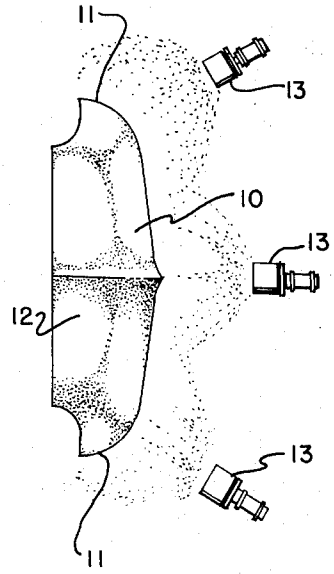


Fig. 3



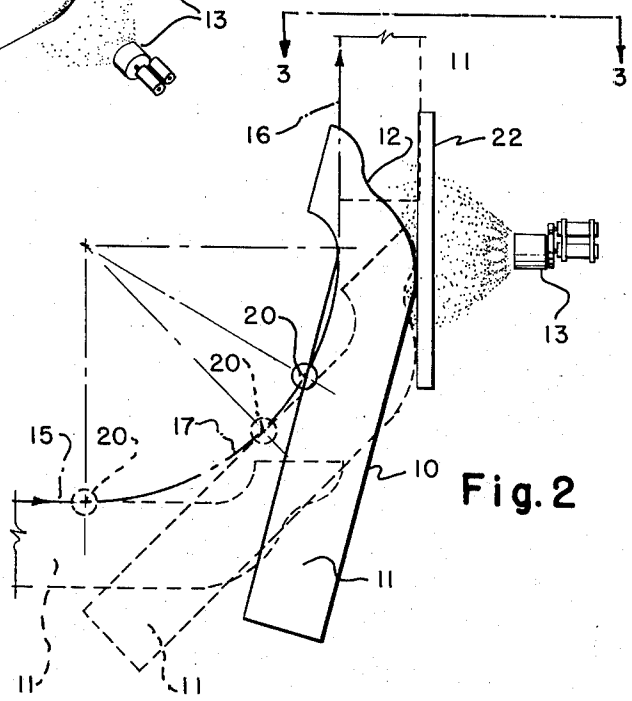


Fig. 2

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COATING METHOD AND APPARATUS

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4 Claims. (Cl. 117—93)

1

This invention relates to the electrostatic coating of articles and more particularly to the electrostatic deposition of a liquid coating material which has been electrostatically atomized. The prior United States patent applications, Serial Nos. 556,390 and 13,174, filed respectively by Edwin M. Ransburg and Williams A. Starkey and William W. Crouse, disclose apparatus and methods in which liquid coating material is fed to an attenuated portion of an atomizing head while a high difference of electrical potential is maintained between the head and an article spaced from it, the electrostatic field thus created causing the coating material to leave the head in atomized condition and move to the article. When the article-surface presented toward the head is large relative to the head, the particles of coating material moving toward the article form a divergent jet or spray. As a result, the area of the deposited pattern will vary in the same sense as the distance between the article and the head, while the density of coating material in the deposited pattern will vary in the opposite sense.

Because of the characteristic just noted, it is desirable to maintain reasonably constant the distance between an electrostatic atomizing head and an article being coated as the article is being moved to present all portions of its surface toward the head for the reception of coating material. For the same reason, it is desirable that the article-surface opposite the head be generally normal to the axis of the jet or spray of coating material emanating from the head. Article-surfaces which are more or less cylindrical (the term "cylindrical" being here used in its board geometric sense to denote a surface made up of parallel, rectilinear elements) may be satisfactorily coated by moving the articles translationally through a coating zone with their generally rectilnear surface elements parallel to the direction of motion. Articles whose surfaces approximate surfaces of revolution may be coated by rotating them about their respective axes while they move through the coating zone in a direction normal to their axes. In either case, an electrostatic atomizing head is arranged at the side of the article path or, if the size of the articles warrants, a plurality of heads arranged in spaced relation and perhaps at different angles may be employed.

Articles whose surfaces depart too widely from cylindrical form or from surfaces of revolution cannot be satisfactorily coated with electrostatically atomized coating material by moving them through the coating zone in either of the two

2

manners set forth above. The precise extent of the departure from cylindrical or surface-of-revolution form which may result in unsatisfactory coating depends largely upon the distance between the atomizing head and the article when the head and article are nearest each other, and that distance, because of the necessity of avoiding sparking, depends in turn upon the potential difference which creates the electrostatic field. If the distance between the head and those surface portions of the articles which approach it most closely is, say, one-half the distance between the head and more remote surface portions of the article, the density of the coating material deposited on the latter surface portions will be approximately one-fourth that of the material deposited on the former surface portions. Such a variation in density would in many cases be regarded as objectionable.

It is accordingly an object of this invention to provide a method and apparatus through the use of which a satisfactory coating of liquid coating material may be deposited upon articles having a shape such that their surface cannot be maintained at a reasonably uniform distance from an electrostatic atomizing head by any of the prior forms of apparatus employing electrostatic atomization of coating material. A further object of the invention is to provide such a method and apparatus which can be practiced by a simple and inexpensive modification of conventional coating apparatus. Still an other object of the invention is to electrostatically deposit electrostatically atomized coating material in satisfactorily uniform density on articles so shaped that they would receive a coating of non-uniform density if coated with any prior apparatus of which I am aware.

In general, the improved method and apparatus are principally suited for the coating of articles having two surface portions one of which is generally cylindrical, so that it can be satisfactorily coated by moving the article translationally past the head as above described, and the other of which is of such an extent and so disposed that at least a part of it would pass at too great a distance from the atomizing head or heads in the translational movement of the article. To coat such an article with the benefit of the present invention, the said first portion of the article-surface is coated while the article is moved translationally, the article being so oriented that the distance of its surface from the head or heads remains reasonably constant. While the article is opposite the head, its condition of orientation relative to the head is changed by a rotative movement either to complete the

coating of the article or to bring the article into such a condition of orientation that its coating can be completed while it moves translationally in its new condition of orientation. Where the article embodies two surface portions one of which lends itself to coating during translation movement and the other of which lends itself to coating during rotational movement, either movement may, in general, precede the other. In many instances it is possible to obtain the desired character of article-movement by supporting the articles on a conveyor which follows a path that includes a curved portion, the atomizing head or heads being so located in respect to such curved conveyor portion that the orientation of the article changes while the article, or at least a portion of it, is opposite the head and receiving coating material therefrom.

The accompanying drawing illustrates the invention:

Fig. 1 is an isometric view, somewhat diagrammatic in character, illustrating one form of apparatus through the use of which my invention can be practiced; Fig. 2 is a diagrammatic plan view showing successive positions of an article moved by the apparatus shown in Fig. 1; and Fig. 3 is a vertical section on the line 3—3 of Fig. 2.

As an example of an article which can be coated satisfactorily through the use of the present invention, the drawing illustrates an automobile hood of the type adapted to be hinged near its rear edge on an axis transverse to the automobile. Such a hood commonly embodies a reasonably flat center portion 10, sides 11, and a front 12. The sides 11 and the front 12, as indicated in the drawing, extend over a considerable distance as measured normally to the center hood-portion 10. It will be obvious that the shape of the hood prevents it from being moved past an atomizing head or heads while its outer surface, which is to be coated, remains at a reasonably constant distance from such head or heads. If, for example, the hoods are suspended in the position indicated in the drawing and moved horizontally through a coating zone, it would be possible to arrange a group of atomizing heads 13, as indicated in Fig. 3, to minimize satisfactorily variations in the distance between each head and those portions of the center 10 and side walls 11 opposite the heads; but the distance between the front edge of the front hood-portion 12 and any of the heads 13 would be objectionably greater than the distance between the heads and the center and side surface-portions 10 and 11. Accordingly, the front edge of the sloping front portion 12 of the hood, and especially the middle part of such front edge, would receive a coating much less dense than that applied to the center portion 10 and the side walls 11. On the other hand, the hood is of such size relative to the minimum distance between it and the heads 13 and of such shape that objectionable variations in its distance from the heads would occur if the hood were rotated about an axis as it moved past the heads.

The apparatus illustrated in the drawing for coating the automobile hoods shown comprises an overhead conveyor having two straight stretches 15 and 16 disposed generally perpendicular to each other and joined by a curved portion 17. From the conveyor there depend at spaced intervals supports 20 upon which the hoods are respectively mounted. Each support 20 is rotatable about a vertical axis to permit control of the orientation of the associated hood relative to the path of conveyor travel. The electrostatic atomizing heads 13 are arranged, along the conveyor, adjacent and outside the curved portion thereof with their axes located in a vertical plane generally parallel to the conveyor stretch 15 but displaced from that conveyor stretch toward the other straight conveyor stretch 16. Each of the supports 20 has rigid with it a cam 21 which co-operates with a stationary guide 22 to control the orientation of the associated hood as the support traverses the curved portion 17 of the conveyor.

In the specific arrangement shown, the conveyor operates to move the hoods successively toward the heads 13 along the conveyor stretch 15, around the curved conveyor portion 17, and then away from the heads along the conveyor stretch 16. The hoods are initially so oriented that their center portions 10 will be generally parallel to the conveyor stretch 15, with the front hood-portions 12 toward the front to be presented toward the heads 13 as the hoods move theretoward along the conveyor stretch 15. As each support 20 approaches or enters upon the curved portion of the conveyor path the associated cam 21, which approximates the shape of the hood in horizontal plan, engages the guide 22, which is parallel to the conveyor-stretch 16, with the result that the hood is rotated about the axis of its support 20 as such support progresses around the curved portion of the conveyor-path. By this rotation of the hood, its orientation with respect to the heads 13 is changed until the central hood-portion 10 comes into approximate parallelism with the conveyor stretch 16, by which time movement of the hood along the conveyor has brought the leading parts of the central portion 10 and side portions 11 opposite the heads 13. At this point rotation of the hoods ceases, and the hood moves along the conveyor stretch 16 and eventually out of association with the heads 13.

In the above described hood movement, the front portion of each hood is coated as the hood is rotating and moving along the curved portion of the conveyor path, and the balance of the hood is coated as the hood moves translationally along the straight conveyor stretch 16. As will be evident from the chain-line showings of successive hood-positions, the distance between the heads and the hood-portions respectively opposite them does not vary greatly during the passage of each hood past the heads. The hoods are desirably spaced as close together as is possible without causing the trailing portion of one hood to electrically shield the leading portion of the next. In this way, loss of coating material is avoided; for the electrostatically atomized spray immediately jumps, as it were, from the rear edge portion of one hood to the front portion 12 of the following hood.

While I have described the conveyor as operating in such a direction that the front hood-portion 12 is coated first, it will be obvious that equally satisfactory results could be obtained by operating the conveyor in the reverse direction, leaving the heads 13 in the same position, and merely rearranging the cam 21 and guide 22 as necessary to swing the hoods successively from positions of parallelism with the conveyor stretch 16 to positions of parallelism with the conveyor stretch 15. As arranged, the apparatus would coat the rear hood-portions first and the front portions 12 last; but in moving past the heads

13, each hood would progressively present its entire outer surface toward and at a reasonably constant distance from the heads. Each arrangement possesses the characteristic feature of my invention in that the article being coated undergoes a predetermined change of orientation with respect to the head or heads while opposite thereto and, before and/or after such change in orientation, is conveyed translationally.

The invention is not dependent upon the use of any particular form of electrostatic atomizing head, that illustrated being shown merely by way of example. Any single head or group of heads which deposits paint in adequate width will suffice.

Parts of the above disclosure which have not been claimed herein are the subject of the patent application of E. M. Ransburg, Serial No. 143,994, filed February 13, 1950.

I claim as my invention:

1. In apparatus for coating an article having first and second surface portions disposed generally at a substantial angle to each other, comprising a conveyor having first and second straight stretches disposed at an angle to each other, means for supporting the article from the conveyor with the second surface portion generally parallel to the conveyor path and the first surface portion presented generally forwardly with reference to the direction of conveyor movement, an electrostatic atomizing head located in general alignment with the first conveyor-stretch and outwardly beyond the second conveyor-stretch whereby the first surface portion is presented toward the head as the article traverses the first conveyor-stretch and the second surface portion is presented toward the head as the article enters and moves along the second conveyor-stretch.

2. In apparatus for coating an article having first and second surface portions disposed generally at a substantial angle to each other, comprising a conveyor having first and second straight stretches disposed at an angle to each other, means for supporting the article from the conveyor with the second surface portion generally parallel to the conveyor path and the first surface portion disposed transversely to the conveyor path, an electrostatic atomizing head located in general alignment with the first conveyor-stretch and outwardly beyond the second conveyor-stretch whereby the first surface portion is presented toward the head as the article traverses the first conveyor-stretch and the second surface portion is presented toward the head as the article moves along the second conveyor-stretch.

3. The method of coating an article having first and second surface portions disposed generally at a substantial angle to each other, comprising moving the article into and longitudinally of a paint-jet and toward the source of the jet with one surface portion of the article transverse to the jet axis, rotating the article while in the jet to bring the other surface portion of the article into a position generally normal to the jet axis, continuing movement of the article during the rotation thereof, and after such rotation moving the article transversely of the jet.

4. The method of coating an article having first and second surface portions disposed generally at an angle to each other, comprising the steps of moving the article through a coating zone along a predetermined path past and in spaced relation to an electrostatic atomizing head, maintaining between the head and the article moving past it a high-potential electrostatic field to cause liquid coating material to be electrostatically atomized as a spray from the head and electrostatically deposited on the article, orienting the article so that it enters the coating zone with its first surface portion disposed generally transversely of the spray, changing the orientation of the article while in the coating zone to bring its second surface portion into transverse relation with the spray, and maintaining the thus changed condition of orientation of the article as it continues to move through the coating zone.

WILLIAM W. CROUSE.

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