March 5, 1957 E. P. MILLER 2,784,114

SPRAY COATING APPARATUS AND METHOD

Filed Nov. 26, 1951

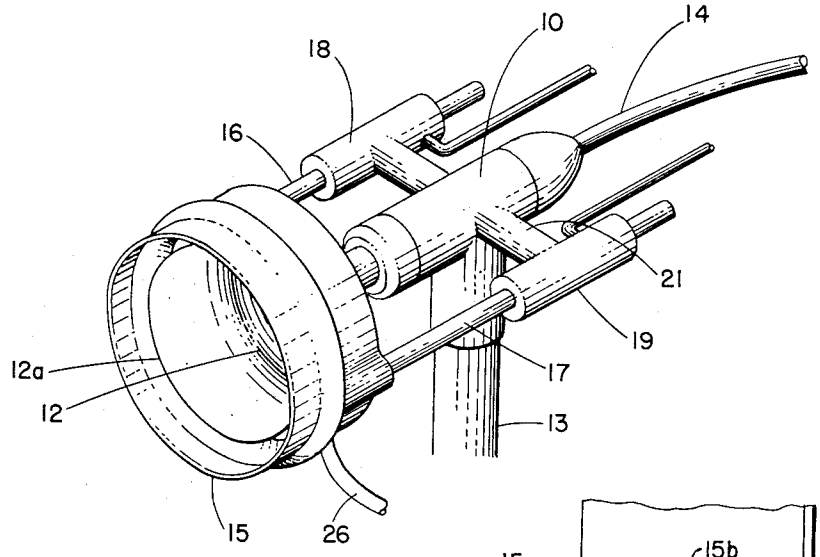

Fig. 1

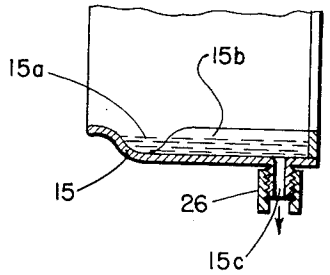

Fig. 3

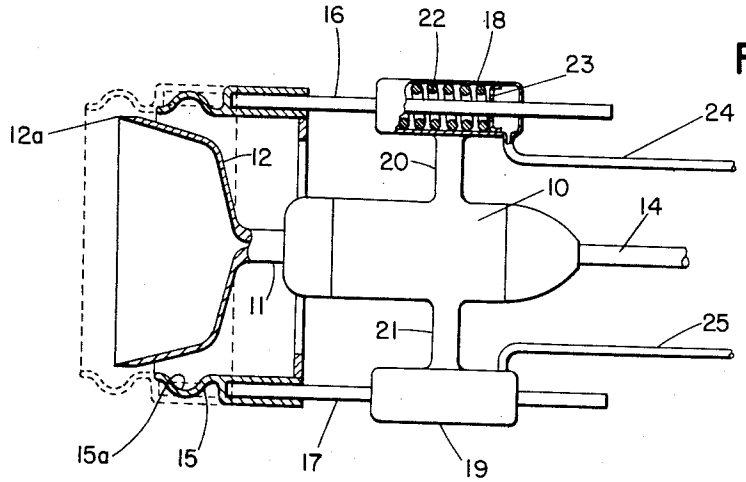

Fig. 2

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United States Patent Office 2,784,114 Patented Mar. 5, 1957

2,784,114

SPRAY COATING APPARATUS AND METHOD

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Application November 26, 1951, Serial No. 258,111

11 Claims. (Cl. 117—93)

This application relates to spray coating apparatus and method and more particularly to an electrostatic atomizing and coating arrangement provided with means for substantially instantaneously terminating and readily re-initiating coating discharge of a liquid material.

Electrostatic coating arrangements and systems have been heretofore developed and are known and used in the coating field, such arrangements being of a character wherein the spray of liquid coating material issuing from an atomizing device is given an electric charge at the time it leaves the spraying device or shortly thereafter, and deposition of the coating material particles is primarily the result of electrostatic forces attracting the particles to the surface of the article being coated. This is accomplished by creating an electrostatic field which includes the surface being coated and the charged coating material particles moving generally toward such articles. Coating arrangements of this character, especially those using electrostatic forces to effect atomization as well as deposition of the electrostatic coating material, have proved very satisfactory and extremely efficient commercially in coating various types of articles, particularly articles of such a character as to have been considered extremely difficult or inefficient to spray coat before the advent of electrostatic coating (as relatively small articles, or articles with large open spaces, as automobile steering wheels).

While electrostatic atomization in such a coating arrangement can be effected in a number of ways, one of the most efficient electrostatic atomizing heads now used employs a rotating bell-like member with a flared inner surface communicating with an annular atomizing edge. When liquid coating material is supplied to the inner flared surface (as through a central passageway in the bell-like member) the rotation effects distribution of the material in a substantially uniform and relatively thin film on such flared surface, the film moving to the atomizing edge where the electrostatic field effects atomization. An electrostatic atomizing head of this type is disclosed and claimed, for example, in the co-pending application of E. M. Ransburg, Serial No. 143,994, filed February 13, 1950.

Since atomization of the liquid coating material from such a head is a function of the rate of supply of liquid coating material to the inner flared surface, it is customary to supply a flow of liquid coating material to the head by use of a positive displacement pump. The accurate control of rate of delivery possible with such a pump, in combination with such normally unvarying factors as the rate of movement of the article through the coating zone and the area of surface being coated, enables close control of the quantity of coating deposited on the article. So long as atomization and coating movement of the particles can be continuous, the constant flow of coating material to the head is desirable; but under some circumstances it is preferable to discontinue atomization temporarily, as between relatively widely spaced objects on a conveyor, or when some adjustment

or correction is to be made, or the like. While shutting off the pump terminates continued flow of material to the head, it does not provide substantially instantaneous termination of atomization from a head of the character mentioned, as the appreciable amount of material in the film on the interior of the head, and some additional material in the passageway in the center of the head, will continue to move outwardly to the annular atomizing edge, although in a constantly thinning and diminishing quantity, to cause a gradual petering out of the coating discharge rather than a relatively sudden termination thereof.

In many cases this relatively gradual discontinuance of coating discharge is obviously undesirable, and the co-pending application of James W. Juvinall, Serial No. 257,501, filed November 21, 1951 now abandoned (the subject matter of which is now incorporated in application Serial No. 300,213, filed July 22 1952 now Patent No. 2,759,763 issued August 21, 1956), shows one apparatus and method for substantially instantaneously terminating coating discharge of the liquid material, the particular embodiment of the invention illustrated in that application showing a valve control member adapted to engage the inside of the bell-like atomizing head close to the atomizing edge thereof. Under certain circumstances, particularly if coating discharge is blocked for an undesirably and unexpectedly long period by the arrangement shown in that application, the coating material may become undesirably tacky or even dry out completely in spots, providing undesirable conditions upon re-initiation of the coating discharge; or in extreme cases, requiring external assistance to pull the valve member loose from the head member to permit resumption of flow of liquid material therebetween.

My invention as disclosed and claimed here accomplishes the advantages of the above mentioned arrangement in providing substantially instantaneous termination and rapid re-initiation or re-starting of coating discharge, without the necessity of shutting down the pump or otherwise terminating the flow of coating material to the head, while under at least certain circumstances providing an improvement thereover. My invention contemplates making the atomizing zone or edge, which is normally one electrode of the atomizing and coating field, temporarily ineffective as a field electrode, while permitting liquid coating material to continue moving to and off of the coating edge by directing the atomized particles into a different path of movement for later re-supply to the atomizing zone rather than permitting them to continue in their normal coating path of movement. In the particular embodiment illustrated herewith, I accomplish this by moving a shield member between coating-terminating and coating-permitting positions, the shield member in coating-terminating position acting as the field electrode and diverting the field from the atomizing zone and at the same time acting as a receiver for atomized liquid coating material which may continue to leave the atomizing zone of the head.

The foregoing and other features and advantages of this invention will be apparent from the following specification and drawings, in which:

Figure 1 is an isometric view of an atomizing head having an embodiment of my coating control means associated therewith, such means being illustrated in coating-terminating position;

Figure 2 is a view of the apparatus shown in Figure 1, partly in plan and partly in horizontal section, with the control member being illustrated in coating-permitting position and its coating-terminating position being indicated by dotted lines; and

Figure 3 is a fragmentary detail vertical sectional view along the line 3—3 of Figure 2.

While one form of means for changing field conditions and for controlling coating discharge is illustrated and will be described as an embodiment of my invention, it will be understood that this is a representative embodiment only; and it is to be further 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 the particular embodiment of the invention illustrated in the drawing, the atomizing unit or atomizing head only is illustrated, it being understood that the coating system as a whole would be of a type known and in use in the art. The arrangement as a whole need be described here only briefly for convenience and understanding of the present invention, inasmuch as reference may be made to issued patents and co-pending applications of the assignee of this application for more details if desired. In general, the article or articles being coated are moved on a conveyor, being grounded through the conveyor if they are conductive; and an electrostatic field is established between the articles and the atomizing head itself, where atomization as well as deposition of the coating material is effected electrostatically. The electrostatic field effecting the atomization and movement of the particles in the coating path of the article to be coated is normally of a relatively high intensity and heretofore normally has been kept in being with little or no disturbance at or near the head comprising one electrode during the entire period of operation of the coating system. In the majority of cases, the atomizing head would be spaced several inches and normally in the neighborhood of 8 or 10 inches from the surface of the articles being coated; and a potential would be used such as to provide a field gradient of the order of 10,000 volts per inch, the atomizing head being supported on suitable insulators and made the "hot" electrode where the articles are carried on a grounded conveyor.

The atomizing unit or head shown in the drawings comprises a body portion 10 having a hollow shaft 11 rotatably mounted therein, this shaft carrying at its outer end a bell-like head member 12 having an outwardly flared portion terminating in an annular atomizing zone or edge 12*a*. In accordance with known practice more fully described and illustrated in the above mentioned Ransburg application, for example, the head would be mounted on an insulating standard 13 having a rotating insulating drive shaft therein operating through suitable gearing (not illustrated) to effect continuous rotation of the shaft 11 and bell-like member 12, as for example at a rate of the order of 900 revolutions per minute during operation of the system. Liquid coating material would normally be continuously supplied through the hose 14 by any suitable means, as by a positive displacement pump drawing from a reservoir of liquid coating material. This liquid coating material flowing through the interior of the hollow shaft 11 would spread out radially in a film on the inner flared surface of the bell-like member 12 and (with the parts in the position illustrated in solid lines in Figure 2) would be atomized from the discharge edge or atomizing zone 12*a* and moved to and deposited upon the articles being coated by the electrostatic field forces.

In order to effect substantially instantaneous termination of coating discharge movement of the particles I provide a shield member having at least a portion generally coextensive with the atomizing edge and adapted to be moved between coating-terminating and coating-permitting positions relative thereto. In the apparatus illustrated this shield comprises the general cylindrical member 15 of conductive material mounted on conductive carrier rods 16 and 17 longitudinally movable through the air motors 18 and 19, these being carried on the head in any suitable manner as by metal brackets 20 and 21. Referring more particularly to Figure 2, wherein the air motor 18 is shown partly broken away, it will be seen that a spring 22 normally biases a piston member 23 on the rod 16 to the right (as the parts are illustrated) to cause the control member or shield 15 to take the position illustrated in solid lines in Figure 2; however, admission of air through the rubber hose 24 effects movement of the piston 23 and rod 16 to the left to the dotted line position, this being the coating-terminating position. It will be understood that, in the embodiment illustrated, the air motor 19 would be simultaneously operated by air supplied through the hose 25, also of suitable insulating material. It will be further understood that the air motors illustrated may be replaced by any suitable motor means capable of operative control from a remote point, as for example solenoid motors with their energizing circuit and control switches properly insulated from ground in a manner appropriate to the high voltage existing at the head.

I prefer to provide the inner surface of the shield member with an annular groove 15*a* adapted to lie in the plane of the discharge edge 12*a* when this member 15 is in coating-terminating position. At the lowest point of this annular groove in the shield member I provide an axially extending groove 15*b* communicating with an outlet nipple 15*c*, to which is connected a hose 26 providing a re-circulation or re-supply path for liquid coating adapted to return such diverted liquid coating material to the reservoir from which the pump draws.

When the control parts are in the position shown in solid lines in Figure 2 the head operates to all intents and purposes as though these parts were not present, liquid coating material moving along the inner surface of the bell-like member 12 being atomized from the annular edge 12*a* by the electrostatic field which has this edge as one electrode and which extends at least to the surface of the article being coated. If an article is missing from its position on the conveyor, however, or if the articles are so widely spaced as to make it desirable to briefly terminate coating discharge therebetween, or the like, manual or automatic controls can effect operation of the motor means to move the control member 15 to its forward or coating-terminating position illustrated in dotted lines in Figure 2. As the control member 15 then has its outer edge extending forwardly of the atomizing edge 12*a*, the electrostatic field which had this edge as one electrode becomes diverted to the shield member since this latter is of conductive material and at the same or substantially the same potential as the head, and since it is in coating-terminating position closer to the other field electrode (as the conductive articles on a grounded conveyor) than is the atomizing edge of the bell-like member 12. Inasmuch as the flow of liquid coating material and the rotation of the member 12 continues despite the movement of the shield member just described, coating material reaching the edge 12*a* is centrifuged off into the receiving trough or annular groove 15*a*, being then recirculated to the coating material supply reservoir in the embodiment being described. The continued movement of the coating material prevents any tendency which it might otherwise have to form in excessively large droplets or "blobs" on the discharge edge or to dry or become tacky at any point on the bell-like member. Accordingly, when it is desired to re-initiate coating movement of the particles and direct them into a path toward the articles being coated rather than in the different path provided while coating operation is terminated, release of air in the hoses 24 and 25 results in the control member 15 moving back to the position shown in full lines in Figure 2. As it moves back even with and then behind the edge 12*a* the member 12 again becomes effective as an electrode of the field and the field again acts to atomize liquid coating material at this edge and to move the particles to the article being coated.

The shield member 15 is shown as conductively mounted on the atomizing head body member 10 and as being

at the same potential as the bell-like member **12**, as this is normally satisfactory and is a convenient construction. If it is desired to keep the particles leaving the edge **12***a* effected by electrostatic field forces, however, rather than relying on centrifugal forces entirely to effect discharge from this edge when coating operation is terminated by the control means, the brackets **20** and **21** may be made of insulating material and the member **15** separately energized from the power supply at a slightly different (and lesser) voltage from that supplied by the bell-like member **12**. For example, if the closest distance between the shield member and the bell-like member were an inch and the bell-like member was being maintained at 100,000 volts potential with respect to ground, the shield member **15** might be maintained at 80,000 volts, providing a 20,000 volt differential with respect to the head. With such a spacing and voltage differential electrostatic field forces would still provide a substantial atomizing effect at the edge **12***a* when the shield member was in its forward or coating-terminating position, resulting in substantially no change in the size of the coating material particles leaving this edge even at relatively low rates of revolution of the head member **12**. At the same time, so long as the shield member **15** is projected more than an inch forwardly (i. e., more than a distance where the field gradients would be equal) of the edge **12***a* under the assumed condition set forth above, it would still render the edge **12***a* ineffective as an electrode and would instead establish the electrostatic field between itself and the article being coated; and when it was withdrawn substantially more than this distance all atomization would be directed in the coating path of movement.

It will also be readily apparent that the receiving and recirculation trough here comprising part of the control member can be of insulating material fixedly mounted at a suitable distance from the rotating edge **12***a*, and the head member having this atomizing edge can be rendered effective and ineffective as a field electrode by other suitable control means.

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. An electrostatic coating arrangement of the character described, including: an atomizing head having a rotatable bell-like portion providing an annular atomizing edge with a flared inner surface communicating therewith for delivery thereto of liquid coating material supplied in a flow to the head; a power supply having one terminal connected to said head to make said atomizing edge one electrode of the electrostatic field effecting coating atomization and deposition; and a control member of conductive material having at least a portion thereof adapted to encircle said edge and comprising an annular shield mounted for movement between coating-terminating position and coating-permitting position, the coating-terminating position being at least somewhat forward of the atomizing edge and the shield receiving the atomized material when in such position.

2. An electrostatic coating arrangement of the character described, including: an atomizing head having a rotatable bell-like portion providing an annular atomizing edge with a flared inner surface communicating therewith for delivery thereto of liquid coating material supplied in a flow to the head; a power supply having one terminal connected to said edge to make it one electrode of an electrostatic field extending to the article to be coated; and a control member of conductive material having at least a portion thereof adapted to encircle said edge and comprising an annular shield mounted for movement between coating-terminating position and coating-permitting position, the coating-terminating position being at least somewhat forward of the atomizing edge and the shield then comprising a terminal for said electrostatic field which would otherwise have its terminal at the atomizing edge.

3. An electrostatic coating arrangement of the character described, including: an atomizing head having a rotatable bell-like portion providing an annular atomizing edge with a flared inner surface communicating therewith for delivery thereto of liquid coating material supplied in a flow to the head; a power supply having one terminal connected to said edge to make it one electrode of an electrostatic field extending to the article to be coated; and a control member of conductive material having at least a portion thereof adapted to encircle said edge, said member being at substantially the same potential as said atomizing edge and comprising an annular shield mounted for movement between coating-terminating position and coating-permitting position, the coating-terminating position being at least somewhat forward of the atomizing edge and the shield then comprising a terminal for said electrostatic field which would otherwise have its terminal at the atomizing edge.

4. An electrostatic coating arrangement of the character described, including: an atomizing head having a rotatable bell-like portion providing an annular atomizing edge with a flared inner surface communicating therewith for delivery thereto of liquid coating material supplied in a flow to the head; a power supply having one terminal connected to said edge to make it one electrode of an electrostatic field extending to the article to be coated; a control member of conductive material having at least a portion thereof adapted to encircle said edge, said member being at substantially the same potential as said atomizing edge and comprising an annular shield mounted for movement between coating-terminating position and coating-permitting position, the coating-terminating position being at least somewhat forward of the atomizing edge and the shield then comprising a terminal for said electrostatic field which would otherwise have its terminal at the atomizing edge, the shield receiving the atomized material when in such position; and a motor for moving said member between said positions, said motor being controllable from a remote point.

5. An electrostatic coating arrangement of the character described, including: a rotatable atomizing head providing an elongated annular electrostatic atomizing zone for effecting coating discharge of a liquid material; means for rotating said head centrifugally to flow liquid coating material to said zone; a power supply for creating an electrostatic field for charging and depositing the atomized liquid material; and a control member having at least a portion thereof adapted to encircle said zone and comprising an annular shield mounted for movement between coating-terminating position and coating-permitting position, the coating-terminating position being adjacent said zone and the shield having an annular groove in the inner wall thereof in the plane of the annular atomizing zone and receiving the atomized material.

6. In the atomizing head of an electrostatic atomizing and coating arrangement wherein the head has a rotating annular atomizing edge, coating control means comprising an electrode, a power supply having one terminal connected to said electrode and to said head to make it one terminal of an electrostatic field for effecting deposition of coating material, and a generally cylindrical conductive shield at substantially the same potential as said atomizing edge and mounted for axial movement between coating-terminating and coating-permitting positions, the shield in coating-terminating position comprising a terminal for the coating field which would otherwise effect coating movement of the atomized particles.

7. The method of controlling coating in an electrostatic atomizing and coating arrangement having an atomizing head with a rotating annular electrostatic atomizing zone comprising terminating coating movement of the

atomized particles from said zone by moving an encircling conductive shield member at substantially the same potential as the material in said atomizing zone into a position forwardly of said atomizing zone for deflecting the atomizing field therefrom and receiving coating material particles spun therefrom.

8. The method of controlling coating in an electrostatic atomizing and coating arrangement having a rotating atomizing head providing a spray of atomized particles at an annular atomizing zone comprising terminating coating movement of the atomized particles from said zone by relative movement between said atomizing head and an encircling conductive shield member to cause said conductive shield member to lie forward of said atomizing zone for deflecting the atomizing field and receiving coating material particles atomized from the head.

9. An electrostatic coating arrangement including a rotatable atomizing head having an annular atomizing zone providing a spray of atomized coating material particles entirely therearound; a power supply for creating an electrostatic field for charging and depositing the atomized liquid particles; an interceptor member adapted to encircle said rotatable head; and means for effecting a relative movement between said atomizing head and said interceptor member generally parallel to the axis of rotation of said atomizing head for intercepting the spray from said atomizing head when desired, said interceptor member intersecting the plane of the annular atomizing zone for said interception.

10. The method of controlling coating in an electrostatic atomizing and coating arrangement having a rotatable atomizing head providing a spray of atomized particles at an annular atomizing zone comprising terminating coating movement of the atomized particles from said zone by relative movement between said atomizing head and an encircling conductive shield member to cause said atomizing head to lie within the confines of said shield member for deflecting the atomizing field and receiving coating material particles atomized from the head.

11. The method of controlling coating in an electrostatic atomizing and coating arrangement having an atomizing head providing a spray of atomized particles at an annular atomizing zone comprising terminating coating movement of the atomized particles from said zone by relative movement between said atomizing head and an encircling conductive shield member to cause said conductive shield member to lie forward of said atomizing zone for deflecting the atomizing field and receiving coating material particles atomized from the head.

References Cited in the file of this patent

UNITED STATES PATENTS

694,106	Metcalf	Feb. 25, 1902
1,861,475	Hopkins	June 7, 1932
2,097,233	Meston	Oct. 26, 1937
2,302,289	Brumston-Cook	Nov. 17, 1942
2,425,652	Starkey	Aug. 12, 1947
2,456,853	Arbron	Dec. 21, 1948
2,568,611	Crouse	Sept. 18, 1951
2,658,009	Ransburg	Nov. 3, 1953