Dec. 30, 1969 R. TILNEY ET AL 3,486,483

ELECTROSTATIC SPRAY COATING APPARATUS

Original Filed April 12, 1967 3 Sheets-Sheet 1

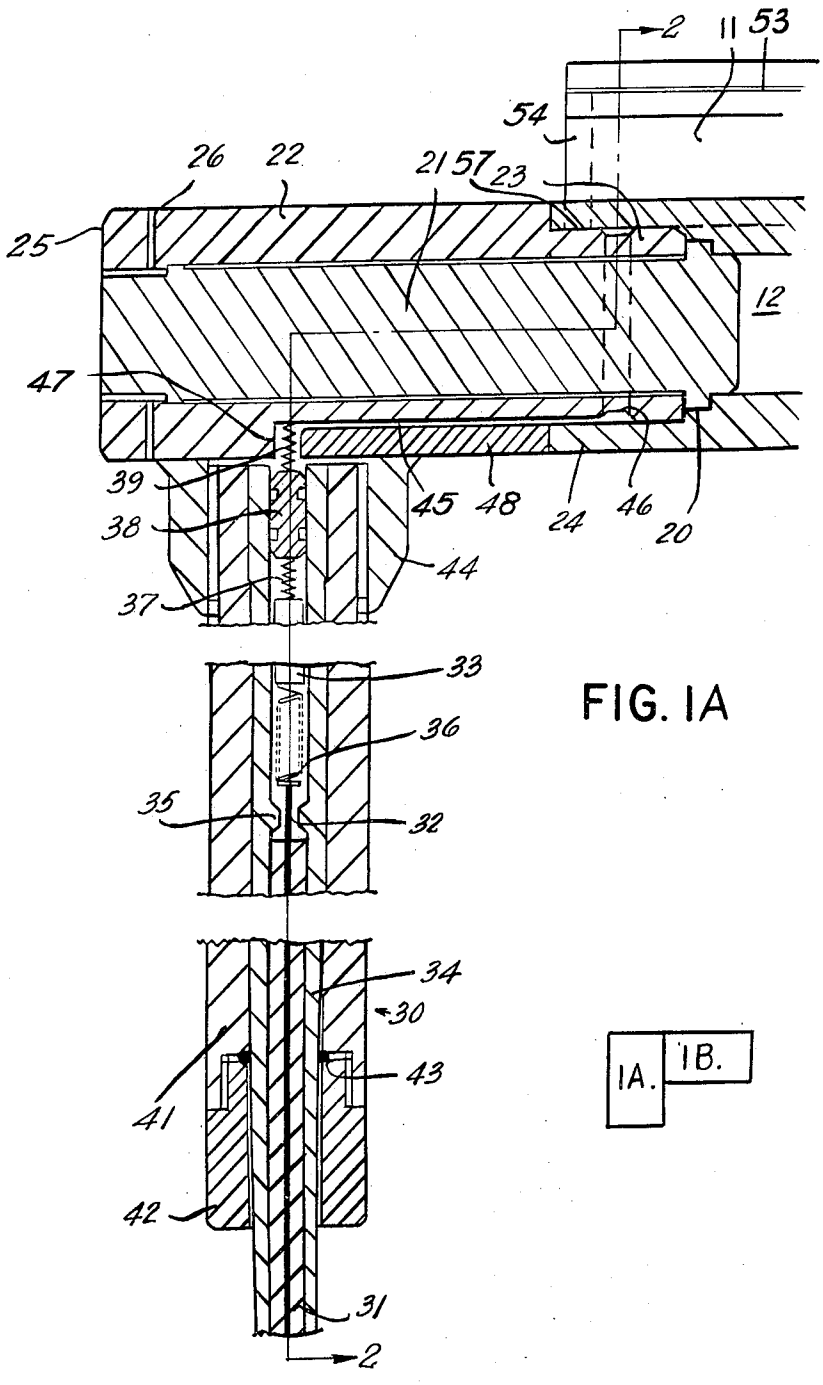


FIG. IA

IA. IB.

ELECTROSTATIC SPRAY COATING APPARATUS

Original Filed April 12, 1967 3 Sheets-Sheet 2

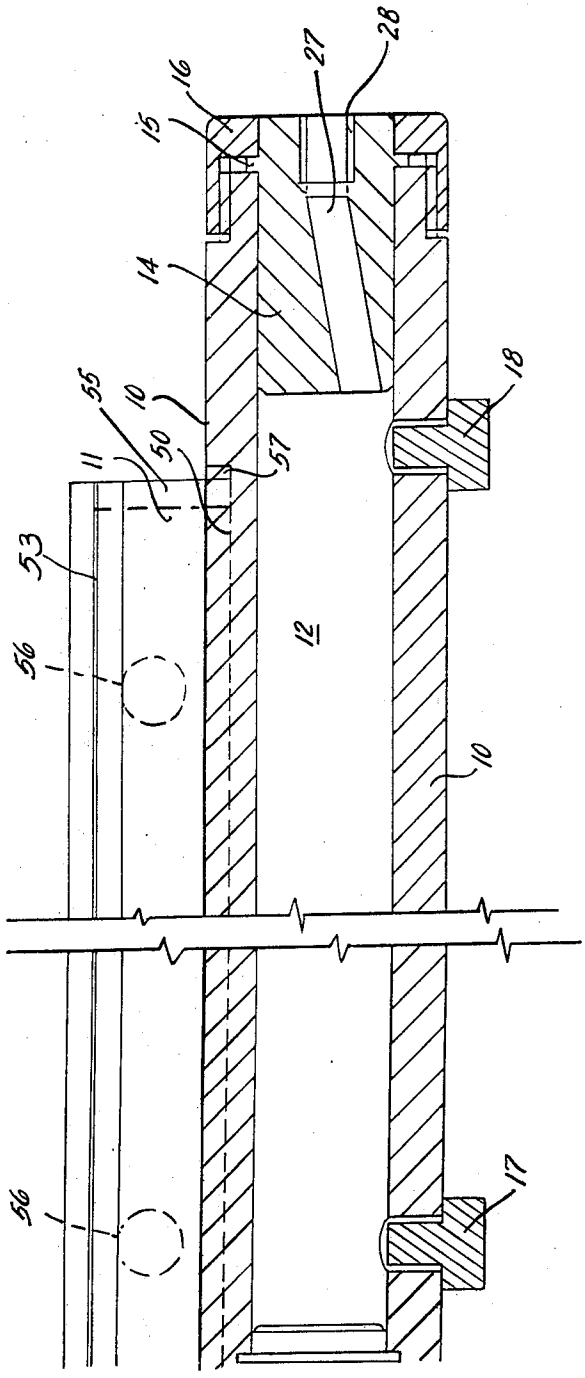


FIG. 1B

ELECTROSTATIC SPRAY COATING APPARATUS

Original Filed April 12, 1967 3 Sheets-Sheet 3

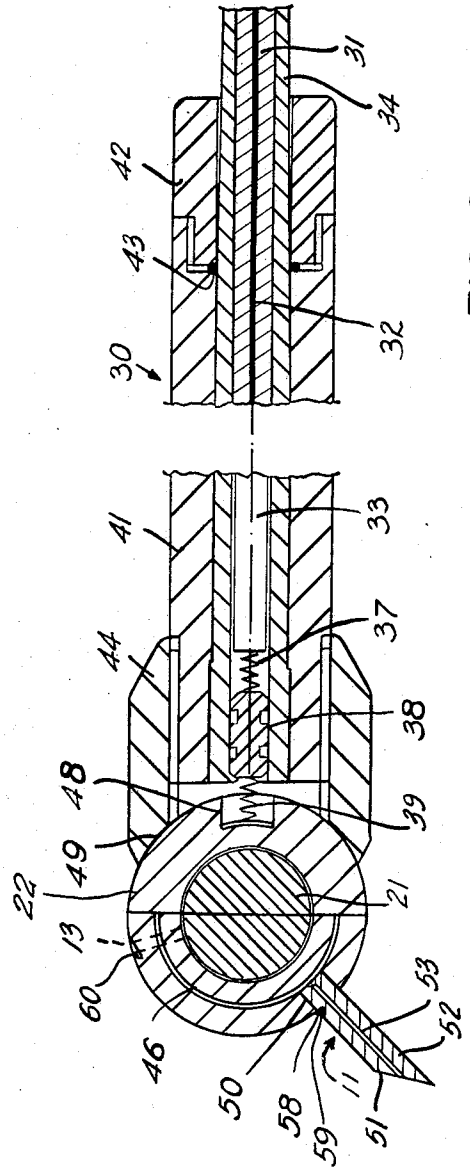


FIG. 2

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ELECTROSTATIC SPRAY COATING APPARATUS

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Int. Cl. B05b 5/02

U.S. Cl. 118—626 7 Claims

ABSTRACT OF THE DISCLOSURE

A safe electrostatic coating apparatus capable of producing a spray pattern having an adjustable width achieved by a laminated resistive blade assembly received in a hollow body, and forming with the body a shallow recess. The hollow body forms a coating material reservoir and has a series of coating material openings spaced from the blade. In operation the blade is charged through a resistive connection and coating material is forced from the reservoir through the opening to flow over the outer surface of the body into the recess and to form a thin film on the surface of the blade from which it is atomized by the electrostatic field to the article and deposited upon the article. Adjustment of spray width is achieved by obstructing a portion of the openings in the body.

This application is a continuation of application Ser. No. 630,236, filed Apr. 12, 1967, now abandoned.

This invention relates to electrostatic spray coating apparatus of the kind in which a liquid coating material to be atomized is fed to the edge of an elongated member, between which and an article to be coated, a high voltage electrostatic field is maintained to cause atomization of the coating material and to promote its deposition upon the article by electrostatic attraction.

Features and advantages of the invention will appear from the following description of an embodiment thereof, given by way of example, in conjunction with the accompanying drawings, in which:

FIGURE 1A is a sectional plan view of a liquid coating atomizing and charging apparatus;

FIGURE 1B is a sectional view of a body member cooperatively associated with the apparatus of FIGURE 1A; and

FIGURE 2 taken on the line 2—2 of FIGURE 1.

The apparatus which is shown in these drawings is suitable for coating an article or succession of articles presenting a surface to be coated which is elongated and of roughly constant width. Thus, the apparatus can be used for coating webs of material, or for coating a succession of tray-like articles on a conveyor. In either case, the article or articles is or are moved past the atomizing and coating apparatus.

The apparatus comprises a main body member **10** of hollow cylindrical form from which extends in an approximately radial direction a blade assembly **11**. Coating material is fed to the interior of the body at **12** and is exuded from the body through a series of parallel spaced radial openings **13**; the exuded material falls by gravity over the outer surface of the body and onto the surface of the blade assembly, forming a thin film along the knife-like edge of the assembly. A high voltage is caused to appear at this edge with respect to the article or articles being coated and by this means the liquid coating material is atomized and deposited.

The body member **10** is formed of insulating material and at one end, which is the inlet end for liquid coating material, is closed by an inlet plug **14**, having a shoulder **15** which abuts against the end of the body and is held by a plug fixing cap **16**, threaded onto the end of the body. The body is provided with drain plug openings closed by drain plugs **17** and **18**. In FIGURE 1, the drain plugs are shown angularly displaced, for purposes of illustration.

The other end of the body member **10** is closed by an end tube assembly. The end of the body is counterbored at **20** to receive the end of an end plug **21**, which is stepped in diameter to fit within the counterbored end of the body, and is there secured by adhesive such as an epoxy resin. The surface of the end plug is cylindrical, and fitting on this is an end tube **22**, the end of this tube being reduced at **23** to fit within a further counterbored portion **24** of the main body. The end tube **22** is held on the end plug **21** by means of a locknut **25**, engaging the threaded end of plug **21** with an interposed washer **26**. Together the end tube **22** and the main body member **10** present an approximately cylindrical external surface. With the end of the body member **10** closed by plug **21** in the way described, and with the inserted inlet plug **14**, there is formed a reservoir within the body member for coating material, and the material can be fed to this reservoir through a feed inlet passage **27**, to which connection can be made at **28** to an external supply of coating material. This coating material is fed by means of a metering pump so as accurately to maintain the desired rate of feed of coating material to the blade assembly.

To effect electrostatic atomization, high voltage which may be in the range of 40 to 100 kv., must be impressed upon the atomizing device in such a way as to establish high voltage at the edge of the blade assembly. It is desirable that the arrangement should be such that the danger of shock or of fire hazard due to excessive or disruptive discharges from the edge of the blade assembly should be avoided. With this object, the blade assembly is made in a way which presents a low effective capacity, in the sense described in U.S. Patent 3,048,498, and the voltage is established at the edge of the blade through a circuit which has effectively a high resistance.

The means for this purpose includes a voltage entry assembly, indicated generally at **30** in FIGURE 1, extending from the main body assembly substantially at right angles. Voltage from a suitable high voltage source is fed through a high voltage cable **31** which passes into the assembly **30**, the central conductor **32** being attached to the end of a high value resistor **33**. The cable and resistor are mounted in a termination unit which includes a housing tube **34** into one end of which the cable **31** is inserted and secured; the tube has a restricted portion **35** through which conductor **32** extends, the conductor being attached to a spring **36** in turn contacting the end of resistor **33**. The forward end of the resistor is attached to another spring **37**, the end of tube **34** being closed by a sealed plug **38**, from which extends a final contact spring **39**. Tube **34** fits within a housing sleeve **41**, where it is held by means of a screwed gland nut **42** and an O-ring **43**. The housing sleeve **41** is mounted on the body, for this purpose there being provided an end tube housing **44**, shaped to fit the main body assembly and held to it by adhesive at **49**, the housing sleeve **41** being threaded to engage the end tube housing **44**.

The high voltage connection from the final contact spring **39** to the edge of the blade is made in the following way. The spring **39** enters a recess **47** formed in the end tube **22**; the recess is relatively narrow and extends along the length of the end tube **22** as far as a peripheral recess at **46**. In the base of recess **45** and around the peripheral recess **46** is laid a coating of material which has a high electrical resistance, such as a carbon or graphite loaded synthetic resin material. Once this material has been placed in position and allowed to harden, the

major part of the elongated recess **45** can be closed and sealed by means **48**, which can be an insert or merely a filling of suitable resin.

To receive the blade assembly **11**, the main body member **10** is formed with an elongated longitudinal slot **50**, of a width to receive the blade assembly in the manner shown in FIGURE 2. The end of this recess breaks into the inner surface of the counterbored end portion of the main body member, so that at the end of the slot **50** the peripheral recess **46** in the end tube **22** is exposed. The blade assembly **11** is formed of two flat strip members **51** and **52** which have sandwiched between them a layer **53** of resistive material, which can be, for example, a fibre glass cloth impregnated with carbon or graphite. The two strip members **51** and **52** are securely fixed together by an epoxy resin adhesive at **54** and **55** and also at intermediate localized areas such as **56**, where the resin may extend through holes formed in the fibre glass material. The strips **51** and **52** are thereby securely fastened together and the exposed edges of the strips are shaped to a knife edge as shown more clearly in FIGURE 2, on the surface of which the edge of the intermediate layer **53** will be exposed. The blade assembly is fastened in recess **50** by means of a carbon loaded resin at **57** so that there will be a high resistance electrical circuit on the exposed edge of strip **53**, through resin **57**, the resin in peripheral recess **46** and thus through the recess **45** back to the contact spring **39**, and thence through resistor **33** to the conductor of cable **31**.

In operation, liquid coating material is supplied by the metering pump to the reservoir **12** and the liquid will emerge slowly through the openings **13**. Size, spacing and rate of flow of liquid are so adjusted that the liquid, moving by gravity over the outer cylindrical surface of the body assembly, will establish at the forward knife edge of the assembly a substantially uniform, thin film of the coating liquid and on this thin film there will appear a high voltage from the supply connected to cable **31**. The liquid is finely atomized and is drawn off by the electrostatic field in the customary manner of electrostatic deposition. By reason of the inclusion of the relatively high resistance material in the layer **53** and the high resistance connections extending back to resistor **33**, the system will be safe inasmuch as it will be substantially free of danger of fire or shock hazard.

The apparatus described can be varied in a number of ways. For example, depending upon the nature and especially the resistivity, of the coating material, it may be arranged that the current path over which high voltage is established at the atomizing edge is provided largely or wholly by the body of the material. One way of doing this is to mount a wire within, and preferably concentrically within, the reservoir provided by space **12**. Also, to supplement or replace this arrangement, or that described with reference to the drawings, the interior walls of the space **12** can be coated with a resistive coating material.

In some circumstances it may be preferable to construct the blade so that a single thickness of insulating material is coated on one side only with resistive material, but the sandwich construction is usually more advantageous; it can, for example, easily be sharpened, to give the knife edge required for atomization, if the edge is damaged charging can also be effected by a fine gauge copper wire **59** embedded in the blade near the junction of the blade and the body.

To vary the rate of flow and distribution of coating material, other than the line of holes described can be used. Slots, disposed along the length of the cylindrical body can be used and the slots can be parallel to, or slightly inclined to the length of the body. With the same object of ensuring good flow control of the coating material, a long recess **60** can be cut in the external cylindrical surface of the body, and coating material into the recess fed from the interior reservoir through holes leading into the bottom of the recess. The recess will serve to stabilize the flow. This stabilizing effect of a trough or groove can be otherwise used; a shallow groove or recess **58** can be provided, extending generally across the flow path of the material, between the delivery holes or recess and the atomizing edge, a convenient position for such a groove is at the junction of the blade and the body.

For uniformity of coating thickness, it is desirable that the material should be atomized from a length of blade which is about the same as the width of the article or articles being coated. For a semi-permanent installation the blade length will about equal the width of the articles, but to adapt a blade for use with narrow articles the feed can be reduced, and limited to part only of the total length of the blade. One method of limiting the feed in this way is by the use of blocks which fit or slide over the exterior of the body and obstruct the exit openings for the coating material. Conveniently, the blocks surround the body but for the blade; if coating material is fed from a groove or recess, the blocks may lodge in the recess. The block can be of the same or a similar insulating material as that used for the body; polyethylene is suitable.

The blade arrangement can be different. The central body can support another blade, the two blades emerging from the body on opposite sides and with their upper surfaces at an angle that gives a suitable gravity flow. The central closed reservoir can be replaced by an open trough with an over-spill feed to the blade or blades. The two blade system obviously gives an increased rate of coating.

It has been assumed that the article being coated is approximately flat, but if articles of other cross-sectional shapes are being coated better deposition may be obtained by changing the shape of the atomizing edge. For example, in coating material which is longitudinally, considered in the direction of movement of the blade with respect to the article, channelled or corrugated the blade may be given an interrupted edge portion of which correspond approximately to the corrugations on the like discrete separated lengths of blade can be used with this arrangement. It is important that in use sufficient field intensity is maintained at the edge, to give adequate atomizing and deposition.

Depending to a large extent on the nature of the coating material, there may be advantage in oscillating or vibrating the blade assembly. Low speed oscillation may give improved lateral uniformity of coating in some application and faster speeds up to vibrations speeds of the order of alternating current supply mains frequency will assert distribution and flow of the coating material over the blade. Vibration may extend the use of the blade to powdered material. The blade can be heated, to improve the flow characteristics of the material, especially liquid material, or to assist polymerization of resin-type coating materials.

We claim:

1. An electrostatic spray coating apparatus for atomizing and depositing liquid coating material upon an article to be coated comprising a hollow body member of insulating material sealed at both ends to form a reservoir for coating material with a coating material inlet, a blade assembly comprising a strip of insulating material and resistive material received in the body and forming at its junction with the body a shallow recess, a series of radial openings in the body spaced from the blade assembly, a high voltage entry housing of insulating material extending from the body member and enclosing a high voltage conductor, means carried by the body connecting one end of the high voltage conductor to the resistive material of the blade assembly, and liquid supply means connected with the coating material inlet to exude coating material from the openings to flow over the surface of the body into the recess to form a thin film on the blade assembly.

2. The apparatus of claim 1 wherein the body is sealed at the end with an end tube assembly including a plug and an end tube having a recess, and means carried by the body connecting one end of the high voltage conductor to the resistive material of the blade assembly includes resistive material carried by the recess in the end tube.

3. The apparatus of claim 1 wherein the body is cylindrical, the blade assembly includes two strips of insulating material with the resistive material between the two strips, and a fine wire is embedded in the blade near the junction of the blade and the body.

4. The apparatus of claim 1 wherein a recess extends over the exterior surface of the body and over the radial openings.

5. An electrostatic spray coating apparatus for atomizing and depositing liquid coating material upon an article to be coated comprising a hollow body member of insulating material sealed at both ends to form a reservoir for coating material with a coating material inlet, a blade assembly comprising a strip of insulating material and resistive material received in the body, means to permit coating material to exude from said reservoir, means to form the coating material into a thin film, a high voltage entry housing of insulating material extending from one end of the body and enclosing a resistance, electrical connection means carried by said body connecting said resistance with said resistive material of said blade assembly, plug means of insulating material sealing said one end of the reservoir and including a portion of said eletrical connection means and liquid supply means connected with the coating material inlet to exude coating material from said reservoir.

6. The apparatus of claim 5 wherein said plug means includes a recess and said portion of the electrical connection means includes a resistive material in said recess.

7. The apparatus as defined in claim 3 wherein said blade assembly is sharpened so that said resistive material forms a part of the flow surface adjacent the discharge edge.

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PETER FELDMAN, Primary Examiner

U.S. Cl. X.R.

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