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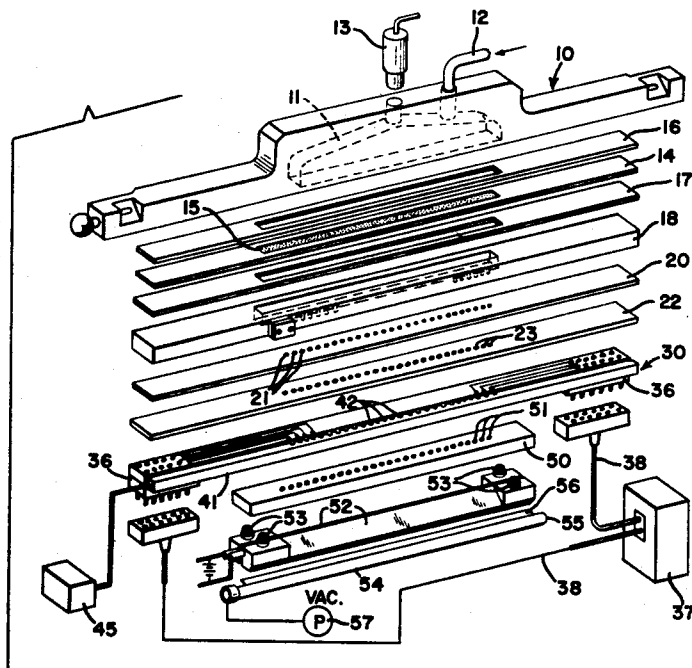
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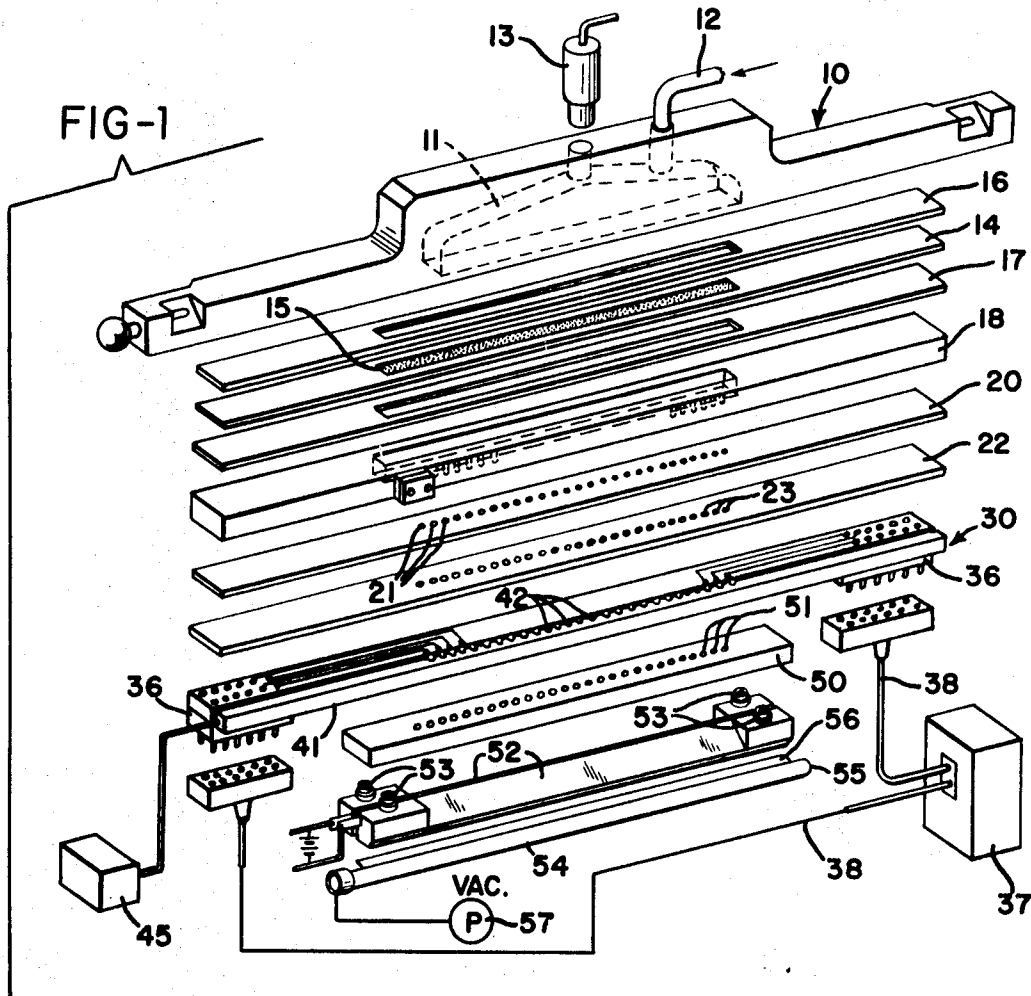
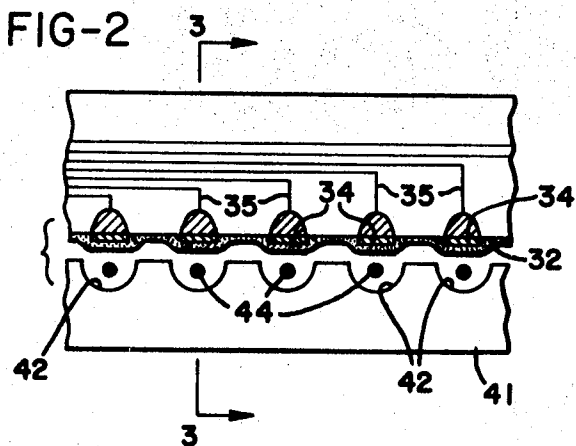
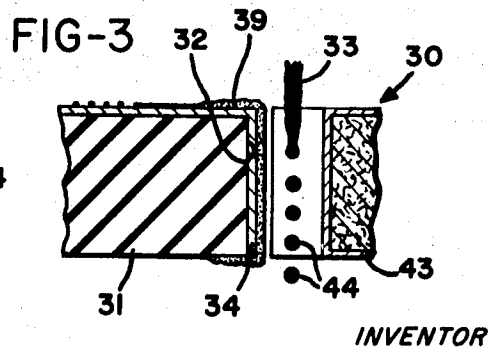
[54] **DROP-CHARGING APPARATUS**
5 Claims, 3 Drawing Figs.

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[51] Int. Cl. **G01d 15/18**,
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239/15; 118/624, 625, 627-638; 346/75

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ABSTRACT: In a noncontacting coating system in which drops of coating material are selectively charged to divert them from their normal trajectory and thereby permit a patterned coating layer to be applied to a workpiece, the drop charging element is formed as a support plate having a planar surface parallel to the initial path of the coating drops and provided with strips of conductive material connected to appropriate leads for selectively charging the drops as they pass the conductive strips. A shield bar is positioned adjacent the support plate and notches are formed in the bar opposite the conductive strips. The shield bar may be formed of a conductive material, or coated with a conductive material at least in the area of the notches, and a selectively variable potential applied thereto to adjust the trajectory of all drops simultaneously.





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DROP-CHARGING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

LAMINATED COATING HEAD, Ser. No. 877,250, filed Nov. 17, 1969 by Dale R. Beam et al.

BACKGROUND OF THE INVENTION

In a laminated coating head of the type described in the above-noted related application, a series of filaments of coating material are formed by ejecting coating material under pressure through orifices formed in an elongated orifice plate. At a point where each of the filaments begins to break down into discrete drops of coating material, a charge is applied to selected coating drops to cause them to be deflected from their normal trajectory and permit a layer of coating to be applied to a workpiece in a preselected pattern.

The element for selectively charging drops of coating material consists of a charge plate positioned in closely spaced relationship to the orifice plate and extending coextensively therewith. A series of openings are formed in the charge plate at intervals corresponding with the orifices in the orifice plate and a coating of electrically conductive material is applied to the interior surface of each of the charge plate openings and interconnected through appropriate leads to a charging source.

The size and spacing of the holes through the charge ring plate are extremely small with a typical charge plate hole being approximately 0.025 inch in diameter and positioned in extremely close proximity to adjacent holes. With these extremely fine dimensions it will be apparent that manufacturing difficulties will often be encountered in forming the holes through the charge ring plate.

While the difficulties encountered in forming extremely small closely spaced holes through a charge ring plate can be alleviated to some extent by providing the plate with a series of milled notches rather than holes, it will be appreciated that the manufacturing tolerances are still extremely fine. Additionally, regardless of whether a hole or a notch is formed in the charge plate, the electrically conductive material which serves as means for imparting the charge to drops passing through the plate must still be applied to an inwardly curved surface. While it is not as difficult to apply the conductive coating the interior of an open-sided notch as it is to the interior surface of a hole through the plate, it will readily be appreciated that uniformity is nonetheless difficult to obtain.

SUMMARY OF THE INVENTION

The charging element of a noncontacting coating apparatus is formed as a rectangularly cross sectioned plate having a substantially planar surface extending in parallel relationship to the path of the coating drops breaking from the filaments of coating material being ejected through the orifices of the orifice plate. Strips of electrically conductive material (charging strips) are applied to this planar surface at points therealong corresponding to the paths of coating material from the orifices of the orifice plate and leads extend from the strips of conductive material to appropriate charging mechanism for selectively applying charges to drops of coating material passing the conductive strips.

A grooved shield bar is positioned in close proximity to the planar surface of the charge plate with the grooves of the bar positioned in opposition to the strips of conductive material. The shield bar functions primarily to isolate each filament of coating fluid from the electrical fields associated with adjacent channels. For this purpose the shield bar is either constructed of a conductive material or is provided with a conductive coating extending across and interconnecting all of the notches. The electric potential of the shield bar is normally the same as that of the jet filaments so that whenever any charging strip is in the "no-charge" condition (i.e. at jet filament potential) the drops forming in the associated channel will in fact not be

charged. As an option, however, the potential applied to the notched area thereof, may be varied from the filament potential in order to impart a net charge to all filaments and thereby adjust the trajectory of all drops simultaneously.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a laminated coating head incorporating the charge element of the present invention;

FIG. 2 is a plan view of a portion of the charge element; and

FIG. 3 is a cross-sectional view taken substantially on line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning first to FIG. 1 of the drawings, a laminated printing head for a noncontacting coating system may comprise a manifold 10 having a chamber 11 therein which is supplied with coating material through a conduit 12 and provided with a vibrator 13 vibrating at a preselected, uniform frequency to insure that the drops of coating material which break loose from the filament thereof are of uniform size and uniform spacing.

Positioned beneath the manifold bar 10 is a filter plate 14 having a series of perforations formed in a central portion 15 thereof opposite the chamber 11 in the manifold 10. Gaskets 16 and 17 are provided on opposite sides of the filter plate 14 and downstream thereof an inlet plate 18 is secured, as well as an orifice plate 20 having a series of regularly spaced orifices 21 formed therein and a spacer plate 22 with openings 23 concentrically positioned with respect to the orifices 21.

As explained in more detail in the above-noted, related application, the purpose of the spacer plate above-noted, is to position the apparatus for imparting a charge on the coating material at a point where the individual drops just begin to break from the filaments of coating material being ejected through the orifices 21. Thus, in the present case, the spacer plate 22 is formed of a sufficient thickness to place the charge element, referenced in its entirety by the numeral 30, the distance necessary to accomplish this result.

A clamp plate 50 is mounted beneath the charge element 30 and is provided with a series of openings 51 therethrough concentrically located with respect to the orifices 21. A pair of electrodes 52 are positioned beneath the clamp plate 50 and secured to the lower surface thereof by means of pins 53 received in openings (not shown) in the lower surface of the clamp plate. Ordinarily, the clamp plate 50 will also be provided with a pair of depending brackets (not shown) which engage and support a catcher 53, which may take the form of an elongated hollow tube 55 slotted along one side to receive a knife edge 56 projecting outwardly beneath the opening between the two electrodes 53. The hollow interior of the tubular member 55 is connected to a vacuum pump 57 so that drops of coating material captured by the blade 56 will pass through the slot in the wall of the member 55 and be evacuated therefrom by the pump 57, all as explained in more detail in the above-noted related application.

With continued reference to FIG. 1 and further reference to FIGS. 2 and 3, it will be seen that the charge element 30 comprises an elongated support plate 31 having a planar surface 32 thereof extending in substantially parallel relationship to the path of the coating material 33 being ejected through the orifices 21. At positions along the planar surface 32 corresponding to the positions of the orifices 21 spaced applications 34 of an electrically conductive material are applied to the surface 32. Leads 35 extend from each of the strips 34 and lead to terminals 36 mounted at either end of the support plate 31 which in turn are connected to a control unit 37 by means of cables 38. An insulating coating 39 may be applied over the surface 32 and adjoining portions of the upper and lower surfaces of plate 31 to insulate the individual conductive strips 34 from each other.

A shielding bar 41 is also positioned beneath the spacer plate 22 and extends coextensively with the support plate 30 with both members 31 and 41 being clamped in the laminated assembly by means of bolts (not shown) extending through the various elements of the coating head. Shield bar 41 is provided with a series of notches 42 with each notch positioned in opposition to one of the spaced applications 34 of conductive material on the plate 31. Bar 41, for a purpose presently to be explained, is preferably formed of either a conductive material or, as shown in FIG. 3, is provided with a coating 43 of conductive material in at least that portion of the bar in which the notches 42 are formed.

With the above construction it will be seen that coating material delivered through the conduit 12 to the manifold 11 is filtered through the plate 14 and passes through the inlet bar 18 and the orifice and spacer plates 20 and 22. As the filaments of coating material formed by the orifices 21 begin to break into discrete drops 44 an electric charge may be applied to selective drops by selectively energizing the conductive strips 34 by means of the control unit 37. As a result, when the drops subsequently pass through the electrostatic field established by the electrodes 52 certain of the drops will be caught by the catcher 54 while others are permitted to pass and be imprinted upon the surface of the workpiece positioned beneath the coating head.

In accordance with a further feature of the invention a second control unit 45 may be provided for controlling the potential applied to the entire bar 41 if it is formed of a conductive material, or merely the notched portion thereof if a conductive coating is applied only to this portion of the bar. Normally, the potential applied to bar 41 will be the same as that of the jet filaments to prevent the formation of charged drops when the adjacent strip 34 is also at the jet filament potential. However, the unit 45 also permits the potential applied to the bar 41, or the notched area thereof, to be varied from the coating material potential in order to impart charge bias to all drops of coating material to permit the trajectory direction of all drops to be adjusted simultaneously.

From the above it will be apparent that the present invention provides an easily fabricated charging element for selectively applying electric charges to drops of coating material in a noncontacting coating system.

While the forms of apparatus herein described constitute

preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In noncontacting coating apparatus including an orifice plate having a series of regularly formed orifices therethrough, means for supplying coating material under pressure to said orifices, and means positioned downstream of said orifice plate for establishing an electrostatic field through which a jet filament of coating material from said orifices passes, the improvement comprising:

- a. an elongated support plate positioned beneath said orifice plate in closely spaced relationship thereto,
- b. said support plate having at least one substantially planar surface extending in substantially parallel relationship to the path of said coating material from said orifices,
- c. spaced applications of electrically conductive material positioned on said substantially planar surface at points therealong corresponding to the positions of said orifices in said orifice plate,
- d. means for selectively energizing each of said applications,
- e. a shield bar extending coextensively with and in close proximity to said substantially planar surface, and
- f. means defining a series of open-sided notches in said shield bar, each positioned in opposition to one of said spaced applications of conductive material.

2. The apparatus of claim 1 further comprising:

- a. a substantially continuous layer of electrically insulative material applied to said substantially planar surface to insulate said spaced applications from each other.

3. The apparatus of claim 1 wherein:

- a. said shield bar is provided with a coating of an electrically conductive material in at least that portion thereof in which said notches are formed.

4. The apparatus of claim 3 further comprising:

- a. means for applying an electric potential difference between said shield bar and said jet filament of coating material.

5. The apparatus of claim 4 further comprising:

- a. means for varying said potential difference.

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