May 26, 1970 H. F. BOK 3,513,765

WET WALL SPRAY-COATING CHAMBER

Filed March 26, 1969 5 Sheets-Sheet 1

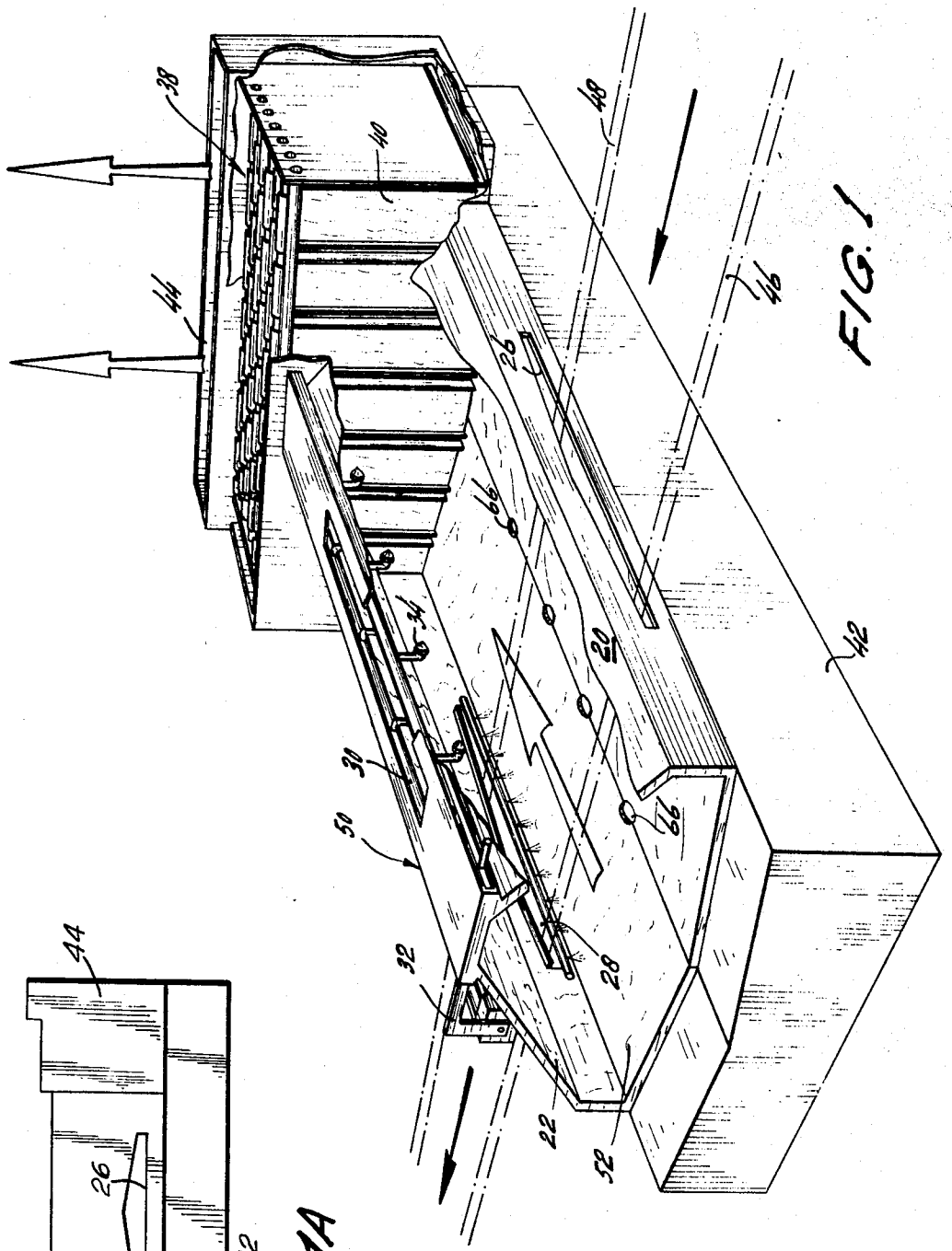


FIG. 1

FIG. 1A

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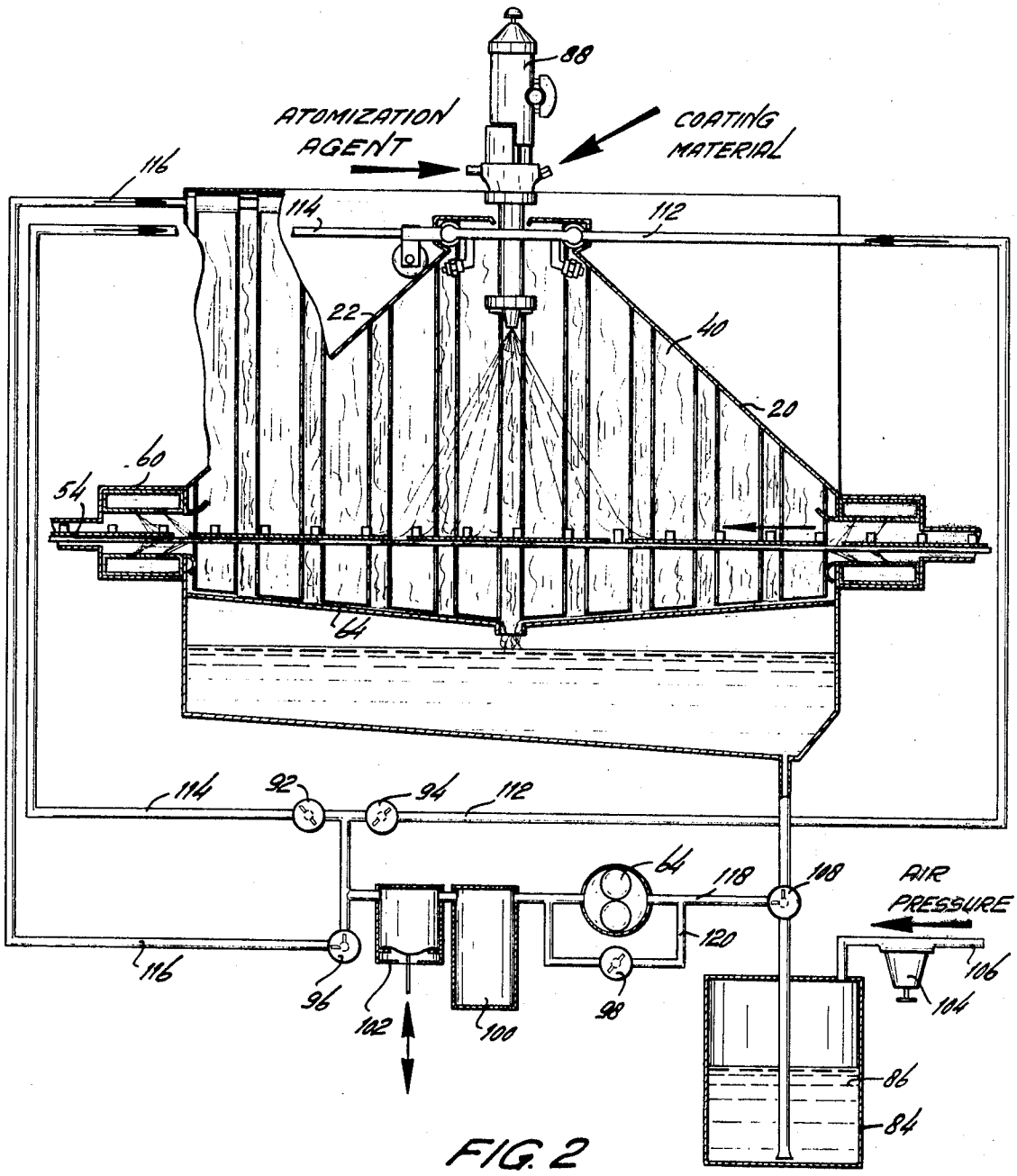


FIG. 2

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WET WALL SPRAY-COATING CHAMBER

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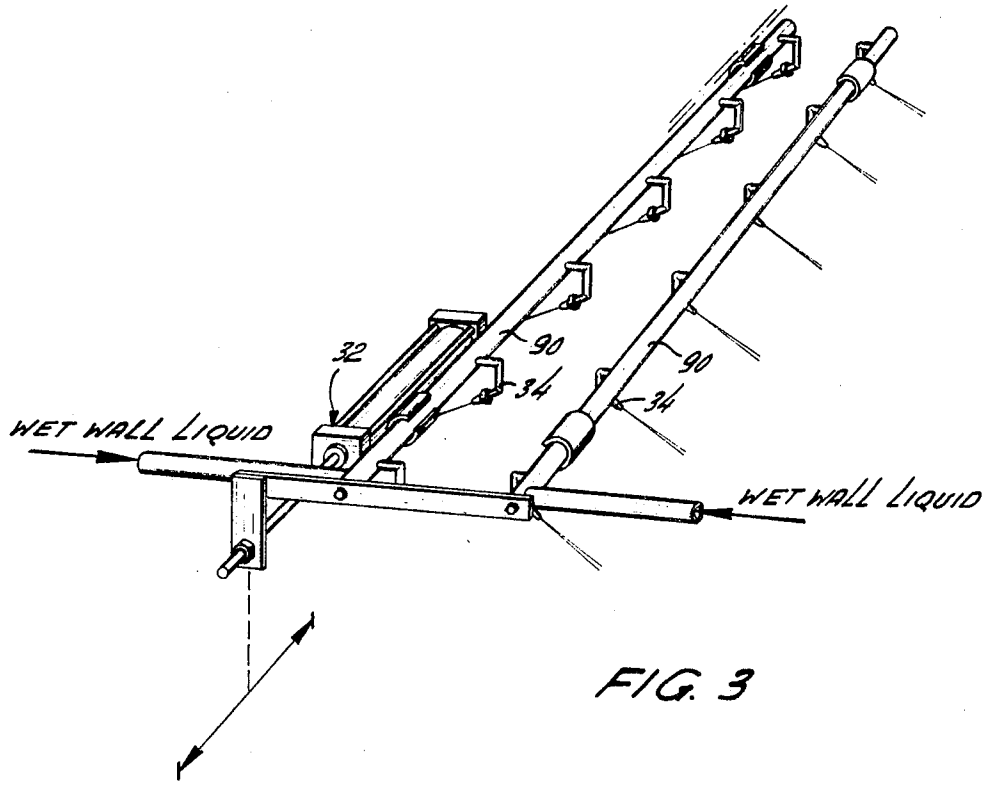


FIG. 3

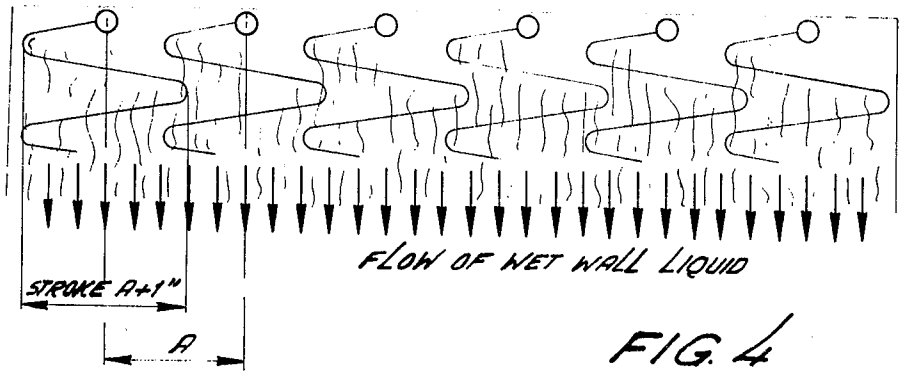


FIG. 4

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WET WALL SPRAY-COATING CHAMBER

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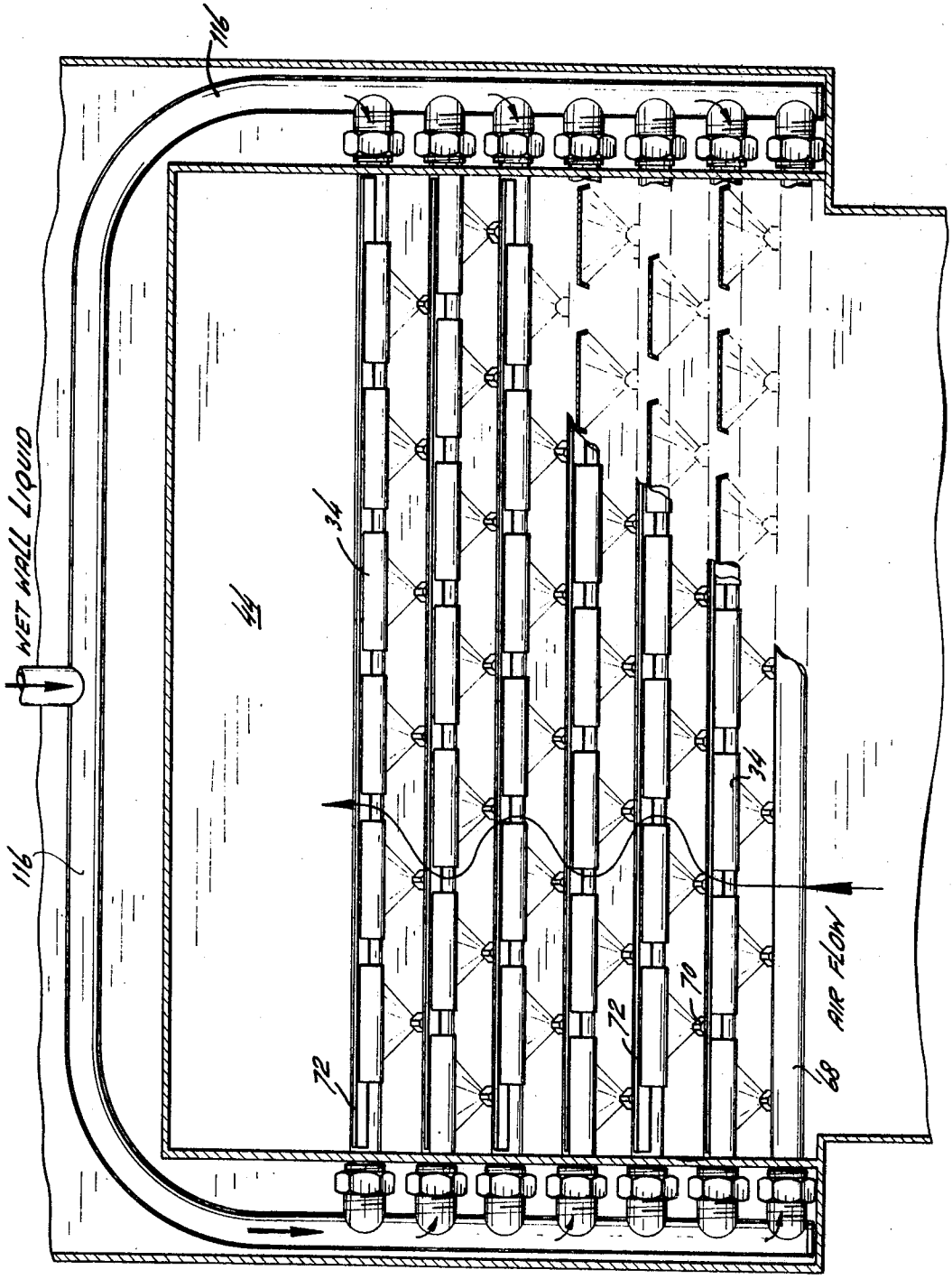


FIG. 5

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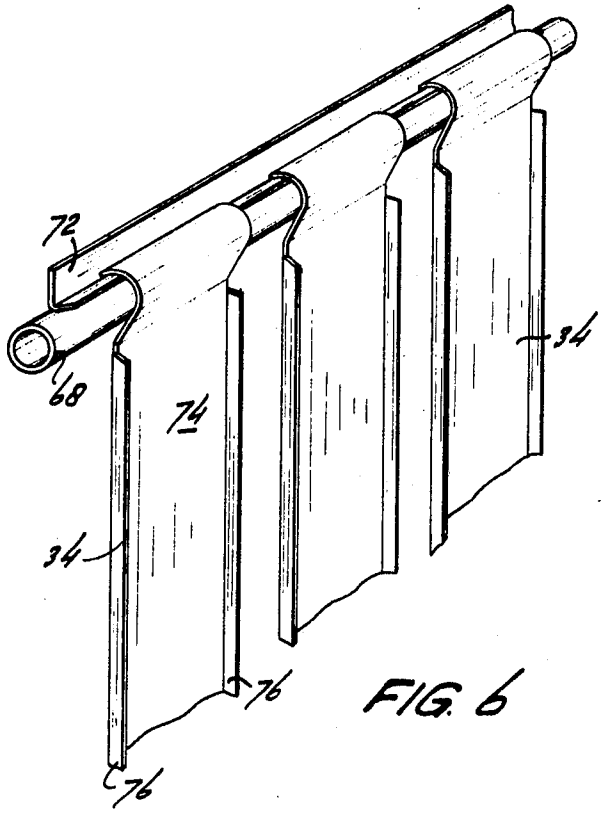


FIG. 6

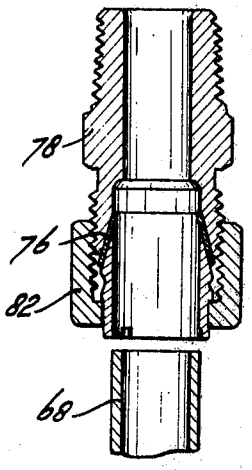


FIG. 7

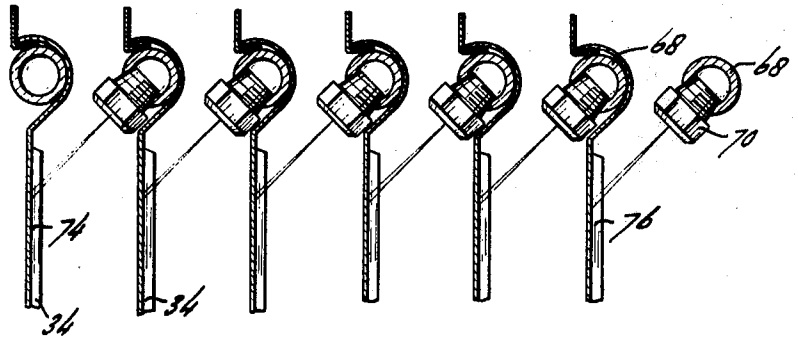


FIG. 8

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United States Patent Office 3,513,765 Patented May 26, 1970

3,513,765

WET WALL SPRAY-COATING CHAMBER

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Continuation-in-part of application Ser. No. 676,599, Oct. 19, 1967. This application Mar. 26, 1969, Ser. No. 810,773

Int. Cl. B05b 15/00

U.S. Cl. 98—115 9 Claims

ABSTRACT OF THE DISCLOSURE

Wet wall chamber for controlling a spray coating environment so as to eliminate the effects of overspray and bounceback of spray dust particles, particularly a structure for circulating solvent for the spray coating as a pluraltiy of staggered downwardly flowing streams, defining a baffle at one end of the chamber, and simultaneously flowing solvent downwardly on the inside inclined roof of the chamber.

CROSS-REFERENCES TO RELATED APPLICATIONS

A continuation-in-part of Method for Controlling a Spray-Coating Environment (Ser. No. 676,599), filed Oct. 19, 1967, now Pat. No. 3,475,202. In the parent application there is disclosed the method of flowing solvent as a plurality of overlapping, staggered channels at one end of the environment. The present application is directed to specific structure for the wet wall baffle and for a plurality of solvent nozzles addressing themselves to the inclined interior roof of the environment.

BACKGROUND OF THE INVENTION

Field of the invention

Control of spray coating of photoresist and like materials on printed circuit boards, semiconductor and microsurface wafers is conventionally conducted within a filtered laminar-flow air environment. This filtered laminar air flow limits somewhat the suspension of impure particles within the environment, but does not guarantee the full removal of overspray and bounceback particles. The present application is directed to structure for removal of overspray and bounceback particles by precipitation in solvent flowing as a wet wall baffle at one end of the environment, flowing on the inner surface of the roof of the environment.

Description of the prior art

Davis, 2,155,932; McGraw, 2,217,345; Erikson, 2,259,626; Norris, 2,848,353; Umbricht, 2,981,525.

The foregoing prior art references teach generally horizontal and vertical flowing of solvent within the confines of a spray coating chamber, while horizontally flowing air perpendicularly to flowing of solvent. See for example, Erikson and Umbricht. McGraw shows flowing of solvent on all vertical walls of the conveyor. Norris teaches flowing of solvent over the walls and floor of the spray coating booth. Davis, also, shows flowing of solvent over the interior walls of the chamber. None of the prior art devices show flowing of laminar air through a plurality of staggered overlapping channels as an end baffle nor a specific structure for effectively flowing solvent over the entire interior walls of the environment. The present application is directed to this structure.

SUMMARY OF THE INVENTION

The present invention is directed to a specific baffle structure including individual baffles and nozzles for feeding of solvent onto the baffles, as well as a structure for reciprocating longitudinally a plurality of nozzles adjacent the top inclined walls of the chamber, the two structures cooperating to present a wet wall environment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a proposed spray coating environment controlled by the end wall baffle and inclined top wall features of the present invention;

FIG. 1A is a view from the right side of FIG. 1;

FIG. 2 is a transverse section, partially fragmentary, showing the end baffle;

FIG. 3 is a fragmentary perspective of the inclined top wlal nozzle reciprocating mechanism;

FIG. 4 is a schematic view showing the overlap stroke of the top wall solvent nozzles, so as to achieve thorough coating of the inclined top walls;

FIG. 5 is a fragmentary top plan of the end wall baffle and solvent nozzles;

FIG. 6 is a fragmentary enlarged perspective of individual baffles affixed to the solvent feeding conduit;

FIG. 7 is a fragmentary vertical section of a proposed swivel assembly for the individual baffle nozzles; and

FIG. 8 is a fragmentary longitudinal section of the end wall baffle, showing the individual channels being sprayed by their respective solvent nozzles.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a controlled environment **50** for spray coating which, when placed in a cleanroom atmosphere, maintains cleanroom condition during and after the spray operation. This spray chamber consists of:

(a) two wetted, sloped, side walls **20** and **22** with conveyor **46–48** feed-in opening **26** and take-out opening **28** and a slotted top opening **30** for the traversing spray gun (not illustrated);

(b) traverse mechanism **32** with nozzles **34** for wetting the sloped side walls;

(c) wetted exhaust baffle system **38** with removable, staggered baffles **40**;

(d) reservoir **42** from which the wet wall liquid is pumped and in which the liquid flows back again after wetting the walls **20** and **22** and staggered baffles **40**; and

(e) exhaust opening **44** behind staggered wet wall baffle.

The exhaust through opening **44** is of such a capacity as to establish an air flow of a minimum of 100 linear ft./minute. As the air is pulled from the cleanroom atmosphere in which the spray chamber **50** is placed and is flowing through the frontal opening **52**, a slight negative pressure is formed inside the spray chamber **50** and the cleanroom-conditioned air is, besides being pulled through the frontal opening, in the direction of the arrow, also is pulled in through the conveyor openings **26** and **28**, as well as through the gun-slot **30** at the top of the chamber. A source of laminar flow air **67** is shown attached to the frontal opening **52** in FIG. 1A.

FIG. 2 shows a cross section of the spray chamber **50** with the pump, filter and valve controls providing the wet wall liquid circulating system. Although not indicated in FIG. 1, FIG. 2 shows the chain conveyor track **46** moving in a direction from right to left. Panel **54**, placed onto chain conveyor **46** and **48**, moves first

through air knife portal **56**. In this portal **56** are placed two slotted tubes **58**, one on each side of panel **54**, through which tubes **58** a precleaned compressed air flows. This air-knife system provides entry portal **56** and identical portal **60** with a positive pressure as compared to the pressure within the spray chamber **50**, thus preventing overspray and bounce-back from penetrating into the portals **56** and **60**.

The wet wall liquid, pumped from reservoir **62** (FIG. 2) by pump **64**, is pressure fed to the traversing, round fluid stream nozzles **34** as shown in FIG. 3. As illustrated in FIG. 4, the traversing stroke is approximately 1" larger than the distance A between the flow nozzles. A round stream nozzle **34** is required since the output can be controlled to a very small flow rate without causing drips which would fall onto the surfaces to be coated. Other types of spray nozzles which form an atomized fan pattern have an inherent drip problem. Furthermore, spray nozzles using an atomization agent such as compressed air, are not acceptable since they cause a considerable amount of turbulence of the air, passing through the spray chamber **50**.

The wet wall fluid **62**, flowing down from the wet walls **20** and **22** and wet baffles **40**, flow onto the top **64** of reservoir **42** and through openings **66** into the reservoir. Practical applications have shown that at least a 3½" distance from the underside **66** of the panel **54** to the top **64** of the reservoir is required to prevent a splash-up of wet wall liquid **62** and splashing onto the underside **64** of the panel.

FIG. 8 shows the side view of the wet baffle system **38**. This consists of identical supply tubes **68**, etc., with identical nozzles **70** threaded into the tubes. Flung over the supply tubes **68** are rows of identical baffles **34**. Such a row of baffles **34**, illustrated in FIG. 6, is formed by connecting strip **72**. The spacing between the baffles is approximately 25% of the baffle width. As can be seen from FIG. 5, the individual rows of baffles **34** are placed staggered so that the coating particles, suspended in the air flow, are forced to strike over the many, wetted baffle surfaces. Each nozzle **70** covers the baffle surface **74** which it faces. Since the spray pattern of the nozzle is to be contained over the surface, the baffle is provided with bent side flanges **76**. In addition to confining the spray wetting, these flanges **76** form an additional air flow restriction and, therefore, increase the filtering efficiency of the total baffle system.

For fast cleaning and replacing of the nozzle **70**, the solvent supply tubes **68** are made to rotate at each end, thus providing a way to turn the nozzles in an upright position. A Teflon washer **76**, illustrated in FIG. 9, between the flared flanges of tube **78** and coupling **80**, provides for proper slip-fit sealing after nut **87** has been tightened.

In FIG. 2 there is also illustrated a pressure pot **84** containing clean wet-wall liquid. During normal spray operation, the wet-wall liquid **62** which is a very slow evaporating solvent, compatible with resins used in the spray coating, absorbs the overspray and bounce-back of the sprayed coating from gun **88** and the resins go in solution. The longer the spray operation, the higher the solid content of the wet-wall **62** liquid will be. It is, therefore, necessary to flush the **34** and **70** nozzles, pipes **68** and **90** and wet-wall **20** and **22** surfaces with the clean wet-wall liquid **86**, stored and pressurized in pressure pot **84**. Prior to shut-off of equipment, a small amount of clean liquid **86** (cleaning cycle) is pushed and pumped through the system which washes all surfaces and assures proper wetting when spray operation is assumed.

As illustrated in FIG. 2, the wet-wall liquid return system may include air pressure conduit **106**, served by pressure regulator **104** as it enters pressure pot **84**. A series of three-way valves **108** and **96** may be employed to regulate solvent pressure flow from reservoir **62** through exit conduit **110**. Alternatively, three-way valve **108** may close exit conduit **110** so as to push clean wet-wall liquid **86** through conduit **118** thence to nozzles **34**, feeding conduits **114** and **112**, as well as wet-wall feeding conduit **116**. Pressure control valves **92**, **94**, and **98** may be employed, the latter valve being employed in pumping bypass conduit **120**. Pump **64**, together with three-way valve **108**, may be utilized to recirculate wet-wall liquid directly from the reservoir bottom into nozzles **34** and **70**. Also, a filter **100** may be employed together with an antipulsating device **102** used to remove pulsations in the liquid caused by the pumping action.

I claim:

1. A baffle structure for downward flowing of solvent in a spray-coating chamber of the type having a conveyor extending transversely through the chamber and an inclined roof comprising:

(A) a solvent reservoir within the bottom of said chamber;

(B) a plurality of vertically upstanding, longitudinally staggered and overlapping channels supported as a wet wall baffle at one end of said environment, each channel having longitudinally extending side flanges and a curvate top;

(C) a solvent circulation end conduit extending from said reservoir to the curvate top of said baffles and including:

(i) a plurality of nozzles positioned adjacent individual channels;

(ii) the curvate tops of the channels engaging said conduit; and

(D) means pressurizing said solvent so as to circulate solvent within said conduit, through said nozzles and into said channels.

2. A baffle structure as in claim **1**, said solvent circulation end conduit including a plurality of extensions laterally traversing said end of said chamber as channel and nozzle supports.

3. A baffle structure as in claim **2**, said nozzles being supported upon one conduit extension and being directed toward the forward surface of a channel supported on the next adjacent conduit extension.

4. A baffle structure as in claim **3**, in combination with:

(E) a roof wetting solvent dispenser including:

(i) a solvent circulating roof conduit extending axially at either side of the top of said inclined roof;

(ii) a plurality of nozzles supported upon the roof conduit and directed to the inclined surfaces of said roof; and

(iii) a solvent conduit reciprocating carriage supporting said conduit and nozzles for longitudinal reciprocation, so as to dispense solvent onto said roof in over-lapping flow.

5. A baffle structure as in claim **4**, including:

(F) An air cylinder engaging said solvent conduit reciprocating carriage as a reciprocating mechanism.

6. A baffle structure in combination with a roof-wetting solvent dispenser as in claim **4**, including:

(G) a source of laminar-flow air positioned in the front end of said chamber opposite said wet wall baffles, so as to direct laminar-flow air longitudinally through said chamber and against said wet wall baffle.

7. A combined baffle structure and roof wetting solvent dispenser as in claim **6**, said chamber having conveyor entry and exit portals intermediate said source of laminar flow air and said wet-wall baffle and including:

(i) pressurized air-knife means traversing said entry and exit portals.

8. A combined baffle structure and roof wetting dispenser as in claim **6**, said reservoir having a collecting roof supported beneath said conveyor, so as to collect without splashing solvent, over spray and bounce back prior to reciprocation.

9. A baffle structure as in claim 3, said extensions of said solvent circulation end conduit being pivotable in a horizontal axis, so as to facilitate adjustment of said nozzles from above.

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U.S. Cl. X.R.

118—326