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Payne et al.

[11] **3,901,184**

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[54] **PNEUMATIC POWDER FLOW DIVERTING DEVICE**

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[52] **U.S. Cl.** **118/629;** 118/308; 118/312; 222/193; 239/15; 239/124

[51] **Int. Cl.**[2] **B05B 5/02**

[58] **Field of Search** 118/629, 627, 308, 312, 118/309; 222/193; 239/3, 15, 124, 125, 127

[56] **References Cited**

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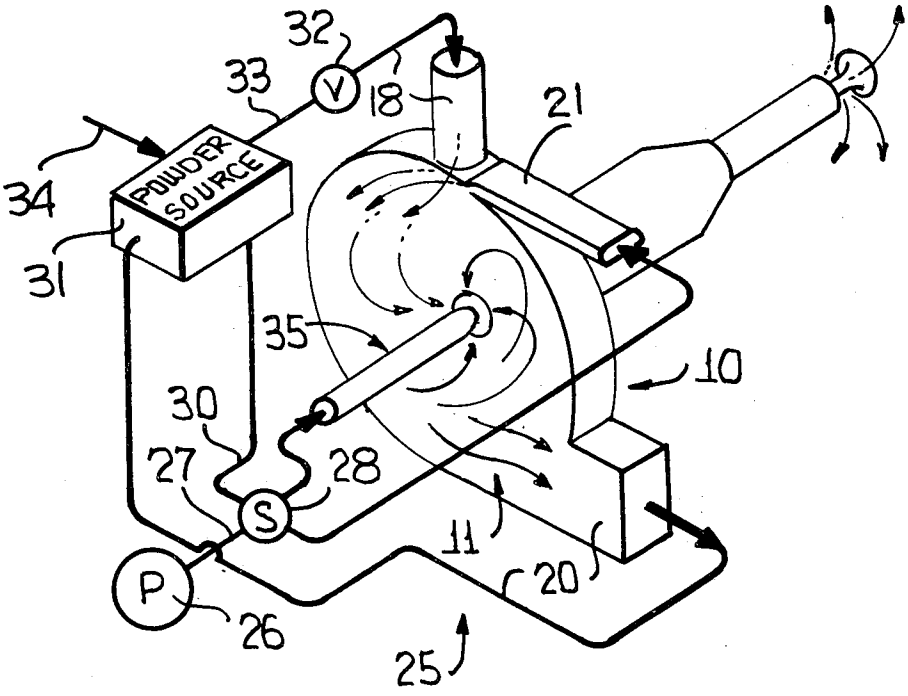
[57] **ABSTRACT**

This invention is directed to a pneumatic flow switching device particularly adapted for the electrostatic coating of tubular workpieces, particularly can bodies, and includes a generally cylindrical chamber, a conduit for peripherally delivering a fluidized admixture of powder and air into the chamber, means for peripherally exhausting the powder-air admixture from the chamber, means adjacent the conduit for directing air tangentially into the chamber whereby the powder-air admixture is directed toward the exhausting means, and means for pneumatically traversing the powder-air admixture generally axially of the chamber for the delivery to an article intended to be treated thereby.

17 Claims, 4 Drawing Figures



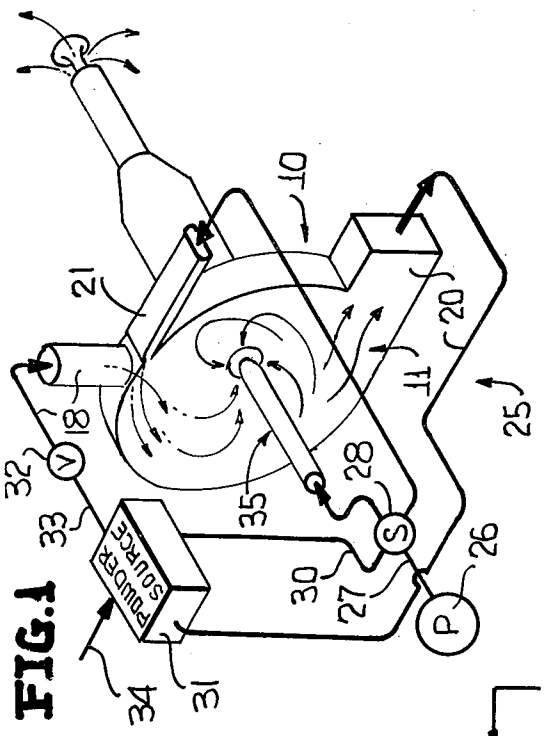


FIG.1

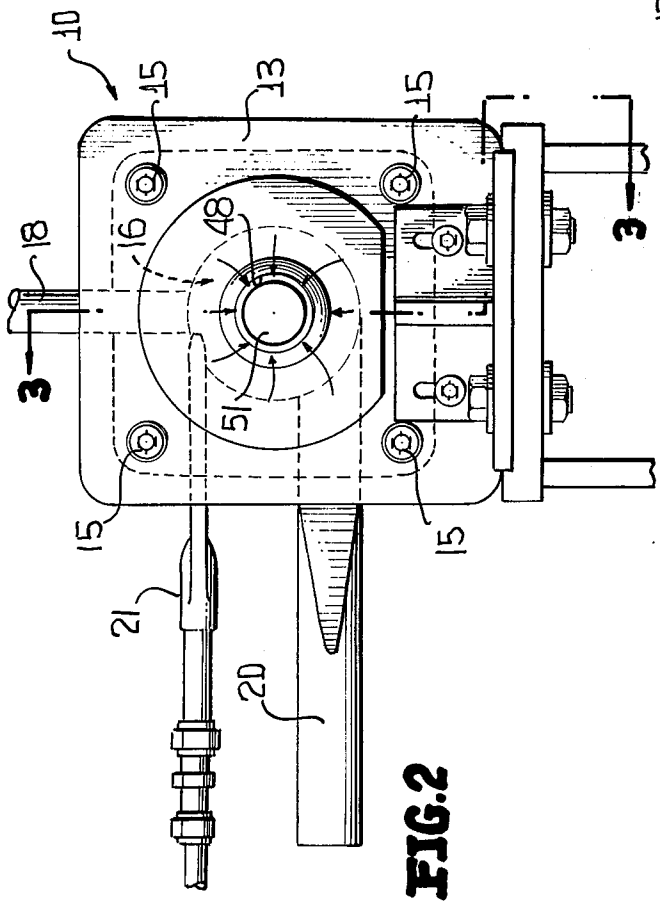


FIG.2

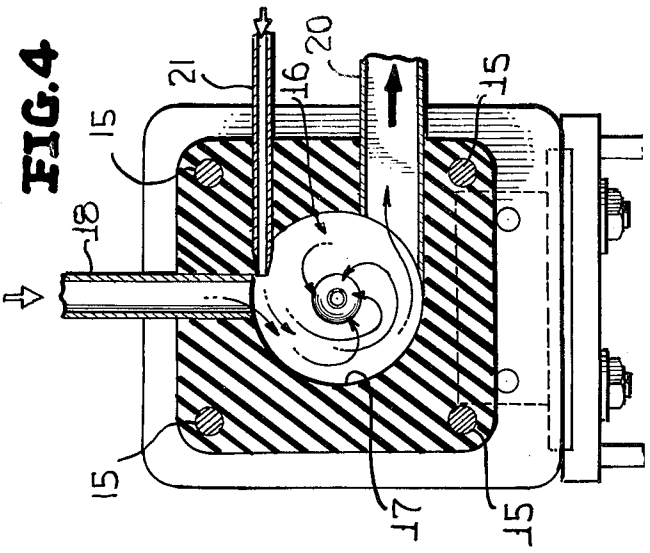


FIG.4

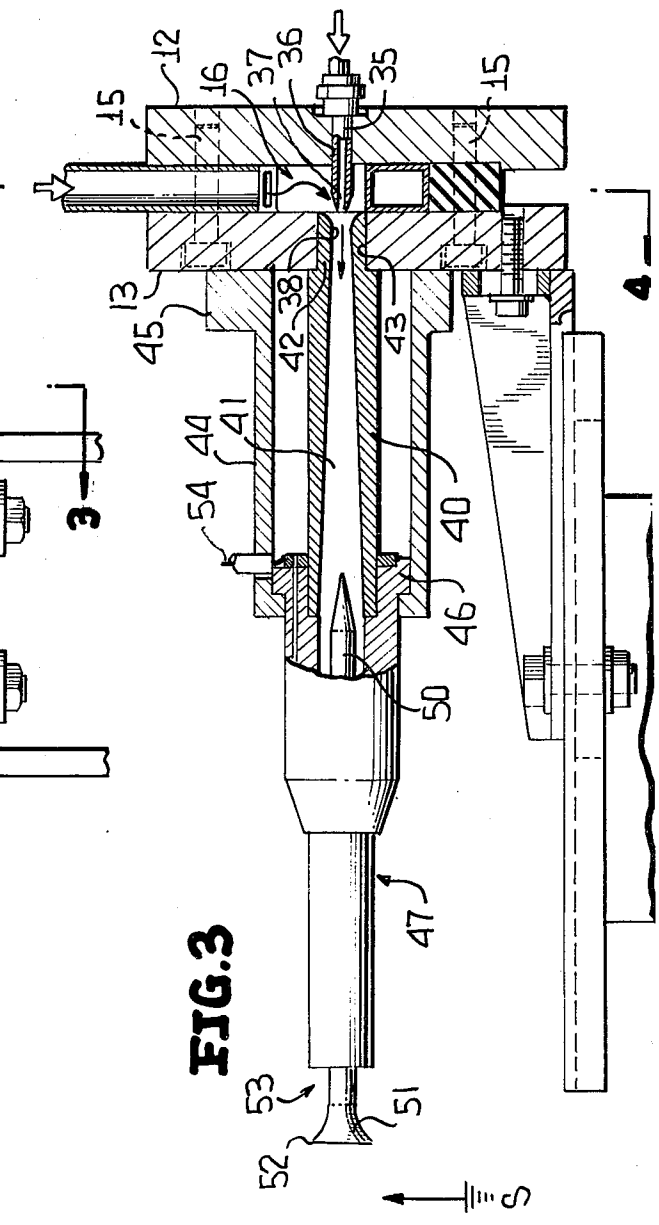


FIG.3

PNEUMATIC POWDER FLOW DIVERTING DEVICE

This invention relates to coating articles, and in particular, to electrostatically coating tubular articles such as can bodies or the like.

Can bodies have the interior surfaces thereof coated with an enamel where the cans are intended to contain beverages or varieties of food products. A thin coating of enamel is usually applied to the interior metal surface of the can by a roller coating process before it is shaped to form the can. During the shaping operation the enamel is usually scratched or otherwise subjected to minor damage which exposes small areas of the metal, rendering the interior can surface liable to corrosion by the contents thereof. The damage affected to the interior enamel coating during can shaping is generally repaired by spraying the interior of the can with a coating of lacquer after fabrication and before attachment of an end thereto. This process is extremely wasteful of lacquer because not only is the lacquer sprayed on to the damaged areas but it is also sprayed on those areas which are undamaged and thus consequently do not require further coating.

The enamel coating and/or the lacquer is heated and until recent developments organic solvents were driven off by the heat creating undesirable atmospheric emissions which presently are becoming increasingly regulated by States as well as by the Federal Government. The latter factor has increased the use of coatings without organic solvents for protective or decorative applications, and since the appearance on the market of the latter materials powder coatings have held a strong position among competitive technologies. Flame spraying, fluid bed and similar means have been used for at least twenty years to apply powders and other solvent-free protective coatings.

Approximately one-half dozen years ago electrostatic deposition technology was employed to stripe welded can bodies on a commercial basis and the success thereof has served as a basis for the development of electrostatic powder technology for coating the inside of beer and soft drink containers. The favorable economics associated with electrostatic coating, either full coat, full overcoat, and/or repair coat, is mainly due to lower material costs on a per can body basis, the reduction in air pollution control equipment and, in some instances, reduction of steps in earlier conventional processes (i.e., the elimination of the two coat system).

In the practice of what is termed the "single" mode operation beer can bodies are entirely electrostatically coated in a single step to give a defect-free coating. Since the deposition occurs after the can body blanks are fabricated into cylindrical bodies subsequent scratching does not occur and again conventional lacquer coating operations are eliminated.

In the "single mode" of operation a powder gun pneumatically discharges an admixture of the electrically charged coating powder and air through the can body resulting in a very thin over-all coating. When operating on a commercial basis the can bodies must be rapidly moved into and out of the spray area and of prime concern is the powder flow to the powder gun which must be accurately controlled in order not to waste powder between cans.

In keeping with the foregoing a primary object of this invention is to provide a novel device for pneumatically

switching the flow of the powder, the device including a cylindrical chamber, means for delivering a fluidized admixture of powder and air into the chamber, means for exhausting the powder-air admixture from the chamber, first means contiguous to the delivering means for pneumatically directing the powder-air admixture from the delivering means toward the exhausting means, and second means for pneumatically traversing the powder-air admixture during its movement between the delivering and exhausting means for directing the powder-air admixture primarily axially from the chamber toward an area at which an article is to be coated or otherwise effected by the powder portion of the powder-air admixture.

A further object of this invention is to provide a novel pneumatic flow switching device of the type immediately heretofore set forth wherein the first-mentioned directing means is a port opening generally tangentially into the cylindrical chamber whereby air directed into the chamber therethrough tends to propel the powder-air admixture in a circular pattern within the chamber.

A further object of this invention is to provide a novel pneumatic flow switching device for activating the second directing means only when an article is at a position to be effected by the powder portion of the powder-air admixture.

yet another object of this invention is to provide a novel pneumatic flow switching device including means for supporting an article, preferably a tubular can body, adjacent the axial output of the chamber whereby the article will be coated by the powder of the powder-air admixture.

Still another object of this invention is to provide a novel pneumatic flow switching device of the type aforesaid wherein means are provided for charging the powder and/or article whereby the latter is electrostatically coated.

With the above and other objects in view that will hereinafter appear the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claimed subject matter, and the several views illustrated in the accompanying drawings.

IN THE DRAWINGS

FIG. 1 is a perspective view of the pneumatic flow switching device of this invention, and illustrates powder-air delivery and exhaust port spaced peripherally with respect to a generally cylindrical chamber, an air input port disposed tangentially with respect to the delivery port, and an axially disposed air input port for propelling the normally circularly flowing powder-air admixture to and through a powder gun for subsequent deposition upon an associated article.

FIG. 2 is a fragmentary front elevational view looking from right-to-left in FIG. 1, and illustrates constructional details of the switching device including an annular discharge orifice for the powder-air admixture.

FIG. 3 is a cross-sectional view taken generally along the line 3—3 of FIG. 2, and illustrates details of the chamber construction and a venturi downstream of the axially disposed air inlet port.

FIG. 4 is a cross-sectional view taken generally along line 4—4 of FIG. 3, and illustrates details of the powder-air admixture flow when the axially disposed air inlet port is cut off from a pressurized air source during a non-coating cycle of the device.

The pneumatic flow switching device of this invention is generally designated by the reference numeral **10**, and as is best illustrated in FIG. **1**, the over-all construction includes a housing **11** defined by a pair of rectangular preferably transparent plates **12, 13** (FIG. **3**) secured together by bolts **15** in a conventional manner. The plates are centrally contoured to define a generally cylindrical or circular chamber **16** having a peripheral wall surface **17.** Means **18** in the form of a generally radially disposed port functions to deliver an admixture of powder and air into the chamber **16** at approximately the 12 o'clock position thereof, as viewed in FIG. **4.** Means, generally designated by the reference numeral **20,** in the form of another port is provided for exhausting the powder-air admixture from the chamber in a continuous fashion irrespective of whether or not an article is being coated at a station S (FIG. **3**) or being transported to or removed therefrom, in the manner to be described more fully hereinafter. Additional means **21** in the form of another port or conduit is disposed such that air is directed generally tangentially into the chamber **16** at approximately the 12 o'clock position and adjacent the port **18** resulting in the powder-air admixture traveling in a generally circular path augmented by the curvature of the surface **17** from the 12 o'clock position of the chamber **16** to approximately the 7–8 o'clock position at which it is exhausted through the port **20.**

Reference is made once again particularly to FIG. **1** in order to indicate the manner in which the switching device **10** is part of a circulating system, generally designated by the reference numeral **25** which includes a source of pressurized air, such as a pump **26** coupled by a conduit **27** to a conventional switch **28.** The switch **28** is, in turn, coupled by a conduit **30** to a source **31** of powder, the particular nature of which will be described more fully hereinafter. The air introduced into the powder source **31** through the conduit **32** maintains the powder-air admixture therein in a fluidized state in order that it might be pneumatically moved through the system **25** with its delivery into the interior of the chamber **16** being under the control of an adjustable valve **32** in a conduit **33** which is in turn coupled to the conduit or delivery port **18.**

By the same token the air input port **21** is a conduit which is likewise coupled to the valve **28** whereas the exhaust port or conduit **20** is fed back to the powder source **31** for subsequent recirculation. Fresh powder, as necessary, may be fed into the powder source or fluidized bed from any other area through a conduit **34.** Thus, in the non-coating or non-application mode of operation the powder-air admixture from the source **31** follows a closed path defined by the conduit **33,** the adjustable valve **32,** the conduit **18,** the interior of the chamber **16,** and the conduit **20** augmented by air introduced into the chamber **16** through the conduit **21** with the bed **31** being maintained in a fluidized condition by air introduced thereinto through the conduit **30.**

The "normal" generally circular path of travel of the powder-air admixture within the chamber **16** just described is interrupted in order to disrupt the flow path of the powder-air admixture within the chamber **16** and instead redirect the same axially outwardly therefrom. The change in travel of the powder-air admixture is effected by a generally axially disposed nozzle or air inlet port **35** which projects through a bore **36** of the plate **12** into the chamber **16** and is positioned with a discharge opening **37** thereof closely adjacent an inlet end **38** of a venturi tube **40** having a leftwardly (as viewed in FIG. **3**) converging tubular passage **41.** The venturi **40** has a reduced end **42** received within a bore **43** of the plate **13** and is held therewithin by a tubular flanged member **44** whose flange **45** is conventionally secured to the plate **13.** An end portion **46** of a powder nozzle or gun **47** is sandwiched and held captive between the venturi **40** and the tubular member **44** and terminates at its leftmost end in a circular opening **48.** Housed within the powder nozzle **47** is a conductive element **50** having a generally bell-shaped end **51** projecting beyond the circular opening **48** and having a maximum diameter as defined by a circular edge **52** slightly less than the circular opening **47** thereby defining a generally annular discharge area **53** between the bell **51,** the projecting leftward end of the element **50,** and the circular opening **48.** This configuration is designed to achieve a generally annular "cloud-like" flow of the powder-air admixture as it departs the orifice **48** for subsequent application to an article supported to the left as viewed in FIG. **3.**

Assuming that an article, such as an open-ended tubular can body, is supported to the left of the gun **47** as indicated by the reference numeral S, and preferably coaxial therewith, the "normal" flow of the powder-air admixture heretofore described is interrupted by operating the valve **28** such that air from the pump **26** is additionally directed through the nozzle or conduit into the chamber **16** and/or the inlet **38** of the passage **41** of the venturi tube **40.** So long as sufficient air is emitted from the nozzle or jet **35** the powder-air admixture continuously delivered into the chamber **16** will be delivered by the powder gun **47** and particularly through the orifice toward and into the can body in the desired configuration as determined by the particular contour of the area generally designated at **53.** It is emphasized that during the redirection of the powder-air admixture from its normal path (generally circular) to a path axial thereto there need be no stoppage of the flow of air to the source **31** through the conduit **30** nor air into the chamber **16** through the conduit **21.** The effect of air issuing from the jet **35** simply redirects the powder-air admixture along an axial path to perform the desired coating operation, and upon the termination of air flow to the jet **35** by appropriately operating the switch **28** the "normal" path is reestablished and the powder-air admixture resumes flow from the chamber through the conduit **20** to the source **31** with the latter being augmented by an exhaust pump (not shown) in the line **20.**

As was stated earlier the particular use to which the device **11** is applicable is that of electrostatically coating in the single mode of operation. In this mode of operation and variations thereof the fundamental laws of electrostatics apply, namely, like charged bodies repel each and unlike charged bodies attract. Applied first to the coating of a can body this can be interpreted to mean that if charged coating particles are introduced into the inside of the can body at the support S they will be attracted with an appreciable force to an oppositely charged can body. Inasmuch as no particular can body and/or powder charging system forms part of this invention, that for the can body is indicated in FIG. **3** diagrammatically by simply illustrating the support S as part of an electrical system. Insofar as the charging of the powder is concerned, this may be readily effected

by a conductor **54** conventionally connected to the element **50** which in turn is preferably insulated by, for example, an insulated spider from the powder nozzle **47**. Irrespective of the particular charging system employed the electrostatic forces are desirably sufficiently strong to hold the powder in place against the bare interior surface of the can body in order that the powder will not be displaced during transportation from the coating station to a final fusing station in an oven, an induction heat unit, or the like.

It is further appreciated that all powder directed into the can body by the powder gun **47** will not be attracted to the can body interior by electrostatic forces and the exodus of excess powder therefrom would be costly if simply wasted. Accordingly, the end of the can body most remote from the powder gun **47** is preferably encircled by a hood connected to a vacuum source which is in turn connected to the powder source **31**. If as described earlier the conduit **20** includes a vacuum source the conduit may simply be extended and coupled to the hood such that both the chamber **16** and the hood, as well as any can body thereat, are continuously under the effect of the vacuum source to return excess powder to the source **31**.

The following are merely typical examples of the type of powders which may be utilized in accordance with the present invention:

Type	Code	Supplier
Epoxy	71 AP 14	Armstrong Products Company, Inc.
Epoxy	F100C	Oxyplast, Ltd.
Polyamide	Nylon 11	Aquitaine-Organics
Polyethylene-Butene	SK 4002	Sinclair-Koppers Company
Polyethylene	SK 7007	Sinclair-Koppers Company

While preferred forms and arrangement of parts have been shown in illustrating the invention, it is to be clearly understood that various changes in details and arrangement of parts may be made without departing from the scope and spirit of this disclosure.

We claim:

1. A pneumatic flow switching device comprising a generally cylindrical chamber, means delivering a fluidized admixture of powder and air into said chamber, means for exhausting the powder-air admixture from said chamber, first means contiguous said delivering means for pneumatically directing said powder-air admixture from said delivering means toward said exhausting means, and second means for pneumatically traversing said powder-air admixture during its movement between said delivering and exhausting means for directing said powder-air admixture primarily axially from said chamber.

2. The pneumatic flow switching device as defined in claim **1** wherein said first delivering means introduces air into said chamber in a generally tangential direction relative to said cylindrical chamber.

3. The pneumatic flow switching device as defined in claim **1** wherein said exhausting means exhausts the powder-air admixture in a generally tangential direction relative to said cylindrical chamber.

4. The pneumatic flow switching device as defined in claim **1** wherein said delivering means and said exhausting means are separated from each other by at least 90°.

5. The pneumatic flow switching device as defined in claim **1** including venturi means into which said axially exhausted powder-air admixture is delivered by said second pneumatic means.

6. The pneumatic flow switching device as defined in claim **1** including means for supporting an article to be coated by the powder of said powder-air admixture adjacent the axial output thereof from said chamber.

7. The pneumatic flow switching device as defined in claim **1** including a source for said powder-air admixture, and means for returning said peripherally exhausted powder-air admixture to said powder-air source.

8. The pneumatic flow switching device as defined in claim **1** including means for supporting an article to be coated by the powder of said powder-air admixture adjacent the axial output thereof from said chamber, and means for charging the powder prior to reaching the article whereby the latter is electrostatically coated.

9. The pneumatic flow switching device as defined in claim **2** wherein said exhausting means exhausts the powder-air admixture in a generally tangential direction relative to said cylindrical chamber.

10. The pneumatic flow switching device as defined in claim **2** wherein said delivering means and said exhausting means are separated from each other by at least 90°.

11. The pneumatic flow switching device as defined in claim **2** including venturi means into which said axially exhausted powder-air admixture is delivered by said second pneumatic means.

12. The pneumatic flow switching device as defined in claim **2** including means for supporting an article to be coated by the powder of said powder-air admixture adjacent the axial output thereof from said chamber, and means for charging the powder prior to reaching the article whereby the latter is electrostatically coated.

13. The pneumatic flow switching device as defined in claim **3** wherein said delivering means and said exhausting means are separated from each other by at least 90°.

14. The pneumatic flow switching device as defined in claim **3** including venturi means into which said axially exhausted powder-air admixture is delivered by said second pneumatic means.

15. The pneumatic flow switching device as defined in claim **3** including means for supporting an article to be coated by the powder of said powder-air admixture adjacent the axial output thereof from said chamber, and means for charging the powder prior to reaching the article whereby the latter is electrostatically coated.

16. The pneumatic flow switching device as defined in claim **12** including a source of said powder-air admixture, and means for returning said peripherally exhausted powder-air admixture to said powder-air source.

17. The pneumatic flow switching device as defined in claim **12** including a source of said powder-air admixture, and means for returning said peripherally exhausted powder-air admixture to said powder-air source.

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