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APPLICATOR FOR PARTICULATE MATERIAL

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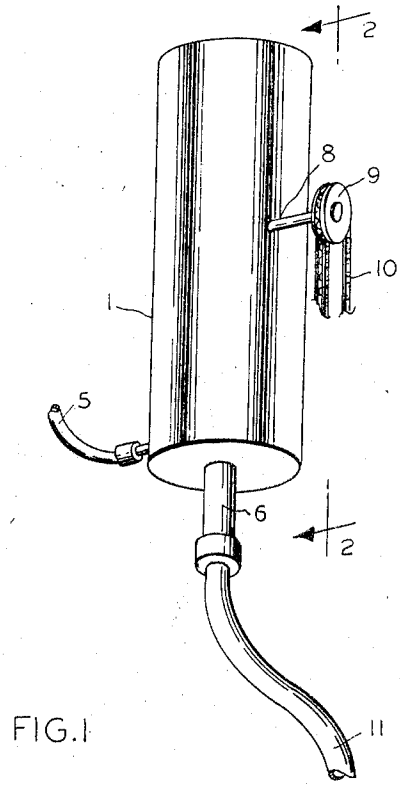


FIG.1

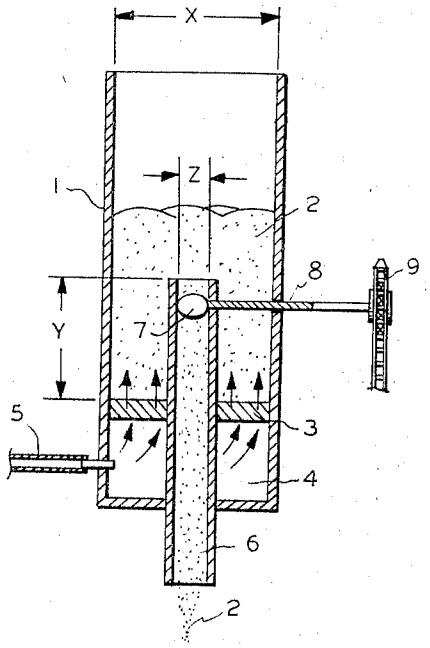


FIG.2

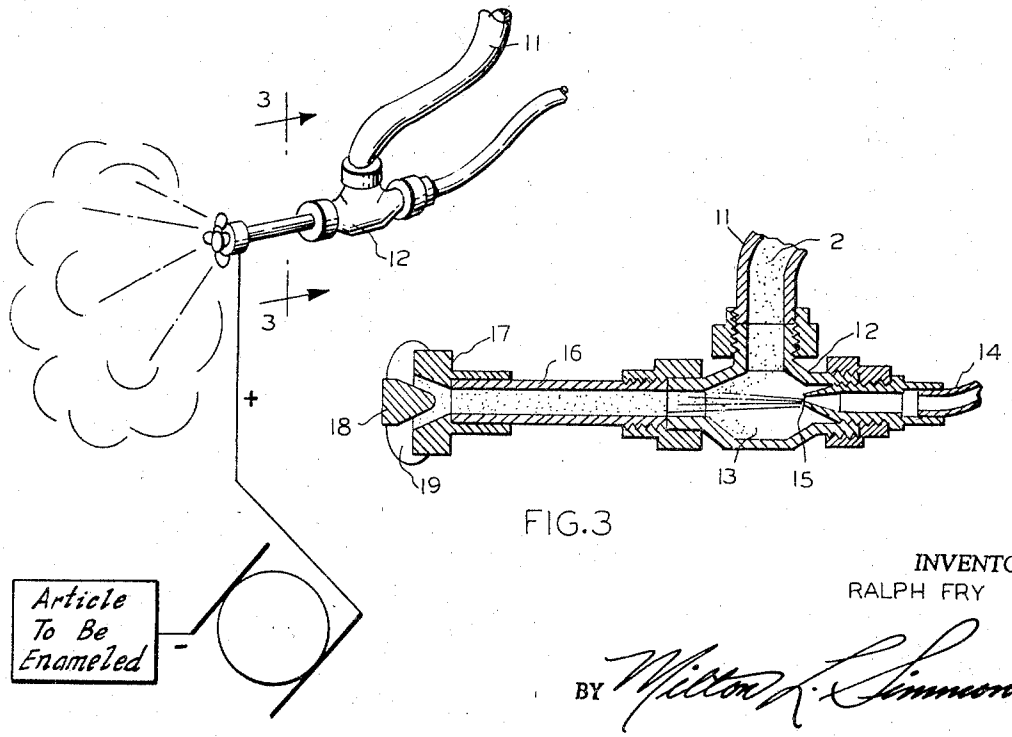


FIG.3

INVENTOR
RALPH FRY

BY Milton L. Simmons

ATTORNEY

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APPLICATOR FOR PARTICULATE MATERIAL

Ralph Fry, Warren, Pa., assignor to Ferro Corporation, Cleveland, Ohio, a corporation of Ohio

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Int. Cl. B67d 5/54; B05b 5/00, 7/00

ABSTRACT OF THE DISCLOSURE

Apparatus for the continuous, controlled deposition of powdered, dry process porcelain enamel to a heated cast metal substrate.

For as long as cast iron sanitary ware such as bathtubs, lavatories and sinks have been coated with vitreous porcelain enamel, the process has usually been carried out by heating the casting to be coated to a temperature of from approximately 1400 to 1700° F., withdrawing the casting from the heating furnace, placing same in a cradle adapted to be tilted through a 90° arc and rotatable 360°, with an operator standing over the hot casting manually sifting powdered porcelain enamel onto the heated article the while it is manipulated in its cradle to present various surfaces to the cascading material.

The heat of the base metal caused the porcelain enamel coming in contact therewith to fuse and adhere thereto, and the process was repeated, with reheating of the casting, two or three times until a sufficiently thick coating of vitreous enamel had been built upon the surface of the article, to thereby provide a protective coating having a pleasing smooth appearance, and high degree of chemical resistance.

The casting, following the above procedure, was then allowed to cool during which the vitreous coating became quite hard and glassy and the article was ready for distribution and installation.

However, one of the drawbacks to the conventional method of manually sifting powdered porcelain enamel onto a hot casting is that rising costs have rendered the manual operation prohibitively expensive.

Too, manual sifting of powdered enamel onto a hot casting to secure proper and even distribution thereof is a highly skilled art, thus resulting in an extremely high wage scale for the skilled operator, as well as necessitating a rather lengthy training period for him. This, plus the fact that the absence of an operator for several days through sickness or otherwise severly hampers production, militates toward substitution of mechanized means for the traditional hand method of coating.

Finally, the hand sifting method, which relies on gravity to transport the powdered particulate material to the substrate to be coated is limited in its rate of application thus resulting in an excessively long period of time being required for adequately covering a predetermined area.

Accordingly, it is an object of this invention to provide an apparatus for the directional deposition of particulate material onto a predetermined area.

It is further an object of this invention to provide an improved apparatus for the directional deposition of particulate, powdered porcelain enamel to a cast metal substrate.

It is a further object of this invention to provide a new and improved apparatus for the directional deposition of

powdered porcelain enamel to a heated, cast iron piece of sanitary ware.

The invention is demonstrated by the attached drawings wherein:

FIG. 1 is a perspective view of the apparatus of this invention;

FIG. 2 is a section taken along the line 2—2 of FIG. 1; and

FIG. 3 is a section taken along the line 3—3 of FIG. 1.

Referring now more specifically to the attached drawings, the reference numeral **1** designates a cylindrical reservoir for powdered particulate material, said reservoir having contained within its confines, means for conventionally fluidizing the particulate material.

From FIG. 2 it will be seen that fluidized powdered particulate material, designated by the reference numeral **2**, is supported by the air-pervious diaphragm **3**, which separates the reservoir of fluidized particulate material from an enclosed air chamber **4**, pressurized by a conventional source of compressed air (not shown) via tubing **5**.

As is well known in fluidizing particulate material, compressed air enters air chamber **4**, passes upwardly as indicated by the arrows in FIG. 2 through the air-pervious diaphragm **3**, and converts powdered particulate material **2** literally into a fluidized mass which possesses many of the characteristics of a low viscosity fluid rather than those of a dry powder.

By any conventional means not shown, the particulate material may be continuously supplied to reservoir **1** so as to maintain its level above the upper extremity of hollow tubular member **6** which, as will be seen from FIG. 2, extends through the air chamber **4**, through diaphragm **3** and has its upper extremity terminating in the body of fluidized particulate material **2**. A butterfly valve **7** disposed adjacent the upper extremity of tube **6**, connected by shaft **8** to sprocket **9**, may be rotated by said sprocket to constrict and completely close tubular member **6** if desired. In FIG. 1 is shown a roller chain **10**, which may be looped around sprocket **9** to provide ready access and control to an operator, for adjusting the degree of closure, or constriction, of tubular member **6**.

In essence then, in operation, reservoir **1** with its fluidized bed apparatus provides a novel means for fluidizing and controllably metering downwardly a flow of particulate material **2** through hollow tubular member **6**.

Heretofore, the transportation of powdered particulate material **2** from a fluidized source has been by way of a rather complex, and easily clogged, series of aspirator tubes near the bottom of the bed. A simple opening through the diaphragm **3**, and flush therewith, has proven unsatisfactory as hereinafter explained.

I have found that there is a critical relationship between the distance tube **6** protrudes above diaphragm **3**, the internal diameter of hollow tubular member **6**, and the internal diameter of the reservoir. From FIG. 2 it will be seen that Z designates generally the inside diameter of hollow tubular member **6**, X designates the inside diameter of reservoir **1**, and Y represents the distance hollow tubular member **6** extends above diaphragm **3**.

In practice, I have found that for suitable flow characteristics, tubular member **6** should preferably extend above the upper surface of diaphragm **3** for a distance at least twice the interior diameter Z of tubular member **6**,

but a distance no greater than twice the interior diameter of the reservoir itself.

Although I don't wish to be bound by these theories, it appears that if the tubular member **6** protrudes too great a distance above the diaphragm **3**, with respect to the internal diameter of the reservoir **1**, the fluid characteristic of the bed is diminished sufficiently so that it tends to pack and its flow characteristics no longer permit the particulate material to readily flow downwardly through tubular member **6**. Too, if the upper extremity of tubular member **6** does not protrude high enough above the upper surface of diaphragm **3**, excessive air turbulence at the surface of diaphragm **3** prevent proper flow downwardly through tubular member **6**, and there is furthermore a decided loss of air through the particulate material discharge opening before it has been effective in fluidizing the bed of particulate material **2**. It is for this reason that the obvious expedient of having the upper extremity of tube **6** flush with diaphragm **3** is unsatisfactory.

Referring to FIGS. 1 and 3, flexible hose member **1**, which may be of any suitable length, is connected by conventional means to the lower extremity of tubular member **6**, the other end of hose member **11** being connected to a dispersal unit generally indicated by reference numeral **12**.

Said dispersal unit has an impeller chamber **13** which receives, and communicates with, the lower end of flexible hose member **11**, said impeller chamber also communicating with and supplied by, a source of compressed air, not shown, delivered by compressed air tube **14**.

Particulate material **2** enters impeller chamber **13** via hose member **11**, compressed air delivered via tube **14** through constricted compressed air injection member **15** intermixes with, disperses, entrains and impels particulate material **2** outwardly through dispersal tube **16**, fitted with flared discharge tip **17**, having partially disposed therewithin conical baffle **18** held to discharge tip **17** by wire members **19**.

Another critical feature of this invention is that the constricted compressed air injection member is essential to successful operation in that initially, a burst of extremely high pressure, relatively low volume air is required to disperse the particulate material entering impeller chamber **13** from hose means **11** to thereby prevent packing of same and to entrain and impart motion thereto.

After effective dispersal has taken place within impeller chamber **13**, the pressure subsides sufficiently toward the discharge end of dispersal tube **16** so that, as the compressed air forces particulate material **2** out the flared end of dispersal unit **12**, there is effectively provided an even spray thereof as shown in FIG. 1, without causing undue localized cooling of the hot casting being enameled.

In operation then, as applied to powdered material for the dry process enameling of hot cast metal, reservoir **2** is maintained full of dry process enamel powder at a level sufficiently above the upper extremity of tube **6** to continually maintain a head of fluidized powder which tends to flow through tubular member **6**, said flow adjustable by valve means **7**, thence through flexible hose means **11**, the dry process powder ultimately delivered to dispersal unit **12** is encountered in impeller chamber **13** by a continual jet of compressed air, from constricted nozzle means **15**, entering the dispersal unit coincident with the long axis of dispersal tube **16**, and substantially at right angles to the long axis of hose means **11** where it joins said dispersal unit, the initial pressure of the air then dropping somewhat after it has initially dispersed and entrained dry process material **2**, thereafter blowing same outwardly in a fog-type spray as shown in FIG. 1, from the flared discharge tip **17**, which provides a new and novel means of continually applying dry process enamel powder to hot cast metal.

In operation, the dispersal unit may be used singly or in combination with others in a programmed fixture to simultaneously coat various faces and surfaces of a casting such as a bathtube, or the dispersal unit may be held manually by an operator who may direct the powdered material as desired, at the same time being in a position to adjust valve **7** via sprocket and chain arrangement **9** and **10** to meter the flow of powdered material as desired.

It will be quite apparent that the operator may adjust both the pressure of compressed air to the dispersal unit, and valve means **7**, to reach just the proper balance of air and powdered material to provide a desirable pattern and density of fog for most efficient enameling under prevailing conditions for the particular item being enameled.

It is also contemplated that my novel device may have its effectiveness supplemented by utilization of conventional electrostatic application principles. That is, dispersal tube **16**, and/or its flared discharge tip **17** may be connected to the positive side of a high voltage direct current, as shown in FIG. 1, the conveyor or cradle which supports the item to be enameled grounded, with the remainder of the apparatus being insulated, to thereby provide a positive charge to the particles being sprayed from the dispersal unit and more efficiently direct them to the item to be covered. As is known, a direct current of at least 50,000 volts is normally utilized to achieve workable efficiency in electrostatic deposition.

As stated above, utilization of conventional electrostatic application principles may be utilized in the practice of this invention as, for example, a direct current system, with reversed polarity, along the lines of that disclosed in U.S. Patent 3,327,948, adapted to the present apparatus as described in the preceding paragraph.

Although my device shows a flared end **17** with conical baffle **18** partially disposed therewith, it is to be understood that while this is a preferred embodiment, various dispersal tube opening arrangements are adaptable without departing from the principle of my invention.

Having thus described my invention, I claim:

1. Apparatus for directional dispersion of dry, particulate material comprising the combination of a fluidized reservoir of said particulate material, said reservoir having a longitudinal axis disposed generally vertically, a substantially continuous source of supply of said particulate material to and into said reservoir, said fluidized material within said reservoir supported by an air-pervious diaphragm disposed generally at right angles to said longitudinal axis, an air chamber below said diaphragm communicating with a source of compressed air, a hollow tubular member generally parallel to said longitudinal axis extending through said air chamber, through said diaphragm, and into said fluidized material, an upper extremity of said tubular member terminating within said material at a point above said diaphragm equal to at least twice the maximum cross-sectional dimension of said tubular member, but no greater than twice the maximum interior dimension of said reservoir, adjustable valve means disposed within said tubular member adjacent said upper extremity thereof for constricting the interior of said hollow tubular member, the lower extremity of said tubular member communicating via a flexible hose member to a dispersal unit, said unit having an impeller chamber adapted to receive an end of said flexible hose, said impeller chamber communicating with, and supplied by, a source of compressed air, a constricted compressed air injection member disposed within said impeller chamber for introducing compressed air therewithin generally at right angles to the long axis of said flexible hose means at the point where it is received by said impeller chamber, said impeller chamber having a dispersal tube connected therewith having its long axis generally coincident with the path of entry of said compressed air into said impeller chamber.

2. The apparatus of claim **1** wherein said dispersal tube has a flared discharge opening with a conical baffle positioned partially therewithin.

3. The apparatus of claim **1** wherein said dispersal tube

has a flared discharge opening with a conical baffle positioned partially therewithin, and means for applying a direct current charge to the discharge end of said dispersal tube of at least 50,000 volts.

4. The apparatus of claim 1 wherein said dispersal tube has a flared discharge opening with a conical baffle positioned partially therewithin, said fluidized reservoir positioned generally higher than said dispersal unit.

5. The apparatus of claim 1 wherein said fluidized

reservoir is positioned generally higher than said dispersal unit, the latter being fed by gravity from the former.

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ROBERT P. REEVES, *Primary Examiner.*