This invention relates to an apparatus for cleaning the interior wall of an atomizing drier. In particular, the invention is directed to an apparatus employing jets of gas emitted under pressure from nozzles which are moved across the wall surface with a slight clearance between the nozzles and the wall.

In drying materials such as soap powders, pulverulent extracts of tea and coffee, preserved dry blood, milk powder, etc., the like, dirt is encountered in atomizing driers in the keeping clean of the interior wall surface of the housing for the drier. Even when the atomized materials do not reach the wall, a quantity of the dust being whirled by the drying gas nevertheless always settles on the wall and can accumulate in the form of relatively large deposits which result in a bad quality of the produced material and interruptions in the operation of the drier in order to clean the walls.

The inner wall of the drier heretofore has been cleaned both by mechanically operated scrapers and pneumatic devices known as air brushes or blast scavengers. The latter are composed, for the most part, of vertical rows of gas nozzles which are moved across the interior wall of the drier housing at a slight distance from the wall and are fed from a common source of gas pressure. The jets of gas emitted from the nozzles moving with sufficient speed and with sufficient gas pressure prevent any permanent deposit of dry material on the wall surface.

Such gas pressure nozzles, however, have objection in that the particles of material whirled up by the gas scaving jets are repeatedly whirled and re-settled on the housing wall so that they have to be removed from the wall several times. This is done finally discharges them from the drier. For satisfactory operation, such gas jet scavengers require at least 10 percent of the total quantity of gas needed for the complete atomizing drying process. This again requires a corresponding insulation for the dust separator following the drier and also consumes a considerable amount of energy. This energy requirement for the gas jet scavenger is most important because the air used for the jets must be pre-conditioned.

The object of this invention is to save on the amount of gas used for the gas jet scaving, while at the same time imparting a more favorable movement of the dust particles settling on the inner wall of the drier housing.

In general, the object is obtained by arranging the jet nozzles in groups or sets which are directed against separate areas respectively of the wall surface and are alternately connected to the source of gas pressure so that the separate sections of the wall are blasted in selected sequence by the gas jets.

In the apparatus of this invention, the gas jets of the blast scavengers are always directed only to one of several vertically separated areas of the wall of the drier housing so that the gas jets of each set of nozzles are directed against another set of nozzles after a certain time interval, for example, one revolution, are directed through another set of nozzles against a separate wall area or several wall areas so that all the wall areas are blasted by the gas jets in selectable succession.

In one embodiment of this invention, the gas feed tube is mounted for rotation around the axis of the drier and from which two or more tubes are branched off to extend parallel to the wall of the atomizer housing. These branched tubes have nozzle openings in the form of slots or the like which direct the gas either perpendicular to or inclined to the surface of the wall. These tube branches are so dimensioned and the nozzles are so arranged that each branch with its set of nozzles always brushes over its respective area of the drier wall. A gas switchover device is arranged in the gas feed tube which is actuated alternately and cyclically connects the individual tube branches with the source of gas pressure.

In another embodiment of this invention, two branch tubes are combined within a single tube having the tube into two sub-tubes by a longitudinal wall extending the entire length of the tube. Each sub-tube is fitted with nozzles in different sections of the main tube and each sub-tube can be alternately connected to the source of gas pressure by means of the switchover device. A plurality of such subdivided tubes can be connected to the central gas feed tube.

The means by which the object of this invention is obtained are disclosed more fully with reference to the accompanying diagrammatic drawings, in which:

FIGURE 1 is a vertical cross-sectional view through an atomizing drier having a gas jet scavenger according to this invention;

FIGURE 2 is an enlarged vertical cross-sectional view through the central gas feed tube and the switchover device;

FIGURE 3 is a vertical cross-sectional view similar to a portion of FIGURE 2 of a modified form of the invention; and

FIGURE 4 is a cross-sectional view on the line 4—4 of FIGURE 3.

As shown in FIGURE 1, the atomizing drier is composed of a cylindrical housing 1 having a conical bottom 2 and a rotary atomizing disc nozzle 4 driven by motor 5. The drive shaft for disc 4 extends through the housing cover 6 and is concentrically surrounded by the drying gas feed pipe 7. A dried material discharge pipe 8 is connected to the lower end of the conical bottom 2. Extending through the apex of bottom 2 is a gas feed tube 9 concentric with the axis of housing 1 and which is connected to a source 10 for gas pressure. A tube 11 is rotatably mounted within tube 9 and at its upper end carries the gas jet tubes 12 and 13, each of which extends parallel to the housing wall. The tube 12 has jet nozzles only in its upper straight portion extending adjacent the cylindrical housing 1, while the tube 13 has jet nozzles along its entire length and corresponding to the wall of the conical bottom 2. Tube 11 contains a switchover device by means of which tubes 12 and 13 are connected alternately to the source 10 of gas pressure. Switchover device 14 is actuated by a switching gear 15 having a crank 15a. Tube 11 is rotated about its longitudinal axis by a motor 16 driving beveled gears 17 and 18, the shaft of the latter being secured to tube 11. By this means, the tubes 12 and 13 are moved continuously across the wall of the drier.

As shown in the enlarged detail view of FIGURE 2, the gas feed tube 9 is rigidly connected by a flange 20 to the bottom 2. The flange fitting 21 at the lower end of tube 9 provides the joint for connecting the tube to the source 10 of gas pressure. A ring bearing 22 secured to the bottom of tube 9 supports the lower end of tube 11. The shaft 23 of gear 18 is hollow and serves as a condensate the extending rod 24 of the switchover device. The lower end of rod 24 is joined to a crank 15a.

A ring bearing 25 mounted in the upper end of tube 9 supports a conical cap 26 covering the portion of the tube 11 extending above the tube 9. Nozzle tubes 12 and 13 branch off from this extended portion of tube 11. Gas passageways 27 in the form of elongated slots are positioned in the portion of the tube 11 telescoped within tube
9. The switchover device is composed of two pistons 28 and 29 secured to rod 24, piston 29 being provided with ports 30. As rod 24 moves up or down, piston 28 will either open or close branch tube 12 and similarly piston 29 will either open or close the entrance to branch tube 13 at the top and bottom of the stroke. As shown, the entrance to tube 12 is open while the entrance to tube 13 is closed. Rod 24 can be actuated by any known mechanism, such as by the gear 15 and the crank 15a or the operating mechanism can be mounted within the tube 11. The gas under pressure flows as indicated by the arrows through the fitting 21, the outer tube 9, the slots 27, the inner tube 11, and then through the ports 30, and then from the space between pistons 28 and 29 into either of the tubes 12 or 13 according to the switching position. In the modification of FIGURES 3 and 4, the single tube 40 is subdivided by the coextensive partition 41 into two sub-nozzle tubes which are alternately connected to the source of compressed gas by the pair of pistons 28 and 29. The tube 40 is joined to the tube 11 by a likewise partitioned tube piece 44. The sub-tube spaces 45 and 46 in piece 44 communicate with the interior of the tube 11 through apertures 47 and 48, respectively, which apertures are displaced with respect to each other in the wall of tube 11. Apertures 47 and 48 are alternately opened or closed in the same manner as described for the switchover device in FIGURE 2.

The structure of FIGURE 3 can be combined with that of FIGURE 2 so that each of the tubes 12 and 13 of FIGURE 2 would be subdivided by being longitudinally partitioned in order to form a two-arm gas nozzle scavenger having four branch units. An example of the operation of the atomizing drier of FIGURE 1 is as follows: 1500 kg. per hour of a milk preconcentrated to a water content of 45 percent were converted into milk powder with a 3 percent residual water moisture content. This required the evaporation of 800 kg. of water. To do this, 20,000 kg. per hour of air at a temperature of 185° C. and a moisture content of 0.01 kg. per 1 kg. of air was introduced through pipe 7. Pneumatic apparatus heretofore employed for preventing powder deposits on the wall of the drier by means of air blown through nozzle openings in a pipe moving parallel to and slightly spaced from the wall, the nozzle openings extending through the entire length of the pipe consumed at least 4,000 kg. of air, plus 4 kg. H₂O, at a pressure of 600 mm. water column, which amounts to more than 15 percent of the total quantity of air required for the drying.

According to this invention, the air consumed in keeping the wall clean was reduced to at least half of that heretofore used by dividing the nozzle openings into at least two separate sets of nozzle openings directed against separate wall areas and alternately operated. A reduction in the cleaning gas flow was obtained by connecting, for example, the tube 13 to the source 10 of compressed gas during one revolution of the tube 9 and then connecting the nozzle openings in the vertical upper portion of the tube 12 to the gas source 10 during the following revolution of tube 9. By so doing, the amount of scavenging gas used drops to 2000 kg. air+2 kg. H₂O, and as a result the power required for the generation of compressed gas was reduced from 12 kw. to 6 kw. per hour. At the same time, moreover, the weight of the air exhausted from the apparatus is reduced by 8 percent so that the separation of the dry product from the exhausted air is appreciably facilitated.

When the apparatus of FIGURE 2 was modified so that three and four separate wall areas were successively subject to the blast from the gas nozzles, the gas consumption and power required was reduced still further. The total gas consumed by the apparatus can be reduced from 24,000 kg. to 21,000 kg., which represents a saving of about 12 percent as compared to the prior art apparatus.

Having now described the means by which the object of the invention is obtained,

I claim:

1. In combination with an atomizing drier having interior wall surfaces including a conical bottom, an apparatus for cleaning the interior wall surface of said drier comprising at least two gas tubes which are substantially parallel to said wall surface and each having a row of nozzles directed toward vertically separated wall surface areas, tube means extending through said conical bottom for furnishing compressed gas to and for rotating said gas tubes around the axis of the wall with a slight clearance between the wall and said gas tubes, a piston switch mounted for longitudinal movement in said tube means for alternately supplying each of said gas tubes with compressed gas for successively and selectively blowing against the separate wall areas to discharge dried particles therefrom, and means for driving said piston switch.

2. In the combination of claim 1, said apparatus further comprising partition means longitudinally dividing a single tube into said at least two gas tubes.

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