April 12, 1927. A. B. JONES 1,624,739

SPRAY DRYING

Filed June 18, 1926

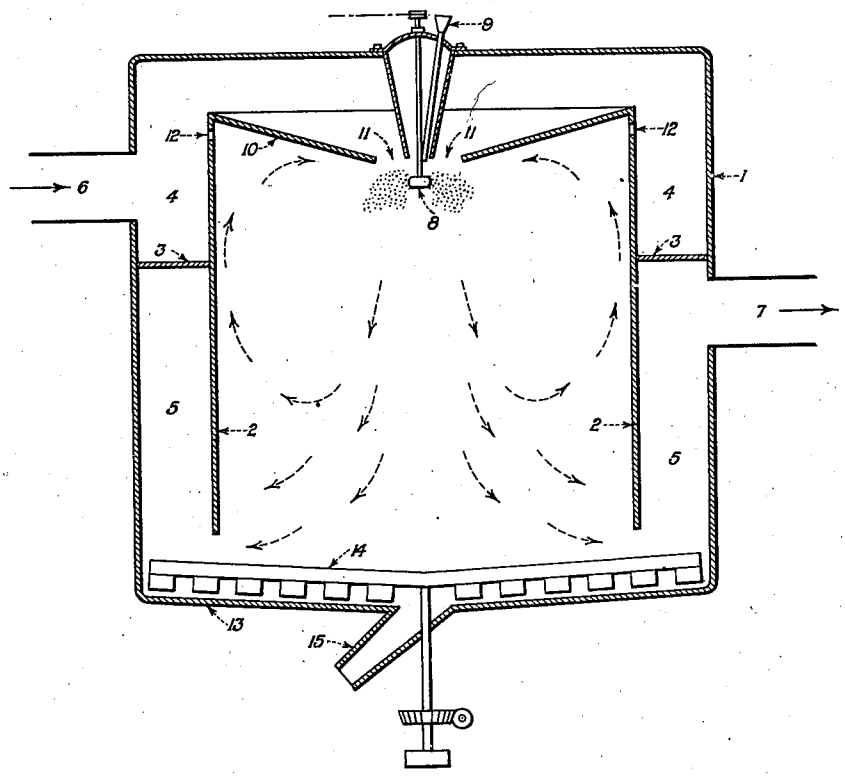


FIG. 1

INVENTOR

BY

ATTORNEYS

Patented Apr. 12, 1927. 1,624,739

UNITED STATES PATENT OFFICE.

ARTHUR B. JONES, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO INDUSTRIAL ASSOCIATES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SPRAY DRYING.

Application filed June 18, 1926. Serial No. 116,930.

My invention relates to spray drying, and is applicable to the recovery of solids from organic and inorganic fluids, semi-fluids, plastics, etc., capable of dispersion in comminuted condition by centrifugal force or otherwise. The object of my invention is to provide improved apparatus and operation for convection current systems, and by which the available heat units of the convection current are more completely exhausted in useful work before the gas leaves the drying chamber.

In the accompanying drawing—

Fig. 1 is a vertical section, through a more or less diagrammatically illustrated layout of apparatus embodying my invention in one form.

Referring to the more or less diagrammatic drawing, I have indicated an outer, closed casing or shell 1, which surrounds but is spaced from a sheet metal cylinder 2 arranged on a vertical axis and constituting the drying chamber proper. The intervening space between the casing and cylinder is horizontally divided by partition 3 into upper and lower compartments 4 and 5 respectively. Heated air or other gas is admitted to the upper compartment 4 through port 6, passes thence through the drying chamber 2, escapes from the bottom of the latter to compartment 5 and exits therefrom through port 7.

Arranged centrally and adjacent the upper margin of the drying chamber is a centrifugal spray unit 8 which receives from feed 9 the fluid or plastic material to be dried, and disperses the same in a surrounding nebula. In the subjoined claims I employ the word "fluid" in a sense broad enough to include any material, whether a liquid or a plastic solid or mud which is susceptible of dispersal in the form of a very fine spray or nebula.

In apparatus of this general type, as heretofore constructed, the upper end of the drying chamber 2 has been open throughout its complete diameter. The incoming hot gases have been distributed consequently over the entire cross sectional area of the cylinder, and their downward flow through the latter has been substantially uniform at all points. This arrangement lacks efficiency, since the nebula is most dense in the immediate neighborhood of the spray unit 8 and the hot gas passing through this portion of the nebula absorbs more moisture than the surrounding or peripheral portion of the gas current. The latter thus gives up a less proportion of its useful heat and leaves the drying chamber without absorbing all the moisture which it is capable of carrying at its exit temperature.

I have found that this waste of useful heat is greatly reduced, if the upper end of the drying chamber is to a large extent closed by a head 10, preferably inwardly dished as shown, and having a central inlet port 11. The precise area of this port may vary—but I prefer that its area shall be approximately four or five times that of the spray unit 8, which is centrally located with respect thereto.

As a result of this construction, the hot gas enters the drying chamber parallel to the axis of the spray unit and is concentrated on the dispersed nebula in its densest area. The force of the impinging current of gas deflects the nebula downward and thus causes the heavier particles thereof to travel a downward and outward path at an angle to the plane of rotation of the centrifugal spray unit. The length of this downwardly deflected path from the spray unit 8 to the wall of the drying chamber is materially greater than the path to the wall in the plane of rotation of the unit 8. Consequently, the particles are subjected for a greater length of time to the desiccating action of the gaseous current.

A second important result of the construction is the establishment of an annular upwardly flowing gaseous current which surrounds a central downwardly flowing current in the drying chamber. This is due not only to the usual tendency to eddy or whirlpool formation incident to the projection of a jet or stream of gas into a larger relatively quiet body thereof, but also to other influences. First, the portion of the gas which contacts with the nebula in its densest area, very rapidly gives up its heat in the absorption of moisture from the nebula, and is therefore chilled to a greater extent than the surrounding portion of the gas which permeates the outer area of the nebula. This central, chilled and moisture laden portion of the gas current tends to sink, by gravity, more rapidly than the

outer, less chilled, less moisture laden, portion thereof and forms in consequence a central downwardly moving column of gas, practically saturated with moisture. The surrounding less saturated gas, at higher temperature, tends to rise and to form an upwardly flowing current. Second, the portion of the drying chamber wall which lies above the diaphragm 3, and also the head 10 of the drying chamber, are heated by the incoming hot gas in the compartment 4. The peripheral unsaturated portion of the gas in the drying chamber is heated by the wall of the drying chamber and tends to rise toward the head 10 of the drying chamber, where it is further heated. Third, the jet effect of the gas entering the drying chamber through port 11, exerts a suction effort upon the surrounding gas which lies against the inner face of the head 10 and draws this partially saturated hot gas into the jet entering through port 11 and into the dense area of the nebula.

The chilled and saturated gas thus forms a central downwardly flowing column, which cones outward at its lower end and escapes below the lower margin of the drying chamber to the exit compartment 5. The surrounding less chilled and unsaturated gas is caused to flow upward and to re-enter the densest area of the nebula, where its useful heat is given up in the absorption of moisture. A marked increase in efficiency results by reason of the fact that practically only moisture saturated gas escapes the drying chamber. Per heat unit for a given volume of incoming hot gas, a greater volume of moisture is extracted from the nebula, before the gas escapes from the drying chamber.

While I have referred to the air currents as 'saturated' and 'unsaturated', it will be understood that these words are not used in their technically exact sense, but to express their relative moisture laden and temperature conditions. Similarly, while the term 'nebula' is also used, it is intended to indicate merely a finely divided condition of the liquid under treatment.

While I have mentioned only the fundamental results flowing from this construction and operation, various modifications will readily occur to those dealing with the problem. Thus I have shown small ports 12 opening through the drying chamber wall just below the head 10. The hot air entering therethrough mingles with the rising gas and not only increases its temperature, but aids the jet action of the gas entering at port 10 in causing the unsaturated gas to re-enter the nebula in its densest area.

The solids fall from the drying zone upon the floor 13 of the casing and are recovered in any suitable fashion. For example, they may be swept by rake 14 into a chute 15 which delivers to a hopper, or bagging apparatus, or to further treating apparatus, as may be desired.

With the understanding that only a typical layout and operation are described to illustrate the thoughts which underlie my invention, I claim—

1. The method of spray drying which comprises dispersing a fluid as a nebula, causing a convection current to traverse the zone of said nebula, leading the chilled and moisture saturated portion of the convection current from the lower end of the drying chamber, and causing the unsaturated portion of the convection current to rise and to re-enter the nebula zone to there absorb further moisture.

2. The method of spray drying which comprises dispersing a fluid as a nebula, causing a convection current to traverse the zone of said nebula, leading the chilled and moisture saturated portion of the convection current from the lower end of the drying chamber, and causing the upward flow of the unsaturated portion of the convection current by bringing it into contact with a heated wall of the drying chamber.

3. The method of spray drying which comprises dispersing a fluid as a nebula, causing a convection current to traverse the zone of said nebula, leading the chilled and moisture saturated portion of the convection current from the lower end of the drying chamber, and causing the unsaturated portion of the convection current to rise and to re-enter the nebula zone to there absorb further moisture, the convection current being concentrated upon the central area of the nebula zone as said current enters the drying chamber.

4. The method of spray drying which comprises dispersing a fluid as a nebula, causing a convection current to traverse the zone of said nebula, leading the chilled and moisture saturated portion of the convection current from the lower end of the drying chamber, and causing the unsaturated portion of the convection current to rise and to re-enter the nebula zone to there absorb further moisture, and augmenting the rise and return of the unsaturated portion of the convection current to the nebula zone by the jet action of the incoming convection current.

5. The method of spray drying which comprises dispersing a fluid as a nebula, causing a convection current to traverse the zone of said nebula, leading the chilled and moisture saturated portion of the convection current from the lower end of the drying chamber, and causing the unsaturated portion of the convection current to rise and to re-enter the nebula zone to there absorb further moisture, and augmenting the return of the unsaturated portion of the con-

vection current by the entraining action of auxiliary hot air jets converging upon the spray zone.

6. A spray-drying apparatus comprising a tubular drying chamber having a restricted top opening, means for dispersing liquid from a point beneath said opening to form a nebula zone of greatest density directly beneath said opening, means for leading a convection current into the drying chamber through said restricted opening, means for leading off moist entrained gas from the lower portion of the chamber, and means for recovering solids deposited out of the liquid.

7. A spray-drying apparatus comprising a tubular drying chamber having a restricted top opening, the top of the drying chamber being inwardly dished to said opening, means for dispersing liquid from a point beneath said opening to form a nebula zone of greatest density directly beneath said opening, means for leading a convection current into the drying chamber through said restricted opening, means for leading off moist entrained gas from the lower portion of the chamber, and means for recovering solids deposited out of the liquid.

8. A spray-drying apparatus comprising a tubular drying chamber having a restricted top opening, means for dispersing liquid from a point beneath said opening to form a nebula zone of greatest density directly beneath said opening, means for leading a convection current into the drying chamber through said restricted opening, means for leading off moist entrained gas from the lower portion of the chamber, and means for recovering solids deposited out of the liquid, the upper portion of said drying chamber having its wall heated by the convection current before the latter enters through said port.

9. A spray-drying apparatus comprising a tubular drying chamber having a restricted top opening, a centrifugal dispersal appliance centrally arranged with respect to said opening to form a nebula zone of greatest density directly beneath said opening, means for leading a convection current into the drying chamber through said restricted opening, means for leading off moist entrained gas from the lower portion of the chamber, and means for recovering solids deposited out of the liquid.

10. A spray-drying apparatus comprising a tubular drying chamber having a restricted top opening, ports formed in the wall of the drying chamber adjacent the dished top, means for dispersing liquid from a point beneath said opening to form a nebula zone of greatest density directly beneath said opening, means for leading a convection current into the drying chamber through said restricted opening, means for leading off moist entrained gas from the lower portion of the chamber, and means for recovering solids deposited out of the liquid.

In testimony whereof I have signed my name to this specification.

ARTHUR B. JONES.