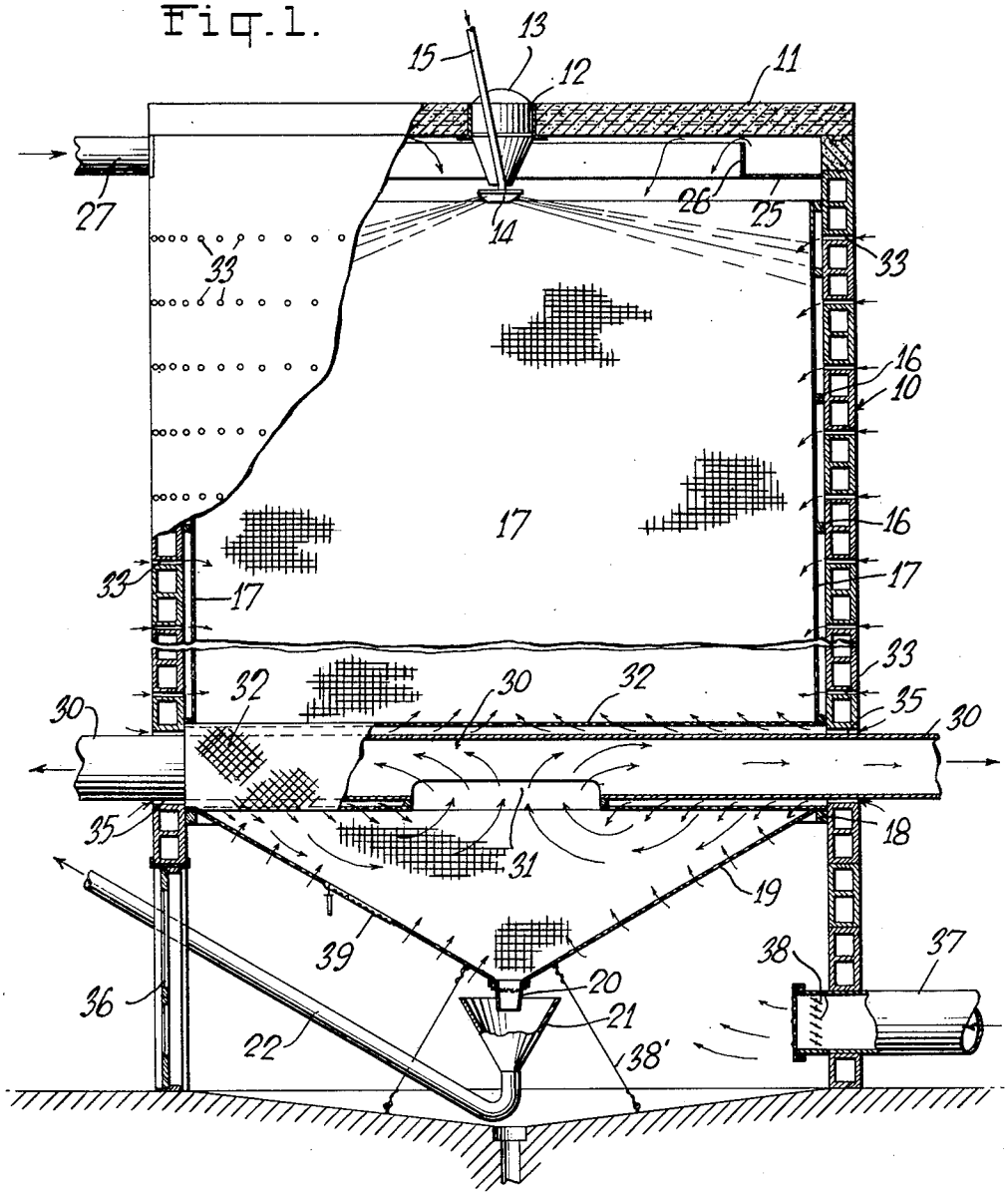
May 15, 1934. A. L. JOHNSTON, JR., ET AL 1,958,702

METHOD AND APPARATUS FOR DRYING SUGARS AND OTHER HYGROSCOPIC MATERIAL

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Fig. 1.



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Fig. 2.

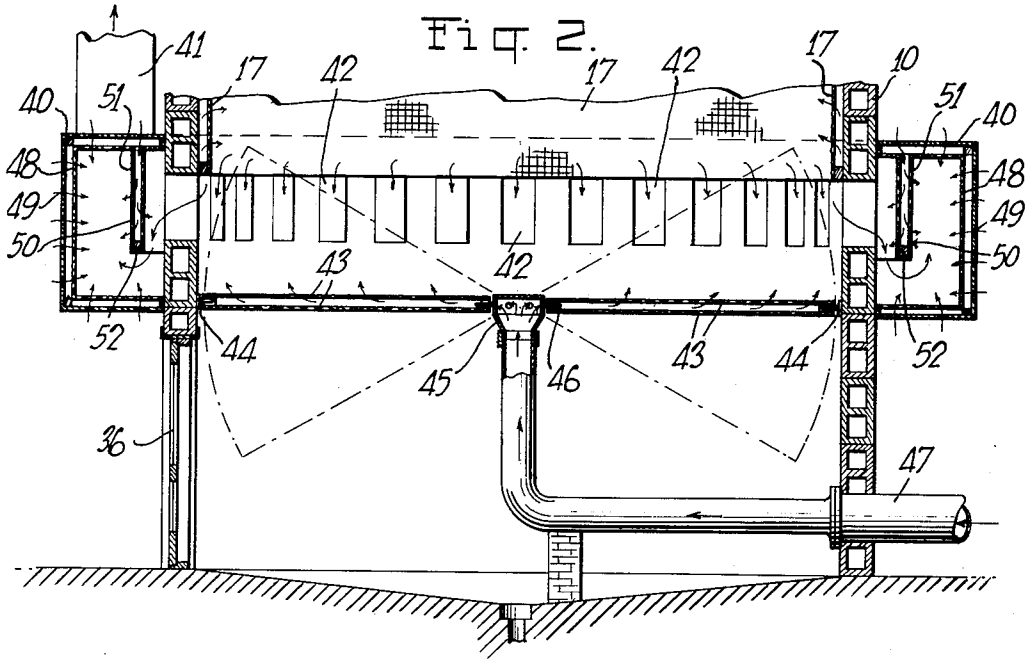


Fig. 3.

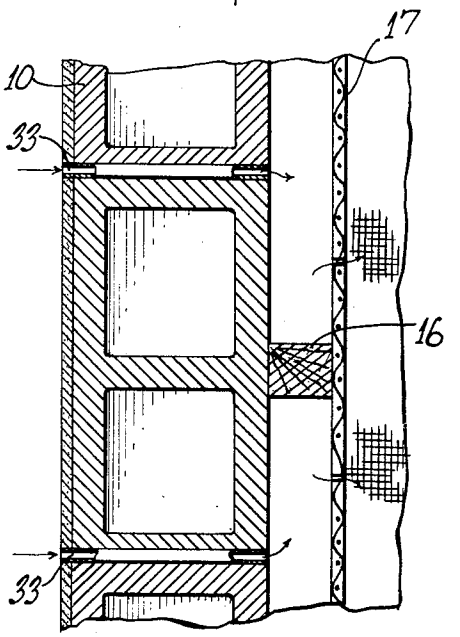
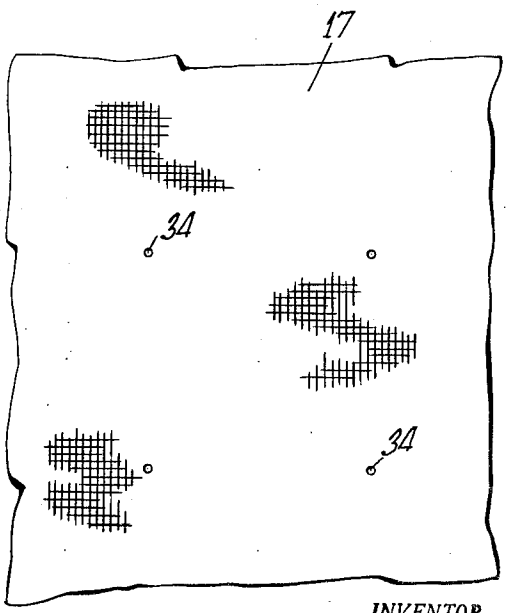


Fig. 4.



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METHOD AND APPARATUS FOR DRYING SUGARS AND OTHER HYGROSCOPIC MATERIAL

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Application August 29, 1930, Serial No. 478,660

4 Claims. (Cl. 159—4)

This invention relates to a method and apparatus for drying carbohydrate material containing sugar or other hygroscopic agents.

The invention has for its object generally, the provision of an improved process for drying comminuted material of the character indicated in a quick, convenient manner without liability of charring or injuring the same. Also, it has for an object the provision of apparatus for the practice of the invention, which is efficient, economical and readily constructed.

More specifically, the invention has for its object the provision of a procedure for drying comminuted carbo-hydrate material containing a fruit sugar, for example, banana pulp, by spraying the same into a heated zone in a manner adapted to remove moisture therefrom relatively quickly through the application of heat of relatively high intensity, and then collecting the material when dried without injury.

A further object is to provide an apparatus having a protecting lining for preventing the injury mentioned that affords circulation and diffusion of cooling air.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements, and arrangements of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a view partly in section and partly in elevation, showing a drying tower adapted for drying comminuted carbohydrate material;

Fig. 2 is a fragmentary sectional view showing a modified construction of the lower portion of a drying tower adapted for practicing the present invention; and

Figs. 3 and 4 are fragmentary detailed views, showing respectively a section and front elevation of a portion of the lining structure employed in the present invention.

In the practice of the invention, comminuted sugar-containing carbohydrate material obtained by finely grinding the pulp of ripe fruits, such as bananas, is introduced into the drying chamber by spraying, and caused to pass through a heated zone of circulated air or other drying gaseous medium. The finely divided material is thereafter collected at the bottom of the chamber.

The introduction of the material to the drying chamber by spraying, is accomplished by feeding the ground material directly onto the edges of a rotating member, such as the blades of a turbine, which may be conveniently disposed at the top of the drying chamber, so that the sprayed material thereafter falls freely through the heated air, which may be somewhat below atmospheric pressure, as low pressures accelerate the drying operation. The drying medium is heated to a relatively high degree of temperature, preferably considerably in excess of the boiling point of water. A suitable temperature range for the practice of the present invention has been ascertained to be from approximately 260° F. up to substantially 600° F.

In order to provide a protecting lining for the chamber in which the drying takes place, spaced sheet coverings are provided on the wall of the tower which have relatively low heat conductivity. It is also desired that the lining shall have a cooling and ventilating effect. To this end, permeable sheet material, such as canvas is employed, the space between it and the chamber wall being arranged to serve as an air supply means for supplying air that percolates and diffuses through the canvas into the drying chamber. The sprayed material that impinges upon or lodges on the canvas is consequently cooled and not charred, since the canvas has relatively poor heat conductivity. The air which diffuses through the canvas in consequence cools the dried deposited material and also assists in removing some moisture to keep the same flaky and dry without forming lumps.

A convenient construction for a drying tower designed for the practice of this process, is shown in Fig. 1, where 10 denotes a main cylindrical wall forming a tower which may be of any desired height and width, for example, thirty-two feet high by twenty-two feet in diameter, and may be constructed of any suitable material, for example, of hollow tiling. The cylindrical wall when built to a desired height, is roofed over in any convenient manner, for example, by means of a reinforced concrete slab 11 which has a central opening 12. In this opening is disposed a motor 13 or other driving means, which actuates propeller blades 14 that spray the material to be

dried across the top of the tower. A conduit 15 is provided entering the roof 11 adjacent to the motor 13 and arranged to supply the material in comminuted form directly onto the propeller blades 14 whereby the same is thrown centrifugally outward from the blade. The material then falls gradually through the chamber.

To line the interior of the drying tower in the manner indicated, scantlings or other suitable supporting strips 16 are disposed about the interior of the chamber wall, spaced both vertically and horizontally, the scantling being adapted to have the canvas sheeting, shown at 17, nailed or otherwise removably secured thereto. The canvas sheeting thus arranged fits snugly around the tower and is extended nearly to the top of the chamber and downwardly therein to a point where the drying chamber proper terminates. At such point, the side coverings are terminated by securing the sheeting to a circumferentially extending scantling 18, to which is also secured the bottom sheet 19.

The bottom sheet may be of any convenient construction, for example, of canvas and shaped to be either plain or conical; the latter however is preferred, since it assists in collecting the deposited material under the influence of gravity in a manner such that it can be readily drawn off from the centre of the sheet, that is, through the apex of the cone. To this end, a short conveyor tube 20 is provided at the centre as a discharge which depends downwardly into a funnel-shaped collector 21 which is disposed on the floor of the tower under the nozzle. This funnel 21 is preferably provided with a suction conveyor conduit 22 for conveying away the collected dried product, the suction being provided in any convenient manner, for example, by air ejectors (not shown in the interest of clearness).

The circulated drying medium is preferably introduced into the drying chamber at the top. To this end, an annular duct 25 is shown as disposed about wall 10 at the top and has its inner side wall 26 cut short, so as not to extend fully up against the top 11, whereby there is provided one or more annular spaces between the edge of wall 26 and the ceiling of the chamber through which the drying medium enters. A supply duct 27 is arranged to pass through the wall 10 and communicate with the duct 25 at a convenient point. The medium introduced by this supply duct is drawn from any convenient source, for example, from a heating furnace, which preheats the medium to the desired temperature. A convenient outlet for the chamber is also provided. It is preferred, however, that this outlet should communicate with an exhaust suction means, for example, an exhaust fan, in order to induce a rapid and uniform circulation of the drying medium in the drying chamber. A cylindrical duct 30 is accordingly provided which extends along a diameter of the drying tower near the base of the drying chamber. This duct is cut away centrally on its under side as indicated at 31 so as to provide an outlet opening through which the spent medium discharges. The duct 30 thus arranged has two ends that project through the tower wall 10, from either or both of which the exhaust may be drawn. This exhaust duct is with advantage constructed of sheet metal, but in order that it may not affect the comminuted material falling upon it, this duct is also provided with a casing constructed of sheet material of the same character as the lining and bottom of the drying chamber. This casing is accordingly shown as a spaced canvas covering 32 entirely surrounding the duct.

In order that the canvas sheeting here employed may be properly cooled and ventilated, the wall 10 of the drying tower is provided with a plurality of small openings 33 spaced apart, affording communication between the outside atmosphere and the space back of the sheeting, whereby air may pass directly from the outside through these openings into the space between the cylindrical wall and the canvas. This construction is best illustrated in Fig. 3, where the openings 33 are shown as ducts.

In certain instances, where it may be desired to effect a particularly rapid diffusion of air, for example, in the bottom of the chamber in some cases,—the canvas or other wall portion may itself contain small perforations, such as shown at 34.

In order that the space between the duct 30 and its covering 32 may also be ventilated, communication between the outside atmosphere and the annular space about the duct under its covering, is also provided. This is here shown in the form of openings 35 which are formed in the wall 10 about both ends of the duct 30.

The air for cooling and ventilating the bottom of the drying chamber is preferably in larger amounts than that which diffuses through the side walls of the tower, and to this end, the tower is constructed to have a chamber in its base under the drying chamber between the bottom 19 and the floor of the tower; this base chamber in commercial towers being preferably large enough to admit a man. The tower accordingly is here shown as provided with a door 36 opening into the base chamber below the canvas bottom. Air for ventilating purposes is introduced into this base chamber through the duct 37, the control of this air being effected in any suitable manner, for example by means of dampers 38. As this air diffuses through the bottom 19, it is seen that its condition will have an effect upon the dried material that collects on the bottom. Consequently, it is desirable that the supply of air introduced through the conduit 37 be clean and be in a proper condition to exercise a cooling effect on the particles of comminuted material adhering to the comminuted material resting on the bottom wall 19. Preferably the air is dehumidified so that no moisture will be added to the dried particles. The temperature of this air may be widely varied depending upon the heat within the chamber and the temperature at which the material being treated chars or otherwise deteriorates. In certain instances, for example, it has been found that a temperature of 80° F. for the incoming gas is sufficient to prevent deterioration of the pulp. If desired, thermometers may be inserted through the bottom of the chamber to determine the temperature of the material resting on the bottom 19, so that the temperature of the incoming gas may be properly controlled.

It is to be borne in mind that while in the exemplification under consideration, untreated air is utilized for exerting the cooling effect on the side walls and treated air is utilized in exerting the cooling effect on the bottom wall, the apparatus and method can be readily modified in accordance with the requirements of any particular case.

It is also to be observed in this connection that the invention in certain of its aspects contemplates the use of cooling means other than a stream of air, it being possible for example to ap-

ply refrigerating means directly to the walls of the chamber, which in this case, need not be of a low thermal conductivity.

The conditioning of air to be utilized in a process such as that under consideration, may be accomplished in any convenient manner, for example, by means of the well known Carrier air-conditioning system (not shown in the interest of clearness). The base chamber thus has a pressure therein slightly above atmospheric, whereas the drying chamber by reason of the suction exhaust has a pressure slightly below atmospheric. This pressure differential operating on the two sides of bottom 19 has a tendency to push the bottom 19 up into the drying chamber. To prevent this, securing means in the form of guying cables 38' hold the bottom 19 to the floor of the tower.

By means of the door 36, the chamber in the base of the tower may be entered at any time it is desired to inspect the operation of the withdrawing apparatus which carries away the dried product. It may also be desired at times to inspect the interior of the drying chamber; for this purpose the canvas bottom 19 is provided with an inspection opening 39 of any convenient form, for example, a window, sliding door, or slit that may be closed by means of interlocking grippers of the so-called "zipper" variety.

In operating this form of drying tower, comminuted sugar-bearing carbohydrate material, such as ground banana pulp, is fed through conduit 15 onto propeller blades 14, from whence it is thrown when the motor runs, across the top of the tower and breaks up into droplets that are substantially uniformly distributed. These droplets fall gradually through the circulated drying medium or atmosphere that enters by way of duct 25 and goes out through exhaust duct 30. This drying medium being relatively highly heated, quickly extracts the moisture from the droplets, the outside being most affected. The droplets in consequence have a glazed exterior and fall somewhat after the fashion of snow-flakes. In time these droplets reach the bottom 19 as properly dried particles, although some may for a period adhere to the side walls or elsewhere in the drying chamber. The conditioned air which passes through opening 33 and thence through the canvas lining, however, keeps both the lining and the dried particles cool and protects them against charring.

The removal of the dried material from the chamber may be accomplished in various ways, certain of which will be hereinafter discussed. In many of these cases, and particularly in the case of the exemplification under consideration, it is desirable, prior to the removal of the material from the bottom of the chamber, to have the material deposited thereon in a loose and readily removable condition. The air permeating through the canvas bottom 19, in the present instance, assists in maintaining this condition; and it is often desirable from time to time to increase the quantity of air blown through the conduit 37 or to decrease the temperature of this air, or both, so as to cause the deposited material to become more friable. This action may be caused to take place continuously if desired; and also, if desired, independent means such as a small blower may be operated within the space beneath the canvas bottom 19 and may be moved from point to point where an excess of material is collected on this bottom. By this means the continuous operation of the apparatus is assured, and the material being cooled to a point where it loses all tendency to stick together and by being thoroughly broken up into its natural grains, will be in particularly good condition for sifting, packing, and subsequent use.

The material which has been maintained in or brought to a loosened state on the canvas bottom will in whole or in part gravitate toward the outlet 20. The movement toward the outlet may be assisted from time to time if desired, by tapping the canvas bottom.

The dried and conditioned particles which pass through the opening 20 are drawn away by a conveyor 22 to a place for use or for packing for sale or shipment.

The cooling and ventilating action of the air percolating through the canvas lining is particularly advantageous in the present process since it keeps the wall of the tower from accumulating heat and also aerates the adhering particles or droplets thereby preventing their tendency permanently to adhere, coalesce, or mat. The process of the present invention is thus seen to be one that can run substantially continuously without liability of charring or otherwise injuring the product.

In the modified form of drying tower shown in Fig. 2, a construction for the bottom of the drying chamber that differs from that in Fig. 1, is shown doing away with a single exhaust duct, like that at 30; instead an annular exterior duct 40 is provided which communicates with the drying chamber at a plurality of points. This duct has an exhaust conduit 41 communicating therewith and is shown as provided with a plurality of communicating openings 42. These openings may be formed in any convenient manner, for example, by cutting rectangular passages directly through wall 10 into the duct 40. The bottom wall of the drying chamber is here also constructed differently from that shown in Fig. 1, where a single sheet of canvas in the form of an inverted cone is employed. In Fig. 2, the bottom is composed of sectors of any convenient size and number, for example, eleven of which are disposed side-by-side and have top and bottom canvas sheets 43 secured to a sector-shaped frame. Each sector thus formed is pivoted to the wall of the tower at its outer central point as indicated at 44, and at its inner central point to a central supporting member 45, as indicated at 46, this support serving also as a fountain-head for supplying cooling and ventilating air to the interior of the sector frames. This fountain-head is supplied with air from a duct 47 which supplies air conditioned in substantially the same manner as that for duct 37.

In order that there may be a free flow of air from the fountain-head 45 into the space between the canvas sheets 43, the pivotal connection 46 is preferably made in the form of a hollow tube through which air may pass.

The duct 40, by reason of the fact that suction means is connected thereto, has deposited therein a certain amount of the dried material, which it is desired to collect and preserve; hence it too is preferably constructed so as to avoid charring or other injury. To this end, the duct also has a lining of canvas sheeting as indicated at 48 and has its outer walls provided with a number of small perforations as indicated at 49, so that cooling and ventilating air may pass therethrough and diffuse through the canvas.

In order better to prevent the dried particles which pass into the conduit 40 from rushing into the exhaust conduit 41, a depending annular baffle 50 is provided in the conduit. This baffle as in-

dicated extends downwardly from the top wall of the conduit 40 like a curtain and depends a sufficient distance to be slightly below the lower end of the openings 42. This baffle is also preferably of a construction adapted to prevent charring or other injury; consequently it is shown as a double wall of canvas sheeting 51 extending around an annular ring 52 disposed in the conduit 40. At its upper end this double wall communicates with the air space about the conduit 40 so that the atmospheric air which percolates through the openings 49 in the conduit 40 also flows in between the sheeting 51 to cool the baffle 50.

In operation, this second form of drying tower is operated substantially similar to the first form, the ground or comminuted material such as banana pulp, being fed in at the top of the chamber, is sprayed uniformly across the top by means of the turbine blades. This material then falls through the heated atmosphere that is supplied through the inlet duct and flows downwardly, the same being drawn out through the openings 42 and thence by duct 41 which communicates with suction means. The dried comminuted particles gravitate generally downward, some adhering to the side walls, but in view of the cool and non-conducting condition thereof, have substantially no tendency to adhere, coalesce, or mat, and hence in time fall on the bottom sectors 43.

In order to remove the dried material thus collected on the bottom sectors, each sector is unfastened and turned about its supporting pintles to an upsidedown position. A large quantity of the collected material may immediately drop off the sector onto the floor of the tower or onto any suitable collecting means that may be placed in the base compartment for the purpose. The remaining material which does not fall off of the under-side of the overturned sector is readily scraped off, the whole of the material being thus collected in the lower compartment of the tower, from whence it is removed and packed for sale or shipment. Immediately upon the reversal of a sector, the material falling in the chamber begins to collect on the side which was turned upwardly, so that a continuous process is provided.

While the process of the present invention as described is manually controlled, it is obviously readily adapted to automatic controls. It is contemplated that such may be applied to the heating of the drying medium and the conditioning of the air admitted through conduits 37 and 47.

Certain subject matter disclosed but not claimed herein is claimed in applicants' co-pending applications Serial No. 572,812, filed November 3, 1931, and Serial No. 700,691, filed December 2, 1933, which are continuations-in-part of the present case.

Since certain changes in carrying out the above process and in the construction set forth, which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. The method of drying hygroscopic material of the type which is rendered adherent by heat, which comprises spraying the material and causing it to flow downwardly in admixture with heated gas, depositing the particles beneath the flow of falling particles, causing a dry cooling gas to flow upwardly through the deposited particles, and withdrawing the heated gas and the cooling gas at a point well spaced below the point of introduction of the material and above the point of deposit.

2. Apparatus for the drying of hygroscopic material of the type which is rendered adherent by heat, comprising a tower, means adjacent the top of the tower for spraying the material to be dried, means to introduce a heated drying gas adjacent the top of the tower, a porous deposit floor at the base of the tower, means to cause an upward flow of dry cooling gas through said floor, and means for the withdrawal of the heated gas and the cooling gas at a point above the deposit floor and well below said spray.

3. Apparatus for the drying of hygroscopic material of the type which is rendered adherent by heat, comprising a tower, means adjacent the top of the tower for spraying the material to be dried, means to introduce a heated drying gas adjacent the top of the tower, a porous deposit floor at the base of the tower, means to cause an upward flow of dry cooling gas through said floor, and means for the withdrawal of the heated gas and the cooling gas at a point above the deposit floor and well below said spray, said deposit floor being arranged for the removal of dried material.

4. Apparatus for the drying of hygroscopic material of the type which is rendered adherent by heat, comprising a tower, means adjacent the top of the tower for spraying the material to be dried, means to introduce a heated drying gas adjacent the top of the tower, a porous deposit floor at the base of the tower, means providing an enclosure beneath said floor, means to cause a flow of dry cooling gas into said enclosure, and means to withdraw the heated gas and the cooling gas at a point well below said spray and above the deposit floor.

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