F. TIEMANN.

DRYING OF NON-PULVERULENT MATERIALS.

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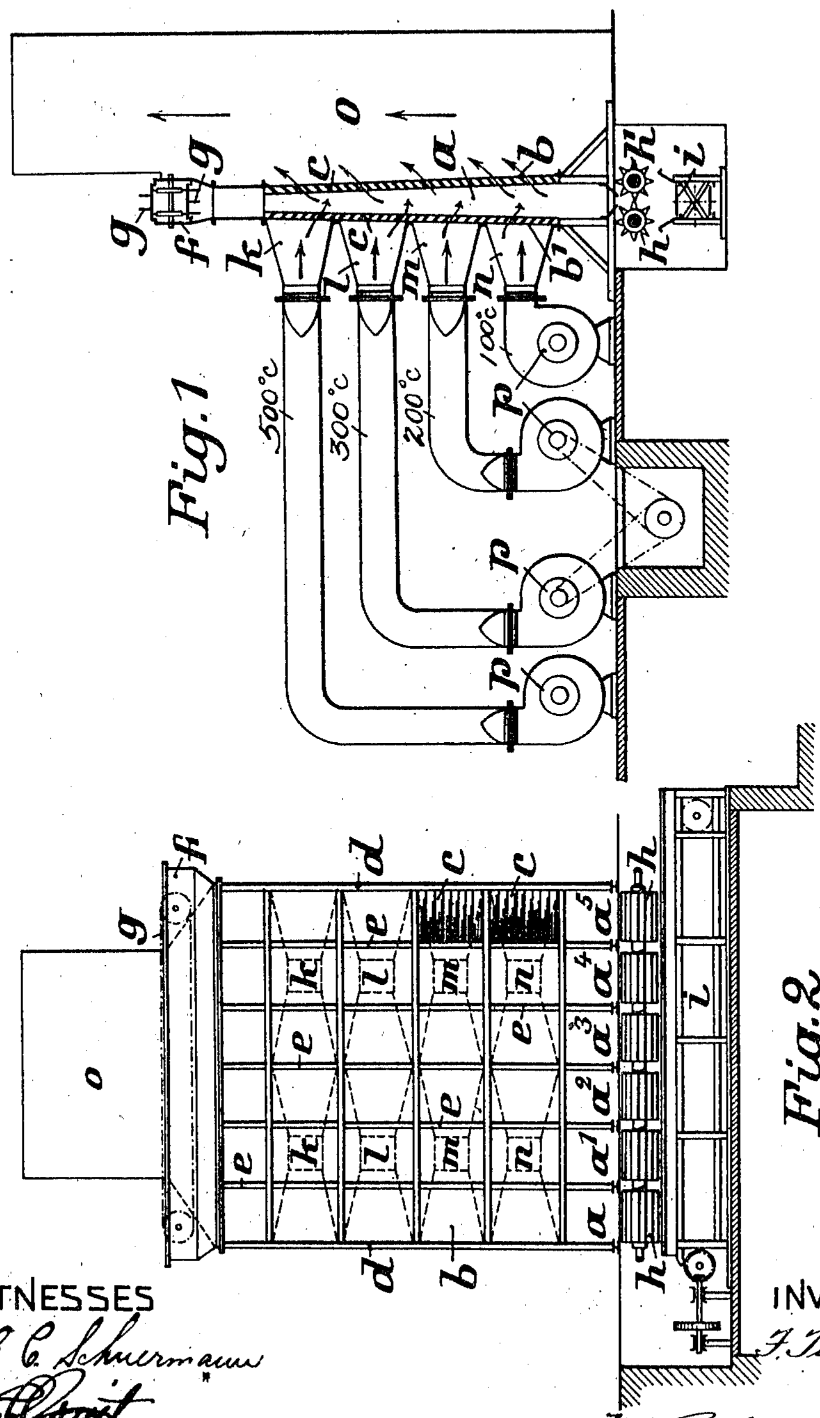
992,295. Patented May 16, 1911



WITNESSES

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DRYING OF NON-PULVERULENT MATERIALS.

992,295. Specification of Letters Patent. Patented May 16, 1911.

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To all whom it may concern:

Be it known that I, FRITZ TIEMANN, director, a subject of the German Emperor, residing at 259 Kurfürstendamm, Berlin, Germany, have invented certain new and useful Improvements in or Relating to the Drying of Non-Pulverulent Materials; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In drying non-pulverulent substances with a high proportion of moisture for use as fuel, such as bagasse or residue of cane sugar manufacture, peat and the like, by means of gases acting directly on the substance to be dried, the serious inconvenience presents itself that the drying gases, forced to pass through the substance to be dried, soon become saturated with moisture and then, during further action, again give off such moisture to the said substance. When gases are used at a high temperature and in large quantities, there is the danger that the material to be dried will become superheated and be ignited, and there is also a loss of heat, as on the one hand the gases have to leave the apparatus at a high temperature in order to avoid the giving off of moisture before-mentioned, and on the other hand, the materials come out from the apparatus hot and have to be cooled.

The objectionable features described above are entirely avoided by the process and apparatus according to this invention.

In carrying out the process forming a part of this invention, the material to be dried is caused to move downward in a widening column, and a heated drying fluid such as air or gas is directed transversely against and through the column of material, so that the latter, as it descends, is continually brought into contact with fresh and unused air or gases.

In practice, it is advisable to cause the drying gases used to act by passing through separate inlets at different levels and not through a single opening on the whole wall of the material. In that way the advantage is obtained that in case of an accidental irregular arrangement of the material, the whole of the gas does not pass without being utilized considerably, while it is also possible to use, at different zones, gases of different temperatures, more particularly with temperatures decreasing from the top downward, while gases of different origin might also be used at different zones.

A constructional form of apparatus for carrying out the process according to this invention is illustrated by way of example in the accompanying drawing in which—

Figure 1 is a vertical section through the apparatus, and Fig. 2 is a side elevation partly in section.

The drying shaft *a*, the width of which is calculated so that the gases leave the material to be dried, at temperatures above their dew point, is limited at the longitudinal sides *b b'* by walls constituted by perforated or permeable or impermeable plates *c* arranged in louver fashion and inclined inwardly, so that when the material is moving downward in the apparatus they do not offer any resistance. The said plates thus contain intermediate spaces through which the heating gases are introduced or discharged. The transverse sides of the apparatus are closed by solid walls *d*. The drying shaft *a* widens toward the bottom, that is to say, the longitudinal sides are arranged with an inclination upwardly and inwardly. In that way the material is prevented from sticking in the apparatus.

The drying shaft is divided in its longitudinal direction into several compartments *a*, a^1, a^2, a^3, a^4, a^5 by means of transverse walls *e*. These walls can be made solid perforated or of louvered plates.

Above the shaft *a* is arranged the feed hopper *f* in which is arranged a conveyer *g* to which the material to be dried is hoisted in any suitable manner and from which it is distributed among the single compartments of the apparatus. The shaft *a* is closed at the bottom by rolls *h h'* adjustable relatively to one another. Owing to this arrangement and to the regulation of the speed with which the rolls move, the constant discharge of the material is regulated.

The conveyer *i* arranged below the rolls, is used for carrying away the dried material.

Drying gases are supplied to the apparatus through the side wall b^1, if desired, at different temperatures and of different origin. To that end, the said wall is divided into several superposed compartments, of which four are shown in the drawing, to which are connected funnel shaped boxes *l k m n*. These compartments may be and are preferably still further subdivided in

order to insure a uniform supply of gas (in the construction shown in the drawing, each compartment is provided with two funnels). To the opposite wall *b* is connected a chimney *o* through which the used up heating gases and vapors escape.

Drying gases are preferably supplied by means of fans *p* which are connected to the piping leading to the boxes *l k m n*.

The material to be dried, which is supplied to the shafts *a*, a^1, a^2, a^3, a^4, a^5 through the hopper *f* will sink slowly as dry material is removed at the bottom by the rolls *h* h^1, while the conveyer *g* will distribute fresh material to the chambers at the top. As the discharge takes place in the center of the conduit in its longitudinal direction, the material, on sinking, comes close together, so that it is continuously mixed, and the portions which are at the walls come to the center and vice versa. The transverse walls *e* contribute to this mixing action. As the heating gases are forced transversely through the material as it descends they have to pass only through a comparatively thin layer of material, so that the transmission of heat is a uniform one. As the gases always pass through material of equal temperature in various equal layers, the material could not be moistened again by gases already saturated with moisture.

The temperature of the gases supplied, is preferably made to decrease from the top downward, for instance the gases are admitted into the upper box *k* at a temperature of 500° C., into the box *l* at 300° C., into the box *m* at 200° C., or they pass through the apparatus in zones situated one below the other, while to the chamber *n* is supplied a gas of about 100° C. so that the material leaves the apparatus comparatively cool. The wettest material comes, therefore, into contact with the hottest gases, is quickly heated thereby and the evaporation of the moisture quickly started. As the drying progresses, the material comes into the zones through which pass gases of lower temperature, in order finally to leave the apparatus at a comparatively low temperature.

The quantity of gas supplied to the heating zone as a whole is so adjusted that the gases in the chimney *o* are not completely saturated with moisture, and at least in the chambers *k l m* do not escape at a temperature lower than 100°.

The regulation of the temperature of the gas is preferably effected by supplying cold air by means of fans, or by using gases of different origin.

By means of the process and apparatus according to this invention, it is therefore possible to carry on the drying of material with any temperatures adjusted to suit the degree of moisture of the material in the single drying periods, to avoid any superheating of the material and to utilize the gases completely.

What I claim is:—

1. A method for drying non-pulverulent material containing a high proportion of moisture, which consists in supporting the material to move downward continuously and in a widening column, and directing heated drying fluid transversely against and through the downwardly moving column so that the latter is continually brought into contact with fresh and unused drying fluid.

2. A method for drying non-pulverulent material containing a high proportion of moisture, which consists in supporting the material to move downward continuously in a widening column, directing heated air or gas transversely through the downwardly moving mass, and removing the dried material continuously from the base of the column.

3. A method for drying non-pulverulent material, which consists in causing the material to move continuously downward, and directing transversely against and through the moving mass separate air or gas currents successively decreasing in temperature from top to bottom of the series, so that the material is successively brought into contact with fresh unused air or gas of lower and lower temperature.

4. A method for drying non-pulverulent material, which consists in supporting the material to move downward continuously in a widening column and causing separately conducted air or gas currents heated to different temperatures to flow transversely through the descending material, so that as it descends and becomes drier the quantity of material exposed to the action of the air or gas increases, as well as the time of exposure to such air or gas.

5. A method for drying non-pulverulent material, which consists in supporting the material to move downward continuously in a gradually widening column, directing heated air or gas transversely through the descending material, and continuously removing the dry material from the center of the base of the column.

6. Apparatus for drying non-pulverulent material containing a high proportion of moisture comprising a vertical shaft gradually widening from top to bottom, two opposite sides of which are perforate to allow the heated air to pass transversely through the shaft, means for supplying separate heated air or gas currents of successively decreasing temperature from top to bottom, to one perforate side of the shaft, means for exhausting said currents from the opposite side of the shaft, a feed hopper at the top of the shaft, and means for withdrawing and removing the dry material arranged below the base of the shaft.

7. Apparatus for drying non-pulverulent material containing a high proportion of moisture, comprising a vertical shaft two opposite sides of which converge toward the top of the shaft and are perforate to allow heated air or gas to flow transversely through the shaft, means for supplying heated air or gas to one perforate side of the shaft, a flue for withdrawing the air or gas from the other side of said shaft, a feed hopper at the top of the shaft and means for withdrawing and removing the dried material arranged below the base of the shaft.

8. Apparatus for drying non-pulverulent material containing a high proportion of moisture, comprising a vertical shaft, two opposite walls of which converge toward the top of the shaft, and are composed of inwardly inclined louvers, two or more superposed compartments in connection with one louvered side of the shaft, means for supplying air or gases heated to different determined temperatures to said compartments, a feed hopper at the top of the shaft and means for discharging and removing the dry material at the base of the shaft.

9. Apparatus for drying non-pulverulent material containing a high proportion of moisture, comprising a vertical shaft, two opposite walls of which converge toward the top, and are composed of inwardly inclined louvers, two or more superposed compartments in connection with one louvered side of the shaft, means for supplying air or gases heated to different determined temperatures to said compartments, a feed hopper at the top of the shaft, and rollers arranged below the center of the base of the shaft, and parallel to its louvered sides, to discharge the dried material onto a conveying device, substantially as described.

10. Apparatus for drying non-pulverulent material, containing a high proportion of moisture, comprising a vertical shaft, two opposite walls of which converge toward the top, and are composed of inwardly inclined louvers and which is divided into two or more chambers by vertical partitions, each of these chambers being in connection with a series of air or gas supplying compartments, a feed hopper at the top of the shaft, and means for discharging and removing the dried material, arranged below the base of the shaft, substantially as described.

In testimony whereof I have affixed my signature, in presence of two witnesses.

FRITZ TIEMANN.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.