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PROCESS OF AND APPARATUS FOR DRYING MATERIAL BY MEANS OF FIRE GASES

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Fig. 1.

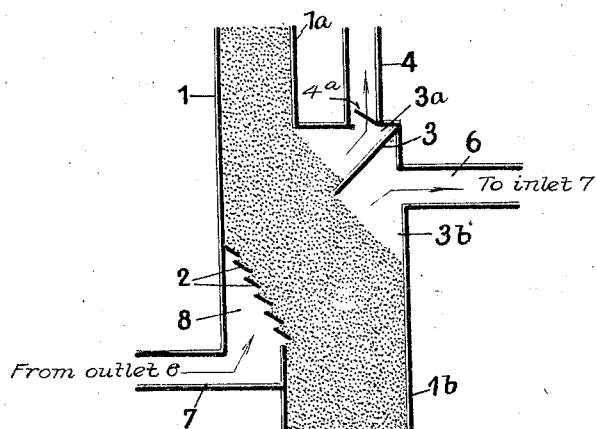
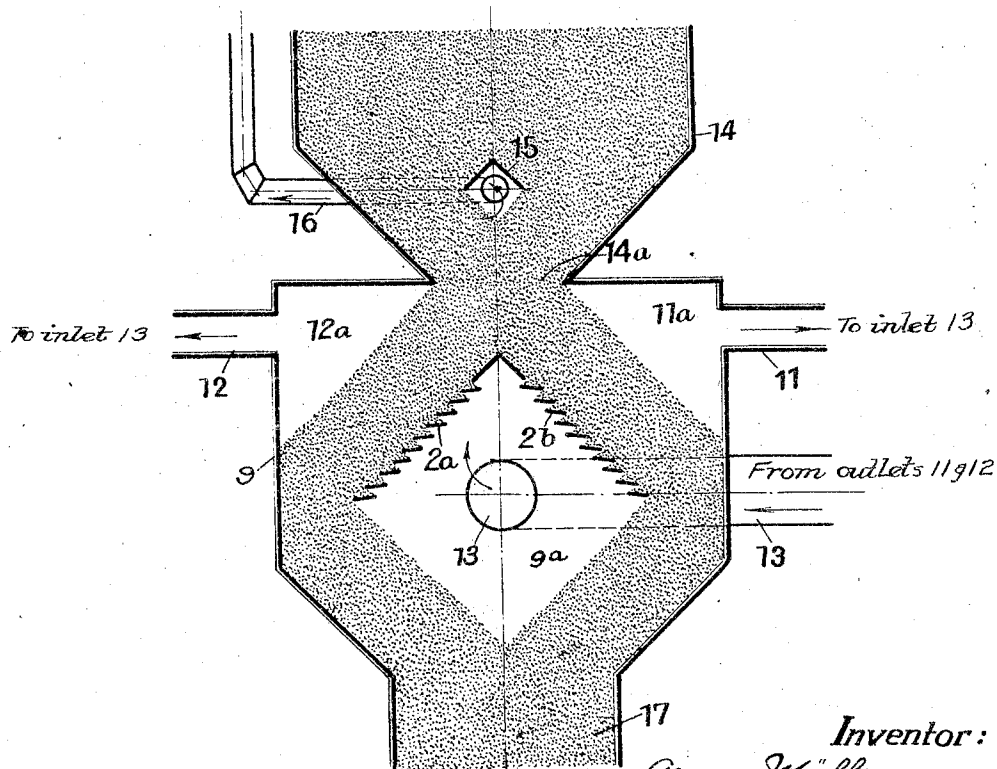


Fig. 2.



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UNITED STATES PATENT OFFICE.

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PROCESS OF AND APPARATUS FOR DRYING MATERIAL BY MEANS OF FIRE GASES.

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To all whom it may concern:

Be it known that I, GEORG MÜLLER, a citizen of Germany, residing at Frankfort-on-the-Main, in the county of Hesse-Nassau and State of Prussia, Germany, have invented certain new and useful Improvements in Processes of and Apparatus for Drying Material by Means of Fire Gases, of which the following is a specification.

The present invention relates to a process of and apparatus for drying material by means of fire gases.

One object of the invention is a simplification of both the mode of operation and the apparatus and an increase in the efficiency thereof.

Another object of the invention is the provision of means and ways for minimizing the dangers of explosion or the destructive results thereof.

For a full understanding of the invention, the principles upon which it is based and its characteristic features reference is made to the accompanying drawings in which:

Fig. 1 is a more or less diagrammatic representation of an apparatus embodying the invention; and

Fig. 2 is a like view showing another embodiment thereof.

In Fig. 1 is shown a drying chamber 1 having an extended charging shaft 1^a and an outlet opening 1^b which is offset laterally relatively to the charging shaft. Within the drying chamber is disposed an inclined grate 2 over which the material slides toward the outlet 1^b in its downward movement through the drying chamber. The upper portion of the drying chamber diametrically opposite the grate 2 provides a gas space which is divided into two parts by a baffle 3. The upper part 3^a is connected by means of a flue 4 to the atmosphere, while the lower part 3^b of the gas space has an outlet 6. The gases enter through inlet 7 into the gas space 8 below the grate 2.

The operation is as follows:

The hot gases entering through inlet 7 into the gas space 8 pass through the grate 2 into and through the charge in the drying chamber 1 and absorb water carried by the charge. The outlet 6 and the inlet 7 are part of a gas circulating system (not shown)

including a combustion chamber and additional means for heating the circulating gases. The volume of gas leaving the drying chamber is greater than the volume of gas entering into it substantially by the volume of water vapor absorbed from the charge, and the heat energy of the excess gas is always utilized to the fullest extent even if the gas returning to the circulating system through the outlet 6 should leave the drying chamber at a temperature which is in excess of its saturation point. The excess gas passes into and through that part of the charge that last enters the drying zone and passes together with moisture absorbed out through the outlet 4.

The only closure at the top of the drying chamber is the column of material in the charging shaft 1^a which affords an effective seal against egress of gas. The arrangement described makes it unnecessary to pass the excess gas out of the drying chamber through a layer of cold fresh charge whereby condensation in the material to be dried of the water vapor carried by the excess gas is avoided.

Any air that might enter through the charging shaft 1^a is carried off together with the excess gas through flue 4 which according to the particular conditions may be a draft flue or an ordinary outlet. The application of a negative pressure or the degree thereof are matters of judgment. At any rate there are no special closures to be controlled. The rate of movement of the material and the rate of movement of the dehydrating gas through the drying chamber and the heating of the gas in the circulation system may be varied to suit best the particular conditions.

In Fig. 2, the drying chamber 9 has a central intake opening 14^a through which the material passes from a hopper 14 and a central outlet opening 17. Within the chamber 9 are disposed two grates 2^a and 2^b diverging downwardly from a point substantially centrally below the intake opening 14^a and relatively close thereto. The material entering the chamber 9 is thus forced to divide, passing down over the two grates which together with the material define a gas space 9^a. The lower portion of the chamber 9 is funnel shaped whereby the

material after passing over the two grates is directed toward the common outlet 17. The dimensions of the intake opening 14^a and outlet 17, the size and disposition of the grates 2^a and 2^b, and the configuration of the chamber 9 are so correlated that the material readily moves through the chamber. There is of course considerable latitude in this respect.

The gas space 9^a is in communication with a tube 13 through which the gas of the circulating system enters the drying chamber. In the hopper centrally above the intake 14^a is a roof-shafted deflector element 15 creating a gas space which is in communication with a tube 16 connected with the atmosphere.

Laterally of the intake opening 14^a are spaces 11^a and 12^a which are not filled by the material. These spaces are in communication through pipes 11 and 12 with the circulating system (not shown).

The gas coming from the circulating system enters through the pipe 13 and passes through the grates 2^a and 2^b into the gas spaces 11^a and 12^a and returns laden with water vapor absorbed from the material to the circulating system. The excess gas must take its course through the intake opening 14^a and following the path of least resistance flows toward the gas space defined by the deflector 15 from which it is passed to the atmosphere. The hopper 14 is of such height that the column of material above the deflector affords an effective seal.

The deflector 15 has been referred to merely as an example for creating a gas space for allowing the excess gas to be drawn off. The particular form and the disposition of the gas space are a matter of engineering practice susceptible to variation in many respects.

For the sake of simplicity the drying chamber has been shown as of rectangular cross-section. It may, of course, have any other cross-sectional configuration and the form of the grate may be changed correspondingly.

The arrangements illustrated and described not only represent simple constructions for carrying out in simple manner the drying of material, but they are peculiarly adapted to minimize the danger of explosions in the drying chamber and the detrimental effects thereof. The direct connection of the gas space 3^a of the chamber 1 with the atmosphere prevents the concentration of a large volume of gas in the chamber. The pressure can not reach such proportions as to do serious damage.

The communication between the gas space 3^a and the atmosphere may be suitably enlarged to carry off gases suddenly evolved at such rate as is necessary to obviate material damage.

The construction of Fig. 2 also may be modified to reduce the effect of an explosion to safe limits.

While in the case of large openings in communication with the atmosphere any air that might enter into the gas space would be carried off again by the current of outgoing gases, it is of course a simple expedient to prevent the entrance of air by applying suitable means as for instance a flap valve 4^a which while normally reducing the effective exit opening, may yield instantaneously to the pressure of gases evolved during an explosion and allow the same to quickly pass to the atmosphere.

What is claimed as the invention is:

1. In a process of drying material, the steps which consist in maintaining a column of material by adding fresh material and removing dried material, passing drying gas into the column and removing moisture-laden gas out of the column at substantially the same rate and separately withdrawing the excess gas corresponding in volume to the amount of water absorbed by the drying gas in its passage through the material.

2. In a process of drying material, the steps which consist in maintaining a column of material by adding fresh material and removing dried material, passing drying gas into the column and removing moisture-laden gas out of the column at substantially the same rate and separately withdrawing the excess gas corresponding in volume to the amount of water absorbed by the drying gas in its passage through the material, at points of the column in advance of the region at which the moisture-laden gases are withdrawn.

3. In a process of drying material, the steps which consist in maintaining a column of material by adding fresh material and removing dried material, passing drying gas into the column at one side thereof and withdrawing moisture-laden gas from the column substantially at the opposite side thereof and separately withdrawing the excess gas corresponding in volume to the amount of water absorbed by the drying gas in its passage through the material at points of the column in advance of the region at which the moisture-laden gases are withdrawn.

4. Process according to claim 1 in which the points of entrance of the drying gas and the points of withdrawal of the gases are so chosen that the sections of the column at both ends thereof afford effective seals against the ingress of air or egress of gases respectively.

5. Apparatus for the drying of material, comprising a drying chamber having an inlet at the top and an outlet at the bottom and including means for maintaining col-

umns of material above the inlet and below the outlet respectively, a conduit for passing drying gas into the chamber, a conduit for withdrawing moisture-laden gases out of the chamber and a separate conduit in communication with a region of the material in advance of the conduit for withdrawing the moisture-laden gases.

6. Apparatus for the drying of material comprising a drying chamber, a foraminous slide-way therein for causing the material to form an inclined column, an inlet at the top of the chamber and an outlet at the bottom thereof including means for maintaining columns of material above the inlet and below the outlet respectively, means for passing gas upwardly through the foraminous slide-way and for withdrawing gas from the opposite surface of the column and

means for separately withdrawing gas at points of the column in advance of said surface.

7. In a process of drying material, the steps which consist in maintaining a moving column of material to be dried by adding fresh material to one end and removing dried material from the other end thereof, passing drying gas into a zone of said column intermediate the ends thereof, and withdrawing the main portion of gas from points opposite the points of admission and the excess gas from points in the column in advance of said first mentioned points.

In testimony whereof, I affix my signature.

GEORG MÜLLER.