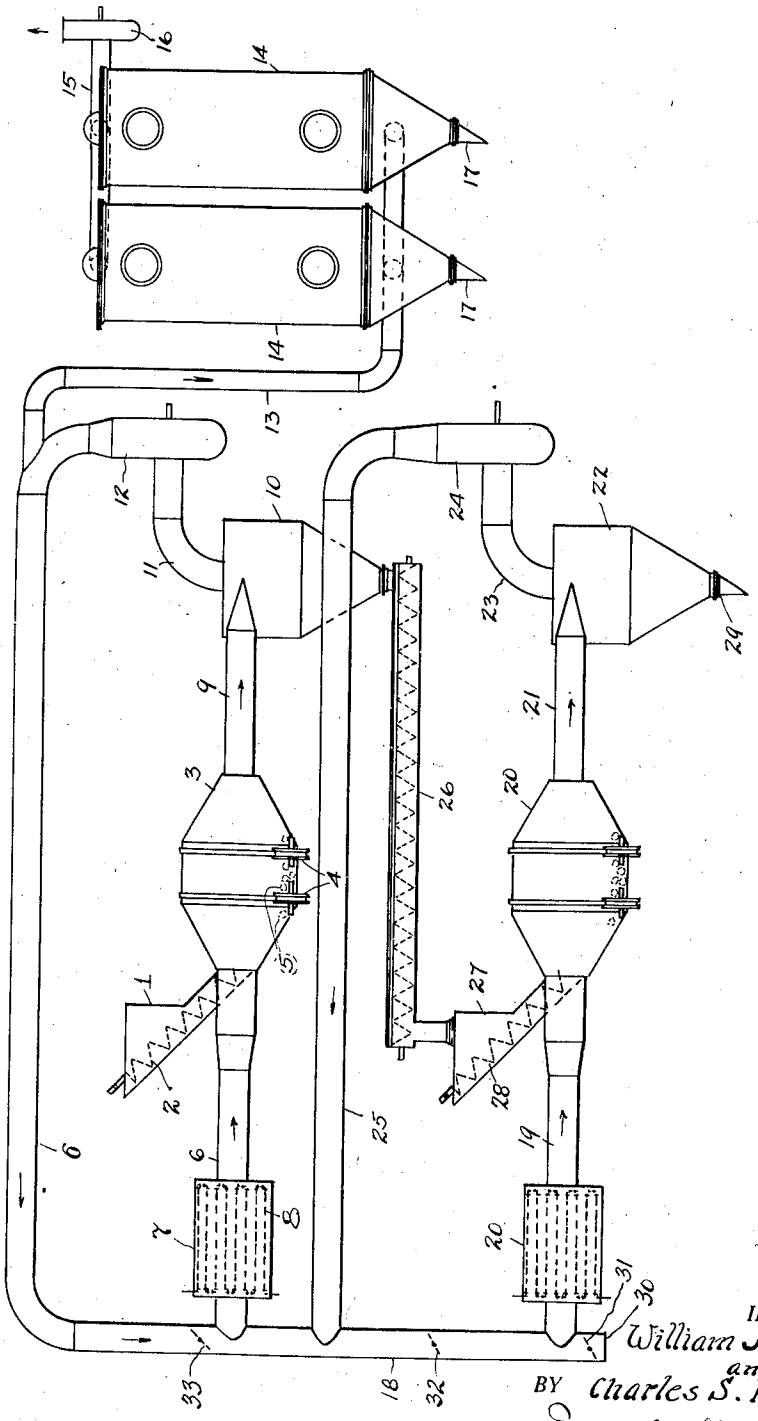
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METHOD OF AND MECHANISM FOR DRYING MATERIALS

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METHOD OF AND MECHANISM FOR DRYING MATERIALS

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Our present improvements are applicable to any finely divided wet substance, such for example as press cake of any material, e. g., a chemical precipitate that is preliminarily separated from the liquid in which such precipitate is formed by means of a filter press. Our improved process and mechanism are equally adapted for drying slimes from mining and metallurgical operations and a variety of other uses might be suggested were it deemed necessary. The field of use, however, will sufficiently appear from the following description. The object of the invention is to provide a self-contained process and apparatus wherein materials of the sort described may be simultaneously dried and pulverized, the material being in effect automatically removed as fast as it is reduced to the desired dry state and pulverulent condition.

To the accomplishment of the foregoing and related ends, the invention accordingly consists of the steps and means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth but one of the various ways in which the principle of the invention may be used.

In said annexed drawing:—

The single figure there appearing is a more or less diagrammatic representation of a mechanism or apparatus adapted for carrying out our improved process.

Referring to the illustrative apparatus shown in the drawing, the material to be treated, i. e., dried, is supplied by means of a hopper 1 equipped with a feed screw 2 to one end of a horizontally disposed rotary drum 3, preferably of the general form shown. In other words, such drum comprises a central cylindrical portion with end portions having the shape of conical frusta. This drum is rotatably supported in any suitable manner, as for example upon rollers 4, and power means, not shown, are provided for rotating same at any desired rate of speed. Within the drum may be placed a number of balls 5 of hard, resistant material, for example iron or steel, which are adapted to come in contact with any material within the drum as the latter is rotated and tend to pulverize and grind such material, as will be readily understood. When the filter press cake, or other material being handled, is a mass of finely divided particles loosely cemented together, or merely agglomerated by the moisture present, the agitation resulting from the rotation of the drum will frequently suffice to pulverize such material without the use of any other grinding means such as the balls 5. It will accordingly be understood that the term pulverizing as hereinafter employed does not imply the use of any special grinding agency where the material is capable of being reduced to a pulverulent form by simple drying and agitation.

Connected with the same end of the drum 3 into which the material is introduced from hopper 1 is a pipe or duct 6 and interposed in such duct is an enlarged heating chamber 7 equipped with a steam coil 8, whereby air circulating through such duct may be raised to any desired temperature. It will be understood, of course, that any suitable means for thus heating the air passing through such duct and into the drum, may be employed in place of the specific heating chamber just described. A second pipe or duct 9 leads from the opposite, i. e. discharge, end of drum 3 to a settling chamber or dust separator 10 which is in turn connected by means of a duct 11 with the intake side of a fan 12. This fan is connected to discharge into the outer reach of duct 6, so that the several ducts 6, 9 and 11, with interposed heating chamber 7, settling chamber 10 and fan 12, are adapted to provide a closed circulatory system, whereby heated air may be passed through drum 3 simultaneously with the introduction of material therein from hopper 1.

A branch duct 13 leads off form duct 6, preferably just beyond the point where fan 12 is connected with the latter, to the lower ends of one or more dust collecting chambers 14 of familiar construction, the upper ends of these chambers being connected by means of a duct 15 with a suction fan 16. Suitable valves 17, or equivalent means, are provided for discharging any material that may accu-

mulate in the lower portions of such dust collectors 14.

The duct 6 is connected or, as is shown, is continuous with an extension 18 at a point in advance of heating chamber 7, having regard to the direction in which the air is circulated through said duct. This extension of duct 6 in effect forms part of a duplicate circulatory system similar to the one just described, in that in a duct 19, that leads from such extension 18, a heating chamber 20 is interposed, such duct 19 connects with a drum 20, similar to drum 3, the discharge end of the latter is connected by means of a duct 21 with a dust separator 22, similar to separator 10, and a duct 23 leads from the latter to a fan 24, which discharges back into extension 18 through a duct 25. The material that settles out in collector 10 is transferred by means of a conveyor 26 to a hopper 27, similar to hopper 1, and like it provided with a feed screw 28, whereby such material is fed into the intake end of drum 20. Collector 22 is provided with a discharge valve 29, or equivalent means, whereby the material accumulating therein may from time to time be removed. It will further be noted that duct extension 18 is open at a point 30 in advance of heating chamber 20, such opening being controlled by a valve 31. A valve 32 is likewise provided in said duct 18 between its connection with heating chamber 20 and the point where the return duct 25 connects with said duct 18; while a third valve 33 is located in duct 6 in advance of heating chamber 7 and the point where the extension 18 leads off from said duct.

The operation of the apparatus may now be inclusively described. Assuming valve 31 to be closed and valves 32 and 33 to be open, and material in raw state, so far as the apparatus in hand is concerned, for example filter pressed cake with a 50 per cent moisture content, to be fed from hopper 1 into the first rotary drum 3, a circulation of air will be maintained through said drum by proper operation of fan 12 and such air heated to a temperature sufficiently high to remove the water present in the material to the desired degree. This removal is facilitated by the agitation or stirring of the material due to rotation of the drum and at the same time the effect of the balls 5 will be to break up the material and reduce it to a pulverulent condition. As fast as this occurs and the particles become dry enough to be carried off by the current of air, they will be conveyed by the latter to the dust collector 10 and there allowed to settle out.

From collector 10 the material is conveyed to hopper 27 and thence introduced into the second rotary drum 20 where the same operation is repeated, the air that is circulated through such drum by means of fan 24 being heated to a temperature sufficiently high to remove the residual moisture in the material or reduce such moisture to a desired minimum.

In other words, with the valves in the positions referred to, each circulatory system would operate as an independent unit, but it is necessary of course that air should be discharged from both systems to prevent it from becoming saturated with moisture and accordingly the valve 31 will be partially open so that suction fan 16 at the end of the first system may withdraw a stated amount of air through duct 13. The interposed collecting chambers 14 serve the purpose merely of saving any material that may be carried over past collecting chamber 10. By completely closing valve 32, only fresh air drawn into duct 18 through opening 30 will be passed through heater 20 and thence through the first rotary drum and connected apparatus, such air thereupon passing into the first circulatory system. Here the extent to which the air will be used over and over again, i. e. continued in circulation, will depend upon the setting of valve 33. Ordinarily the best results will be secured by introducing fresh air through opening 30 at a rate just sufficient to prevent the air from becoming over saturated as it is circulated through the successive systems and the rate of transfer of air from the second to the first system can be nicely regulated by means of valves 32 and 33. The suction fan 16 of course can withdraw air from such first system no faster than it is admitted through opening 30 to the second.

It will be apparent that where in handling any particular material the latter can be reduced to a sufficiently dry state by one operation, the second circulatory system may be entirely dispensed with. Duct 18 with valve 31 in its end will, in that event, constitute merely the inlet through which fresh air is directly supplied to such first system. On the other hand, should it be found desirable to effect desiccation of a material in more than two stages, it will be evident that a third circulatory system may be coupled onto the second system, as shown, in the same manner as the latter is coupled onto the first in the illustrated form of our apparatus.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by any one of the following claims or their equivalents be employed.

We therefore particularly point out and distinctly claim as our invention:—

1. In a process for drying materials, the steps which consist in pulverizing and agitating the material to be dried, at the same time passing through such material a gaseous current capable of absorbing mosture therefrom, such current being of sufficient force to carry along the dried particles of the material,

separating such particles from such current, returning the latter for use over again, further pulverizing and agitating the material separated as aforesaid, passing therethrough another gaseous current capable of absorbing moisture therefrom, such current being of sufficient force to carry along the dried particles of the material as before, separating such particles from such current, returning the latter for use over again in the last-mentioned moisture absorbing step, gradually replacing a portion of such last-mentioned current with fresh gas, and similarly replacing a portion of such first-mentioned current with gas from such last-mentioned current.

2. In mechanism of the character described, the combination of a material pulverizing and agitating device, a duct adapted to form a closed circuit with such device included therein, means adapted to circulate a gaseous moisture-absorbent medium through said duct, means interposed in the latter adapted to separate out particles of the material carried along by such medium, a second pulverizing and agitating device connected to receive the material from said separator means, a duct adapted to form a closed circuit with such second device included therein, means adapted to circulate a gaseous moisture-absorbent medium through said second duct, means interposed in the latter adapted to separate out particles of the material carried along by such medium as before, means adapted gradually to withdraw a portion of such medium from said first duct, and a connection from said second duct to said first duct, said second duct being provided with an opening at one point for the supply of fresh medium thereto and through said connection to said first duct.

Signed by us, this 6th day of February, 1924.

WILLIAM J. HARSHAW.
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