

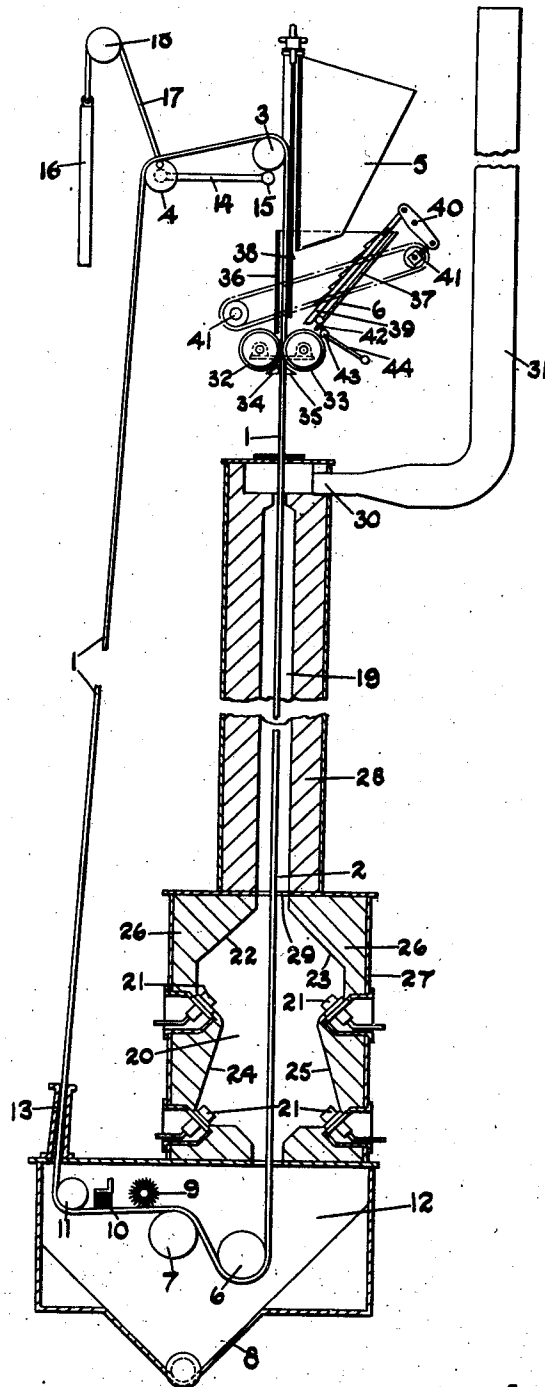
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METHOD AND APPARATUS FOR DRYING SOLID SUB-DIVIDED MATERIALS

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METHOD AND APPARATUS FOR DRYING
SOLID SUB-DIVIDED MATERIALS

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This invention relates to the drying of wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, by the process which comprises passing the material through a heating zone in extenuated distribution, for example as a thin layer-like deposit, upon a suitable travelling support.

The object of the invention is to provide an improved method and means for drying such materials, which among other things will ensure a high order of efficiency and economy of operation as compared with known methods and apparatus at present in use.

According to the invention, a process of the character referred to for the drying of wet clay, sedimented or filtered sludges or precipitates and like pastes of material comprises heating the material in the heating zone at least mainly on the principle of radiant heat emission from a surface or surfaces heated to incandescence, for example white heat, and emitting strong radiant heat towards the material.

The temperature of the incandescent heating surface or surfaces of the heating zone may be varied widely according to the nature of the material to be dried and to the amount of water associated with it. Generally speaking, however, the temperature will be at or near white heat, for example at white heat.

The strong radiant heat from the heating surface may, if the nature of the material to be dried permit, be accompanied by heat of direct contact of flame with the material and/or by heat of convection conveyed to the material by a current of hot gas flowing in contact with it. With certain materials, however, for example materials which would be injuriously affected by actual contact with flame or combustion gases, the heating surface would be heated by flame produced at or conveyed to the rear of the surface, the latter thus intervening as an incandescent screen between the flame and combustion gases therefrom, and the material undergoing drying. Alternatively, electrical heating elements would be incorporated with the heating surface.

According to a preferred form of the invention, the conveyor is an endless travelling loop which after the removal of the dried material from it is charged with a fresh deposit of material to be dried and again fed past the heating surface. In this way a continuous process is provided.

Advantageously, the material may, in position upon the conveyor, be pre-dried on its way to the drying position proper, opposite the heating

surface, the pre-drying being effected by residual heat from the operation of drying proper, for example by the heat of combustion gases proceeding from the flame by which the heating surface aforesaid is heated. By this means, certain economies may be effected, as will be appreciated, and at the same time the material is less suddenly submitted to the strong radiant heat from the heating surface with consequent avoidance of such violence in the evaporation of the water associated with the material as would tend to disintegrate the deposit on the conveyor. In this connection, it may be remarked that a preferred form of said deposit is a thin sheet, as hereinafter described.

The invention includes apparatus for carrying the improved drying process into effect the said apparatus comprising a heating zone and an endless loop conveyor (more especially a vertical single loop conveyor) which passes through said heating zone with the material to be dried in position upon it as a thin layer or like extenuated deposit, means being provided to deposit the material upon the conveyor in this form and the conveyor after having passed through the drying zone and after the dried material has been detached from it being re-loaded with a fresh deposit of material to be passed in turn through the drying zone, characterized by the fact that the drying zone comprises one or more heating surfaces which, in the use of the apparatus, are heated to incandescence, for example at or near white heat, and emitting strong radiant heat to the deposit of material on the conveyor, the said material being thereby heated by heat transmitted to it at least mainly on the principle of radiant heat emission.

By employing strong radiant heating in accordance with the principle underlying the present invention, not only is a rapid transmission of heat to the material to be dried obtained, but also an effective penetration of this heat throughout the material without relying on conduction, which, as is well known, often becomes very low as drying proceeds. This, as will be appreciated, is an important feature of the invention.

It should also be remarked that the invention is specially applicable in the case of vertically disposed single loop conveyors, for such conveyors are well known to be uneconomically slow in their drying action. By the use of strong radiant heat in accordance with the present invention, this difficulty is entirely met and a thoroughly efficient, economical and other-

wise satisfactory process results, principally, it may be added, by reason of the above effect of rapid and efficient penetration of the radiated heat right into the body or mass of the material upon the conveyor.

The invention will now be further described with reference to one convenient embodiment, illustrated more or less diagrammatically in the accompanying drawing, but it is to be understood that this embodiment is described purely by way of example and that the invention is susceptible to considerable variation as regards constructional and other details.

In this embodiment of the invention, the endless conveyor for the material to be dried consists of a wide band 1 of wire mesh which is continuously fed through a vertically disposed two-zone drying space 2.

The conveyor passes over two horizontally disposed rollers 3, 4 situated at the top of the conveyor loop. These rollers are spaced apart from one another and from one of them the conveyor extends vertically down first through a deposition hopper 5 for depositing the material to be dried upon the conveyor and then through the drying space. Emerging from the bottom of said drying space, the conveyor with the now-dried material upon it passes under and over two juxtaposed horizontally disposed guide rollers 6, 7 which sharply flex the conveyor and thereby disintegrate and loosen and in measure detach the dried material from the conveyor, the detached material falling from the conveyor into a hopper 8 provided beneath the rollers to receive it. From these rollers, the conveyor passes horizontally past first a rotary wire brush 9 and then past one or more stationary wire brushes 10 which operate to complete the detachment of the dried material from the conveyor. From the last of these brushes the conveyor passes on to another horizontal guide roller 11 and from thence substantially vertically up to the horizontal roller 4 at the top of the conveyor loop.

The drying space aforesaid and the space 12 below, wherein the detachment of the dried material from the conveyor takes place and also the hopper 8 beneath this space, are enclosed and thereby separated from the external atmosphere. In consequence, any dust which forms in the detachment of the dried material from the conveyor is confined and prevented from clouding the external atmosphere to the discomfort and possible danger of the workmen operating the plant. With this in view, moreover, the conveyor passes through a dust seal 13 at the point where it passes out of the enclosed space aforesaid on its way up to the top of the loop.

The conveyor loop should be maintained taut and for this purpose any convenient form of tautening means may be provided; for example the horizontal roller 4 at the top of the conveyor loop may be mounted upon the extremity of an arm 14 pivoted at 15 and constrained upwardly by pull from a counter-weight 16 connected to the arm by a chain or rope 17 passing over a guide pulley 18. Alternatively the roller 4 may be mounted upon the extremity of one arm of a bell crank lever of which the other arm is operatively connected to an adjustment means for varying the angle of setting of the lever about its pivot at the junction of the arms and thereby lengthening or shortening one side of the conveyor loop.

The drying space of the plant comprises two zones, a pre-drying zone 19 and a drying-proper

zone 20. The pre-drying zone 19 is approximately twice the depth of the drying-proper zone and it constitutes in effect a flue for combustion gases therefrom, these gases being produced by oil or gas fired burners 21 playing flame in the spaces between the conveyor, with the deposit of material to be dried thereon, and two pairs of heating surfaces disposed one pair 22, 23 in advance of the other 24, 25 along the downward path of the conveyor through the drying-proper zone and with the surfaces of each pair disposed opposite to one another, one opposite to one face of the conveyor and the other opposite to the other face.

There are, therefore, four spaces between said heating surfaces and the conveyor carrying the material to be dried, the said spaces being abreast one another in pairs one below the other. In the lower part of each space is a burner (21) which projects flame upon the lower part of the heating surface in such a manner that the projected flame and the hot products of combustion therefrom travel upwards over the heating surface and heat it to incandescence. As shown, the general inclination of each of the four heating surfaces above the burners is toward the face of the conveyor in the upward direction. The spaces therefore between the heating surfaces and the conveyor become smaller toward the top.

The four heating surfaces of the four spaces respectively are constituted by the face of a firebrick or other refractory block or lining 26 built into a sheet metal casing 27 enclosing all four heating spaces collectively. Any convenient construction in this respect may be employed, and as will be appreciated, although in the particular embodiment of the invention now under description, the drying-proper zone of the drying space is described as comprising four heating spaces and correspondingly four burners, any convenient arrangement other than this may be employed, according for example to the size of the plant or to the character of the material to be dried. For example there may, if desired, be only one heating space or any necessary number other than four and correspondingly the number of burners may be different. In this connection, moreover, the heating spaces may if desired be heated by means other than oil or gas fired burners; for example as already intimated herein, electrical means may be employed for this purpose, the essential consideration being that whatever the heating means employed, they shall be adapted to heat the heating surfaces to incandescence so that these surfaces shall be capable of emitting strong radiant heat to the material to be dried passing them on the conveyor.

The pre-drying space through which the conveyor passes is constituted by a firebrick flue 28 extending vertically upwards from the top of the casing 27 enclosing the drying-proper zone, the throughway of the flue registering at the bottom with an opening 29 in the top of said casing through which the conveyor passes downwardly into the said drying-proper zone. This opening is narrow as compared with the width of the heating spaces in the drying-proper zone, that is to say in a direction perpendicular to the general plane of the conveyor, and the width of the said throughway of the flue is also narrower than said width of the heating spaces below. By this means, the opposed surfaces of the throughway of the flue are disposed in close proximity to the surfaces of the material to be

dried on the conveyor and in consequence maximum efficiency is realized in the heating and pre-drying of the material which proceeds in the flue.

5 In this connection, it is to be remarked that the heating which proceeds in the flue is by reason of the passage up therethrough of combustion gases from the drying-proper zone below, these gases finding an outlet from the flue by way of an exit passage 30 therefrom at the top, which exit passage may conveniently lead to the external atmosphere via a chimney 31.

Any available residual heat in the humid gases leaving the pre-drying zone may be utilized to pre-heat the air supply to the burners.

The means for depositing the material to be dried upon the conveyor may take any desired form. In the present specific embodiment, there is a primary hopper superposed above a secondary hopper 6 and delivering thereinto, the secondary hopper delivering in turn into the pinch between two horizontal feed rollers 32, 33 disposed above the inlet for the loaded conveyor into the top of the pre-drying flue. The conveyor also passes between these rollers, and as it does so, it becomes evenly loaded with wet material distributed across it and compressed into its mesh by the rollers 32, 33.

Extending snugly into the space between the two feed rollers from below is a pair of doctors 34, 35 between which the loaded conveyor passes and by which the deposit on the conveyor is prevented from adhering to the feed rollers and becomes evened out before actually entering the pre-drying flue.

The secondary feed hopper has two mutually inclined end walls 36, 37 disposed in planes parallel to the axes of the feed rollers and two side walls disposed parallel to one another and joining the end walls. One of the end walls 36 is vertically disposed and is situated immediately in rear of the unloaded conveyor as the latter descends through the secondary hopper and the other end wall is of course inclined. Then, located in front of the descending conveyor is a false end wall 38, also vertically disposed and located close to the face of the conveyor, and extending down in front of the inclined end wall of the hopper is a second false end wall 39 which is adjustable towards and away from the opposite false end wall to vary the width of the gap between the two false end walls at the bottom and therefore, as will be appreciated, the size of the outlet of the hopper.

In order further to vary the width of this gap, the vertical false end wall in front of the descending conveyor may, if desired, be adjustable up and down.

Further to ensure even distribution of the material being loaded on to the conveyor, the inclined false end wall 39 of the secondary hopper is preferably vibratable in its general plane, the stroke being adjustable to suit the particular conditions of operation at the time, for example the nature and specific gravity of the material to be dried. The mechanism to this end may take any desired form. In the embodiment of the invention shown, the vibratable wall 39 is articulated to a rocker 40 driven by a belt and pulley or chain and sprocket drive 41.

Similarly the means for adjusting the position of the lower end of the vibratable wall 39 to vary the width of the hopper outlet may take any convenient form. In the construction illus-

trated, the adjusting means comprises a lever 42 pivoted at 43 and having a manipulating arm 44. Movement of this lever effects alteration of the inclination of the wall 39 about the axis of its pivotal connection to the rocker 40 and therefore variation of the width of the gap at the outlet of the hopper.

Conveniently, the conveyor is driven through the intermediary of a variable speed gear enabling the rate of movement of the conveyor through the drying spaces to be varied as necessary to suit the condition of wetness of the material to be dried in relation to the temperature obtaining in the drying spaces.

It is found that by operating in accordance with the present invention as described above, wet materials of the character referred to may be dried very rapidly and economically and without the clouding of the atmosphere with dust from the operation of detaching the dried material from the conveyor.

It is, of course, not broadly new in the drying of wet materials to pass the material in position upon an endless conveyor through a drying zone and no broad claim is made herein to this procedure. Nor is it new in such procedure to derive the heat for the drying of the material from a heated surface in close proximity to which the conveyor with the material upon it is passed. In the process and apparatus of the present invention, the heat which is received in the material in the heating zone, that is to say the zone referred to in the immediately foregoing description as the drying zone proper, is conveyed to the material at least mainly on the principle of radiant heat emission in contrast to transmission by convection or conduction, although, as previously intimated herein, a certain proportion of the total heat conveyed to the material may be transmitted to it upon one or other or both of these principles.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A process for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, which consists in feeding the material in the form of a thin layer past incandescent heat radiating surfaces throwing strong radiant heat on to the material whereby the latter is heated and in consequence dried by heat transmitted to it at least predominately on the principle of radiant heat transmission.

2. A process for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, which consists in feeding the material in the form of a thin layer past and in close proximity to incandescent heat radiating surfaces throwing strong radiant heat on to the material whereby the latter is heated and in consequence dried by heat transmitted to it at least predominately on the principle of radiant heat transmission.

3. A process for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, which consists in feeding the material in the form of a thin layer-like deposit on an endless conveyor past and in close proximity to incandescent heat radiating surfaces throwing strong radiant heat on to the material whereby the latter is heated and in consequence dried by heat transmitted to it at least predominately on the principle of radiant heat transmission.

4. A process for heat drying wet clay, sedi-

mented or filtered sludges or precipitates and like pastes of finely divided material, which consists in feeding the material in the form of a thin layer past and in close proximity to heat radiating surfaces heated to a temperature of the order of white heat and throwing strong radiant heat on to the material whereby the latter is heated and in consequence dried by heat transmitted to it at least predominatingly on the principle of radiant heat transmission.

5. A process for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, which consists in feeding the material in the form of a thin layer first through a pre-drying zone and then past incandescent heat radiating surfaces throwing strong radiant heat on to the material whereby the latter is heated and in consequence dried by heat transmitted to it at least predominatingly on the principle of radiant heat transmission.

6. A process as specified in claim 5, wherein the heat employed in the pre-drying zone is residual heat from the operation of drying proper.

7. A process as specified in claim 5, wherein the heat radiating surfaces are heated by flame from fuel burners and the combustion gases from these burners are employed as the heating medium in the pre-drying zone.

8. In apparatus for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, the combination of a drying zone comprising heat radiating surfaces adapted when heated to incandescence to throw out strong radiant heat, means to heat said surfaces to incandescence and an endless loop conveyor adapted to carry upon it at thin layer-like deposit of the paste to be dried and arranged to pass through the drying zone in close proximity to the heat radiating surfaces therein so that the material upon the conveyor becomes exposed to strong radiant heat from the heating surfaces and in consequence heated and dried by heat transmitted to it at least predominatingly on the principle of radiant heat transmission.

9. In apparatus for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, the combination of a drying zone comprising heat radiating surfaces adapted when heated to incandescence to throw out strong radiant heat, means to heat said surfaces to incandescence, an endless loop conveyor adapted to carry upon it a thin layer-like deposit of the paste to be dried and arranged to pass through the drying zone in close proximity to the heat radiating surfaces therein so that the material upon the conveyor becomes exposed to strong radiant heat from the heating surfaces and in consequence heated and dried by heat transmitted to it at least predominatingly on the principle of radiant heat transmission and a pre-drying zone through which the conveyor with the deposit of paste upon it passes on its way to the drying zone.

10. Apparatus as specified in claim 9, wherein the heating means for the heat radiating sur-

faces comprise fuel burners and the pre-drying zone is constituted by a flue communicating with the drying zone and along which hot combustion gases therefrom pass, the pre-drying zone being arranged to be heated by these gases.

11. Apparatus as specified in claim 9, wherein the heating means for the heat radiating surfaces comprise fuel burners and the pre-drying zone is constituted by a flue which communicates with the drying zone so as to provide an exit passage for the combustion gases therefrom and is constructed with a refractory heat radiating lining opposed and in close proximity to the face of the conveyor.

12. In apparatus for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, the combination of a drying zone comprising heat radiating surfaces adapted when heated to incandescence to throw out strong radiant heat, means to heat said surfaces to incandescence and a vertically disposed endless single loop conveyor adapted to carry upon it a thin layer-like deposit of the paste to be dried and arranged to pass through the drying zone in close proximity to the heat radiating surfaces therein so that the material upon the conveyor becomes exposed to strong radiant heat from the heating surfaces and in consequence heated and dried by heat transmitted to it at least predominatingly on the principle of radiant heat transmission.

13. In apparatus for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, the combination of a drying zone comprising heat radiating surfaces adapted when heated to incandescence to throw out strong radiant heat, means to heat said surfaces to incandescence, a vertically disposed endless single loop conveyor adapted to carry upon it a thin layer-like deposit of the paste to be dried and arranged to pass through the drying zone in close proximity to the heat radiating surfaces therein so that the material upon the conveyor becomes exposed to strong radiant heat from the heating surfaces and in consequence heated and dried by heat transmitted to it at least predominatingly on the principle of radiant heat transmission and a pre-drying zone through which the conveyor with the deposit of paste upon it passes on its way to the drying zone.

14. A process for heat drying wet clay, sedimented or filtered sludges or precipitates and like pastes of finely divided material, by feeding the material through a drying zone in the form of a thin layer-like deposit on a vertically disposed endless single loop conveyor, which consists in drying the material by heat imparted to it at least predominatingly on the principle of radiant heat transmission, the conveyor with the material upon it being traversed for this purpose past radiant heating surfaces in the drying zone heated to incandescence and throwing in consequence strong radiant heat towards the conveyor.

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