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METHOD OF AND APPARATUS FOR DRYING MATERIALS

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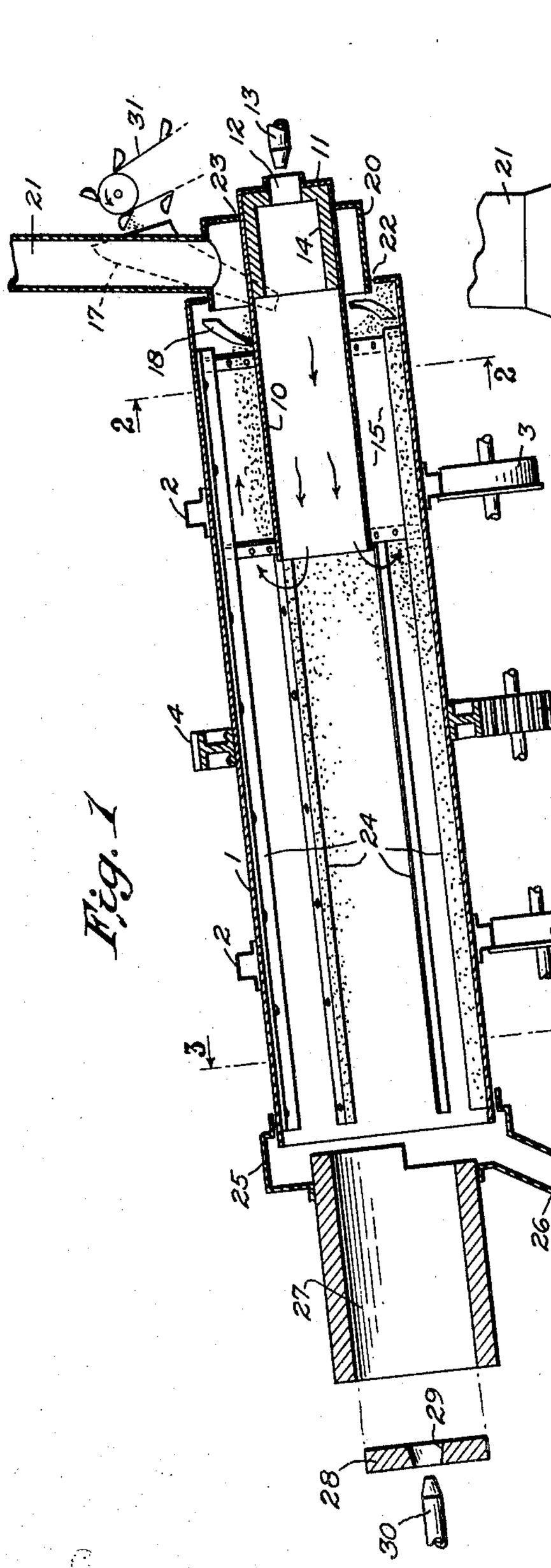

Fig. 1

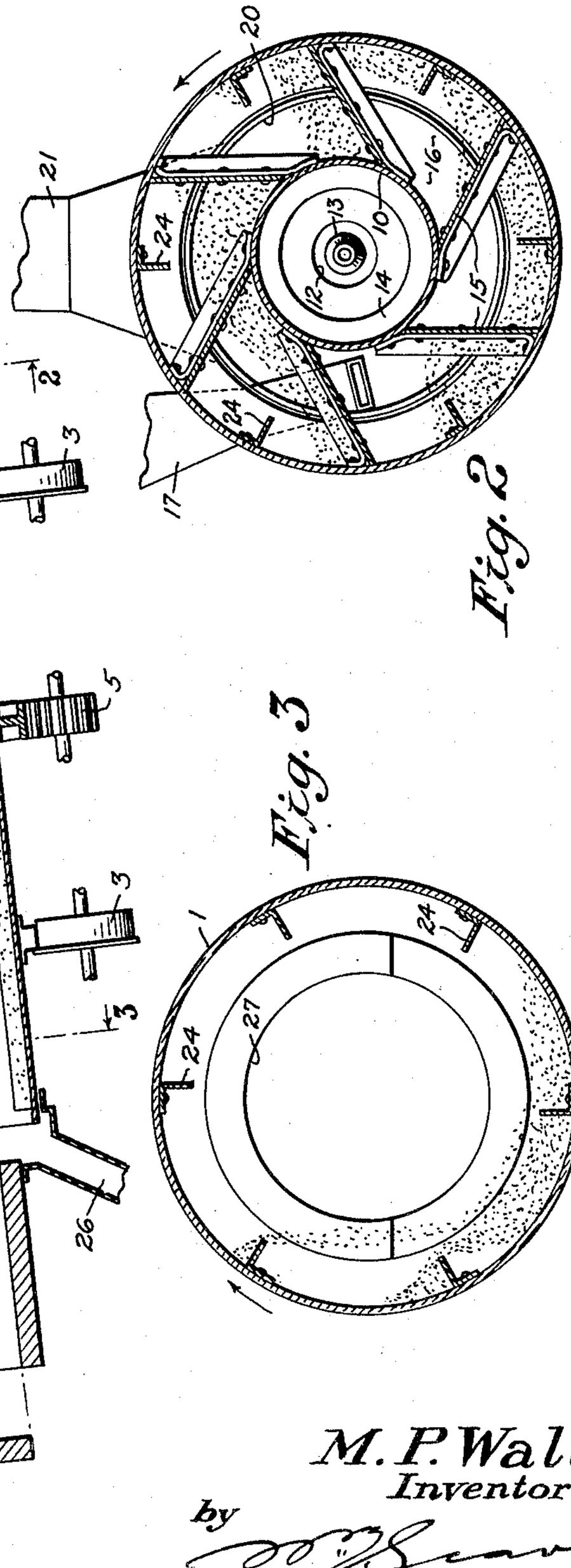

Fig. 2

Fig. 3

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METHOD OF AND APPARATUS FOR DRYING MATERIALS

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2 Claims. (Cl. 34—6)

This invention relates to driers in combination with furnaces and has for its object to provide a method of and an apparatus for drying materials which will be more efficient and less costly to operate than those heretofore proposed.

With these and other objects in view the invention resides in the novel details of construction and combinations of parts constituting the apparatus, as well as the steps and combinations of steps constituting the method of drying which will be disclosed more fully hereinafter and particularly pointed out in the claims.

Referring to the accompanying drawing forming a part of this specification in which like numerals designate like parts in all the views;—

Fig. 1 is a central vertical longitudinal sectional view of a device made in accordance with this invention;

Fig. 2 is a transverse sectional view taken as on the line 2—2 of Fig. 1 and looking in the direction of the arrows, and

Fig. 3 is a transverse sectional view taken as on the line 3—3 of Fig. 1 and looking in the direction of the arrows.

1 indicates a drier casing of cylindrical or other shape having mounted thereabout a plurality of spaced rings or rails 2 adapted to ride upon a plurality of supporting rollers indicated at 3 in a manner well known, the casing adapted to be rotated about its longitudinal axis by virtue of a bull or ring gear 4 secured to the casing at about its midpoint and meshing with a driving pinion 5. The axis of the casing is inclined to the horizontal in order that the material to be dried may travel under the urge of gravity from one end to the other or the casing may be horizontally disposed and the material made to travel therethrough by means of suitable blades or baffles upon the interior of the casing. At 10 is indicated a conduit which may be the flue of a furnace or which may be any other suitable conduit cylindrically or otherwise formed for the hot gases utilized to dry the material, said conduit extending into the drier casing an appreciable distance and in accordance with the furnace capacity required, in the drawing the extent being shown as approximately one-third of the length of said casing. This conduit likewise extends exteriorly of the casing and may communicate with any suitable furnace or may have its outermost end reduced as indicated at 11 to provide an axial aperture 12 registering with which is the nozzle 13 of an oil or other fuel burner. Preferably the inner surface of the exteriorly extending portion of the conduit is insulated as shown at 14, but this insulation need not extend within the drier casing because the wet material forms a natural insulation upon the outside surface of the conduit to prevent the conduit wall from burning out.

The conduit 10 is rigidly mounted with respect to the casing for rotation therewith and this mounting preferably comprises a plurality of partition plates 15 secured in any suitable manner to the conduit and casing but disposed obliquely with respect to a radial plane of the drier. With particular reference to Fig. 2 it will be seen that each partition plate is disposed substantially tangential with respect to the conduit 10 and that said plates divide the space between said conduit and casing into a plurality of compartments 16. These plates extend from the innermost end of the conduit not quite to the end of the casing, to provide in the latter an inlet chamber for the material admitted as through the hopper or chute 17. In this chamber is preferably provided a screw 18 or other means for positively directing the admitted material into said compartments and it will be understood that the opposite ends of each compartment are entirely open so that the material may pass therethrough longitudinally with respect to the drier.

Surrounding the exteriorly extending portion of the conduit 10 is a housing 20 which is stationary and does not rotate with the casing and the conduit. This housing communicates with the flue 21 for conducting away the spent drying gases, and is adapted to have a close fit as at 22 and 23 respectively with the inturned peripheral edge portion of the inlet end of the casing and with the outer surface of the conduit, so that little if any escape of gas is permitted.

Extending longitudinally within the drier casing is a plurality of material agitating elements such as the blades or angle irons 24, at least one for each compartment 16 and which are preferably equidistantly spaced from each other and/or from the partitions 15. These blades extend practically to the outlet end of the casing and are for the purpose of moving upwardly a quantity of the material from the lowermost portion of the rotating drier casing, permitting said material ultimately to drop off the edge of said blades and to shower or cascade across the interior space of said casing to again fall to the lowermost portion, thereby subjecting said material to a further drying action by the air and/or gases travelling toward the inlet end of said casing.

The outlet end of said casing has disposed there-

about a substantially gas-tight stationary housing 25 which has at its lower portion a delivery chute 26 for the dried material. This outlet end of the casing may be otherwise closed but in the drawing it is shown as communicating with one end of a flue 27 coaxial with the casing and for conveying therethrough either hot or cold gas, at atmospheric or other pressure. For this reason there has been shown a closure member 28 having a central aperture 29 and a registering nozzle 30 of an oil or other fuel burner, it being understood that the member 28 may be, for example, a door to the flue 27 when hot gases are desired, and which may be opened or entirely removed to permit air alone to pass through said flue. On the other hand, the entire flue or furnace 27 might be mounted for longitudinal or axial travel, in which case it could be moved back from or out of the housing 25 to permit air at atmospheric temperature to enter the drier casing through the opening for said flue.

The operation of the device is as follows. The wet material is elevated as by the bucket conveyor 31 and dumped into the hopper 17, ultimately passing into the inlet chamber portion of the drier casing. Hot gases as from the nozzle 13 enter the furnace conduit 10, pass therethrough in the direction of the arrows, and heat the cylindrical wall of said conduit, ultimately passing around the open end into the compartments 16 and flowing therein, in a reverse direction, to reach the stack or flue 21. The wet material from the inlet chamber is forced by the screw 18 into the compartments 16 and, in their rotation, is brought ultimately in contact with the hot wall of the furnace conduit 10 to abstract heat therefrom as well as from the flow of gas current passing through said compartments.

The rotation of the casing is not too rapid nor its inclination too great and therefore the wet material is subjected to repeated contacts with the hot furnace conduit wall, and repeatedly showered through the hot gases in the compartments 16, before it passes from the compartments into the drier casing proper. After reaching the latter, the partially dried material is successively elevated by the blades 24, and cascaded across the interior space of the casing to be acted upon by additional hot gases emanating from the auxiliary nozzle 30, or acted upon by cooling air entering the drier casing as through the flue 27, as desired. The speed of rotation and the dimension of the drier are both made such that, coupled with a controlled admission of wet material, the material will be completely dried when it reaches the discharge chute 26, either in hot or cooled condition.

It is to be observed that the direction of movement of the material through the apparatus is, at all times, counter to the direction of flow of the heating and/or cooling gases. Thus the material from the time it leaves the inlet chamber, in its passage through the drier, comes first in contact with gases which have been passed entirely through the drier and have been deprived of considerable of their original heat content. However, the material, in its continued travel, comes in progressive contact with uniformly hotter and hotter gases until, having progressed to the innermost end of the furnace conduit 10, said material is in contact with the full temperature of the gases coming from said furnace conduit. It is hereby, seen that the coolest and wettest material is brought into contact with the coolest of the gases but is subjected to the hot furnace conduit wall and, as it progresses through the compartments 16, the material comes in contact with progressively hotter gases but is brought into contact with portions of the conduit wall which are a little cooler than those portions immediately adjacent the inlet chamber.

Therefore there is a compensation which results in a substantially uniform heating of the wet material or, in other words, the wetness of the material and the various temperatures of heat to which it is progressively subjected, have a ratio which results in a substantial uniform but rapid heat treatment.

It is evident therefore that this condition of treatment is conducive to the most rapid transfer of heat from the gases and/or the wall of the furnace conduit to the material and, consequently conducive to the most rapid and economical process through first drying and then heating the material in the case where the material is desired delivered in hot condition or first drying and then cooling the material in the case where the material is desired delivered in cooled condition.

When operating to dry and then cool the heated material, it should be observed that a particular feature of this invention is the fact that the heat abstracted from the material in the drier casing proper, by the cooling air, is not lost but is carried back into the compartments 16 to assist in drying the oncoming fresh and wet material.

The cool and wet material from the inlet chamber is brought into substantial immediate contact with the outer surface of the furnace conduit 10 at the end thereof which is subjected to the most destructive effect from the highest temperature of the oncoming gases. Said conduit is thus cooled by said wet material and prevented from being injuriously overheated, as is the case in such apparatus of this character heretofore constructed. Therefore, this apparatus is adapted to utilize, without injury to itself, gases of much higher temperature than would be practical if the conduit were not so cooled by the oncoming wet material. Also, at all times, heat by radiation from the wall of the conduit is not lost to surrounding atmosphere, but passes into the compartments 16 and thereby valuably aids in the drying of the material in said compartments. In this latter connection it will be appreciated that the material in each compartment, as well as the material in the drier casing proper, is agitated or mixed in the rotation of the device by the inclined partitions as well as by the showering blades so that a relatively uniform drying and/or heating effect is obtained by all of the particles of the mass to be treated. Obviously either or both of the nozzles 13 and 30 may be used as sources of heat according to the nature and condition of the material to be dried.

It is obvious that those skilled in the art may vary the details of construction involving the apparatus, as well as the steps and combinations of steps constituting the process without departing from the spirit of the invention, and therefore it is not desired to be limited to the foregoing except as may be required by the claims.

What is claimed is:—

1. In a drier the combination of a rotatable casing; a furnace conduit for hot drying gases extending interiorly and exteriorly of said casing at one end thereof, the exteriorly extending portion only provided with insulation; a plural-

ity of partitions joining said conduit to said casing and dividing the space therebetween into a plurality of compartments to receive portions of the wet material to be dried; a housing disposed about the insulated exterior portion of said conduit, said housing in open communication with said casing, said housing provided with means to admit the wet material to said compartments, the wet material constituting a natural insulation upon the outside surface of the uninsulated portion of said conduit; a delivery for the dried material; and an outlet for the drying gases.

2. In a drier the combination of a rotatable casing; a furnace conduit for hot drying gases extending interiorly and exteriorly of said casing at one end thereof and joined thereto by a plurality of partitions establishing open-ended compartments to receive portions of the wet material to be dried, the exteriorly extending portion only of said conduit provided with a heat insulating lining, said conduit extending interiorly substantially one-third the length of said casing, and devoid of insulation within said casing, the wet material forming a natural insulation upon the outer surface of the conduit within said casing, said partitions extending from the innermost end of said conduit to a point near the inlet end of said casing, said partitions disposed in planes parallel to the axis of said casing; means to admit the wet material to the space between said conduit and said casing at the end of said partitions; a housing disposed about the insulated exterior portion of said conduit and carrying the material admitting means; means comprising a screw to positively convey the material from said space into said compartments; a delivery for the dried material; and an outlet for the drying gases through said housing.

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