

Aug. 30, 1927.

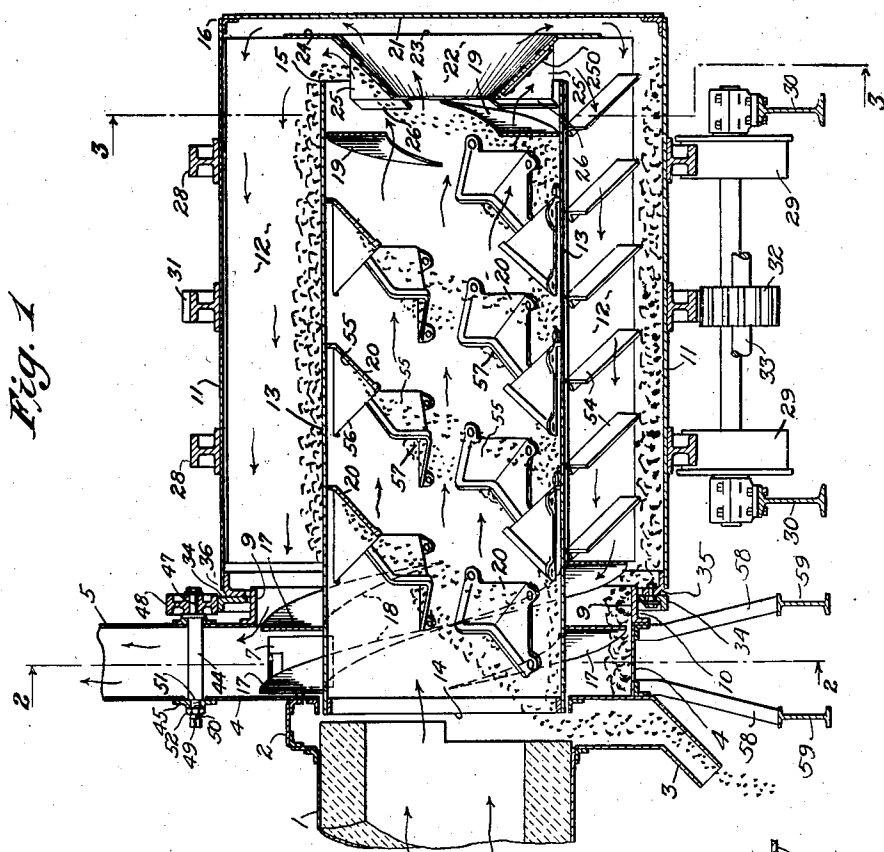
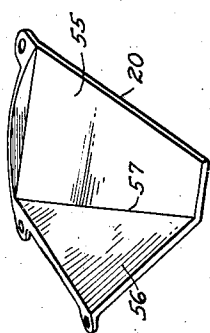
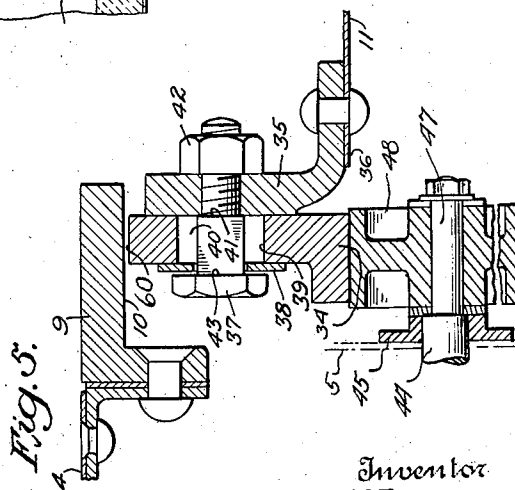
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1,641,108

APPARATUS FOR DRYING AND HEATING MATERIAL

Filed March 19, 1926

2 Sheets-Sheet 1



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APPARATUS FOR DRYING AND HEATING MATERIAL

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2 Sheets-Sheet 2

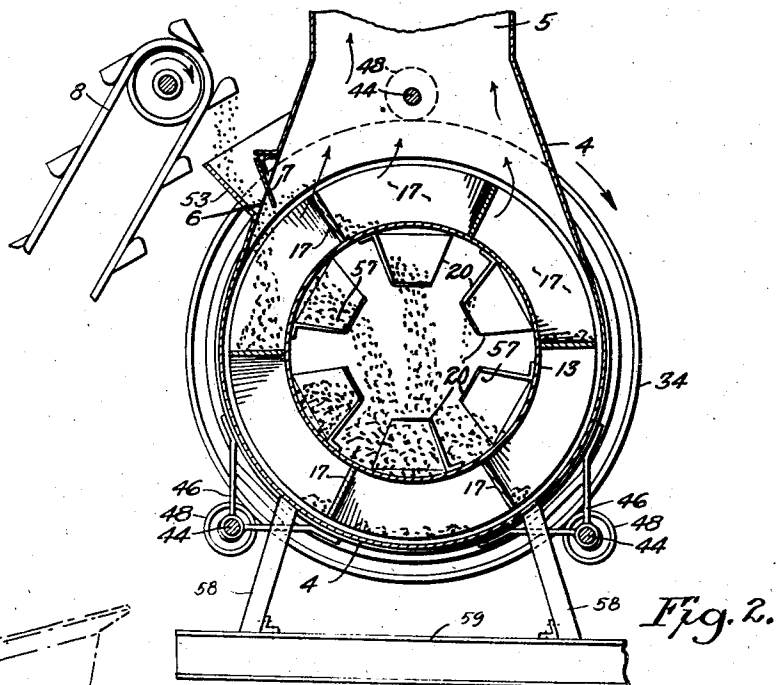


Fig. 2.

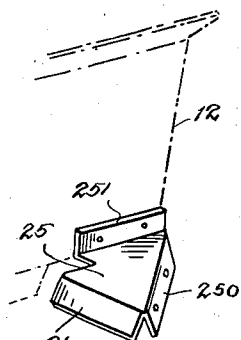


Fig. 7.

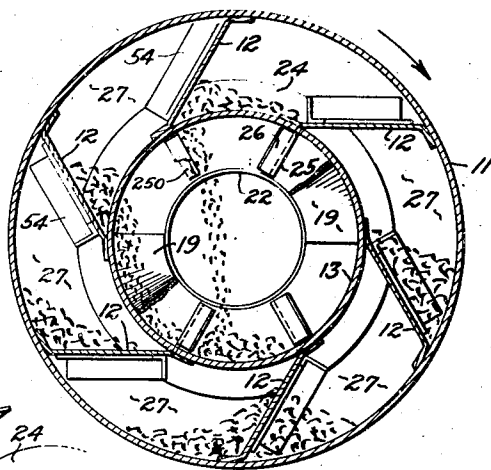


Fig. 3

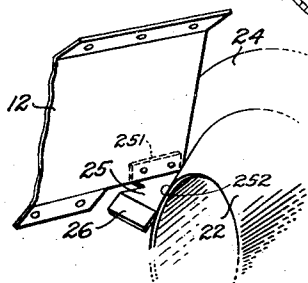


Fig. 6

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APPARATUS FOR DRYING AND HEATING MATERIAL.

Application filed March 19, 1926. Serial No. 96,031.

This invention relates to a combined dryer and heater and has for its object to provide an apparatus and a process which will be more efficient and less costly to operate than those heretofore proposed.

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

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

Figure 1 is a longitudinal sectional view of a device made in accordance with this invention;

Figure 2 is a transverse sectional view taken on the line 2—2 of Figure 1 and looking in the direction of the arrows;

Figure 3 is a transverse sectional view taken on the line 3—3 of Figure 1 and looking in the direction of the arrows;

Figure 4 is a perspective view of one of the flights used in this apparatus;

Figure 5 is an enlarged sectional detail illustrating the connection between the dryer cylinder and the draft chamber or breeching; and

Figures 6 and 7 are perspective views illustrating one of the deflecting plates 25 associated with one of the compartment partitions 12 and the conical member 22.

1 indicates the flue from any suitable furnace or source of heat supply, at the end of which is the annular compartment 2 communicating with the delivery chute 3. This annular compartment 2 is interposed between the flue 1 and the draft chamber 4, the upper end 5 of which communicates with a stack, or other suitable means, not illustrated, but adapted to remove spent gas. In the draft chamber 4 is located an aperture 6, to the upper edge of which is hinged a flap or trap door 7, and through which material to be dried and thereafter heated, may be introduced to the dryer by any suitable means such as the endless conveyor 8. To the draft chamber 4, and on the side thereof opposite the annular compartment 2, is secured an annular casing 9, the outer circumferential surface 10 of which is machined for a purpose to be disclosed later.

The draft chamber 4 is rigidly secured

by the supporting member 58 to any suitable foundation, such as the beams 59, as is clearly seen in Figures 1 and 2.

The dryer comprises the outer cylindrical casing 11 to the inner surface of which is riveted or otherwise secured a plurality of division or compartment partitions 12, the main body portion of each extending longitudinally approximately the entire length of the dryer casing 11 and positioned within said dryer casing 11 obliquely to a diameter passing through one of the longitudinal edges thereof as clearly illustrated in Figure 3.

Within said outer dryer casing 11, and concentrically disposed thereto, is the inner tubular superheater casing 13 riveted or otherwise secured to the inner longitudinal edges of the compartment partitions 12 to hold said superheater casing 13 in spaced relation to the dryer casing 11. The superheater casing 13 is somewhat longer than the dryer casing 11, and is so dimensioned and placed that one end 14 thereof will extend into and through the draft chamber 4, as is clearly shown in Figure 1. The other end 15 of the superheater casing 13 lies within the plane of the other, or closed extremity 16 of the dryer casing 11 for a purpose, as will presently appear.

Referring particularly to Figure 1, the end 14 of the superheater casing 13 is provided exteriorly with a plurality of flanges 17 helically disposed to said superheater casing 13 to provide a plurality of screws, or worms, 18, by means of which the wet material, upon entering the draft chamber 4 may be moved into the dryer. These screws 18, it will be observed, extend longitudinally of the superheater casing 13, only a short distance, as their purpose is only to move the wet material out of the draft chamber 4, and insure the material reaching the compartments formed in the dryer by the partitions 12. The other end 15 of the superheater casing 13 is provided interiorly with a similar set of worms, or screws, 19, of short length to prevent the possible collection, in large quantities, of the material within the end 15 of the superheater casing 13. Their purpose, therefore, see Figure 1, is to move the material rapidly within the superheater casing 13 from the end 15 thereof, in order that the same may positively reach the flights 20 with which the inner

surface of the superheater casing 13 is provided.

At the end 16 of the dryer casing 11, there is provided an end plate 21 which forms a complete closure for this end of the apparatus. Between the end 15 of the superheater casing 13 and the end plate 21 is positioned a conical member 22 disposed substantially concentric with the superheater casing 13, and the smaller end of which lies somewhat within the plane of the end 15 of said superheater casing. The larger end 23 of the cone 22 is provided exteriorly with the annular flange 24, which lies in a plane parallel to and spaced from the end plate 21. Suitable supporting means are provided by which the cone 22 is secured to the ends of the compartment partitions 12. Such a means is illustrated in Figures 1, 3 and 6 wherein it will be seen that inclined triangularly shaped deflecting plates 25 are riveted, or otherwise secured, by means of a turned over flange 251 formed thereon, to the ends of the compartment partitions 12 as is especially illustrated in Figure 6. An opposite edge 252 of the deflecting plate 25 is also provided with a flange 250, see Figures 1 and 3, by means of which said plate is riveted, or otherwise secured, to the outer surface of the cone 22. The third, or free, edge of each plate 25 is provided with a lip 26, obliquely disposed to the plane of the plate 25, for a purpose to be disclosed later.

From the foregoing, and with particular reference to Figures 1 and 3, it will be seen that the hot gases from the furnace, or other source of heat supply, will leave the flue 1, and pass into the end 14 of the superheater casing 13. They will then pass longitudinally, in the direction of the arrows, through the superheater casing 13, to the other end 15 thereof, where a portion of the gases will continue in a straight path through the opening in the conical member 22, to be deflected by contact with the end plate member 21 as clearly shown in Figure 1. They will then pass through the space between the annular flange 24 and the end plate 21, and subsequently enter the longitudinal compartments 27 formed between the dryer casing 11, the superheater casing 13, and the compartment partitions 12, as particularly shown in Figure 3. The gases will here unite with other portions of the gases which did not pass through the cone 22, but which passed through the spaces between said cone and the superheater casing 13, as is clearly shown by the arrows in Figure 1.

The hot gases, having now arrived in the plurality of compartments 27, will travel therethrough, in a direction opposite to the flow of gases inside of the superheater casing 13, toward the draft chamber 4, and through the same to the upper portion 5 thereof, where they may escape to the at-

mosphere through the usual stack or other means of exit commonly provided in apparatus of this character.

The dryer casing 11 is exteriorly provided with a plurality of annular bearing rings 28, which are adapted to rest on the rollers 29 suitably supported on any base or foundation such as the beams 30, as clearly shown in Figure 1. By so mounting the apparatus upon the free turning rollers 29, it may be rotated by any suitable means, such as the annular gear ring 31 securely attached to the exterior of the dryer casing 11, and driven by the gear 32, meshing therewith and mounted on the shaft 33 adapted to receive its power from any suitable source.

In order that gases may not escape from the apparatus, except through the upper portion of the draft chamber 4, all joints will be substantially gas tight and of any suitable well known construction. In order that the annular casting 34, carried by the dryer casing 11 and rotating therewith, may move relatively to the annular casting 9, carried by the stationary draft chamber 4, and at the same time have therewith a substantially gas tight joint, it has been found advisable to machine finish the outer circumferential surface 10 of the casting 9 and the inner circumferential surface of the casting 34. The annular casting 34 is secured to the circular flange 35, disposed at the end 36 of the dryer casing 11 and circumjacent the casting 9, by means of a plurality of bolts 37 and washers 38. Because the rollers 29 and the rings 28 associated therewith are subject to wear, the dryer may become radially displaced in its relation to the casting 9; but, in order that a substantially gas tight joint may be maintained between the casting 34 and the casting 9, it is necessary that said casting 34 shall, at all times, remain substantially concentric with the casting 9. Therefore, the annular casting 34 is not rigidly secured to the circular flange 35, but is held only loosely thereto by the plurality of bolts 37 and washers 38. In Figure 5, it will be seen that the bolts 37 are of lesser diameter than the holes 39 provided for them in the annular casting 34 so that there is about each bolt 37 a space 40 of a dimension greater than any probable radial displacement of the dryer in its relation to the casting 9. It is further seen, in Figure 5, that the bolts 37 are provided with shoulders 41, adapted to be firmly drawn against the circular flange 35 by the nut 42, and that the length of the bolt 37, from the shoulder 41 to the head 43 thereof, is slightly greater than the combined thickness of the annular casting 34 and the washer 38, so that there may never be a bind action between the casting 34 and the flange 35 of the dryer casing 11. Furthermore, it will be seen that, due to the space 40 about each bolt 37, the annu-

lar casting 34 may, within the limits of the space 40, be readily moved in any radial direction with reference to the circular flange 35 and the dryer casing 11.

5 The draft chamber 4 is provided with a plurality of spindles 44, rigidly secured thereto by the collars or flanges 45 or the brackets 46, see Figures 1, 2 and 5, and said spindles are held in rigid relation to the casting 9 by the structure of the draft chamber 4 to which the casting 9 is itself rigidly secured. Each spindle 44 is provided with a journal 47 eccentrically disposed to the axis of said spindle for a purpose presently to appear. Each spindle has mounted upon its journal 47, a roller 48 adapted to contact the outer surface of the annular casting 34 carried by the dryer casing 11. Each spindle is further provided, at the end opposite to the journal 47, with a squared portion 49, a threaded portion 50, a shoulder 51, and a nut 52. From Figure 1 it will be readily seen that, by means of the shoulder 51 and the nut 52, the spindle 44 is rigidly secured to the collar 45, or the bracket 46—see Figure 2—and, therefore, to the draft chamber 4. It will, therefore, be obvious that, by loosening the nuts 52, each spindle may be loosened, with relation to the draft chamber 4, so that each spindle may be rotated, through the application of a wrench to the squared portion 49, and that, by again tightening the nuts 52, each spindle may again be rigidly secured to the draft chamber 4. Thus, it is obvious that the position of the eccentrically disposed journal 47 may be changed, by the rotation of the spindle 44, and that, therefore, one would be enabled to change the position of each roller 48 with relation to the casting 9. Thus, by means of the eccentric journals 47, can various adjustments be made as needed with the result that the annular casting 34, which, in Figures 1, 2 and 5, is seen to be guided by the rollers 48, may be correctly positioned relatively to the casting 9 secured to the draft chamber 4.

It is now seen, in Figures 1, 2 and 5, that the rollers 48 may be accurately positioned so as to support the annular casting 34 in a position so nearly approaching a truly concentric relation with the casting 9 that the space 60, between the annular casting 34 and the casting 9, may be so small as to make a substantially gas tight joint, and, at the same time allow relative rotary or axial motion between the casting 34 and the casting 9, without actual contact with its resultant friction and wear taking place. Also, it will be seen that the dryer casing may be radially displaced in its relation to the draft chamber 4 without disturbing the gas tight relation between the castings 34 and 9.

The material to be dried, and thereafter heated, may be deposited, by any suitable

means—such as the conveyor 8, in the hopper 53 which communicates with the aperture 6 in the draft chamber 4. The weight of the material thus deposited in the hopper 53 will cause the trap door 7 to swing inwardly, as clearly shown in Figure 2, so that the said material may not only flow by gravity through the aperture 6, but, by occupying the entire space between the bottom portion of the hopper 53 and the trap door 7, prevent the entrance of any substantial amount of air into the draft chamber 4. The material, having passed through the aperture 6, will fall upon the exterior surface of the cylindrical superheater casing 13 and will be moved, by the screws 18 on said superheater casing, from the end 14 thereof toward the compartments 27 between the superheater casing 13 and the dryer casing 11. A considerable portion of the material will, through the action of gravity, slide down the inclined surfaces of the screws 18 and, therefore, be guided into the compartments 27. Other portions of the material falling too high upon the curved surface of the superheater casing 13 to slide quickly therefrom, will be carried over by said superheater casing in its rotation until finally deposited in the bottom of the draft chamber 4, but, due to the fact that the screws 18 are of such radial dimensions as to fit closely within the outer casing of the draft chamber 4, any material deposited in the bottom of said chamber will ultimately be moved, by said screws 18, into the dryer proper, all as will be clear from Figures 1 and 2.

The material, having arrived in the end 36 of the dryer casing 11, and entered the longitudinal compartments 27, will be moved toward the end 16 of said dryer casing 11. That is to say, each compartment partition 12 is provided, on one side thereof, with a plurality of obliquely disposed angular cleats 54, as clearly shown in Figures 1 and 3. These cleats 54 are so mounted upon the partition wall that, as the dryer rotates, said cleats will cause the material to move to the right, as seen in Figure 1, in each compartment 27, thus insuring the travel of the material toward the end 16 of the dryer casing 11. In Figure 3 it will be clearly seen that the material is divided, by the partitions 12, into a plurality of advancing streams, or, in other words, the entire bulk of material dumped into the dryer is divided into substantially equal parts or streams, one stream for each compartment 27. Further, it will be observed that, as the dryer rotates, these separate streams of material will be much disturbed, tumbled and rolled about within each compartment 27, and will be caused to slide successively across all sides of these compartments including the side formed by the superheater casing 13.

When the material has thus progressed to the end 16 of the rotating dryer, it will have reached the extreme end 15 of the superheater casing 13, and, being no longer supported by said superheater casing, the material will fall over the extreme end 15 upon the inclined surface of the conical number 22, and be propelled therefrom, under the action of gravity, down and into the interior of the superheater casing 13. To facilitate the entrance of the material into the end of the superheater casing 13, as well as to prevent flow of the material from said conical surface to the bottom of the dryer proper, triangularly shaped deflecting plates are provided, all as heretofore disclosed. The free edge of each plate 25 is provided with the obliquely disposed flange 26, which constitutes substantially a directing chute for the material. Especially from Figure 1 will it be seen that the material which falls upon the conical surface will slide therefrom and, further, that that which slides off laterally will be caught by one of the deflecting plates 25 with the result that all of the material is positively directed into the superheater casing 13. However, to prevent an undue collecting of material within the superheater casing 13 at the end 15 thereof, a screw or worm 19 is provided which is adapted to move the material quickly away from the said end 15 toward the flights 20.

These flights 20 are disposed more or less helically within the superheater casing 13, and, furthermore, are staggered with relation to each other as clearly seen in Figure 1. Each flight 20 is formed with an inclined bottom portion 55, and a side 56 extending substantially radially from the superheater casing 13, as particularly illustrated in Figure 4 and in such manner as to form a pocket 57 in each flight, which is adapted to be filled with the material as the flight moves upwards from the bottom of the rotating superheater casing 13. However, the flights are open on the side opposite the side 55, as well as open on the side opposite the side 56, and, therefore, as the superheater casing 13 continues its rotation, the material caught in each flight 20 will fall out of the pocket 57 as the flight approaches and passes its uppermost position, as clearly shown in Figures 1 and 2. The material will thereupon drop downwardly and forwardly in a more or less divided condition and be showered across the space encompassed by the superheater casing 13, thereby exposing practically the entire surface area of the particles comprising the material to the hot gases flowing past the material. That is to say, the inclined bottom 55 of each flight 20 will cause the material, as it slides from the pocket 57 of

said flight, to be directed forwardly from said flight 20, or to the left, as seen in Figure 1. Thus, it will be seen that the flights 20 not only agitate, spill and shower the material, in the superheater casing 13, but they also cause a forward movement of the material in the said superheater casing toward the delivery chute 3.

In the foregoing 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 gases. Thus, the material, upon being introduced through the aperture 6 in the draft chamber 4, comes first in contact with the gases which have passed entirely through the superheater and the dryer and have been deprived therein of most of their original heat content. However, as the material progresses on its journey through the outer drying compartments and the inner superheating compartment, it comes successively in contact with uniformly hotter and hotter gases, until, having progressed to the inside of the end 14 of the superheating drum 13, and being about to fall therefrom into the delivery chute 3, said material is in contact with the fresh hot gases entering the superheater from the flue 1. It is, thereby, seen that the coolest and wettest material is in contact only with the coolest of the gases and that the material, as it is progressively dried and heated, comes in contact with progressively hotter gases, until finally the hottest material is in contact with only the hottest gases. Thus, there exists the greatest average difference in temperature between the material and the gas with which it is in contact. It is evident, also, that this condition is conducive to the most rapid transfer of heat from the gases to the material and, consequently conducive to the most rapid and economical process through first drying and then heating the material.

The gases having entered the superheater casing 13 at the end 14 thereof, and, being hottest at that point, will, after traveling through the said superheater casing 13, past the conical member 22, and through the plurality of dryer compartments 27, and having encountered in their passage progressively cooler and cooler material, eventually reach the draft chamber 4 and the upper portion 5 thereof in a greatly cooled condition, and are discharged therefrom into the usual stack, not shown, practically devoid of the heat carried by them when they entered the superheater casing.

The cool and wet material entering through the aperture 6 in the draft chamber 4, is brought into immediate contact with the outer cylindrical surface of the superheater casing 13 at the end 14 thereof, which is subjected to the highest temperature of

the oncoming gases, and to the most destructive effect thereof on the said superheater casing. The superheater casing is thus cooled by said wet material and prevented from being injuriously overheated, as is the case in much apparatus of this character heretofore constructed. Moreover, it is to be observed that the heat thus abstracted from the cylindrical surface of the superheater casing 13 by the wet material, serves to materially assist in the drying of said material.

The material fed to the dryer proper, is seen to immediately enter the longitudinal compartments 27, and to be much tumbled and rolled about therein in such manner that all portions of said material are many times exposed to the heat from the gases passing through said compartments. It is further seen that the material, in its passage through the compartments 27, is brought into contact with a considerable area of the exterior cylindrical surface of the hot superheater casing 13, and, therefore, said material will absorb much heat therefrom, thereby not only greatly aiding in the drying of said material, but also aiding in the preserving of the life of said superheater casing 13.

The material, upon entering the superheater casing 13 at the end 15 thereof, by means of the conical member 22, and the deflecting plates 25, is seen to be quickly brought to the flights 20 by means of the screws 19. Having reached the flights 20, the material is seen to be much agitated thereby, lifted up, and cascaded therefrom in a forwardly direction or toward the delivery chute 3. The material is thus subjected, in the superheater, to the uniformly increasingly hot gases passing through said superheater, and in such a manner that all particles of said material are many times exposed directly to the blast of said hot gases, and thereby completely superheated by the time the material reaches the delivery chute 3. It is further observed that the gases supplied through the flue 1 may be of such temperature as will heat the material much beyond the temperature required to drive the moisture only therefrom, so that the apparatus is thus adapted to those processes which require that material shall be heated as well as dried. It is also seen that because of the protection afforded to the superheater casing 13 by the comparatively cool material upon the exterior surface thereof, the apparatus is adapted to utilize, without injury to itself, gases of much higher temperature than would be practical if the superheater casing were not so cooled.

In the usual apparatus of this character heretofore constructed, there has been a serious loss of heat from the exterior surface thereof. This invention on the other hand, avoids this serious defect by having its hottest portion, the superheated casing 13, com-

pletely surrounded by compartments or passages 27 conducting material so that any heat which may escape from said superheater casing 13 by radiation, will be captured by said material and not lost. It is further seen that the gases, by the time they have traversed the length of the superheater casing 13, entered the compartments 27, and there encountered the dryer casing 11, will have been so cooled by the material in said superheater casing that they will be incapable of heating the outer casing 11 of the dryer sufficiently to cause any considerable loss of heat by radiation therefrom.

It is seen, in Figure 3, that the weight of the material in the compartments 27 on the ascending side of the dryer is balanced substantially by an equal weight of material in the compartments on the descending side. But, by providing compartment partitions 12 obliquely disposed as shown in said Figure 3, the material on the ascending side is directed toward the center of rotation of the dryer, whereas the material on the descending side is directed toward the outer circumference of the dryer or away from the said center of rotation of the dryer. This has the tendency of over-balancing the structure, and placing an increased weight upon the descending side, which would normally lessen the power necessary to rotate the dryer and the super-heater contained therein. However, as illustrated in Figure 2, the flights 20, within the super-heater casing 13, scoop material upwardly and dump the same, while passing the vertical plane, thus adding weight to the ascending side. In practice, it is observed that there is an approximate balance of the entire device, when in full operation, whereas, if the partition plates were radially disposed to the super-heater casing 13, much more power to rotate the device would be required due to the unbalanced weights.

From the foregoing disclosure it will thus be seen that there is provided an apparatus comprising an outer drum or casing 11, an inner drum or super-heater casing 13 concentrically and coaxially disposed relatively to each other and secured to each other by the obliquely disposed partitions 12 having the obliquely disposed cleats 54 carried on one side thereof. Further it will be observed that the material admitted to the apparatus through the opening 6 will contact with the outer surface of the inner drum 13 which receives the gases of highest temperature from the flue connected with a suitable source of heat supply, not shown. The burning out of the end 14 of the inner drum 13 is thus prevented by the wet material contacting therewith, and in fact the life of the entire inner drum is lengthened because of the material being dried disposed on the outer circumferential surface thereof

and the hot gases contacting with the inner surface thereof. Further, it will be observed that the hot gases are brought into the apparatus at its central portion, and being under a slight pressure, have to travel to the end 15 of the inner drum 13 before they can escape from said drum, and that upon the escape of said gases, said pressure thereof will cause them to flow in the direction of the arrows in the passages formed by the partitions 12 between the outer and inner drums eventually escaping to the atmosphere from the conduit 5.

Thus the apparatus may be considered as having two zones. The inner drum 13 in its length constitutes a high temperature zone for heating the dried material to that degree found necessary in the ultimate use of the material. The space between the outer and inner drums, on the other hand, constitutes a relatively low temperature zone in which such heat as remains in the gases, after their passage through the high temperature zone, is absorbed by the wet material in the passages 27 and in which there is also transmitted to the wet material such heat as may find its way, by conduction, radiation, or otherwise, through the circumferential wall of the inner drum 13. The essence of this invention lies in the fact that the final or high temperature stage of the process takes place in the heart or core of the apparatus where it is surrounded on all sides by material which, undergoing processing at lower temperatures and being capable of absorbing heat which escapes from the hot zone, will eventually return such heat to the hot zone thus preventing its dissipation into the atmosphere. This makes it unnecessary in industrial processes to use recuperators, regenerators, heat exchangers, or other external heat recovery apparatus. In other words, the fresh material admitted to the apparatus tends to sweep the escaping heat back into the apparatus to be utilized therein and not lost, thus preserving the relatively high temperature of the heating zone within the inner drum 13.

It is obvious, to those skilled in this art, that the details of construction may be varied without departing from the spirit of the invention, and therefore, I do not desire to be limited to the above disclosure, except as may be demanded by the claims.

What is claimed is:—

1. In an apparatus of the character described the combination of an outer drier casing; a superheater extending beyond said casing and spaced therein; a flue adapted to admit hot gas to one end of the superheater; a stationary draft chamber disposed about the extending end of said superheater and communicating with the space between said superheater and said drier casing; means to deliver material to the space between said

superheater and said drier casing; means to positively convey the material to the interior of said superheater from said space including means to maintain the high temperature of said superheater; means to deliver the material from said superheater; and means to rotate said superheater and said drier casing.

2. In an apparatus of the character described the combination of an outer drier casing; a superheater extending beyond said casing and spaced therein; a flue adapted to admit hot gas to one end of the superheater; a stationary draft chamber disposed about the extending end of said superheater and communicating with the space between said superheater and said drier casing; means to deliver material to the space between said superheater and said drier casing; means to convey the material to the interior of said superheater from said space including directly connected means to maintain the high temperature of said superheater; screw means to positively direct said material into said superheater from said conveying means; means to deliver the material from said superheater; and means to rotate said superheater and said drier casing.

3. In an apparatus of the character described the combination of an outer drier casing; a super-heater extending beyond said casing and spaced therein by a plurality of longitudinally extending partitions; a flue adapted to admit hot gases to one end of said super-heater; a draft chamber disposed about the extending end of said super-heater and communicating with the space between said super-heater and said drier casing; means to continuously deliver material to the space between said super-heater and said drier casing; means connected to said partitions to convey the material to the interior of said super-heater from said space; means to deliver the material from said super-heater; and means to rotate said super-heater and said drier casing.

4. In an apparatus of the character described the combination of an outer drier casing; a super-heater extending beyond said casing and spaced therein by a plurality of longitudinally extending partitions each angularly disposed to a diametric plane of said super-heater passing therethrough, said partitions adapted to aid the acceleration of a portion of the rotation of said superheater; a flue adapted to admit hot gases to one end of said super-heater; a draft chamber disposed about the extending end of said superheater and communicating with the space between said super-heater and said drier casing; means associated with said chamber to deliver material to the space between said super-heater and said drier casing; means to convey the material to the interior of said super-heater from said space; means to de-

liver the material from said super-heater and means to rotate said super-heater and said drier casing.

5. In an apparatus of the character described the combination of an outer drier casing, a super-heater extending beyond said casing and spaced therein; a flue adapted to admit hot gases to one end of said super-heater; a draft chamber to continuously receive the material to be dried, said chamber disposed about the extending end of said super-heater and communicating with the space between said super-heater and said drier casing; means associated with said chamber to positively deliver material to the space between said super-heater and said drier casing said means comprising a screw mounted on the extending portion of said super-heater; means to convey the material to the interior of said super-heater from said space; means to deliver the material from said super-heater; and means to rotate said super-heater and said drier casing.

6. In an apparatus of the character described the combination of an outer drier casing; a superheater extending beyond said casing and spaced therein; a flue adapted to admit hot gas to one end of the superheater; a draft chamber disposed about the extending end of said superheater and communicating with the space between said superheater and said drier casing; means to deliver material to the space between said superheater and said drier casing; means to convey the material to the interior of said superheater from said space including a cone and means connected thereto to maintain the high temperature of said superheater; means to deliver the material from said superheater; and means to rotate said superheater and said drier casing.

7. In an apparatus of the character described the combination of an outer drier casing; a superheater extending beyond said casing and spaced therein; means to rotate said superheater and said drier casing; a flue adapted to admit hot gas to one end of the superheater; a draft chamber disposed about the extending end of said superheater and communicating with the space between said superheater and said drier casing; means to deliver material to the space between said superheater and said drier casing; means to convey the material to the interior of said superheater from said space including means adapted to aid the acceleration of a portion of the rotation of and to maintain the high temperature of said superheater; and means comprising a plurality of independent flights to deliver the material from said superheater.

8. In an apparatus of the character described the combination of an outer drier casing; a super-heater extending beyond said casing and spaced therein by a plurality of longitudinally extending partitions; a flue

adapted to admit hot gases to one end of said super-heater; a draft chamber disposed about the extending end of said super-heater and communicating with the space between said super-heater and said drier casing; means to deliver material to the space between said super-heater and said drier casing; means to maintain the high temperature of said super-heater including said partitions and means secured thereto to convey the partly dried material to and into the interior of said super-heater from said space; means to deliver the dried material from said super-heater; and means to rotate said super-heater and said drier casing to dry said material.

9. In an apparatus of the character described the combination of an outer drier casing; a super-heater extending beyond said casing and spaced therein by a plurality of longitudinally extending partitions; a flue adapted to admit hot gases to one end of said super-heater; a draft chamber disposed about the extending end of said super-heater and communicating with the space between said super-heater and said drier casing; means to deliver material to the space between said super-heater and said drier casing; means to maintain the high temperature of said super-heater including said partitions and means comprising a cone and a plurality of deflecting plates secured to said partitions to convey the partly dried material to the interior of said super-heater from said space; means to deliver the dried material from said super-heater; and means to rotate said super-heater and said drier casing to dry said material.

10. In an apparatus of the character described the combination of a super-heater comprising an inner drum; a drier comprising a casing secured to said drum and spaced therefrom to provide a plurality of passages in closed communication with the interior of said drum at one end thereof for rotatably moving material therein; a draft chamber encompassing said drum at the other end thereof and communicating with the passages of said casing; an inlet in said chamber for the material to be dried; means to positively move said material in one direction in said passages; means to positively move said material in an opposite direction in said drum; an outlet for the dried material; means to direct hot gases through said drum and passages in a direction opposite to the travel of said material; and means to rotate said drum and casing.

11. In an apparatus of the character described the combination of a super-heater comprising an inner drum; a drier comprising a casing circumjacent to said drum and spaced therefrom by a plurality of longitudinally extending partitions disposed obliquely between said drum and cas-

ing to provide a plurality of passages communicating with the interior of said drum at one end thereof, said partitions and passages constituting means for rotatably moving material therein; a draft chamber encompassing said drum at the other end thereof and communicating with the passages of said casing; an inlet in said chamber for the material to be dried; means disposed on said partitions to move said material in one direction in said passages; means to move said material in an opposite direction in said drum; an outlet for the dried material; means to direct hot gases through said drum and passages in a direction opposite to the travel of said material; and means to rotate said drum and casing.

12. In an apparatus of the character described the combination of a super-heater comprising an inner drum; a drier comprising a casing secured to said drum and spaced therefrom by a plurality of longitudinally extending partitions disposed obliquely between said drum and casing to provide a plurality of passages communicating with the interior of said drum at one end thereof, said partitions and passages constituting means for rotatably moving material therein; a draft chamber encompassing said drum at the other end thereof and communicating with the passages of said casing; an inlet in said chamber for the material to be dried; means comprising a plurality of cleats disposed on said partitions to move said material in one direction in said passages; means to move said material in an opposite direction in said drum; an outlet for the dried material; means to direct hot gases through said drum and passages in a direction opposite to the travel of said material; and means to rotate said drum and casing.

13. In an apparatus of the character described the combination of a draft chamber having an annular casting associated therewith; a drier casing provided with an annular flange circumjacent said casting and provided with a plurality of bolts; a second annular casting provided with a plurality of apertures adapted to be engaged by said bolts, said second casting associated with said drier casing; and means associated with said draft chamber for adjusting said second casting relatively to said chamber.

14. In an apparatus of the character described the combination of a stationary draft chamber having an annular casting associated therewith; a rotatable drier casing provided with an annular flange circumjacent said casting and provided with a plurality of bolts; a second annular casting provided with a plurality of apertures adapted to be engaged by said bolts, said second casting associated with said drier casing for rotation therewith and means associated

with said draft chamber for adjusting said second casting relatively to said chamber while said casing is rotating.

15. In an apparatus of the character described the combination of a draft chamber having an annular casting associated therewith; a drier casing provided with an annular flange circumjacent said casting and provided with a plurality of bolts; a second annular casting provided with a plurality of apertures adapted to be engaged by said bolts; said second casting adjustably associated with said drier casing and coacting with said first named casting to provide a joint; and means carried by said chamber to maintain said joint substantially gas tight.

16. In an apparatus of the character described the combination of a stationary draft chamber having an annular casting associated therewith; a rotatable drier casing provided with an annular flange circumjacent said casting and provided with a plurality of bolts; a second annular casting provided with a plurality of apertures adapted to be engaged by said bolts, said second casting associated with said drier casing for rotation therewith; and eccentric means associated with said draft chamber for adjusting said second casting relatively to said chamber while said casing is rotating.

17. In an apparatus of the character described the combination of a draft chamber having an annular casting associated therewith; a drier casing provided with an annular flange circumjacent said casting and provided with a plurality of bolts; a second annular casting provided with a plurality of apertures adapted to be engaged by said bolts, said second casting associated with said drier casing; and means including a roller eccentrically mounted with respect to said chamber coacting with said second named casting for adjusting the same relatively to said chamber.

18. A rotating dryer comprising inner and outer drums spaced by a plurality of continuous partitions extending the length of said outer drum, said drums so associated as to provide a passageway in each for hot gases, said passageways including said partitions adapted to so positively convey material therethrough to be dried that the heat from said gases is conserved.

19. A rotating dryer comprising inner and outer drums devoid of heat insulation and spaced by a plurality of continuous partitions extending the length of said outer drum, said drums so associated as to provide a passageway in each for hot gases, said passageways including said partitions adapted to so positively convey material therethrough to be dried that the heat from said gases is conserved.

20. A rotating dryer comprising inner and outer drums spaced by a plurality of partitions continuously extending therebetween throughout the length of the outer drum, said drums so associated as to provide a passageway in each for hot gases, said passageways including said partitions adapted to so positively convey material to be dried from the outer drum into the inner drum that the heat from said gases is conserved.

21. A rotating dryer comprising an inner drum provided with a plurality of spaced flights and an outer drum spaced from said inner drum by a plurality of continuous partitions extending the length of said outer drum, said drums so associated as to provide a passageway in each for hot gases, said passageways including said partitions and said flights adapted to so positively convey material therethrough to be dried

that the heat from said gases is conserved within the inner drum.

22. A rotating dryer comprising an inner and an outer drum so spaced by a plurality of partitions continuously extending therebetween throughout the length of said outer drum, and so associated as to provide a passageway in each for hot gases, said passageways adapted to so positively convey material therethrough to be dried that the high temperature stage of the drying takes place within the inner drum the material in the outer drum being so conveyed to and into the inner drum as to undergo processing at a lower temperature thus absorbing heat escaping from, and returning the same to, the high temperature zone.

In testimony whereof I affix my signature.

LAWRENCE B. WEST.