Dec. 18, 1923. 1,477,823

A. J. GRINDLE

ROTARY DRIER

Filed Dec. 30, 1921 3 Sheets-Sheet 1

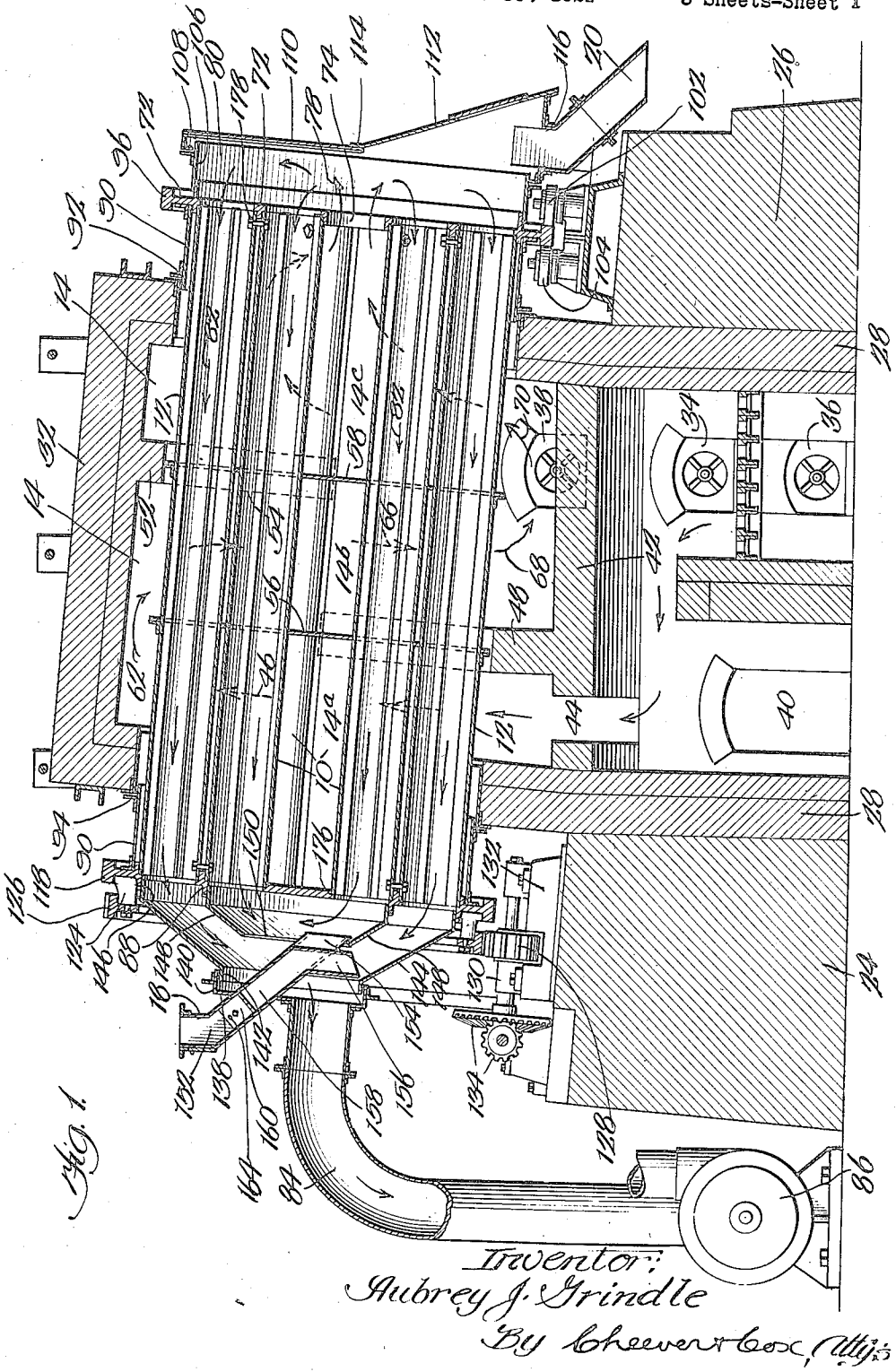


Fig. 1.

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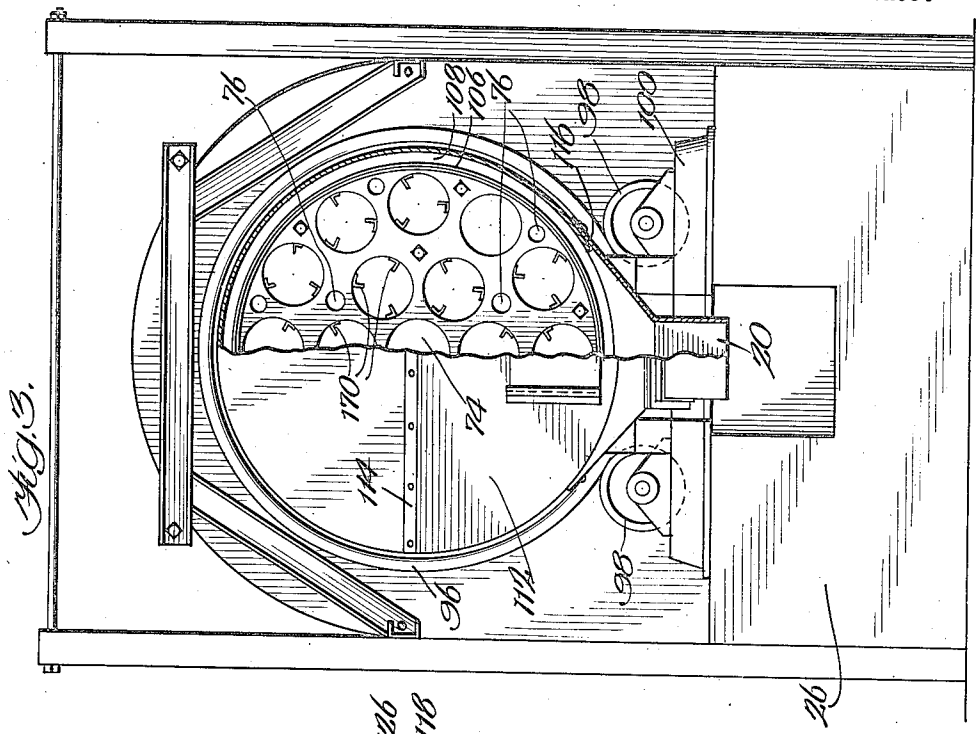


FIG. 3.

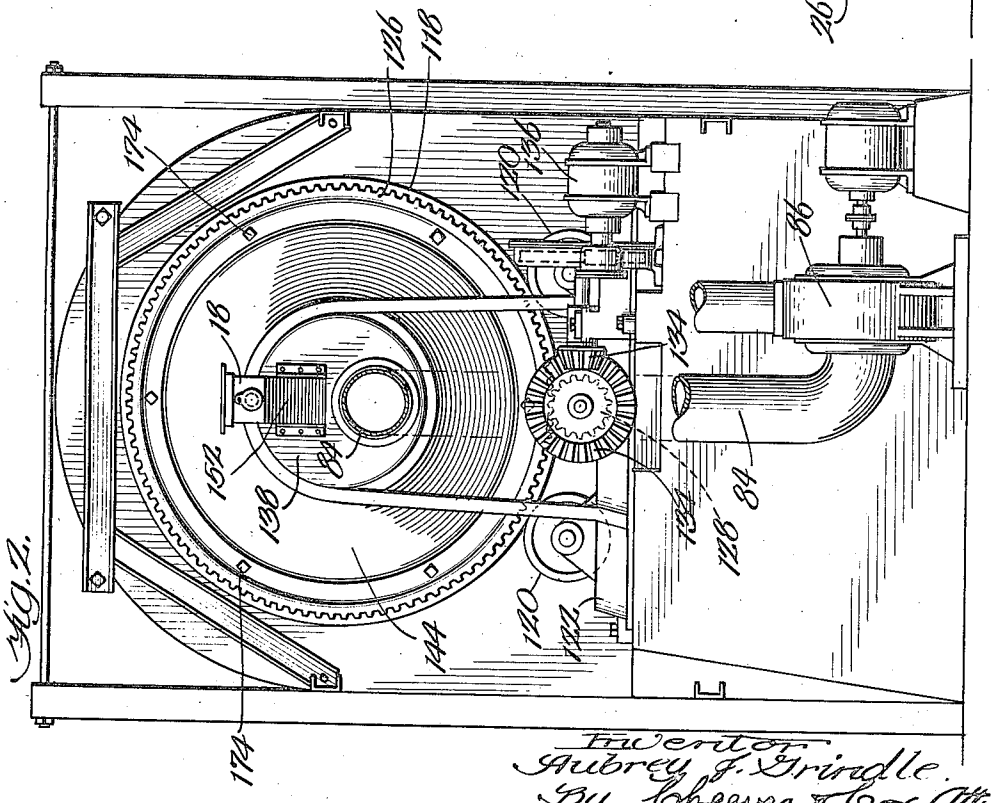


FIG. 2.

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Fig. 6.

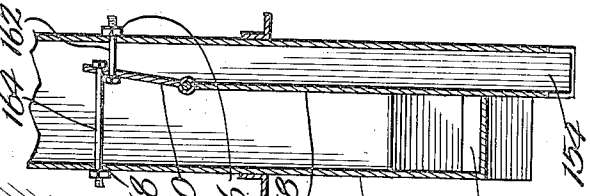


Fig. 5.

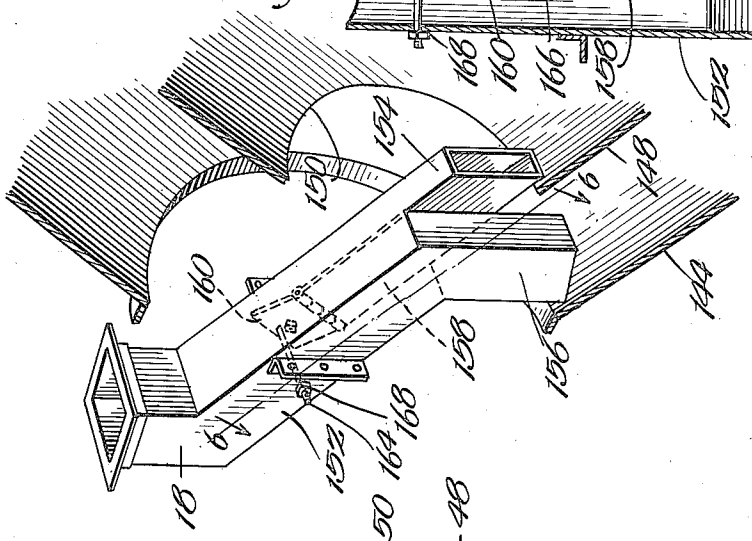
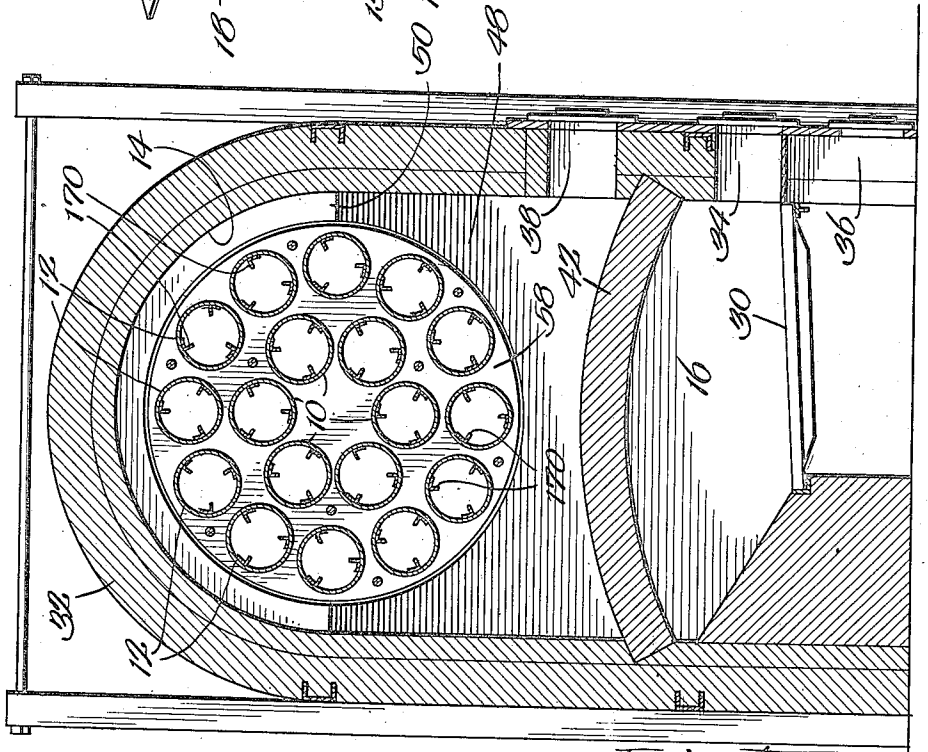


Fig. 4.



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Patented Dec. 18, 1923. 1,477,823

UNITED STATES PATENT OFFICE.

AUBREY J. GRINDLE, OF CHICAGO, ILLINOIS, ASSIGNOR TO GRINDLE FUEL EQUIPMENT COMPANY, OF HARVEY, ILLINOIS, A CORPORATION OF ILLINOIS.

ROTARY DRIER.

Application filed December 30, 1921. Serial No. 525,869.

To all whom it may concern:

Be it known that I, AUBREY J. GRINDLE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Rotary Driers, of which the following is a specification.

This invention is a drier mechanism for use in removing the moisture from any sort of ground or crushed material, such as sand, stone, coal, and the like. In this art there have been a number of devices employing very long cylinders, through which the material travels for the purpose of having heat applied to it to try out the moisture. These devices occupy a very large amount of floor space and therefore require payment of excessive rental, at points where rent is important, over what should be required in taking care of a machine to do the necessary work.

The object of this invention is to provide a machine of the same or greater drying capacity than machines in the prior art, in which the material to be dried occupies a much higher vertical, and therefore less expensive, space than in machines of the prior art.

The invention consists in a machine capable of attaining the foregoing objects, which is less expensive to make, more efficient in operation and less liable to get out of order than devices heretofore known in the art. The invention further consists in many features and details of construction which will be hereafter more fully set forth in the specification and claims.

Referring to the drawings, in which like numerals designate the same parts throughout the several views—

Figure 1 is a side elevation, largely in section, of mechanism illustrating this invention in its preferred form;

Figure 2 is an end view taken from the left hand side of Figure 1;

Figure 3 is a corresponding view, partially in section, taken at the right hand end of Figure 1;

Figure 4 is a vertical sectional detail end view taken at approximately the center of Figure 1;

Figure 5 is a perspective view showing the chute for conducting the material to be dried into the machine; and

Figure 6 is a sectional detail plan view on approximately the line 6—6 of Figure 5.

In order to give the reader a general conception of the device before going into any details whatever, it may be stated that the mechanism includes a plurality of groups of hollow pipes 10 and 12, so arranged as to be bodily rotatable as a group inside the upper hot air chamber 14 of a furnace construction, heated by any suitable means from the fire chamber 16, the material to be dried being passed through the sets of tubes 10—12, entering them through an intake funnel 18 and being finally delivered through a spout 20. The invention consists broadly in the arrangement of the tubes 10—12 and the arrangement of the hot air passages for supplying the heat to these tubes so that a large number of comparatively short tubes is used, arranged in a relatively high space.

In the particular embodiment of the invention here illustrated, the whole mechanism is arranged between and over two main foundation blocks 24 and 26 having between them a conventional form of heating furnace, having the customary vertical walls 28 lined in conventional manner with refractory material so that heat produced in any sort of manner in the lower fire box 16, as for instance by coal or other material burned on the fire grate 30, may pass about inside of this furnace and up as high as the arch 32, thus fully heating all parts of the air chamber 14, without injuring the exterior walls of the furnace. The drawing shows conventionally the fire door 34, the ash door 36 and clean-out doors 38 and 40. The interior of the furnace is provided with a conventional form of arch 42 over the fire chamber 16 having at one end a perforation 44 in the form of a slot extending entirely across the furnace, through which heated gases may pass from the chamber 16 upward towards the tubes 10 and 12, as indicated by the arrows 46. Rising from this arch 42 and adjacent to this passage 44 is a wall 48 enclosing the lower circumferential portion of the body of tubes 10—12, and extending, as shown, part way up outside them to the point 50.

Similarly, there is formed on the top interior wall of the hot air chamber 14 a depending wall member 52 having branches

54 extending circumferentially around the general body of tubes 10—12 and extending downward to approximately the center line 50. This wall 54 is placed as shown in Figure 1, intermediate between the wall 48 and the outside vertical wall of the furnace chamber, and in that part of the chamber 14 to which the passage 44 does not deliver heated gases. The body of tubes 10—12 mounted in general cylindrical form, as described hereafter in detail, is provided with two radially extending baffle plates 56 and 58 closing the spaces between the tubes 10 and 12 and located respectively in vertical alignment with the two walls 48 and 52 heretofore referred to, the result being that heated air delivered from furnace chamber 16 through opening 44 travels upward as indicated by the arrows 46 around the exterior surfaces of the tubes 10 and 12 in a passageway 14^a, thence turns at the arrow 62 into a corresponding passageway 14^b and travels downward in this passageway, as indicated by the arrow 66 until it closely approaches the top of the arch 42, where it turns, as indicated by the arrows 68 and 70 into a rear chamber 14^c, which is defined in its rear end by a metallic head 72 provided with one central perforation 74, and preferably but not necessarily with additional smaller perforations 76 through which the heated gases escape, as indicated by the arrow 78, into a circular chamber 80, in which the gases which have heretofore been outside of the pipes 10 and 12 turn to the interior of the pipes and travel, as indicated by the various arrows 82 through these pipes, to the front end of the machine, where they are drawn out through the pipe 84 under the action of suitable propelling means, as for instance, the suitably driven fan 86.

The left hand end of the passage 14^a heretofore referred to is closed by a head 88 corresponding to the head 72. Each of these heads 72 and 88 constitutes the end support for the purpose of holding the tubes 10 and 12 rigidly in approximately the position shown in Figure 4, in which a certain number of the tubes, viz, those designated 10, occupy the center of the generally cylindrical group of tubes, while the remaining tubes 12 are arranged around these central tubes 10. Each of the heads has projecting from it towards the furnace structure described, tubular members 90 which are rotatable at the points 92 and 94 respectively inside suitable perforations formed for them in the adjacent vertical furnace walls. The fit at this point in each case is such that the general cylindrical body of tubes is freely rotatable within the furnace end walls but no substantial amount of heat in the upper furnace chamber 14 can escape to the open air, and conversely, no substantial amount of air can be pulled from outside into the interior of the furnace chamber 14 when the device works partially under a vacuum as it does through the agency of the fan 86 heretofore described.

Each of the heads 72 and 88 is in fact a wall having an exterior circumferential tire. The tire 96 of head 72 simply rests on and rolls against the circumference of anti-friction rollers 98 suitably disposed as shown in Figure 3 on brackets 100 rising from base block 26. This same bracket also carries a pair of rollers 102 and 104 engaging opposite sides of the tire 96 so as to hold the entire tube mechanism against longitudinal movement. This is particularly necessary in the case shown, in view of the fact that the tubes 10—12 are inclined downwardly from left to right, as shown in Figure 1, this for reasons which will appear hereafter in the description of the travel of the material being dried.

Extending from the right hand end of head 72 is a hollow cylindrical member 106 rigid with the head and rotatable inside the enclosing flange 108 on rear plate 110 forming the rear wall of the chamber 80 heretofore described. As before, the fit between the cylinder 106 and the flange 108 is sufficiently tight to prevent the free passage of either hot gas or external air as the cylinder rotates. Plate 110 is outwardly flared in its lower portion in the angularly disposed plate 112 which is, in the particular case here illustrated, a separate plate attached at the point 114. Rigidly secured to the bottom of this plate 112 by any suitable means, as for instance the structure shown at 116, is the downwardly inclined material discharge spout 20 heretofore referred to.

Head 88 supporting the left hand end of the tubes 10 and 12 is bordered by a tire 118 identical in character with the tire 96, resting upon anti-friction rollers 120 carried on brackets 122 from the base block 24.

Parallel with tire 118 and rigidly secured in position by suitable brackets 124, which extend from the head 88 just inside the tire 118, is an annular gear ring 126 having gear teeth meshing with the pinion 128 mounted on a shaft 130 suitably journaled in a bracket 132 on the base block 24. This shaft 130 is driven by a conventional form of gearing 134, not entering into this invention, driven by any suitable source of power, in the particular case here illustrated the electric motor 136, the result being that when the motor is in operation, thereby rotating the pinion 128, the gear ring 126 is rotated and consequently the entire cylindrical body of tubes 10—12 is rotated about the central axes of the heads 72 and 88 and inside the furnace chamber 14. The upper or intake end of pipe 84 heretofore referred to, enters and is rigidly secured to a stationary vertical plate 138 positioned as

shown in Figure 1, concentrically with the axes of the heads 72 and 88 and at a distance from the left hand ends of the pipes 10—12. This plate 128 has projecting from it a tubular flange 140 turned towards a cylinder mechanism and having its interior circumference concentric with the axes of the heads 72 and 88. Rotatably mounted inside of this flange 140 is the flange end 142 of a conical cap 144 rigidly connecting at 146 with the head 88 and at the outer circumference of the body of pipes 12. Concentric with the conical cap 144 and connecting with the head 88 in a circle intermediate between the group of pipes 10 and the group of pipes 12 is another conical cap 148 having at its contracted end a material intake port or opening 150.

Extending through the plate 138 and above the pipe 84 is a downwardly inclined material intake chute 152 terminating at its upper end in the intake opening 18 heretofore referred to. The lower or delivery end of this chute 152 is divided so as to form two discharge spouts, one of them, 154, passing through the perforation 150 heretofore referred to and being therefore adapted to deliver material to be dried inside the cap 148 and within reach of the left hand ends of the pipes 10. The other discharge spout from chute 152, designated 156, leads down outside of and entirely clear of the cap 148 and is adapted to deliver material to be dried into direct contact with the interior of cap 144 so that it readily travels into the intake ends of the pipes 12.

Adjustable means is provided in the chute 152 for regulating and controlling the amount of material to be dried passing from hopper 18 down the chute. In the particular case here illustrated, this mechanism comprises a central partition wall 158 clearly shown in Figures 5 and 6, separating the two spouts 154 and 156, there being at the upper end of this partition wall a guide door or wing 160 having its free, swinging end pointed toward the downwardly passing material to be dried going through chute 152 and adjustable in different angular positions by means of the bolts 162 and 164 extending outside of opposite sides of the chute 152, and they are controllable by properly adjusting the nuts 166 and 168 in the manner entirely obvious to any mechanic. By changing the angular position of this door 160, the amount of material to be dried passing from chute 152 into spouts 154 and 156 may be regulated at the will of the operator.

Each tube 10 and 12 is preferably, but not necessarily, equipped on its interior circumference with a plurality of projecting members, in the particular case here illustrated, angle irons 170 adapted to engage material to be dried which is passing through the tubes and carried around with the tube as the tube is moved, thereby aiding in bringing all the material which passes through the various tubes, as hereafter described, into contact with the heated air.

The tubes 10 and 12, and the heads 72 and 88 are rigidly held as a unitary structure for rotating purposes in the manner hereafter described, through the agency of suitable tie rods 174.

In assembling the pipes 10 and 12 between the heads, the upper ends of the pipes, as viewed in Figure 1, are first placed in position against the head 88, resting in the annular recesses 176, then the head 72 is put in place on the opposite ends of the pipes and the bolts 178 are put in place, thus limiting the movement of the head 72 toward the head 88 under the action of the tie rods 174.

In the operation of the device, material to be dried is fed, preferably in regulated quantities, under control mechanism not entering into this invention, into the hopper 18, from which it flows down the chute 152 past the dividing door 160, part of it going to spout 154 and part of it to spout 156. As a result of this, the material to be dried should be divided aproximately in proportion to the carrying capacities of the tubes 10 and 12, and delivered to the respective ends of each group. As this is being done, the motor 136 is operated to rotate this generally cylindrical body of pipes in front of these discharge spouts 154 and 156, with the result that each of the tubes 10, as it passes through its lower position, takes up some of the material to be dried and carries it along as it rotates about the central axes of the heads 72—88. Due to this rotation of each pipe, combined with the action of the angles 170 and the fact that all of the pipes incline downwardly from left to right, the material to be dried slowly passes through these pipes from left to right until finally it is delivered from the right hand ends of the pipes into the discharge spout 20.

There is never in any pipe sufficient material to be dried to seriously obstruct the passage of heated gas through the pipe, so that there is nothing to prevent the heated air from passing, as indicated by arrows 82, as heretofore described, through these pipes while the material to be dried is passing as described.

As the body of pipes rotates in the heated air delivered through port 44 and following the passages 14^a, 14^b and 14^c, the hot air so traveling contacts with the outside of the various pipes but does not come in direct contact with the material to be dried, which is within the pipes, thereby, while the air is excessively hot, doing away with the possibility of combustion between the air and a

material to be dried which is combustible. By the time the air has passed through passages 14ª, 14ᵇ, and 14ᶜ, and has started to go through the pipes, as indicated by the arrows 82, in the direction contrary to the movement of the material to be dried, the drying air is cool enough so that this danger of combustion does not exist, even though a material like coal may be passing through the tubes for the purpose of being dried.

As in the construction of sky scraper office buildings and the like air is inexpensive, so in this device it costs practically nothing for ground space and rent therefor to carry the heating device up into the air above the floor of the factory wherein the device is used. By the construction here set forth, it is possible within reasonable limits, to make the general cylinder pipes 10 and 12 as large as may be desired and make the lengths of the pipe and consequently the length of the entire machine very short. Again, a large number of pipe portions is inserted in the same body of passing hot air, thereby insuring the consumption and utilization of a very much larger proportion of the heat in the air traveling from passage 44 to pipe 84 than is possible where, as in the prior art, the heated air only comes in contact with one or two pieces of pipe. In actual practice, the reduction in temperature between the hot air intake port 44 and the pipe 84 is very much greater than is possible in any machine of the prior art within my knowledge.

Another important advantage of the device lies in the fact that the construction permits the use of very large size tubes in proportion to the amount of material to be dried traveling through them, thereby giving increased space for the hot air to travel. This materially reduces the amount of dust of material to be dried which is picked up by the traveling air and carried out through the fan 86, it being well understood in the art that such removal of dust of material to be dried is a serious financial loss to the user of the machine. The reason why the passing hot air does not pick up this dust is because it does not have to travel in the large pipes at such a high velocity as is required when traveling through the small pipes which are of necessity used in the prior art machines.

It should be understood that the particular structure and arrangement of baffle plates and walls for leading the hot air upward and downward in the vertical plane over the rotating pipes is not material so long as air is in fact forced to travel in vertical planes under sufficient control to perform the functions desired, as heretofore described.

What I claim is:

1. In mechanism of the class described, a group of generally horizontal parallel tubular members arranged in a group so that they are spaced one from the other and the group can be rotated as a group about a fixed axis, means for rotating the group about said axis, means supplying material to be dried to the ends of the tubes at one end of the group and for removing said material at the opposite end, means regulating the division of material to be dried between two different tubes of the group, and means passing heated air first in one direction and then in the opposite direction across the outsides of all of the tubes as the group rotates, for the purposes set forth.

2. In mechanism of the class described, a group of generally horizontal parallel tubular members arranged in a group so that they are spaced one from the other and the group can be rotated as a group about a fixed axis, means for rotating the group about said axis, means supplying material to be dried to the ends of the tubes at one end of the group and for removing said material at the opposite end, means regulating the division of material to be dried between two different tubes of the group, and means passing heated air across the outsides of all the tubes then through the tubes over the passing material to be dried, as the group rotates, for the purposes set forth.

3. In mechanism of the class described, a group of generally horizontal parallel tubular members arranged in a group so that they are spaced one from the other and the group can be rotated as a group about a fixed axis, means for rotating the group about said axis, means supplying material to be dried to the ends of the tubes at one end of the group and for removing said material at the opposite end, means regulating the division of material to be dried between two different tubes of the group, and means passing heated air first in one direction and then in the opposite direction across the outsides of all the tubes, then through the tubes over the passing material to be dried, as the group rotates, for the purposes set forth.

4. In mechanism of the class described, a group of generally horizontal parallel tubular members arranged in a group so that they are spaced one from the other and the group can be rotated as a group about a fixed axis, means for rotating the group about said axis, means supplying material to be dried to the ends of the tubes at one end of the group and for removing said material at the opposite end, means regulating the division of material to be dried between two different tubes of the group, and means passing heated air across the outsides of all the tubes then through the tubes over the passing material to be dried, and in a direction opposite to its motion, as the group rotates, for the purposes set forth.

5. In mechanism of the class described, a group of generally horizontal parallel tubular members arranged in a group so that they are spaced one from the other and the group can be rotated as a group about a fixed axis, means for rotating the group about said axis, means supplying material to be dried to the ends of the tubes at one end of the group and for removing said material at the opposite end, means regulating the division of material to be dried between two different tubes of the group, and means passing heated air first in one direction and then in the opposite direction across the outsides of all the tubes, then through the tubes over the passing material to be dried and in a direction opposite to its motion, as the group rotates, for the purposes set forth.

6. In mechanism of the class described, a group of parallel pipes arranged about a fixed center, another group of pipes arranged around the first group, perforated heads supporting opposite ends of the pipes, spacing them apart and closing the end spaces between them, a furnace chamber enclosing the pipes between said heads, mounting for the heads to rotate the pipes as a group inside the furnace, means so rotating the group, means conducting hot gas from the furnace first across the outsides of the pipes, then through the pipes and then out of the furnace and means passing material to be dried through the pipes as they are rotated in the furnace, for the purposes set forth.

7. In mechanism of the class described, a group of parallel pipes arranged about a fixed center, another group of pipes arranged around the first group, perforated heads supporting opposite ends of the pipes, spacing them apart and closing the end spaces between them, a furnace chamber enclosing the pipes between said heads, mounting for the heads to rotate the pipes as a group inside the furnace, means so rotating the group, means conducting hot gas from the furnace first across the outsides of the pipes, then through the pipes and then out of the furnace, means passing material to be dried through the pipes as they are rotated in the furnace, and means apportioning the entering material between the central and outer groups of pipes, for the purposes set forth.

In witness whereof, I have hereunto subscribed my name.

AUBREY J. GRINDLE.