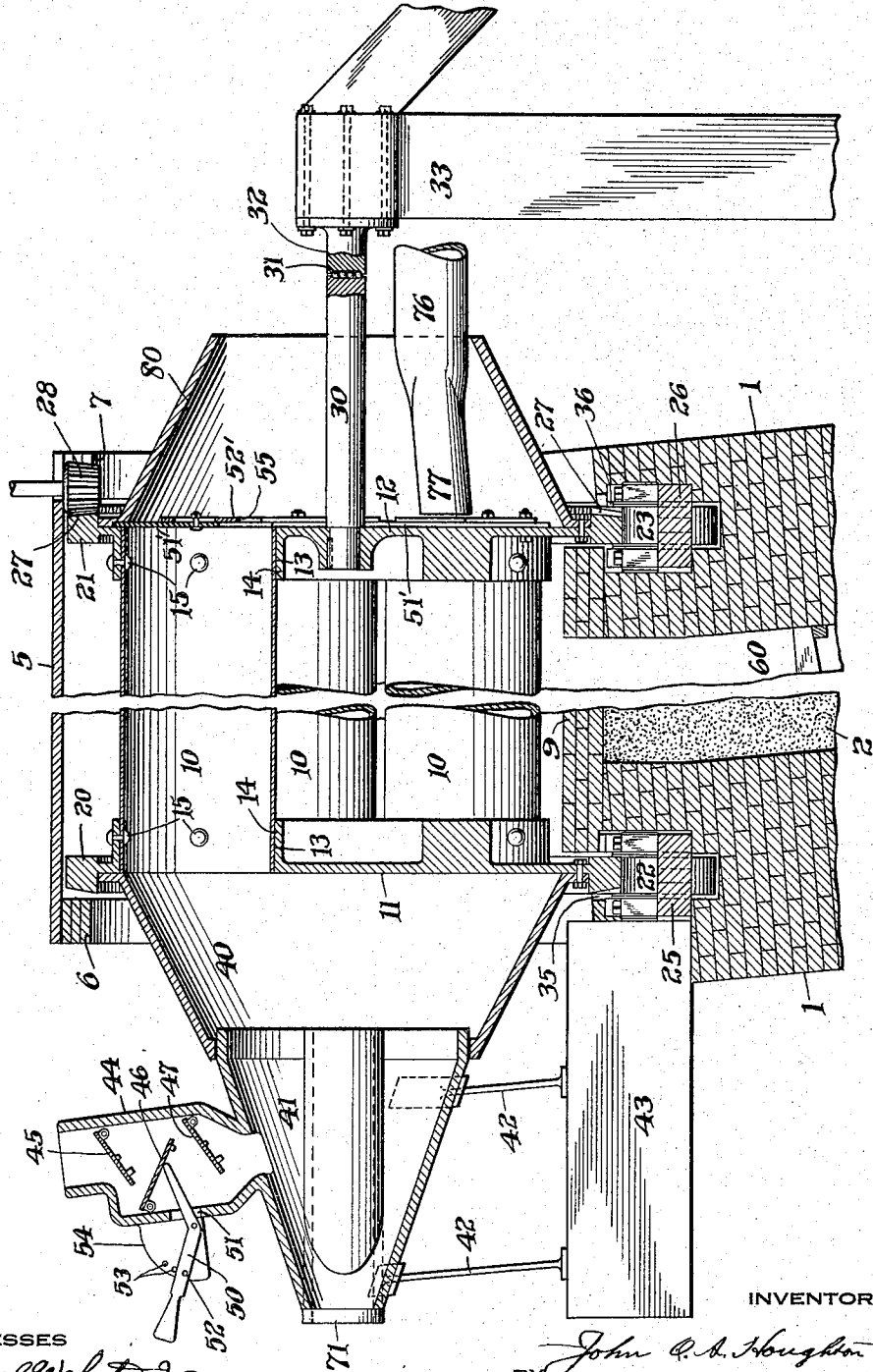


J. Q. A. HOUGHTON.
ORE DRYING APPARATUS.
APPLICATION FILED OCT. 19, 1914.

1,166,909.

Patented Jan. 4, 1916.
3 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

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Carrie E. Kleinfelder

INVENTOR

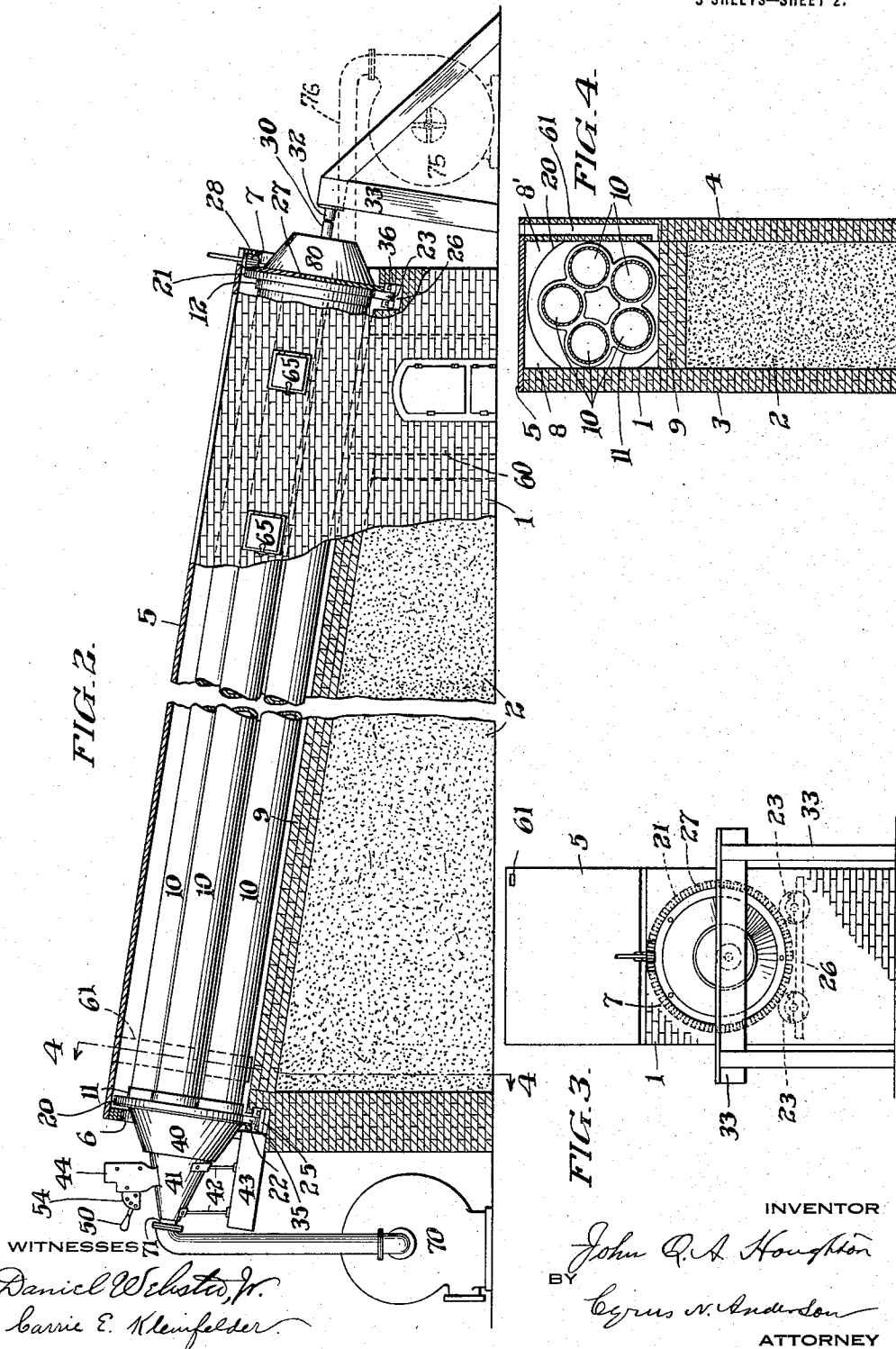
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3 SHEETS—SHEET 3.

FIG. 6.

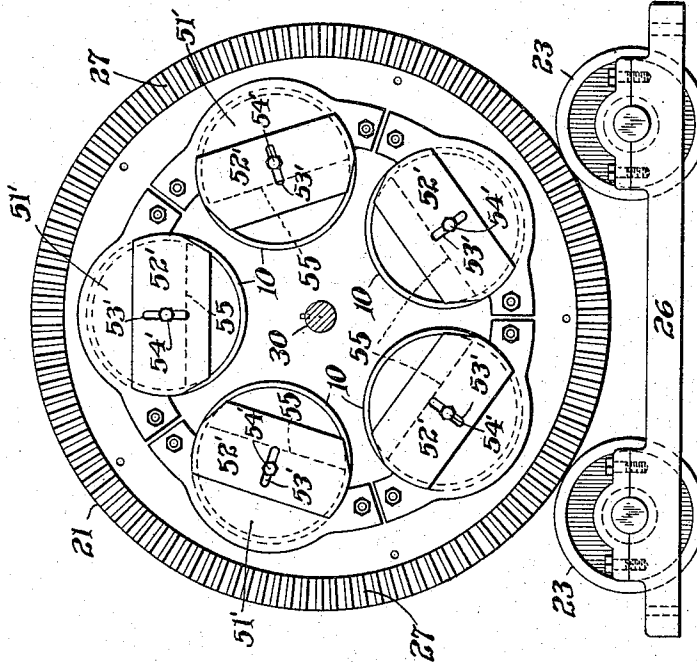
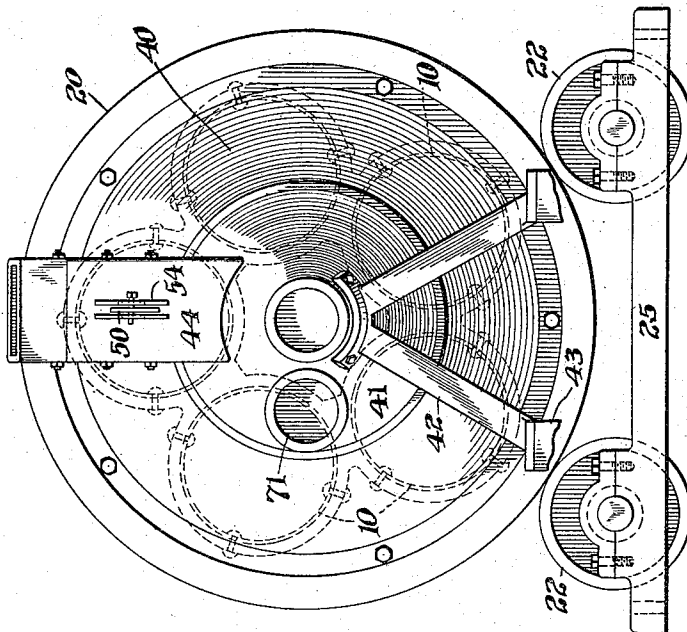


FIG. 5.



WITNESSES

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UNITED STATES PATENT OFFICE.

JOHN Q. A. HOUGHTON, OF LOWELL, VERMONT.

ORE-DRYING APPARATUS.

1,166,909.

Specification of Letters Patent.

Patented Jan. 4, 1916.

Application filed October 19, 1914. Serial No. 867,408.

To all whom it may concern:

Be it known that I, JOHN Q. A. HOUGHTON, a citizen of the United States, and a resident of Lowell, county of Orleans, State of Vermont, (temporarily residing in the city of Philadelphia, State of Pennsylvania,) have invented certain new and useful Improvements in Ore-Drying Apparatus, of which the following is a specification.

My invention relates to ore drying apparatus, suitable also for drying other similar materials, in which the ore or other material to be dried is contained in revoluble containers which are subjected to the action of heat.

One of the objects of my invention is to provide a construction such that products of combustion may be carried from the fire box or fire chamber without contacting with the material being dried.

A further object of my invention is to provide an improved construction of feeding means whereby the passage of the ore or similar material through the feeding chute to the feed box may be controlled.

A still further object of my invention is to provide an improved construction of means whereby the containers for drying the ore or similar material may be revolved.

A still further object of my invention is to provide an improved construction of means for supporting the revoluble drying means.

Another object of my invention is to provide an improved construction of means for removing vapors and gases from the revoluble containers of the ore or similar material.

Other objects and advantages of my invention will be referred to specifically in the description of my invention which follows or will be apparent therefrom.

In the accompanying drawings to which reference should be had for a full and clear understanding of my invention I have illustrated one form of a convenient embodiment of apparatus embodying my invention, but it will be understood that the same is susceptible of embodiment in other forms within the scope of my invention and without departing therefrom or from the scope of the claims.

Figure 1 is a longitudinal sectional view of an apparatus embodying my invention, showing the same enlarged and showing the central portion thereof broken away; Fig. 2 is a view partly in vertical longitudinal

section and partly in side elevation; Fig. 3 is an end elevation of an apparatus embodying my invention, the blower shown in Fig. 2 being omitted; Fig. 4 is a transverse section taken on the line 4—4 of Fig. 2; Fig. 5 is an elevational view of the front end of the apparatus embodying my invention with the suction pump shown in Fig. 2 omitted, and the foundation and supporting brick structure shown in said figure also omitted; and Fig. 6 is a similar view of the rear or discharge end of the apparatus, the supporting brick structure and foundation work being omitted as well as certain other parts of construction shown in Fig. 2.

Referring to the drawings, 1 designates the brick supporting structure of the apparatus, the central interior part of which is filled with foundation material, such as dirt 2. The brick material is extended upwardly upon opposite sides of the apparatus, as shown at 3 and 4. The top of the brick structure is covered or inclosed by means of a flat plate 5 of iron or other suitable material which is supported upon the upper edges of the sides 3 and 4 of the brick structure. The front and rear ends of the sides 3 and 4 of the brick structure are arched, as indicated at 6 and 7, so that the triangular spaces 8 and 8' indicated in Fig. 4 of the drawings are closed to prevent the products of combustion from passing out of the chamber inclosed by the bottom part 9 of the brick structure, the sides 3 and 4 thereof, and the covering plate 5, through the triangular spaces below and at the opposite ends of the plate 5 which spaces are indicated at 8 and 8' already referred to.

10 designates a series of tubes extending longitudinally of the drying apparatus the opposite ends of which are secured in and supported upon heads 11 and 12, said heads being provided with flanged holes 13 extending therethrough through which holes the tubes 10 pass as shown quite clearly in Fig. 1 of the drawings. These tubes are secured to the flanges 14 surrounding the said holes by means of rivets 15. These heads 11 and 12 are each provided with rims 20 and 21 which rims respectively rest upon wheels or trucks 22 and 23. The wheels 22 and 23 are revolutely supported upon cross members 25 and 26 supported upon and within the brick work as clearly shown in Figs. 1, 2 and 3 of the drawings.

The rim 21 is provided with beveled gear

teeth 27 with which engages a beveled pinion 28 the latter being driven and operating to cause revolution of the head 12 and consequently the series of tubes 10, the head 20 and the parts which are rigidly connected thereto. Although not shown, it will be understood that preferably means should be provided for varying the speed of rotation of the beveled gear 28 and consequently of the parts of the apparatus driven thereby. Any suitable change speed means may be employed for that purpose.

The head 12 has secured thereto a central short stub shaft 30 the lower or outer end of which abuts against a series of bearing rollers 31 which are interposed between the said lower or outer end and the inner upper end of an abutment 32 which is supported upon the upper end portion of a braced supporting structure 33.

By reference to Fig. 2 it will be observed that the series of tubes 10 are inclined to a horizontal line, the inclination being approximately seven degrees. It is apparent, therefore, that unless some means were provided to prevent it the said tubes when revolved would tend to slide to the right. The shaft 30 abutting against the rollers 31 supported in the manner shown and described prevents such downward sliding movement to the right, having reference to Figs. 1 and 2 of the drawings. The rollers 31 against which the outer lower end of the short or stub shaft 30 projects coöperate with the wheels 22 and 23 so as to reduce friction and thereby reduce the power necessary to effect revolution of the series of drying tubes with the material contained therein and the parts having rigid connection therewith. It may be noted also that by reason of the abutment of the stub shaft 30 against the projecting abutment 32 it is unnecessary that the rims 20 and 21 of the heads 11 and 12 be provided with flanges of any kind to hold the drying apparatus in proper position upon the supporting rolls or wheels 22 and 23.

It will be noted upon reference to Figs. 1 and 2 of the drawings that the rims 20 and 21 occupy what may be termed pockets 35 and 36 in the brick work. These pockets constitute dead air spaces and perform a function to which reference will be hereinafter made.

At the front end of the apparatus I have provided a hood 40 the outer end of which surrounds loosely the inner end of a feed box 41 which is supported upon standards 42 projecting upwardly from a support 43, the latter being supported by any suitable means. The inner end portion of the supporting part 43 is supported as shown in Figs. 1 and 2 of the drawings upon a portion of the brick work of the apparatus.

The feed box 41 is provided with a feed chute 44 having inclined members 45, 46 and

47 extending transversely thereof to control the passage of the material through the chute into the said feed box. The central inclined member 46 is adjustable by means of the pivoted lever 50, the said lever projecting through an opening 51 in the side of the said chute. The handle portion of the said lever is provided with a hole 52 which is adapted to register with holes 53 in the outer curved edge portion of a fan shaped flange 54 secured upon the side of the chute 44 adjacent to the opening 51. The lever 50 may be moved so as to bring the hole 52 into registry with any one of the holes 53 and by means of a pin retained or secured in such position, the inner end of the said lever holding the inclined member 46 in whatever position to which it may have been adjusted.

The material to be dried is introduced into the chute 44 and passes therethrough into the feed box 41 and thence into the revoluble cone 40 and from the latter it passes into the upper ends of the drying cylinders or tubes 10.

By reason of the inclination or sloping position of these tubes the material introduced at the upper ends thereof gradually and slowly slides downwardly toward the lower ends thereof where it is discharged.

In order to retain the material which is being treated within the drying tubes 10 a sufficient length of time to drive the moisture and other vapors, which it is desired to eliminate therefrom, the lower ends of the said tubes are provided with means for partially closing the same. This means consists of closing plates 51' which partially close the ends. It sometimes happens that it is necessary to retain certain material within the tubes for longer periods of time than is found necessary in connection with certain other materials. In order to accomplish this I have provided adjustable closing means 52' which are adjustably secured to the plates 51'. In order to secure the adjustable plates 52' to the plates 51' I have provided the former with slots 53' through which pins 54' project which pins have screw-threaded connection (not illustrated) with the closing end plates 51'. It will be seen, therefore, that these plates 52' may be adjusted so as to vary the open space above or outside of the edges of the plates 51' which edges are indicated by dotted lines 55. The plates 52' should not, however, be adjusted so as to completely close the lower ends of the tubes or cylinders 10. When in the position illustrated in the drawing these adjustable plates 52' obviously will retain the material in the cylinders or tubes for a longer period than if the said adjustable plates were lowered so that their upper edges coincided or were flush with the edges 55 of the plates 51'.

The openings in the lower ends of the tubes above the closing plates are situated

upon what may be termed the inner side portions of the said tubes so that the material is discharged from the said tubes when they are in their uppermost positions and as they approach and leave such positions as will be clear from an examination of Fig. 6 of the drawings. When the tubes or cylinders are in their bottom or lowermost position it will be observed that the openings are at the top side portions of the said tubes so that the material does not discharge therefrom.

In order to supply the heat necessary for heating the tubes 10 and for drying the material therein I have provided a fire box, indicated at 60 in Fig. 2 of the drawings. In this fire box any suitable fuel may be burned. The heated products of combustion travel upwardly into the chamber in which the pipes 10 are located, traveling around the latter and finally escape from said chamber to the flue 61 indicated in dotted lines in Fig. 2 of the drawings. Instead, however, of employing a burning fuel in the fire box 60 I may otherwise heat the chamber in which the tubes or cylinders 10 are situated as by means of an electric heater. In fact, I do not desire to be limited to any specific heating means or specific form of fire box or furnace.

I have provided doors 65 in the side walls of the chamber in which the cylinders or tubes 10 are situated which doors may be opened to permit the cleaning of the tubes and the inside surfaces of the walls of the chamber in which said tubes are situated. If coal or any hydrocarbon fuel should be employed it would most likely become necessary to remove the soot or carbon deposits from the tubes 10 from time to time in order that the full effect of the heat of the products of combustion would be realized upon the said tubes or cylinders.

In order to further assist in the drying of the material in the tubes 10 and withdrawing of the moisture and vapor therefrom I have provided a suction blower 70 having connection with the upper ends of the tubes or cylinders 10 through a suction tube or pipe 71 extending through and being supported upon the feed box 41 as clearly shown and indicated in the drawings. As a matter of fact the tube 71 and the feed box 41 in the specific construction illustrated are integral.

It will be understood, of course, that the feed box 41 is stationary while the hood 40 is revolvable, revolving around the inner larger end of the said box.

In lieu of the suction blower 70 I may employ a blower which is indicated in dotted lines at 75 in Fig. 2 of the drawings for forcing hot dry air upwardly through the pipes or cylinders 10. The air from the blower 75 is conducted through a hollow pipe or tube 76, as clearly indicated, and is dis-

charged through the flattened funnel-like portion 77 into the pipes or cylinders 10. The said flattened portion 77 in which the end of the pipe 76 terminates is of a contour and size substantially equal to the largest dimension of the openings in the lower ends of the tubes 10 above or outside of the closing plates 51' and 52'.

Although I have referred to the suction blower 70 and to the air forcing blower 75 as being used separately or alone it should be understood that these two blowers may be used simultaneously and in conjunction, the blower 70 operating to withdraw the vaporous heated gases from the tubes or cylinders 10 while the blower 75 operates to force hot dry air through the said tubes or cylinders and thereby tends not only to vaporize such moisture as may be contained within the material therein to be dried but also to displace any vapor generated by the heat applied to the external surfaces of the tubes or cylinders 10.

The air which is forced through the tubes or cylinders 10 as they move successively past the flattened funnel-shaped end 77 of the pipe 76 escapes principally through the tube 71 and also partly through the feed chute 44.

The extension of the brick walls so as to extend upon opposite sides of the rims 20 and 21 provides circular spaces in which the said rims are situated. These spaces are filled with air so that they constitute what may be termed dead air pockets which prevent the escape of the hot products of combustion around the outer edges of the said rim and confine the same within the chamber and cause such products of combustion to be discharged through the flue 61. By the construction and arrangement shown it is impossible for the products of combustion to contact at any point with any portion of the material being treated or dried.

It may be noted that as the dry material is discharged from the lower ends of the tubes or cylinders 10 it falls into a hood 80 from which it is conducted in any suitable manner as by a discharge chute or trough which is not shown.

It will be understood that as the series of cylinders or tubes 10 are revolved the material therein, as well as that which may be contained in the hood 40, is agitated which facilitates the drying of the same.

In the construction as illustrated I have provided but one series or group of drying tubes but it should be understood that there may be two or more series or groups of such tubes all situated in a single chamber or else situated in a series of chambers arranged side by side and all of the said chambers being heated from a single source of heat if desired.

I claim:—

1. In a drying apparatus, the combination of a series of tubes, heads having flanged openings therethrough through which the opposite ends of the said tubes project and to the flanges of which the said tubes are secured, the said heads being provided with rims, trucks upon which the said rims are supported, means for causing revolution of the said heads and the said tubes, means for supplying material to be dried to the said tubes, and power means for removing vapors and gases from the said tubes.

2. In a drying apparatus, the combination of a series of tubes, heads having flanged openings into which the opposite ends of the said tubes project and in which openings the said tubes are secured, the said heads having circular rims, trucks upon which the said rims revolve, one of the said rims being provided with gear teeth, a driving gear in engagement with the gear teeth upon the said rim whereby revolution of the said heads and the said tubes may be caused, means for feeding material to be dried to the said tubes, and means for removing moisture from the said material to dry the same.

3. In a drying apparatus, the combination of a plurality of drying tubes, heads having flanged openings extending therethrough into which the opposite ends of the said tubes project and in which openings the said tubes are secured and the said heads being provided with rims, wheels situated within the region of the opposite ends of the said tubes upon which the rims rest whereby the said heads and the parts of the structure supported thereby are supported, one of the said rims being provided with gear teeth upon one side, a driving gear in engagement with the said teeth for driving the said head and the parts of the structure rigidly connected therewith, means for feeding material to be dried to the said tubes, means for supplying heat to the exteriors of the said tubes, and power means for removing vapor from the said tubes to facilitate the drying of the material therein.

4. In a drying apparatus, the combination of a tube or tubes said tubes being supported at an acute angle to a horizontal plane, heads connected to the opposite ends of the said tube or tubes, the said heads being provided with rims, trucks upon which the said rims rest and by which the said heads and the tube or tubes carried thereby are supported, a shaft connected with the lower end of the said tube or tubes, an abutment in

alignment with the said shaft for resisting the downward pressure of the drying tubes and parts rigidly connected therewith, and friction reducing means interposed between the said abutment and the said shaft.

5. In a drying apparatus, the combination of a tube or tubes supported at an acute angle to a horizontal plane, means for supplying material to said tube or tubes to be dried, means for supplying heat to said tube or tubes for drying the material therein, means for causing revolution of said tube or tubes, a member projecting from the lower end of said tube or tubes, an abutment for resisting the thrust of said member, and friction reducing means interposed between said member and said abutment.

6. In a drying apparatus, the combination of a series of circularly arranged tubes, means for supporting said tubes in fixed relation with respect to each other, a stationary feed box, a hood interposed between said feed box and the adjacent ends of said tubes to receive material from said feed box, said hood being rigidly secured to said tubes, means for controlling the feed of material to said feed box, and means for causing revolution of said tubes.

7. In a drying apparatus, the combination of a series of drying tubes circularly arranged, means for securing and supporting the said tubes in fixed relation with respect to each other, means for supplying material to the said tubes, means for causing revolution of the said tubes, means for heating the material in said tubes to dry the same, suction means for removing vapors and gases from the said tubes, and means for forcing air through the said tubes.

8. In a drying apparatus, the combination of a series of tubes circularly arranged, means for securing and supporting the said tubes in fixed relation with respect to each other, a feed box, means for conducting material from said feed box to the said tubes, means for causing revolution of the said tubes, means for heating the material to be dried in said tubes, a tube extending through the said feed box, and a suction device having connection with said tube for withdrawing vapors and gases from the said tubes.

In testimony that I claim the foregoing as my invention I have hereunto signed my name this 8 day of October, A. D. 1914.

JOHN Q. A. HOUGHTON.

In the presence of—

WM. STANLEY,
HENRY F. LOVEJOY.