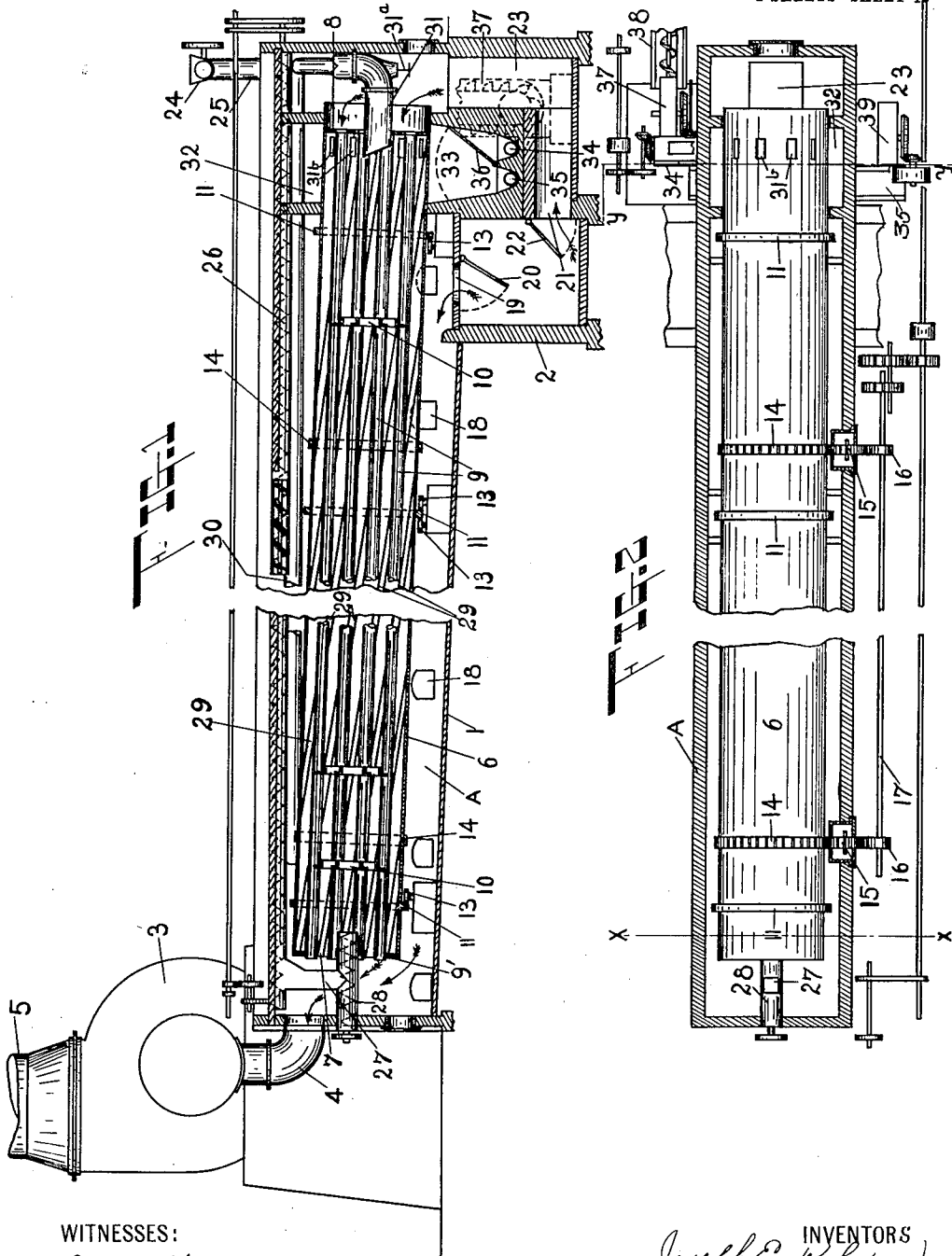


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 DRYING APPARATUS.
 APPLICATION FILED MAY 23, 1908.

910,071.

Patented Jan. 19, 1909.

2 SHEETS—SHEET 1.



WITNESSES:

J. Ray Abbey
 Ralph S. Warfield.

INVENTORS

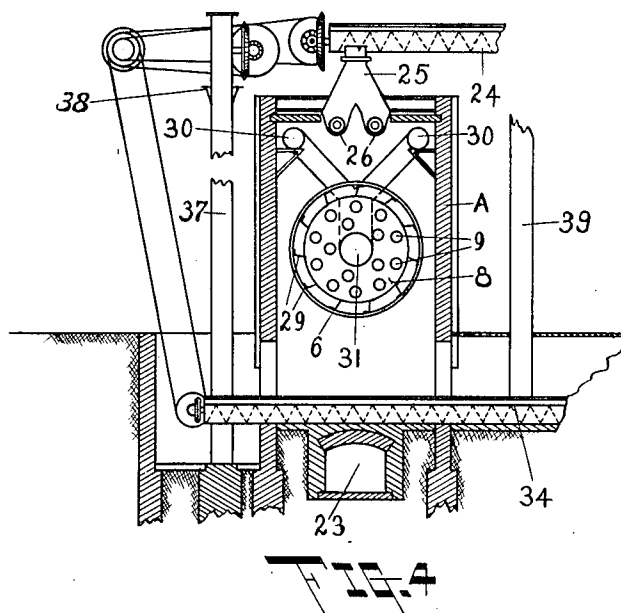
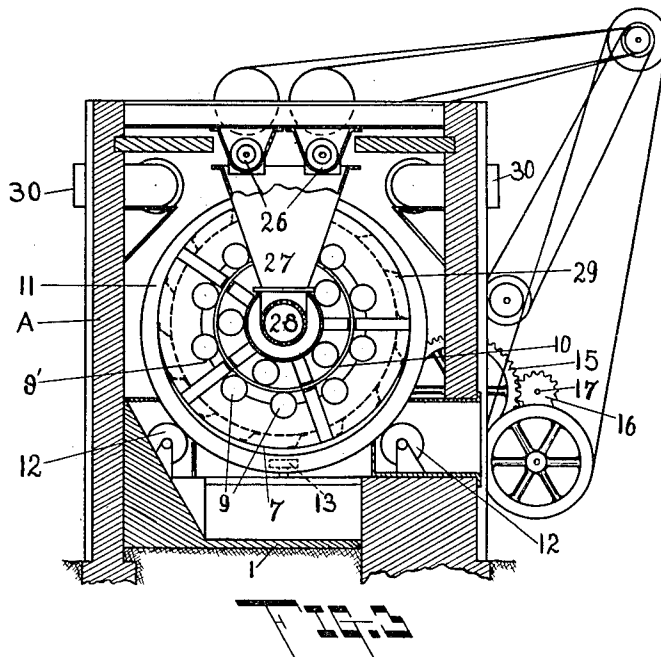
Joseph E. Kohn and
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UNITED STATES PATENT OFFICE.

JOSEPH E. KOHN, OF BAY CITY, AND JOHN B. ROOS, OF OWOSSO, MICHIGAN.

DRYING APPARATUS.

No. 910,071.

Specification of Letters Patent.

Patented Jan. 19, 1909.

Application filed May 23, 1908. Serial No. 434,633.

To all whom it may concern:

Be it known that we, JOSEPH E. KOHN and JOHN B. ROOS, citizens of the United States, residing, respectively, at Bay City, in the county of Bay, State of Michigan, and Owosso, in the county of Shiawassee and State of Michigan, have invented certain new and useful Improvements in Drying Apparatus; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to rotary driers for drying vegetables or other pulp, grains and in fact any wet material which it is desired shall be dried.

One object of our invention is the provision of means for utilizing the heat from stack gases without bringing such gases into contact with the material to be dried.

Another object is the provision of a drier wherein the heat may be applied to the interior and exterior of the drier either simultaneously or otherwise throughout its entire length.

Still another object is the provision of means for controlling the application of heat to the drier.

A further object is the provision of means for imparting a preliminary heating to the material before it is discharged into the drier.

A still further object is the provision of means for preventing contact of the flue or stack gases with the material discharged from the drier.

Another object is the provision of means for returning the material discharged from the drier to the supply of conveying it to any suitable delivery point as desired.

Another object is the provision of means for supplying fresh air to the drying cylinder in order to maintain the air in the cylinder below the saturation point of vapors and imparting a preliminary heating to such air before it is delivered to the cylinder.

Another object is the provision of a single means for creating a circulation of the heating products and air and causing their discharge into the stack.

To these and other ends our invention consists in certain novel features and combinations of parts such as will be more fully described hereinafter and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view through an apparatus embodying our invention, Fig. 2 is a top plan view—partly in section, and Figs. 3 and 4 are cross sectional views taken on lines $x-x$ and $y-y$ respectively of Fig. 2.

The invention comprises a chamber A of masonry, of any convenient length, say, about 75 feet, having an inclined floor 1. The chamber is provided with a pit at one end as at 2, the opposite end of the chamber communicating with an exhaust fan 3, by means of a pipe 4. The fan is conveniently located at the base of a stack 5. An inclined cylinder 6 extends lengthwise within the chamber, such cylinder being substantially open at its receiving end 7 and having a tube sheet 8 in its opposite end. A series of drying tubes 9, 9, extend lengthwise within the cylinder, the tubes being suitably supported by hangers 10, 10, in concentric rows as shown in Figs. 3 and 4. The ends of the tubes at the receiving or raised end of the cylinder preferably project slightly beyond the end of the cylinder as shown. The opposite ends of the tubes are supported in the tube sheet 8. Tires 11, 11, surround the cylinder, such tires resting on suitably journaled rolls 12, 12. Stop rolls 13, 13, engage the side edges of the tires to prevent undue endwise movement of the cylinder and to retain the tires in engagement with the rolls which constitute the support for the cylinder.

In order to rotate the cylinder, we may provide the ring gears 14, 14, surrounding the cylinder, such gears meshing with gears 15, 15, boxed in the side walls of the chamber A as shown, to prevent the admission of cold air or the exit of hot air. The gears 15, 15, are driven by means of gears 16 on the counter shaft 17. Clean out doors 18 are provided in the chamber A. It will be noticed that the entire length of the cylinder is inclosed within the chamber.

This invention is particularly designed for use in connection with a boiler or other plant where there is a considerable amount of waste heat passing up the stack with the products of combustion. Thus the drier may be used with a sugar factory wherein the saccharine juices are extracted from beets. The beet pulp remaining after the juices are removed, is a good stock food. Such pulp, in order to be used commercially and transported and preserved must be dried. The reduction of the beets to pulp

and the removal of the saccharine material requires a boiler plant, it being possible to lead the products of combustion from the plant to the drier in any convenient manner, as by means of a driving fan not shown, and to this end, we provide a main flue leading from the boiler plant to the pit 2.

An opening 19 leads from the pit directly into the chamber A, such opening being controlled by a damper 20, whereby the products of combustion are brought into contact with the exterior of the cylinder near its discharge end and travel practically throughout the length of the cylinder exteriorly thereof, to the exhaust pipe 4, their progress being facilitated by the action of the exhaust fan 3. The hot gases envelop the cylinder in their passage along the chamber, and impart heat thereto. Another opening 21 controlled by a damper 22 admits the products of combustion to an up-flue 23 leading to the tube sheet 8 at the discharge end of the cylinder, the hot gases being drawn through the tubes 9, 9, by the action of the exhaust fan 3, adjacent the opposite end of the cylinder, thus heating the interior of the cylinder.

The material to be dried such as pulp, grain or other matter, is supplied to the drier as follows:—A conveyer 24 which may be of the screw type as shown leads the material to a down chute 25 communicating with one or more screw conveyers 26, 26, at the discharge end of the chamber. The screw conveyers 26, 26 lie preferably parallel with each other and extend throughout the entire length of the chamber, being located just below the ceiling of the chamber. By this arrangement, the wet pulp or other material is subjected to a preliminary heating before it is fed to the drier. The material after traveling the length of the chamber A is delivered by the conveyers 26, to a hopper 27 which deposits the material in a short feeding spout 28 which spout may have a screw conveyer therein. This feeding spout preferably extends some distance into the raised open end of the cylinder and past the open discharge ends of the heating tubes 9, 9. The object of extending the feed spout some distance into the cylinder is to deliver the material far enough into the cylinder to prevent it from falling out. As a further means for preventing the discharge of material from the open end of the cylinder, we may locate an annulus 9' in the open end of the cylinder, as shown. The smoke and gases constituting the heating medium cannot come into contact with the material at the open end of the cylinder because of the suction created by the fan. The feed spout discharges the pulp, grain or other material onto the concentric heating tubes 9, 9, whence it sifts to the bottom of the cylinder. The inner periphery of the cylinder is provided

with a series of continuous inclined flights 29, 29, extending lengthwise of the cylinder and adapted to shift the material toward the discharge end thereof, coöperating with the incline of the cylinder. The flights are adapted to catch the material, as the cylinder is rotated and carry it to the top of the cylinder when the material is discharged and sifts back around the tubes 9, 9 to the bottom of the cylinder. This action is constantly repeated as the material works down the incline of the cylinder to the discharge end, thoroughly disintegrating any lumps and permitting the heat to drive out any moisture. Furthermore, the material is kept constantly traveling and does not become overheated.

It is obvious that steam and vapors will be generated and the air in the cylinder laden with moisture. Now, air can only hold a certain amount of moisture in suspension, consequently, it becomes necessary to remove the vapor laden air in the cylinder and admit fresh air thereto to which end we provide the following arrangement. Air inlet pipes 30, 30, project through the opposite side walls of the chamber preferably at some point near the receiving end of the cylinder, such pipes extending lengthwise of the chamber A near the upper corners thereof. These air pipes communicate with an air discharge conduit 31 at the discharge end of the cylinder, which air discharge conduit extends through the tube sheet 8 axially of the cylinder. The partial vacuum created by the exhaust fan 3 serves to withdraw the vapor laden air from the cylinder and cause fresh air to supply its place, such fresh air having been given a preliminary heating in its travel through pipes 30 in chamber A to prevent chilling the material being dried. The amount of air admitted through the air conduit 31 may be controlled by a valve 31^a.

Just behind the tube sheet 8, the cylinder is provided with a plurality of discharge slots 31^b preferably arranged peripherally of the cylinder. Furthermore, the discharge section of the cylinder is inclosed in a sub-chamber 32 which extends down into the pit 2 and prevents the access of the products of combustion admitted through the main flue from coming into contact with the dried material discharged from the cylinder. The discharge slots deliver the dried material into a hopper 33 constituting the bottom of the sub-chamber 32. A pair of screw conveyers 34, 35 extend into the bottom of the hopper, a valve 36 in the hopper pivotally supported intermediate the conveyers, operating to shunt the material into one conveyer or the other. In case the material has not been sufficiently dried it is shunted into one of the conveyers 34 which conducts the material to an elevator 37 (shown in dotted

lines in Fig. 1) which in turn delivers the material to the conveyer 38 leading to any suitable packing machinery or bin. In case the material has not been sufficiently dried, it is shunted into the conveyer 35. The conveyer 35 delivers the material to a similar elevator 39 which in turn discharges the material to the down chute 25 or such elevator may convey the material to a supplementary drier, not shown. When the material is delivered to the down chute 25, it is mingled with the fresh incoming wet pulp.

Although we have shown and described screw conveyers, it is obvious that other conducting mechanism might be used and that changes might be made in other of the several parts and features described without departing from the spirit and scope of our invention. It will also be seen that the material is prevented from contact with the products of combustion and consequently is delivered from the drier in a pure untainted state. When drying beet pulp, the dried pulp is delivered in a light fluffy condition and is uncolored by smoke or gases.

By applying the heat to the cylinder in the foregoing manner, the pulp is not subjected to intense heat but the heating effect is mild and will not disturb the structure of the fibers, by scorching or burning. The pulp is led by the incline of the cylinder and the continuous flights constantly and slowly from the receiving to the discharge end of the cylinder. In its travel the pulp is alternately lifted and discharged so that the heated air has access to every particle thoroughly drying the fibers thereof as they travel toward the discharge end of the cylinder.

Both the material to be dried and the air supplied thereto are heated preliminary to their admission into the cylinder to avoid chilling the latter and retarding the drying process.

Having thus fully disclosed our invention, what we claim as new is:—

1. The combination in a drying apparatus, of a chamber, a rotary cylinder wholly inclosed within the chamber, means for rotating the cylinder, a tube sheet closing one end of the cylinder, tubes mounted in the tube sheet and extending lengthwise of the cylinder, means for admitting a heating medium to the chamber and to the inlet ends of the tubes in the tube sheet, means for controlling the admission of the heating medium to the chamber and to the tubes, means for supplying material to the cylinder and means for causing the heating medium to travel through the chamber and through the tubes.

2. The combination in a drying apparatus, of a chamber, having a pit formed at one end thereof, a cylinder within the chamber, a tube sheet closing one end of the cylin-

der, tubes mounted in the tube sheet and extending lengthwise of the cylinder, the pit having an opening communicating with the chamber, and an up-flue leading to that portion of the chamber in front of the tube sheet, dampers controlling the opening and the flue, means for supplying the open end of the cylinder with material to be dried and means for causing the heat from the pit to travel through the chamber and through the tubes.

3. The combination in a drying apparatus, with a chamber, of a pumping member, a conduit connecting one end of the chamber with the pumping member; a cylinder wholly inclosed within the chamber, a tube sheet closing one end of the cylinder, tubes mounted in the tube sheet and extending lengthwise of the conveyor, means for conducting a heating medium to the ends of the tubes mounted in the tube sheet and means for supplying material to the opposite open end of the cylinder.

4. In a drying apparatus, the combination with a main chamber, of an inclined cylinder wholly inclosed within the chamber and having discharge openings near one end, means for rotating the cylinder, a tube sheet closing one end of the cylinder, tubes mounted in the tube sheet and extending lengthwise of the cylinder, a feed spout projecting into the opposite open end of the cylinder past the adjacent open ends of the tubes, means for supplying material to the feed spout, means for admitting previously heated air to the closed end of the cylinder, means for admitting a heating medium to the tube sheet, and means connected with that end of the chamber adjacent the open end of the cylinder for causing the heating medium to pass through the tubes and the air to pass through the cylinder.

5. A drying apparatus comprising a chamber, a rotary cylinder received therein, means for rotating the cylinder, a tube sheet closing one end of the cylinder, a series of tubes mounted in the tube sheet and extending longitudinally of the cylinder, means for admitting a heating medium to the chamber near one end and to the ends of the tubes in the tube sheet, means for supplying air to the interior of the cylinder near its closed end, means for feeding material to the open end of the cylinder and a fan connected with the chamber opposite the open end of the cylinder, for causing the heating medium to travel through the chamber and the tubes and for drawing fresh air into the cylinder and removing the vapor laden air therefrom.

6. The combination, in a drying apparatus, with a chamber, of an inclined rotary cylinder, within the chamber, means for rotating the cylinder, a tube sheet closing one end of the cylinder, an exhaust fan adapted to create a partial vacuum at the

opposite open end of the cylinder, tubes mounted in the tube sheet and extending lengthwise of the cylinder, flights on the interior periphery of the cylinder, means for feeding material into the open end of the cylinder, means for conducting a heating medium to the open ends of the tubes in the tube sheet, an air inlet pipe traversing the chamber, a single air conduit communicating with the air inlet pipe and extending through the tube sheet and means for controlling the admission of air into the cylinder.

7. A drying apparatus comprising a chamber, a rotary cylinder within the chamber, means for rotating the cylinder, a tube sheet closing one end of the cylinder, an exhaust fan connected with the chamber near the opposite open end of the cylinder, tubes mounted in the tube sheet and extending lengthwise of the cylinder, means for admitting heat to the chamber near one end exteriorly of the cylinder, means for admitting heat to the tubes, a conveyer extending lengthwise of the chamber, a feed chute extending into the open end of the cylinder, means connecting the conveyer and the feed chute, flights in the cylinder for agitating the material, means for supplying air to the cylinder, the cylinder having discharge openings near its closed end, a sub-chamber inclosing that portion of the cylinder containing the discharge openings and a conveyer to which the material discharged is fed.

8. A drying apparatus comprising a chamber, a cylinder wholly inclosed within the chamber, a tube sheet closing one end of the cylinder, tubes mounted in the tube sheet and extending lengthwise the cylinder, means for admitting air to the chamber and to the tubes, means for causing the heat to traverse the chamber and the tubes, and means for feeding material to the cylinder.

9. A drying apparatus comprising a chamber, a cylinder wholly inclosed therein, means for rotating the cylinder, tubes supported within the cylinder, means for admitting heat to the chamber and to the tubes, means for causing the heat to traverse the chamber and the tubes and separate means for feeding material and air to the cylinder, the cylinder having discharge openings isolated from the chamber.

10. The combination, in a driving apparatus, with a chamber, a rotary cylinder in the chamber, means for rotating the cylinder and means for feeding material into the

cylinder at one end, of an air inlet pipe traversing the chamber and communicating with the opposite end of the cylinder, means for heating the chamber and an exhaust fan for drawing fresh air into the cylinder.

11. The combination, in a drying apparatus, of a chamber, a cylinder inclosed within the chamber and having discharge openings near one end, and a sub-chamber inclosing that portion of the cylinder equipped with the discharge openings, a hopper into which the cylinder discharges its contents, a plurality of conveyers in the hopper and a valve for shunting the material discharged into one or the other of the conveyers.

12. In a drying apparatus, the combination with a chamber, an inclined cylinder within the chamber, the cylinder provided with a discharge opening, and means for rotating the cylinder, of a tube sheet closing one end only of the cylinder, the opposite end of the cylinder being open within the chamber, tubes mounted in the tube sheet and extending lengthwise of the cylinder, a feed spout projecting into the opposite open end of the cylinder past the adjacent open ends of the tubes, means for admitting a heating medium to the ends of the tubes in the tube sheet, and to the chamber exteriorly of the cylinder, and a pump for drawing the heating medium through the tubes and the chamber.

13. In a drying apparatus, the combination with a chamber, an inclined cylinder within the chamber, the cylinder provided with a discharge opening, and means for rotating the cylinder, of a tube sheet closing one end of the cylinder, the opposite end of the cylinder being open, tubes mounted at one end in the tube sheet and extending longitudinally of the cylinder, means for delivering material into the open end of the cylinder, an air conduit, one end of which projects through the closed end of the cylinder and discharges into the cylinder, means for admitting a heating medium to the tube sheet, and means at the opposite end of the chamber for drawing the heating medium through the tubes and the air through the cylinder.

In testimony whereof, we affix our signatures in presence of two witnesses.

JOSEPH E. KOHN.
JOHN B. ROOS.

Witnesses:

RALPH S. WARFIELD,
J. RAY ABBEY.