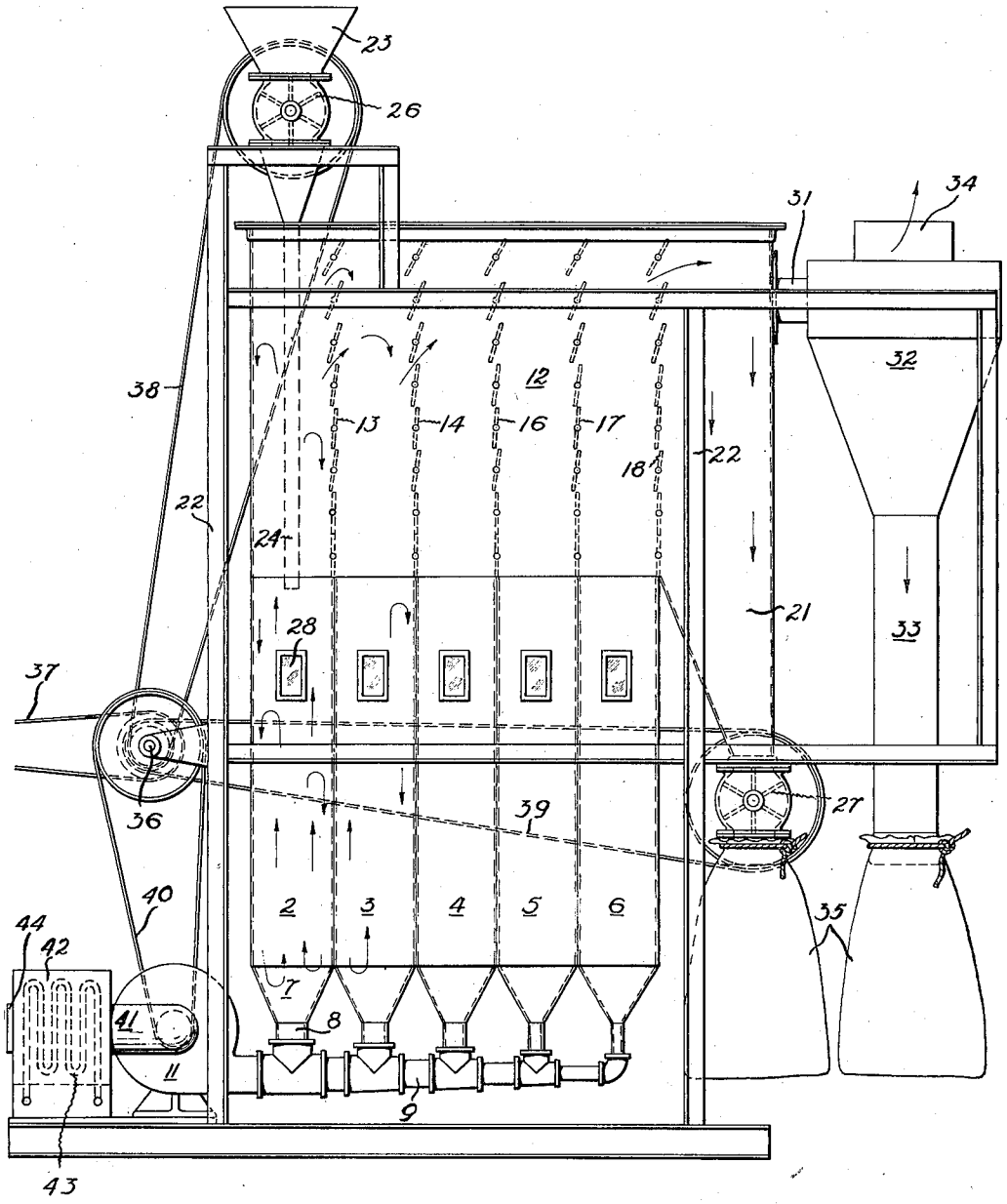
June 24, 1930. E. T. MEAKIN 1,766,030

APPARATUS FOR AND METHOD OF TREATING MATERIAL

Filed Aug. 2, 1926



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Patented June 24, 1930 1,766,030

UNITED STATES PATENT OFFICE

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APPARATUS FOR AND METHOD OF TREATING MATERIAL

Application filed August 2, 1926. Serial No. 126,357.

My invention relates to an apparatus for and method of treating material and particularly of evaporating moisture containing materials.

One of the objects of the invention is the provision of means for drying certain substances which have heretofore been very difficult or impossible to dry; and another object of the invention is the provision of means for speeding up the process of drying so that deterioration of delicate material does not occur.

Another object of the invention is the provision of a drying apparatus of relatively simple construction embodying but few moving parts.

Still another object of my invention is the provision of a drying apparatus of large capacity which occupies a relatively small floor space.

Other objects of the invention, together with the foregoing, will be set forth in the following description of the preferred process, and the preferred embodiment of means for practicing the same, which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood that I do not limit myself to the showing made by the said description and drawings, as I may adopt variations of my preferred form within the scope of my invention as set forth in the claims.

Referring to the drawings, the figure is a side elevation of the drying apparatus of my invention.

Many substances such as casein, lactose, albuminous matter, and many other materials are exceedingly difficult or impossible to dry into a satisfactory product. So far as I am aware, lactose has never been dried except in the sun. Since this material decomposes after several hours of exposure, sun treatment is not a satisfactory method of evaporation. By my method of treatment, I am able to dry this material without deterioration in 35 to 40 minutes. Other material, such as casein tends to roll up into balls in a rotary dryer, and is handled only with great difficulty. In tray driers, such material clings together, and comes out in the form of mats which require reduction to flour or grain form.

When such material is treated in tunnel driers, the drying time varies from 6 to 24 hours, and during this time the material is subject to discoloration as well as other deterioration, since the material in trays will ultimately acquire the heat of the drying air. This tends to bake the material rather than dry it.

When dried in a tunnel drier, casein requires about 12 hours, and there is no practicable means for securing a uniform product. By the use of my invention, casein may be dried in from 10 to 30 minutes, the product being uniform in size and appearance, without discoloration, of the highest degree of solubility and low viscosity.

I am able to accomplish these superior results by dropping the material to be dried into an ascending column or current of air, in which it dances about, rising and falling, until with the evaporation of its moisture content, it is entrained and swept out of the drying chamber.

In terms of broad inclusion, the apparatus of my invention comprises an elongated substantially vertical chamber into the bottom of which air or other treating fluid is introduced under pressure. Discharge outlets are arranged at the top of the chamber, and the material to be treated is fed into the chamber below the outlets and above the entering current of air. The volume and velocity of the entering air bear a definite predetermined relation to the specific gravity of the wet and dried material, the wet material tending to fall to the bottom of the chamber where it is caught and whirled upwardly by the entering air stream rising to a point above the sustaining power of the current, from which it falls once more toward the bottom of the chamber. This range of up-and-down movement gradually rises as the moisture content of the material is freed, until finally the dried material is entrained in the air and carried out of the chamber through the discharge opening. Preferably a plurality of such chambers are provided through which the material suc-

cessively passes; and means are provided for ultimately permitting the dried material to settle out of the entraining stream of air issuing from the last chamber. Means are also provided for feeding in regulated amounts, the material to be dried into the drying chamber, and means are also provided for heating the air introduced into the chamber.

In terms of greater detail the apparatus of my invention comprises a plurality of vertically disposed elongated drums 2, 3, 4, 5 and 6 arranged side by side as shown in the drawings. Conveniently, these drums may be square in cross section. At the lower end, each drum is provided with a conical bottom 7, connected by the pipe 8 with the manifold pipe 9, into which air under pressure is forced by the blower 11, preferably of the centrifugal type. As indicated in the drawings, the manifold pipe 9 decreases in size, with a corresponding decrease in the size of the pipes 8, connecting the manifold with the conical bottoms 7. The proportion of parts is such as to cause a proper distribution of the air into the several drums.

At the upper ends, the drums are connected into a rectangular box or housing 12, in which is disposed a series of individually adjustable louvers or gates 13 in line with the dividing wall between the drums 2 and 3, so that by the closing of these gates, the chambers or passages enclosed by the drums 2 and 3 are continued upwardly into the housing 12.

Alined with the dividing wall between the drums 3 and 4 is a second and similar series of gates 14; and a similar series of gates 16 and 17 are disposed in the housing in alinement with the dividing walls between the drums 4 and 5, and 5 and 6 respectively so that the passage or chamber enclosed by each of the drums may be continued upwardly into the housing 12 by closing the gates. By opening selected gates, these chambers may be thrown together.

Alined with the outer wall of the drum 6 is also a series of similar gates 18, which divide the chamber above the drum 6 from the downwardly extending passage within the spout-like extension 21 of the housing.

The housing 12 and the drums are suitably supported upon a framework 22, upon the top of which, above the first drum 2, is arranged a feed hopper 23, into which the material to be dried is fed by any suitable means. Extending downwardly from the hopper 23, is a feed conduit 24 in the upper end of which is a feed wheel 26, for regulating the amount of material passing into the conduit. The conduit 24 opens into the drum 2 at a point below the gates 13, and above the bottom, so that material issuing from the conduit falls directly into the upwardly sweeping current of air entering the bottom of the drum. The material then moves up and down in the drum, being entrained and swept upwardly, and then released to fall again, meanwhile losing some of its moisture which is carried off at the top of passage thru the opened gates. The lighter particles are entrained and carried over with the escaping air, falling into one or another of the next drums where they encounter the upward currents in these drums. The result is that shortly after the introduction of the material into the first drum, all of the drums are full of material in varying stages of dryness, dancing up and down on the currents and eddies of the air streams. As the material dries out and becomes lighter its range of movement is of course toward the top and ultimately the dry particles find their way thru the last series of gates into the housing above the spout 21, in which there is no upwardly moving current. Here the material settles rapidly downwardly into the discharge passage within the downwardly extending spout 21 from which discharge of the dry material is controlled by the feed wheel 27, similar to the feed wheel 26.

The distribution of the material from one drum to another is readily controlled by adjustment of the gates; and if desired, a slight opening of the lower gates in, say the series 13 and 14, effects an almost immediate distribution of the wet material into the first three drums. This would be done when handling a large volume of material having a low moisture content. Progress of the drying operation may be observed thru suitable glass windows 28.

The moisture laden air is permitted to escape from the upper part of the housing thru a suitable conduit 31; and because dust may be entrained in the air, I prefer to provide a cyclone separator 32 of well known type, into which the conduit 31 is tangentially connected. The dust settles thru the cyclone and connected pipe 33 and the air is discharged from the vent 34. The bottom of the pipe 33 as well as the bottom of the discharge under the feed wheel 27 is arranged for the convenient attachment of bags 35.

While any convenient means may be used for rotating the feed wheels 26 and 27 and the blower 11, I prefer to drive them all from a jack shaft 36, journaled in suitable bearings arranged on the frame 22, and driven by the belt 37 from any suitable source of power. Belts 38, 39 and 40 respectively connect the jack shaft with the feed wheels 26 and 27 and the blower.

Since warm or heated air is usually preferable in evaporating the moisture content from a wet material, I provide means for heating the air entering the blower. The intake pipe 41 of the blower is connected to

a housing 42 in which is arranged a steam coil or other suitable heating element 43. Atmospheric air entering the intake 44 of the housing 42 is drawn over the coils, the temperature of which may be regulated in any desirable way, and heated to the desired degree.

It will also be understood that I may inject a treating fluid, such as the fumes of sulphur, into the air entering the blower so that the effect of the gas may be secured on the material in the drums. I may also interpose at this point an ozonator so that the air injected into the drums is charged with ozone. This is desirable for its oxidizing effect when treating or drying animal or fish meals.

Since the drying operation in my apparatus is accomplished in a very short time, the material does not remain in the heated air long enough to be injured even if there should be a sudden rise in the temperature of the air, and I have found that a much higher temperature of air can be used in my apparatus than is possible with other forms of driers, without injury to delicate products.

Of course the pressure of air delivered into the bottom of each drum is varied with the material being treated, but in each case the velocity and volume should be sufficient to keep the material circulating about the chamber. Obviously material of a fluffy, featherlike nature requires less air velocity to keep it dancing about than would a heavier material such as grain or rice.

I have found that the material treated in my dryer comes in intimate contact with from two to twenty times a greater quantity of air per time unit of treatment than in any other method of drying known to me. The fact that the material is at all times surrounded by air in motion and is never at rest is a large factor in this. In treating material such as sulphur compounds, flour and zinc dust, where the dust is very fine, further treatment of the dust may be required. For example dust collectors, such as are used in flour mills can be applied to the discharged air, or water may be applied to entrain the dust and permit the air to escape.

While I have shown my dryer with five drying chambers, and arranged for continuous operation, it will be apparent that a single drying chamber would be entirely suitable for some purposes, as a batch dryer.

I claim:

1. A dryer comprising a plurality of substantially vertical drums, passages connecting the upper portions of adjacent drums, gates arranged in said passages to control the areas thereof, means for introducing material to be dried into the first of said drums below the passage leading into the second drum, means for collecting dried material from the last drum, and means for introducing air under pressure into the lower portion of each drum.

2. A dryer comprising a plurality of upwardly extending drums, passages connecting the upper portions of adjacent drums, gates arranged in said passages to control the areas thereof, a conduit extending into the first of said drums below the passage leading into the second drum, means for collecting dried material from the last drum, and means for introducing air under pressure into the lower portion of each drum.

3. A dryer comprising a plurality of upwardly extending drums, passages connecting the upper portions of adjacent drums, gates arranged in said passages to control the areas thereof, means for introducing material to be dried into the first of said drums below the passage leading into the second drum, means for collecting dried material from the last drum, and means for introducing a fluid under pressure into the lower portion of each drum.

4. A dryer comprising an upwardly extending drum, a second upwardly extending drum adjacent the first drum, a passage connecting the upper portions of said drums, a gate in said passage, means for introducing material to be dried into the first drum below said passage, means for collecting the dried material, and means for introducing a fluid under pressure into the lower portion of each drum.

5. A dryer comprising an upwardly extending drum having a plurality of discharge passages, means for introducing a fluid under pressure into said drum below said discharge passages, gates arranged in said passages to control the areas thereof, and means for introducing material to be dried into said drum above said fluid introducing means.

6. A dryer comprising an upwardly extending drum, a second upwardly extending drum adjacent the first drum, a passage connecting said drums, a gate in said passage, means for introducing material to be dried into the first drum, and means for introducing a fluid under pressure into each of said drums at a point below the material introducing means.

7. A dryer comprising an upwardly extending drum, a second upwardly extending drum adjacent the first drum, passages connecting said drums, gates arranged in said passages to control the areas thereof, means for introducing material to be dried into the first drum, and means for introducing a fluid under pressure into each of said drums at a point below the material introducing means.

8. A dryer comprising an upwardly extending drum having a plurality of passages,

means for introducing fluid under pressure into said drum below said passages, gates arranged in said passages to control the areas thereof, and a conduit extending downwardly into the said drum for introducing material into the drum above said fluid introducing means.

In testimony whereof, I have hereunto set my hand.

EDGAR T. MEAKIN.