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J. CREDO

METHOD AND APPARATUS FOR DRYING

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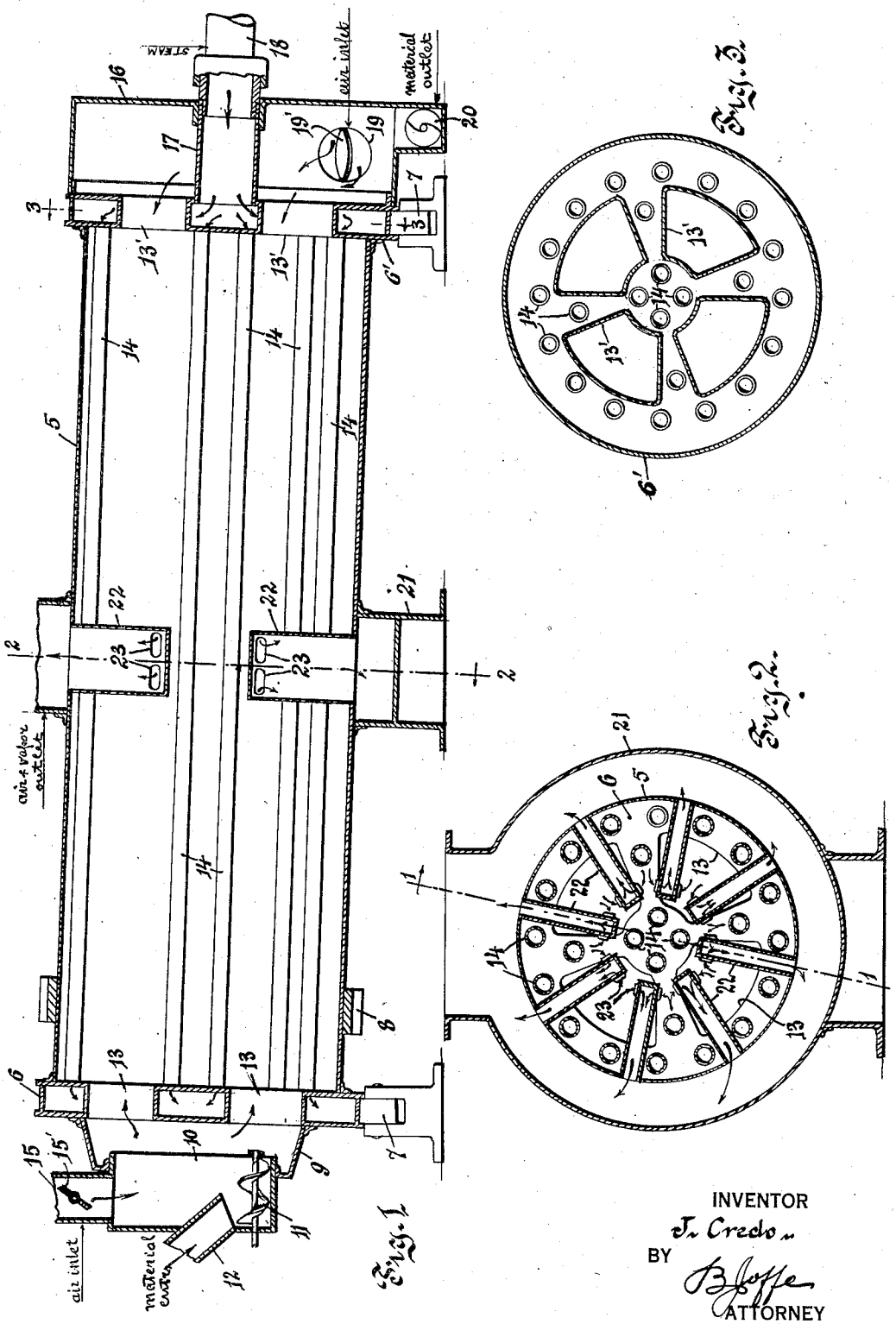

Fig. 1

Fig. 3

Fig. 2

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METHOD AND APPARATUS FOR DRYING.

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To all whom it may concern:

Be it known that I, JULIUS CREDO, a citizen of the United States, and a resident of the county of Jefferson, city of Louisville, and State of Kentucky, have invented a new Method and Apparatus for Drying, of which the following is a full, clear, and exact description.

My invention relates to a method and apparatus for drying and has reference more particularly to drying in rotary dryers.

An object of the invention is to be able to dry at a temperature below that at which the substance to be dried is injured, and with an economy of air and at a reduced air velocity to decrease the loss of the finer particles of the dried substance.

Another object of the invention is to regulate the temperature of evaporation by the volume of air supplied.

A further object of the invention is to control the rate of evaporation by a supply of additional air.

Another object of the invention is to provide a rotary dryer suitable for carrying out my method of drying.

In the appended drawing I illustrate a form of an apparatus suitable for carrying out my method and in which

Figure 1 is a longitudinal section on line 1—1, Figure 2,

Figure 2 is a cross-section on line 2—2, Figure 1, showing the rear head, and

Figure 3 is a cross-section on line 3—3, Figure 1, of the head only.

In methods of drying in rotary cylinders hitherto employed, the wet material in entering the dryer is forced to a temperature which is injurious to the substance to be dried. As for example, pomace when first introduced into a dryer is subjected to air having a temperature of about 175 degrees F., saturated with water vapor, thus being subjected to a high vapor pressure. As heat from the tubes is being constantly supplied to the material, and it cannot, because of the vapor pressure give up any moisture until it first assumes a temperature higher than 175 degrees F., it is rapidly heated far above that dew point temperature. Of course, as the wet material progresses through the dryer and meets air of constantly lowering temperature, and lowering vapor pressure as well, the evaporation of water from it proceeds more and more rapidly and the material cools in proportion. The damage to the material, however, has already been done at the beginning of the process, because firstly, its temperature has been forced to rise above 160 degrees F., which is injurious to the pomaces and the color has deepened, and secondly, because the temperature was high while the material contained the maximum of free water, a hydrolization of the pectin resulted, with a lowering of quality and marketability.

To cure this condition requires the passing of a much larger than usual volume of air through the dryer in a given time, so that the air exhausted from the dryer will be at a lower temperature and a much lower saturation than at present. Tests indicate that three times as much air as is now employed will suffice for pomace. This, however, would have the effect of tripling the velocity of the air through the cylinder and would carry out of the dryer a prohibitive percentage of the finer particles of the material to be dried.

To overcome this, I propose to introduce air from both ends of the dryer, taking it out between the ends. This arrangement permits me to introduce the necessary volume of air but the velocity is increased only fifty per cent over the original. By this proposed change I will be able to discharge the dried materal from the dryer with a residual moisture content of about ten per cent and at a temperature of 140 degrees F., or even less. This temperature is below 160 degrees F., for pomace, and the improvement in the quality of the dried material is very striking. The color of the dried product is lighter and it contains more water soluble pectin, and therefore it commands a higher price. Such results are obtainable also with other substances of a similar nature that are now dried in rotary dryers of this type.

To carry out my method of drying I employ a rotary cylinder 5 terminating at the ends with hollow heads 6 and 6′ secured to the cylinder. The cylinder is supported on rollers 7 preferably near each end of the cylinder, in a manner that it is maintained in a slightly inclined position, the high point being the inlet end for the material and the lower end the discharge end for the material to be dried. Rotary motion is transmitted to the cylinder through a

gear 8 secured to the cylinder, the driving mechanism for which is not shown. The head 6 at the raised end of the cylinder has an extension 9 which bears on a stationary housing 10 wherein a conveyor 11 is mounted. A trough 12 extends through the housing 10 to the conveyor 11, to supply material to be dried, which the conveyor feeds through the extension 9 and through the apertures 13 of the head 6.

The hollows of the heads 6 and 6′ are connected by tubes 14 extending through the cylinder 5. The said tubes 14 are suitably disposed in the cylinder to supply the maximum amount of radiant and transmitted heat when steam is supplied to the tubes. The housing 10 has also an air inlet 15 through which air may be supplied to the cylinder at the raised end. The air supplied at this end is controlled by a damper 15′ and will travel in the same direction as the material which is fed through the cylinder. The head 6′ at the lower end of the cylinder fits into the stationary housing 16. The said housing 16 has a central passage 17 leading into the hollow of the head 6′. A steam conduit 18 is connected to the central passage to supply the steam to the head 6′ from where it passes to the head 6 through the tubes 14. The housing 16 has also an air inlet 19 through which air is introduced to pass into the cylinder through the apertures 13′ of the head 6′. The air entering the head 6′ is controlled by a damper 19′ and will flow in a direction opposite to the travel of the material in the cylinder. The housing 16 has a suitable conveyor 20 for discharging the dried material which is delivered to the housing 16 through the openings 13′ of the head 6′.

Somewhere along the length of the cylinder between the heads 6 and 6′, I provide a stationary housing 21 which encompasses the cylinder and which is in communication with the interior of the cylinder through a series of air outlets 22 carried by the cylinder. The outlets 22 extend from the periphery of the cylinder to a point above the level of the material to be dried which is maintained in the cylinder, and the apertures 23 of the outlets 22 are so formed that the material to be dried cannot enter the said apertures 23 while the cylinder is rotated and the material is caused to rise and fall by the motion of the members and the tubes provided in the cylinder. The air laden with moisture escapes through the apertures 23 into the outlets 22, thence into the housing 21, from where it may be carried off either by a high stack or an exhaust fan.

The material as it travels from the higher to the lower end of the cylinder, is subjected to the radiant and transmitted heat supplied to the tubes 14. The air to carry off the evaporated moisture, is supplied from both ends of the cylinder. In other words, part of the air for carrying off the moisture travels with the material and part travels in a direction opposite to the material to be dried.

By the means described I am able to introduce a desired volume of air with the required reduced velocity, thereby eliminating losses of the material dried.

By the means described, and through the regulation of the air volumes supplied through each end of the dryer, either independently or conjunctively, I can control the maximum temperatures to which the material is heated initially, and then the rate of evaporation of moisture caused by the heat supplied by the tubes.

The temperature is controlled in the dryer by the manual setting of the dampers and this is dependent upon the temperature desired and the location of the air outlet.

I claim—

1. In a method of drying, steps which consist in feeding substance to be dried in one direction, supplying air from opposite directions to the substance to be dried, heating the substance and the air and removing the products of evaporation and the air supplied.

2. In a method of drying, steps which consist in feeding and heating the substance to be dried, supplying air from opposite directions to the substance so that the air meets, and removing the air supplied and the products of evaporation substantially at the meeting point of the supplied air, the air supplied being subject to the same heat as the substance.

3. In a method of drying in a rotary dryer, steps which consist in feeding the substance to be dried from the inlet to the outlet end of the dryer, introducing air from both ends of the dryer, heating the substance and air in the dryer, and removing the air and products of evaporation at a place between the ends of the dryer.

4. In a method of drying, steps which consist in causing a progression of the material to be dried, subjecting the material while it is being progressed first to an air current moving into the same direction with the material and then to an air current moving in a direction opposite to that of the material, heating the progressing material and the oppositely moving air currents and regulating the air volume moving in opposite directions.

5. In a method of drying, steps which consist in causing a progression of the material to be dried, subjecting the material to regulate currents of air flowing in opposite directions and heating the material and air currents.

6. In a method of drying, steps which consist in causing a progression of the material to be dried, heating the material while it progresses, regulating the temperature of evaporation by the volume of atmospheric air caused to flow in a direction with that of the material but in a different path, and controlling the rate of evaporation by a supply of additional atmospheric air which flows in a direction opposite to that of the material but in a different path of said material.

7. A method of drying pomace in a rotary dryer, which consists in feeding the pomace from one end to the other of the dryer, heating the pomace while it is being fed, introducing air from both ends of the dryer, heating the pomace and the air and removing the air at places between the ends of the dryer.

8. A method of drying pomace which consists in feeding the pomace to be dried through a cylinder, introducing air from both ends of the cylinder, supplying heat to the cylinder to heat the pomace and the air and removing the air and the products of evaporation substantially from the middle part of the cylinder.

9. In a method of drying pomace, steps which consist in feeding the pomace from the inlet to the outlet end of rotary dryer, introducing air from the inlet and the outlet end of the dryer, heating the pomace and the air and removing the air and the product of evaporation between the ends of the dryer.

10. In a method of drying pomace, steps which consist in supplying air all over the pomace, heating the pomace and the air and removing the air and the product of evaporation from above and substantially midway of the pomace.

11. In a dryer, a cylinder having air inlets at each end and an air outlet between the ends.

12. In a dryer, a revoluble cylinder through which a substance to be dried may be fed and heated, said cylinder having an air inlet at each end and an air outlet between the ends.

13. In a dryer, a revoluble cylinder, means whereby heat may be supplied, means at one end of the cylinder to feed the substance to be dried, means at the other end of the cylinder to discharge the substance dried, said cylinder having an air inlet at each end, a housing associated with the cylinder between the ends thereof, means establishing communication between the cylinder and the housing for delivering the air and the product of evaporation to said housing from the cylinder.

14. In a dryer, an inclined revoluble cylinder having air inlets at each end, means for supplying heat to the cylinder, means at the higher end for receiving material to be dried and feeding it into the cylinder, means at the lower end for discharging the dried material, a housing encompassing the cylinder between the ends of said cylinder, said cylinder having outlets for the air and product of evaporation leading into the housing.

15. In a method of drying, steps which consist in feeding the substance to be dried in one direction, supplying air to the substance from opposite directions, so that the air currents meet, heating the substance and air, and removing the air and the products of evaporation from the substance, substantially as the meeting point of the air currents.

JULIUS CREDO.