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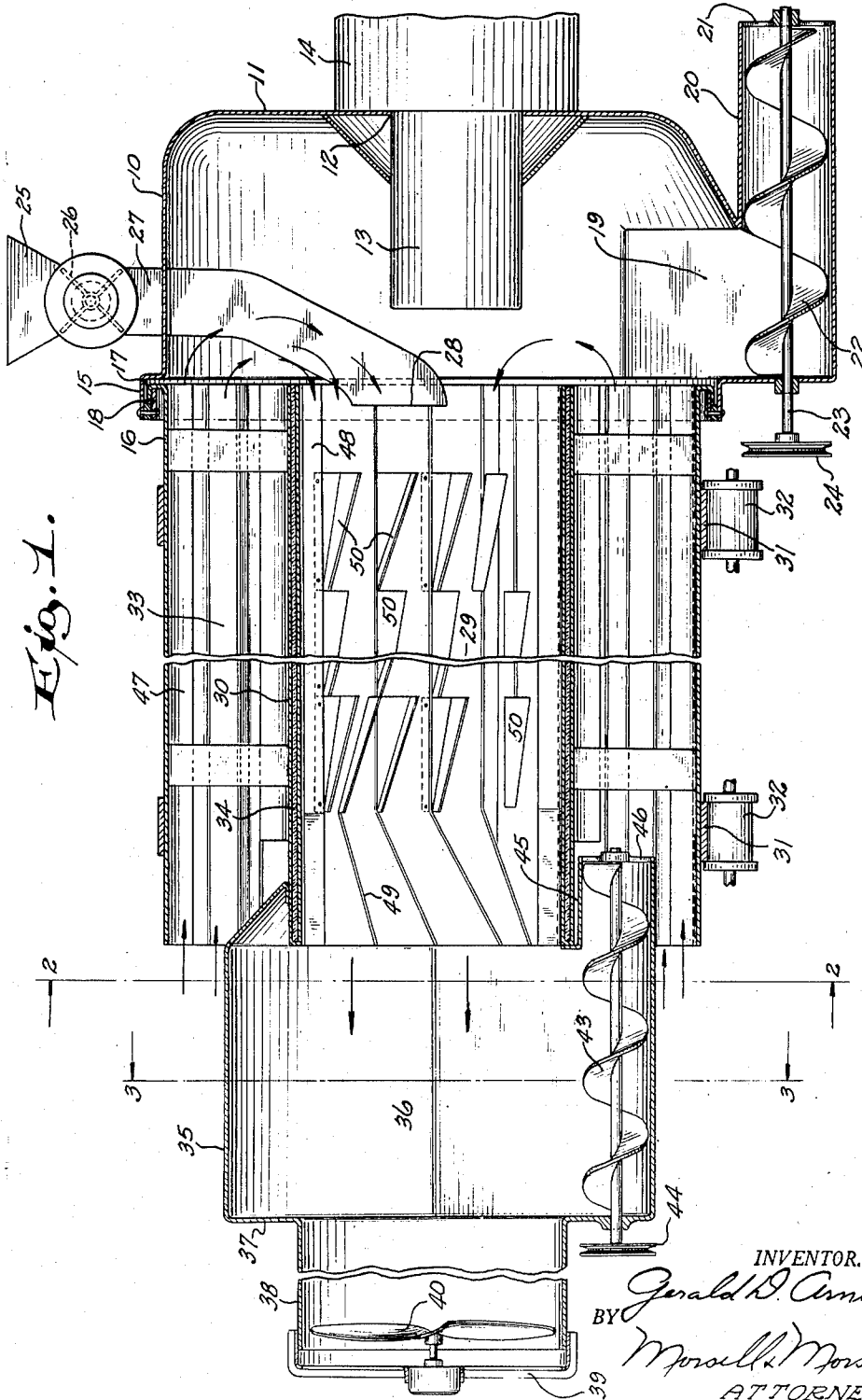
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DRIER AND COOLER FOR GRAIN OR THE LIKE

Filed Dec. 11, 1946

2 Sheets-Sheet 1



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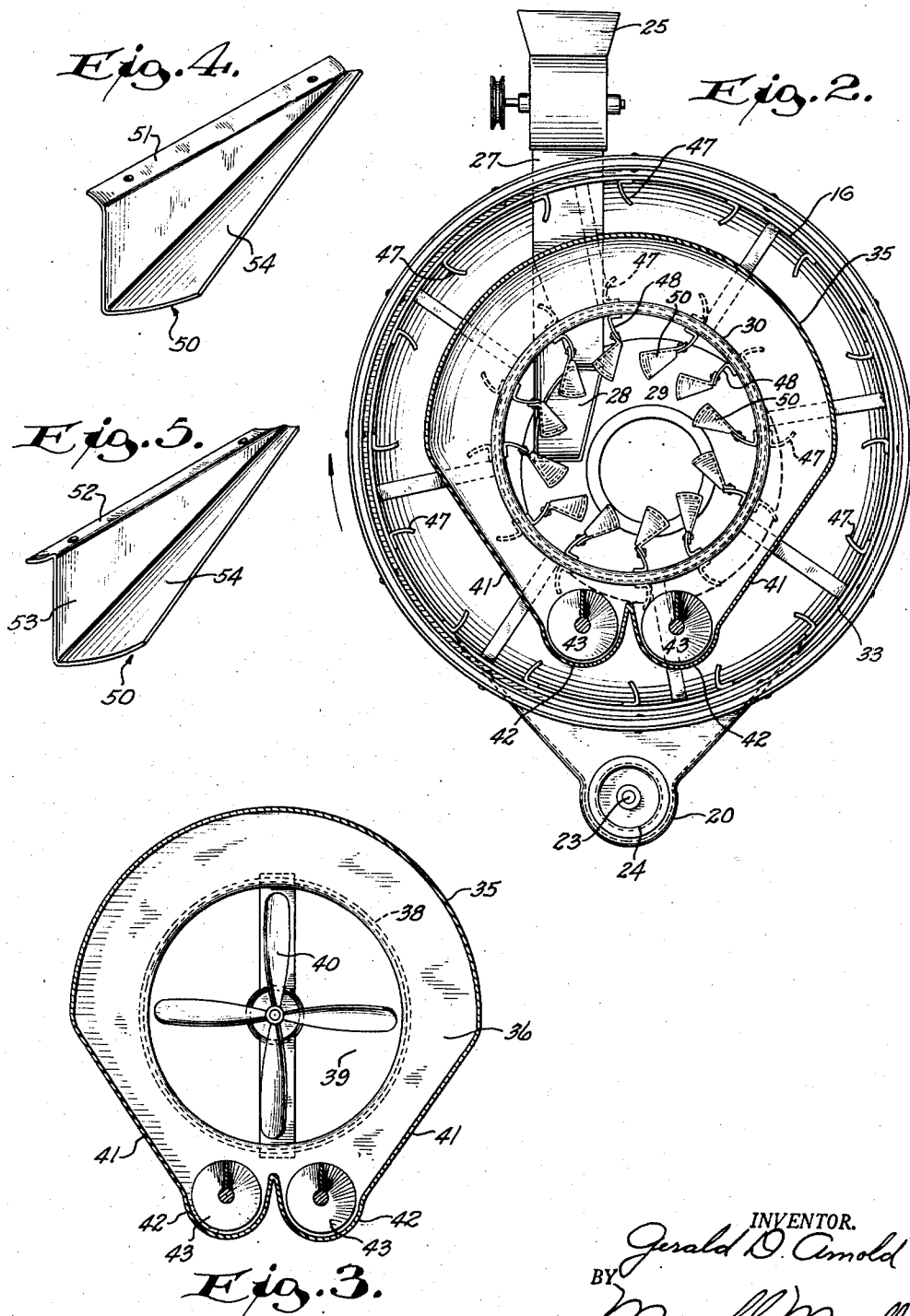
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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DRIER AND COOLER FOR GRAIN
OR THE LIKE

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Application December 11, 1946, Serial No. 715,393

8 Claims. (Cl. 34—63)

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This invention relates to improvements in dryer and cooler for grain or the like.

Rotary, direct heat dryers for forage crops have not been satisfactory for the purpose of drying grain, shelled corn, or like products, because the grain is not held within the drum for a sufficient length of time to accomplish proper dehydration. Furthermore, no satisfactory method has been provided for quickly cooling the hot, dehydrated material in the same apparatus.

To successfully dry grain or shelled corn it is necessary to heat up the product relatively slowly, before very much drying action takes place. This heating up cannot be accomplished with too high a temperature or the grain will become case hardened to seal the moisture in. Therefore, the product must first be heated up slowly to boil moisture out of the grain particles so that the heated air currents within the dryer can carry this moisture off. To attempt to dry grain without a preheating period would require the use of a substantially lower temperature within the dryer, and a reduction in the velocity of the air currents. This, however, would materially reduce the capacity and render the dryer impractical.

It is a general object of the present invention to provide an improved dryer for grain or the like wherein means is provided for mechanically retarding the flow of the grain, particularly through the inside cylinder so that a heating up period is provided to effectively drive the moisture out of the interior of the grain whereby the air currents may be effective in carrying said moisture away.

A further object of the invention is to provide an improved dryer and cooler particularly, but not exclusively adapted for the drying of grain, comprising a plurality of concentric drums, wherein the annular chamber within the outermost drum is so utilized as to cool the hot dehydrated material before the latter is discharged, and wherein the heat which is picked up by the cooling air is utilized in the dryer for drying purposes thereby reducing fuel consumption, the preheated air being very effective when acting on grain or shelled corn, to start the heating up process.

A further object of the invention is to provide a dryer and cooler as above described wherein a single fan serves to create movement of air currents for both the cooling and drying processes.

Other objects of the invention are to provide a dryer and cooler for grain or the like which is relatively simple in construction, which has a minimum number of parts, and which is well adapted for the purpose described.

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With the above and other objects in view, the invention consists of the improved dryer and cooler for grain or the like, and all its parts and combinations, as set forth in the claims, and all equivalents thereof.

In the accompanying drawings, illustrating one complete embodiment of the preferred form of the invention, in which the same reference numerals designate the same parts in all of the views:

Fig. 1 is a vertical, longitudinal, sectional view through the improved dryer and cooler, an intermediate portion of the unit being broken away;

Fig. 2 is a sectional view taken approximately on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a perspective view of one type of retarding plate attachment; and

Fig. 5 is a similar view of a slightly different type of retarding flight attachment.

Referring more particularly to the drawings, the numeral 10 designates a generally cup-shaped, nonrotatable head portion having a closed outer end 11 formed with an opening 12 for receiving the nozzle 13 of an oil burner 14 or other suitable source of heat.

The open end of the head member is provided with a projecting annular flange 15 within which the end of an outer cylinder 16 is rotatable. Said end of the cylinder may have its peripheral edge formed with a reversely bent part 17 for rotation within an annular space formed between the flange 15 and a sealing ring 18. Any other suitable type of rotary seal may be utilized.

The bottom of the head member 10 has downwardly converging walls leading to an opening 19, and the latter communicates with a discharge tube 20. Any suitable means may be utilized in the tube 20 for discharging the product from the discharge end 21. In the drawing there is illustrated a screw 22 formed by a spiral blade connected to a rotatably mounted shaft 23. The shaft may be rotated by transmitting power from any suitable source to a pulley 24.

A receiving hopper 25, which may have an air excluding metering valve 26 associated therewith, is adapted to direct the grain or other material to be dried, in a substantially air free condition, into a chute 27. The open end 28 of the chute directs the material into the open end of the drying chamber 29.

The drying chamber is formed by an inner cylinder 30 which is positioned concentrically within the outer cylinder 16. The cylinder 30 is

suitably connected to the outer cylinder for rotation therewith.

The outer cylinder may be provided with external tracks 31 which cooperate with suitable flanged rollers 32 to support the cylinders for rotation. Suitable means may be utilized to cause rotation of the drum.

Suitable insulating means is necessary between the drying chamber 29 and the annular cooling chamber 33 which is formed within the outer cylinder. This may be accomplished by having the cylinder 30 provided with a double wall and by having an intervening layer of insulating material 34. In lieu of the insulating material a vacuum or dead air space may be utilized.

Projecting into the outer cylinder 16, and co-operable with the outer end of the inner cylinder in such a way as to substantially exclude air is a housing 35 forming a transfer chamber 36. The closed end 37 of the housing 35 may have a projecting tubular portion 38 which is open as at 39. A suction fan 40 is suitably supported adjacent the opening 39.

The bottom of the transfer chamber 36 has downwardly converging side walls 41 leading to one or more transfer troughs 42. Each transfer trough has a screw 43 therein which may be suitably driven by transmitting motion to pulleys 44.

The inner ends of the troughs 42 merge into tubular extensions 45, and the latter have open ends 46 positioned within the cylinder 16 for depositing dried grain or other material in the cooling chamber 33.

The inner surface of the cylinder 16 and the outer surface of the cylinder 30 are provided with suitable flights such as the lineal, transversely curved flights 47. Similar lineal flights 48 are connected to the inner surface of the inner cylinder 30. These flights may have angled discharge ends 49.

In order to retard the flow of material through the drying chamber 29, attachable segmental flights 50 are utilized. These segmental flights are best illustrated in Figs. 2, 4 and 5. The type of segment illustrated in Fig. 4 has a longitudinal attachment flange 51 shaped transversely so as to fit the concave side of one of the longitudinal flights 48 as is clear from Fig. 2. The attachable segment of Fig. 5 has its flange 52 shaped transversely to cooperate with the convex side of one of the longitudinal flights 48. The segments are suitably bolted or riveted to the lineal flights 48. The segmental flights 50 are generally L-shaped in cross-section as is clear from Figs. 4 and 5, and comprise one triangular wall 53 and a second, substantially triangular wall 54 positioned at an angle to the wall 53. The narrow ends of the walls are juxtaposed so that the entire member is of tapering cross-section. The wall portions 54 are also preferably transversely concave.

For grain drying purposes the segments are connected to the lineal flights 48 in the general manner indicated in Fig. 1 with the larger ends facing the receiving end of the drying chamber. Any desired number of the segments may be utilized on one of the lineal flights, and they may be spaced close together or far apart according to requirements. It is also desirable, in the drying of certain products, to stagger the attachable segments which are on one lineal flight with respect to the attachable segments on an adjacent lineal flight. If desired, segmental flights may also be used on the lineal flights 47 in the cooling chamber.

Operation

In use of the improved dryer and cooler it is first necessary to impart rotating movement to the concentric cylinders 16 and 30 by any suitable means. It is also necessary to have the suction fan 40 in operation. The blast of hot gases discharged from the nozzle 13, together with air drawn in or around the nozzle from the cooling chamber 33 is discharged into the inner end of the inner cylinder 30. Into this mixture of gases, the wet material to be dried is fed from the opening 28 of the chute 27. As the drum rotates, those particles of material to be dried which drop to the bottom of the cylinder 30 are carried by the lineal flights 48 toward the top of the cylinder where they ultimately drop off of the edges of said flights. The lighter particles of material will tend to be advanced through the cylinder, by the air currents therein, more rapidly than will the heavier particles. As the heavier particles roll off of the edges of the longitudinal flights 48, many of them will be intercepted by the attachable segments 50, and the shape of said segments will tend to retard the falling movement of the grain and will also make the particles flow backwards, or counter to the direction of flow of air within the cylinder. This action effectively retards the movement of the particles of grain or other material through the drum and provides a necessary preheating period for products such as grain or shelled corn.

After the particles have become thoroughly dry they will eventually be discharged into the transfer chamber 36 and will fall by gravity into the troughs 42. The screws 43 will then move the dried material toward and through the openings 46 and into the cooling chamber 33. The construction of the screw 43 and extensions 45 is such as to substantially prevent the entrance of heated air into the cooling chamber.

In the cooling chamber the particles of grain or other material are picked up by the lineal flights 47 and ultimately dropped to fall back toward the bottom. At the same time fresh air from the outside enters the cooling chamber 33 at the open end thereof, and moves longitudinally therethrough and serves to cool the particles.

Movement of the cooling air through the cooling chamber in the direction indicated by the arrows is produced by the same fan 40 which creates movement in the drying chamber. Inasmuch as the cooling air picks up heat from the dried particles, it is delivered in a preheated condition into the receiving end of the drying chamber. Thus, the same air is used for both cooling and drying and the movement of the air in both the cooling and drying chambers is produced by the same suction fan. The cooled and dehydrated product is ultimately discharged from the cooling chamber through the opening 19 and into the discharge tube 20.

The segmental flights 50 when used as illustrated, make the dryer particularly adapted for the drying of grain or shelled corn. However, the dryer and cooler may obviously be used for the drying of a variety of products either with or without the attachable segments 50 depending upon the particular requirements.

The present application deals with the use of the segmental flights only in combination with the type of apparatus claimed herein. The construction of the segmental flights per se forms the subject matter of a companion application.

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If desired, more than two concentric cylinders may be employed for dehydrating as in my prior Patent No. 1,988,678.

Various other changes and modifications may be made without departing from the spirit of the invention, and all of such changes are contemplated, as may come within the scope of the claims.

That I claim is:

1. In a dehydrating apparatus, a rotatable inner cylinder forming a drying chamber, a larger cylinder surrounding said inner cylinder and rotatable therewith and housing an annular cooling chamber, there being an opening for cooling air communicating at one end with said cooling chamber, means at the opposite end of the apparatus for introducing material to be dried into said drying chamber, means for delivering heat to said drying chamber, means connecting said drying chamber with said cooling chamber for directing material which has been dried from said drying chamber into said cooling chamber, said means including a transfer tube and a screw of substantially the same diameter as the internal diameter of said transfer tube rotatable therein in a direction to cause movement of material into said cooling chamber.

2. In a dehydrating apparatus, a rotatable cylinder forming a drying chamber, a larger cylinder surrounding said inner cylinder and rotatable therewith and housing an annular cooling chamber, there being an opening for cooling air communicating at one end with said cooling chamber, means at the opposite end of the apparatus for introducing material to be dried into said drying chamber, means for delivering heat to said drying chamber, means connecting said drying chamber with said cooling chamber for directing material which has been dried from said drying chamber into said cooling chamber, said means including a transfer tube, a screw of substantially the same diameter as the internal diameter of said transfer tube rotatable therein in a direction to cause movement of material into said cooling chamber, and means for causing cooling air to circulate from said cooling chamber into said drying chamber.

3. In a dehydrating apparatus, a rotatable inner cylinder forming a drying chamber, a larger cylinder surrounding said inner cylinder and rotatable therewith and housing an annular cooling chamber, a fixed head having an open end within which one end of said outer cylinder is rotatably positioned, said cooling chamber having an opening for cooling air communicating therewith, means connected to said head for delivering heat to said drying chamber, means connected to said head for introducing material to be dried into said drying chamber, a transfer housing at the opposite end of the apparatus from said head into which said inner cylinder rotatably projects, a suction fan connected to said transfer housing, means for directing material from said transfer housing into said annular cooling chamber, and discharge means in the lower portion of said head into which cooled material from said cooling chamber is directed.

4. In a dehydrating apparatus, a rotatable inner cylinder forming a drying chamber, a larger cylinder surrounding said inner cylinder and rotatable therewith and housing an annular cooling chamber, said cooling chamber having an opening for cooling air communicating therewith, means for delivering heat into one end of said drying chamber, means for introducing material

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to be dried into the same end of said drying chamber, a transfer housing at the opposite end of the apparatus with which said inner cylinder is rotatably and sealingly connected, a suction fan connected to said transfer housing for moving material through the drying chamber, and means for directing material from said transfer housing into the adjacent end of said annular cooling chamber while closing said end to the action of said suction fan, and a head forming a direct communication between the other end of said cooling chamber and the material feed end of said drying chamber whereby the suction fan also aids in moving material through the cooling chamber.

5. In a dehydrating apparatus, a rotatable inner cylinder forming a drying chamber, a larger cylinder surrounding said inner cylinder and rotatable therewith and housing an annular cooling chamber, said cooling chamber having an opening for cooling air communicating therewith, means for delivering heat into one end of said drying chamber, means for introducing material to be dried into the same end of said drying chamber, a transfer housing at the opposite end of the apparatus with which said inner cylinder is rotatably and sealingly connected, a suction fan connected to said transfer housing for moving material through the drying chamber, means for directing material from said transfer housing into one end of said annular cooling chamber while closing said end to the action of said suction fan, there being communication between the other end of said cooling chamber and said drying chamber whereby the suction fan also aids in moving material through the cooling chamber, and means for discharging the material from said last-mentioned end of the cooling chamber.

6. In a dehydrating apparatus, a rotatable inner cylinder forming a drying chamber, a larger cylinder surrounding said inner cylinder and rotatable therewith and housing an annular cooling chamber, a fixed head having an open end with which one end of said outer cylinder is rotatably and sealingly connected, said head forming a direct communication between one end of said drying chamber and the adjacent end of the cooling chamber said cooling chamber having an opening for cooling air communicating therewith, means connected to said head for delivering heat to said drying chamber, means connected to said head for introducing material to be dried into the end of said drying chamber adjacent said head, a transfer housing at the opposite end of the apparatus from said head to which said inner cylinder is rotatably and sealingly connected, a suction fan connected to said transfer housing for moving material through the drying chamber, and means for directing material from said transfer housing into the adjacent end of said annular cooling chamber while closing said end to the action of said suction fan, the direct communication between the other end of said cooling chamber and the feed end of said drying chamber permitting the suction fan to also aid in moving material through the cooling chamber.

7. In a dehydrating apparatus; a rotatable cylinder forming a drying chamber; a second cylinder of larger diameter surrounding said first mentioned cylinder, said cylinder being rotatable with said first cylinder and forming therebetween an annular cooling chamber having a cooling air inlet opening; a head forming a direct communication between one end of the drying chamber and the adjacent end of the annular cooling

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chamber; means for delivering heat to said drying chamber; means for introducing material to be dried into said drying chamber adjacent said head; a transfer housing communicating with the end of the inner cylinder opposite said head; means for causing cooling air to circulate from said cooling chamber through said head and into said drying chamber; and means for directing material from said transfer housing into the adjacent end portion of said annular cooling chamber while preventing any substantial air flow from said housing into said cooling chamber.

8. In a dehydrating apparatus; a rotatable cylinder forming a drying chamber; a second cylinder of larger diameter surrounding said first mentioned cylinder, said cylinder being rotatable with said first cylinder and forming therebetween an annular cooling chamber having a cooling air inlet opening; a head forming a direct communication between one end of the drying chamber and

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the adjacent end of the annular cooling chamber; means for delivering heat to said drying chamber; means for introducing material to be dried into said drying chamber adjacent said head; a transfer housing communicating with the end of the inner cylinder opposite said head; means for causing cooling air to circulate from said cooling chamber through said head and into said drying chamber; means for directing material from said transfer housing into the adjacent end portion of said annular cooling chamber while preventing any substantial air flow from said housing into said cooling chamber; and means in said head for receiving the dried and cooled material from said cooling chamber and for discharging said material from said head.

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No references cited.