United States Patent [19]

Sheehan

[11] **3,852,892**

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[54] **ROTARY DRUM DRYER**

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[52] **U.S. Cl.** **34/134,** 34/138, 34/242, 165/88, 165/92

[51] **Int. Cl.** **F26b 11/02**

[58] **Field of Search** 34/138, 134, 142, 135, 34/137, 128, 130, 242; 165/88, 92

[56] **References Cited**

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548,651	10/1895	Lamb	34/138
1,573,144	2/1926	Credo	34/17
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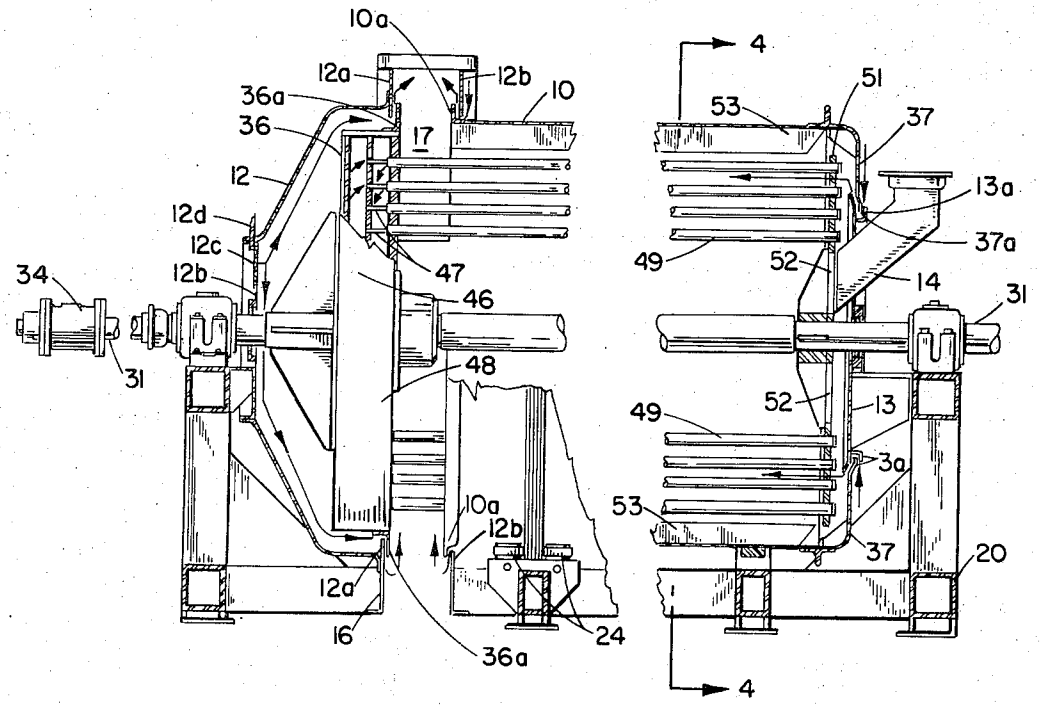
Assistant Examiner—Larry I. Schwartz
Attorney, Agent, or Firm—Woodard, Weikart, Emhardt & Naughton

[57] **ABSTRACT**

Disclosed is a dryer for comminuted or powdered material, such as grain particles, having an outer drum and an interior element through which a heating medium such as steam is circulated, the drum and the interior element being concentric and rotated independently of each other. The drum rotates on a vertically tilted longitudinal axis so that material to be dried moves by gravity through the rotating drum which has vanes or lifts for raising the material to fall through the heated interior element. The assembly is characterized by use of seals through which air is drawn into the drum and air intake openings at both ends of the drum.

3 Claims, 6 Drawing Figures



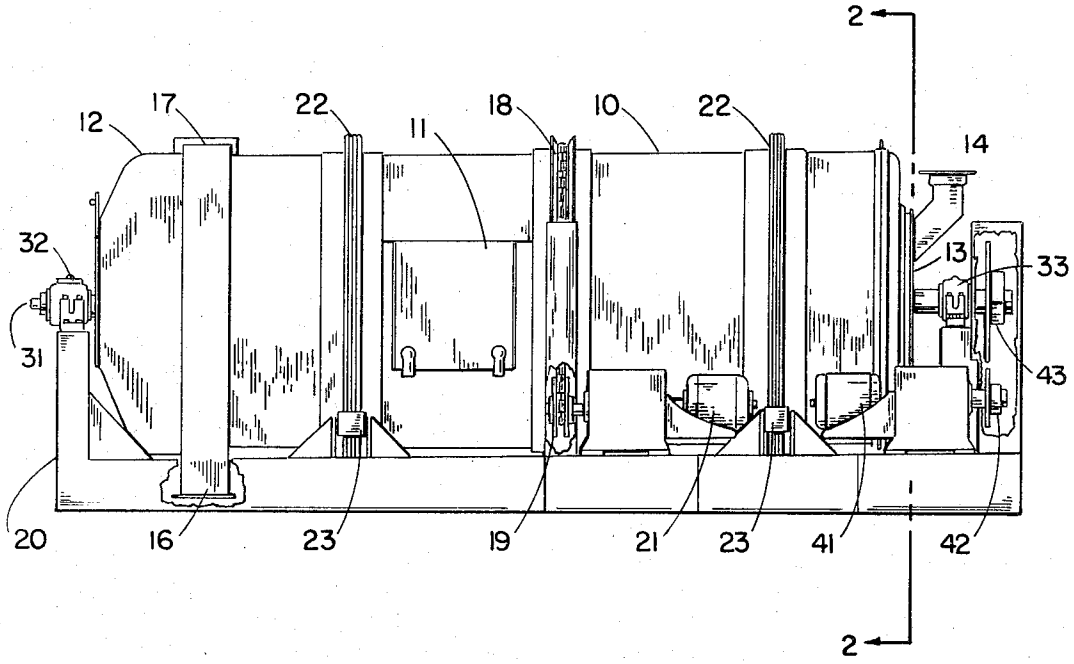

2
12
17
22
11
18
10
22
14
32
13
33
31
43
20
16
23
19
21
23
41
42
2

Fig. 1

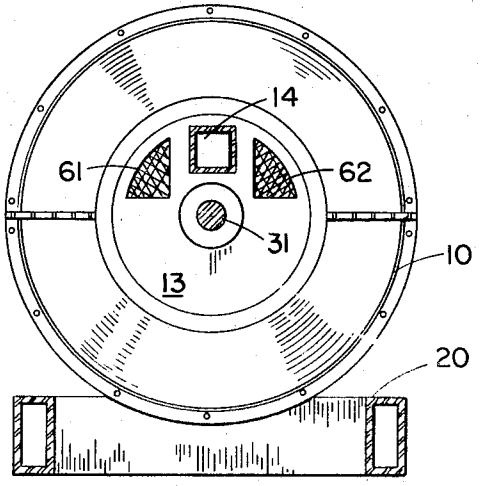

14
61
62
31
10
13
20

Fig. 2

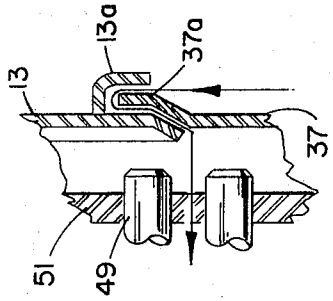
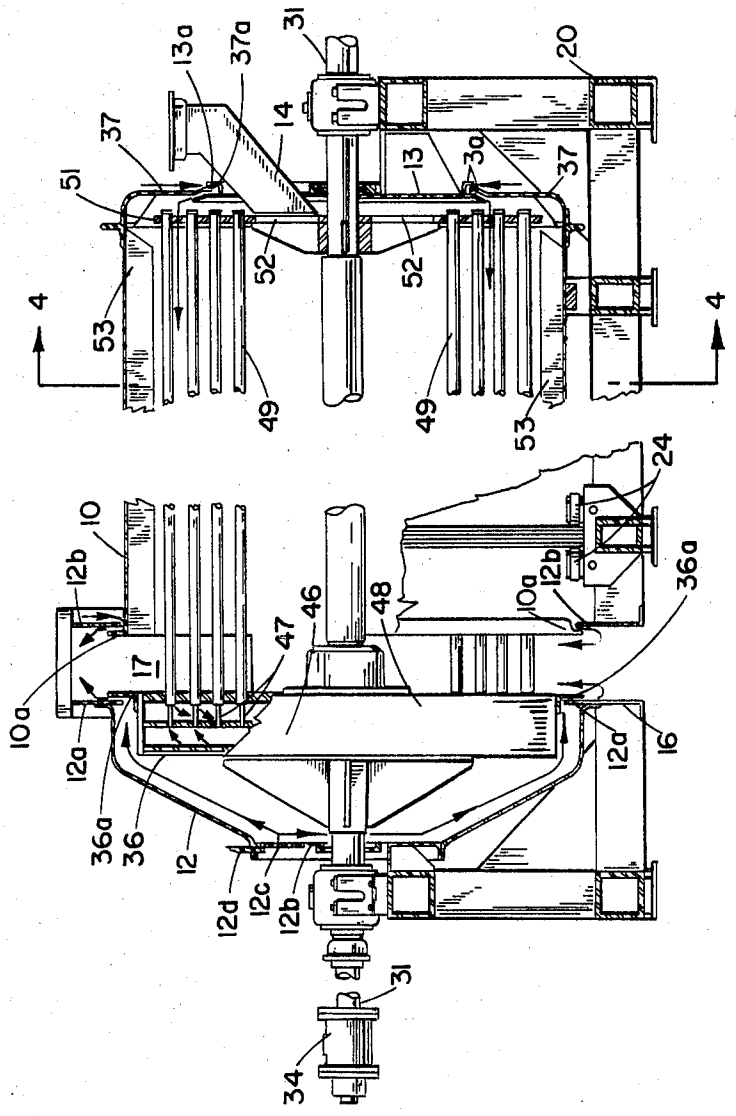

13a
37a
13
37
51
49

Fig. 3a


31
13a
37a
20
14
37
13
3a
51
52
52
53
49
49
53
4
4
24
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12b
10a
12b
36a
46
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10a
12a
16
12a
36a
36
12
12d
12c
12b
31
34

Fig. 3

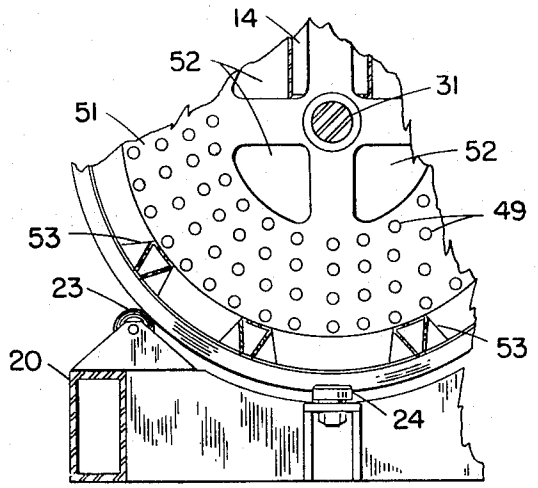

Fig. 4

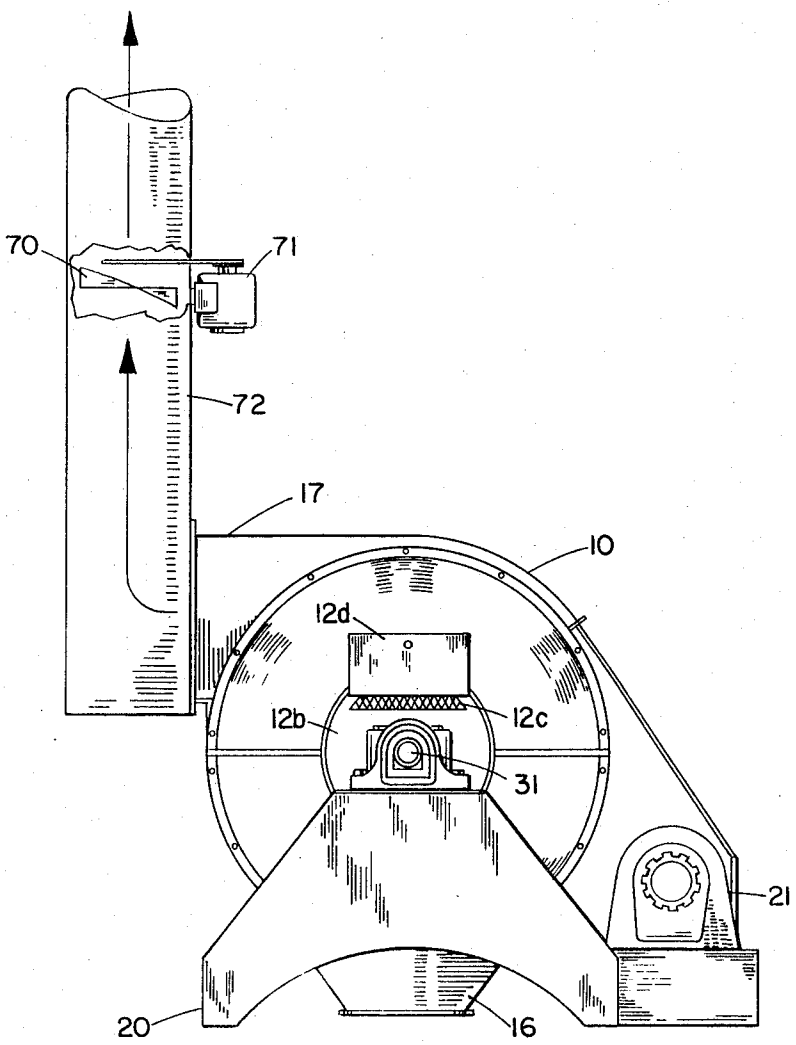

Fig. 5

ROTARY DRUM DRYER

BACKGROUND OF THE INVENTION

Dryers of the counter rotating type are not unknown in the prior and an example of prior art structures is disclosed in Bullerjahn U.S. Pat. No. 1,928,004. The structure of the present invention distinguishes over the prior art in that, among other things, it utilizes adjustable air intake registers at both ends of the drum, one being adjacent to the subatmospheric air outlet duct from the drum and acting as a partial by-pass for incoming air thus controlling the air intake from the register at the opposite end of the drum and the pressure drop across the seals. By permitting air to be drawn through the structural seals, "leakage" is always inward and the area around the exterior of the dryer installation is kept free of dust and particles passing through the dryer. The air moving inwardly through the seals may be sufficient to provide the desired air flow through the dryer, however, the presence of the intake registers permits more flexible control of this air flow component of the drying operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the rotary drum dryer assembly of the present invention.

FIG. 2 is an end view taken generally along the line 2—2 of FIG. 1.

FIG. 3 is a side sectional view of the assembly shown in FIG. 1.

FIG. 3A is an enlarged showing of a portion of FIG. 3.

FIG. 4 is a sectional view, taken generally along the line 4—4 of FIG. 3.

FIG. 5 is an end view, taken from the left-hand end of FIG. 1 and showing the air exhaust duct and fan.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring initially to FIG. 1, the assembly of the present invention includes a stainless steel drum 10 having a clean out door 11. The drum 10 is essentially an open ended cylinder with one end closed by the housing 12 and the other end closed by the stationary plate 13. A material inlet tube 14 communicates with an aperture in the plate 13 and provides for entry of finally divided or granulated material, such as grain to be dryed into the drum. The housing 12 at the opposite end of the drum is provided with a material discharge fitting 16 at its base and at its upper portion, an air discharge duct 17 extends tangentially sidewardly, the duct 17 being more clearly visible in FIG. 5.

The drum is rotated about its longitudinal axis by means of a chain 18 which extends around the drum and is driven by a drive member 19 rotated by the electric motor 21. The drum is supported for rotation on trunnion rings 22 which rest upon trunnion rollers 23 and thrust rollers 24 (FIG. 4). The rollers and the shaft extending through the drum are supported by a support frame 20.

The longitudinal axis of the drum is tilted downwardly slightly, that is, its left-hand end, as viewed in FIG. 1, is slightly lower than its right-hand end so that material introduced through the inlet 14 will move, by gravity, through the length of the drum to be discharged through the discharge fitting 16. Extending axially through the drum is a central shaft 31 supported

on bearings 32 and 33. As may best be seen in FIG. 3, a conventional rotary steam union fitting, indicated generally at 34 is attached to the shaft 31 and permits introduction of steam through interior passages in the shaft to a steam head, indicated generally at 36 in FIG. 3, whose purpose will be subsequently more fully described.

Referring now primarily to FIG. 3 and 3A, an inwardly extending end portion 37 on the drum is provided with a marginal offset flange and the stationary plate 13 is provided with an adjacent, parallel, annular flange 13*a* and, as indicated by the air flow arrows in FIG. 3A, when the pressure within the drum is below atmospheric, air will move through the restricted space between the annular flanges 37*a* and 13*a* into the drum.

The housing 12, as may best be seen in FIG. 3, at its rightward margin forms the air discharge passage 17 and the material discharge passage 16. Within the housing, adjacent these passages there are annular, inwardly extending flanges 12*a* and 12*b*. The end of the drum 10 adjacent the flange 12*b* is provided with an outwardly extending annular flange 10*a*. As indicated by the flow arrows in FIG. 3, air may flow from the exterior of the drum through the restricted space between the flanges 10*a* and 12*b* and into the drum interior.

Rotatable within the interior of the drum is the heating element, indicated generally at 36, which is supported on the shaft 31. The shaft and the heating element 36 rotate independently of the drum 10, the drive for the rotation of shaft 31 being provided by the electric motor 41 (FIG. 1) which, through the drive member 42 chained to the sprocket 43, rotates the shaft and, hence, the heating element.

Referring primarily, again, to FIG. 3 it will be evident that the heating element includes a steam chest or header 46 through which steam from the fitting 34 circulates through tubes 47. The tubes 47 extend through a drain chamber 48 and through larger diameter tubes 49. The tubes 49 extend into apertures in a tube support plate 51 and are capped adjacent the plate. The smaller diameter tubes 47 terminate short of the capped ends of the tubes 49 permitting steam to circulate back into the drain chest 48, as is conventional in the art. As will be evident from FIG. 4, the plate 51, near its center, is provided with multiple, relatively large area openings 52 which permit entry of material moving through the inlet duct 14 into the interior of the drum. Extending radially inwardly from the interior of the drum are a series of spaced lifter blades 53 which function to raise the grain within the drum as the drum rotates depositing it onto the moving steam-heated tubes 49 of the heating element. Since the tubes of the heating element and the drum are rotated at different speeds, as is conventional, the grain or other finally divided material within the drum is repeatedly dropped over the heated tubes, the temperature of the grain being thereby raised by conduction of heat from the tubes.

The heating element 36 carries an annular, outwardly extending flange 36*a* which is adjacent to the flange 12*a* carried by the housing 12. The vertical end plate 12*b* of the housing 12 is provided with an opening into the interior of the housing, the opening being covered by the grill 12*c*. A vertically adjustable closure member 12*d* (shown also in FIG. 5) is slidable in vertical uprights and is thus capable of adjustably masking or clos-

ing all or a portion of the grill **12***c*. With the grill **12***c* open as shown in FIG. **3** air may enter through the grill into the housing and, as indicated by the flow arrows, move through the restricted annular space between the flanges **12***a* and **36***a* into the interior of the drum. Since the grill **12***c* is adjacent to the air discharge duct **17**, opening of the grill **12***c* has a by-pass effect on the amount of air drawn through the various annular flange seals. As may best be seen in FIG. **2** the stationary plate **13** is also provided with grill covered openings **61** and **62**, whose effective area may be adjustable, which permits entry of air through the plate into the drum at its end remote from the material and air discharge openings **16** and **17**.

In operation, with the tubes **49** heated by steam circulating therethrough, and with the heating element **36** and the exterior drum **10** rotating at the desired speeds, finally divided material may be introduced through the duct **14**. Finally divided material will be turbulently lifted and dropped through the moving, heated tubes **49** and contact with the heated surface of the tubes will transfer heat, by conduction, to the finally divided material. The interior of the drum **10** is at sub-atmospheric pressure brought about by operation of the exhaust fan **70**, in discharge duct **72**, driven by the fan motor **71** (FIG. **5**). The discharge duct **72** communicates with the discharge passage **17**, and upon operation of the fan air will be drawn through the annular restricted space between the flanges **37***a* and **13***a* and **10***a* and **12***b*. This air drawn through the restricted space between the flanges is heated and expanded by contact with the heating element **36** and flows through the drum and out the discharge duct **17**. In its passage through the drum the air takes up the moisture evaporated from the material moving through the drum and exits with its acquired moisture through the discharge duct **17**. The material, releived of its moisture after passage along the length of the drum, exits through the discharge duct **16**. Material may be added and withdrawn from the drum on a continuous basis.

The provision for the intake of air into the drum through the flange seals functions to retain the material being dryed inside the drum and inhibits any fine dust in the material in the drum from flushing out to the exterior of the dryer. The rotating and sifting action provided by the lifter blades **53** serves to blend the material passing through the drum. The drum and the interior heating element may be rotated in the same direction at differing speeds or in opposite directions depending upon requirements. As previously mentioned, the adjacent flanges will normally provide sufficient air induction area for normal operating conditions, however, where necessary, the inlet registers or grills **12***c*, **61** and **62** may be opened to increase the air inlet area.

I claim:

1. A rotary drum type dryer for grannular material comprising: a rotatably mounted drum and an interior heating element mounted for independent concentric rotation within the drum, means for independently rotating said drum and said heating element, a stationary plate at one end of said drum having a material inlet tube extending therethrough and into the drum interior, annular adjacent flanges on said drum and said plate defining an annular restricted air intake passage from the exterior to the interior of the drum, a stationary housing at the other end of said drum into which said drum extends, adjacent annular flanges on said drum and said stationary housing defining a further annular restricted air intake passage to the interior of said drum and housing, a material discharge opening at the base of said housing and an air discharge opening at the upper end of the housing, and air moving means for drawing air from said drum through said air discharge opening.

2. A rotary drum type dryer as claimed in claim **1** in which auxiliary air inlet passages are provided in said housing adjacent said air discharge opening and in said stationary plate for admitting air into said drum and housing other than through the space between said adjacent annular flanges.

3. A rotary drum type dryer as claimed in claim **2** in which the effective size of said auxiliary air inlet passages in said housing are adjustable.

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