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[54] **CONTINUOUS DRYING OF SOLID PARTICLES**

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[51] **Int. Cl.**.. **F26b 5/08**

[58] **Field of Search**............................... 34/8, 58, 15

[56] **References Cited**

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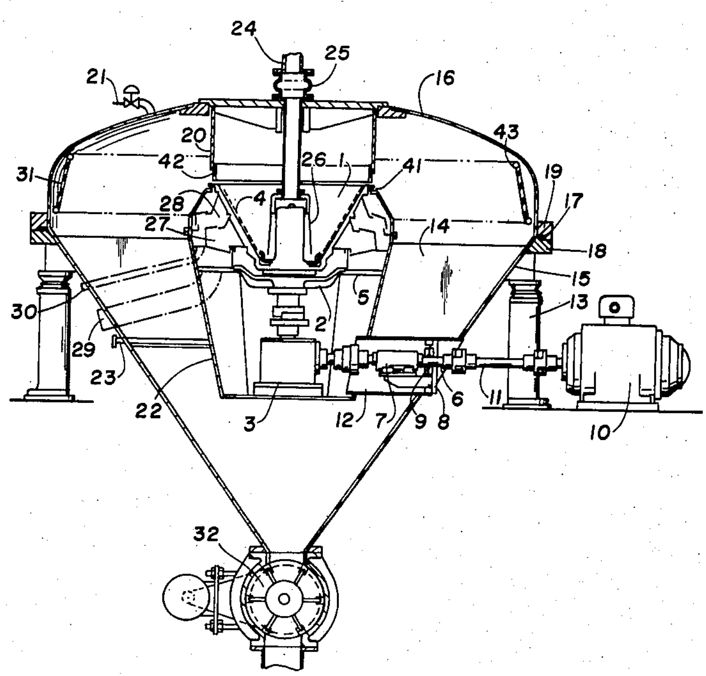
[57] **ABSTRACT**

A liquid-solid mixture is dried in a rotary basket, the separated liquid phase is received in an annular housing surrounding the basket and the centrifugally ejected solid particles are dried in a fluid-tight, closed casing defining a drying chamber surrounding the housing and filled with a dense and inert fluid, such as compressed air, to increase the drag on the projected particles and to brake them along the entire length of their trajectory.

8 Claims, 2 Drawing Figures



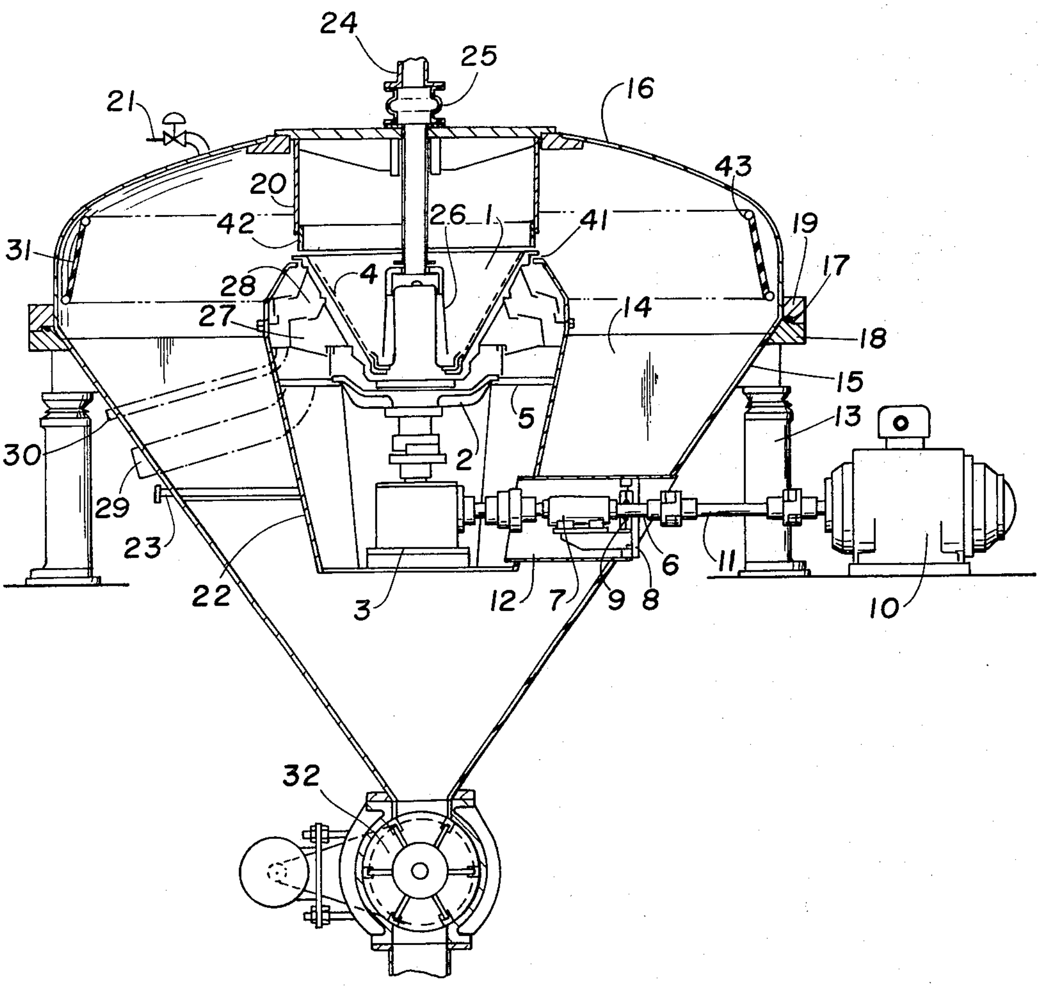

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FIG. 1

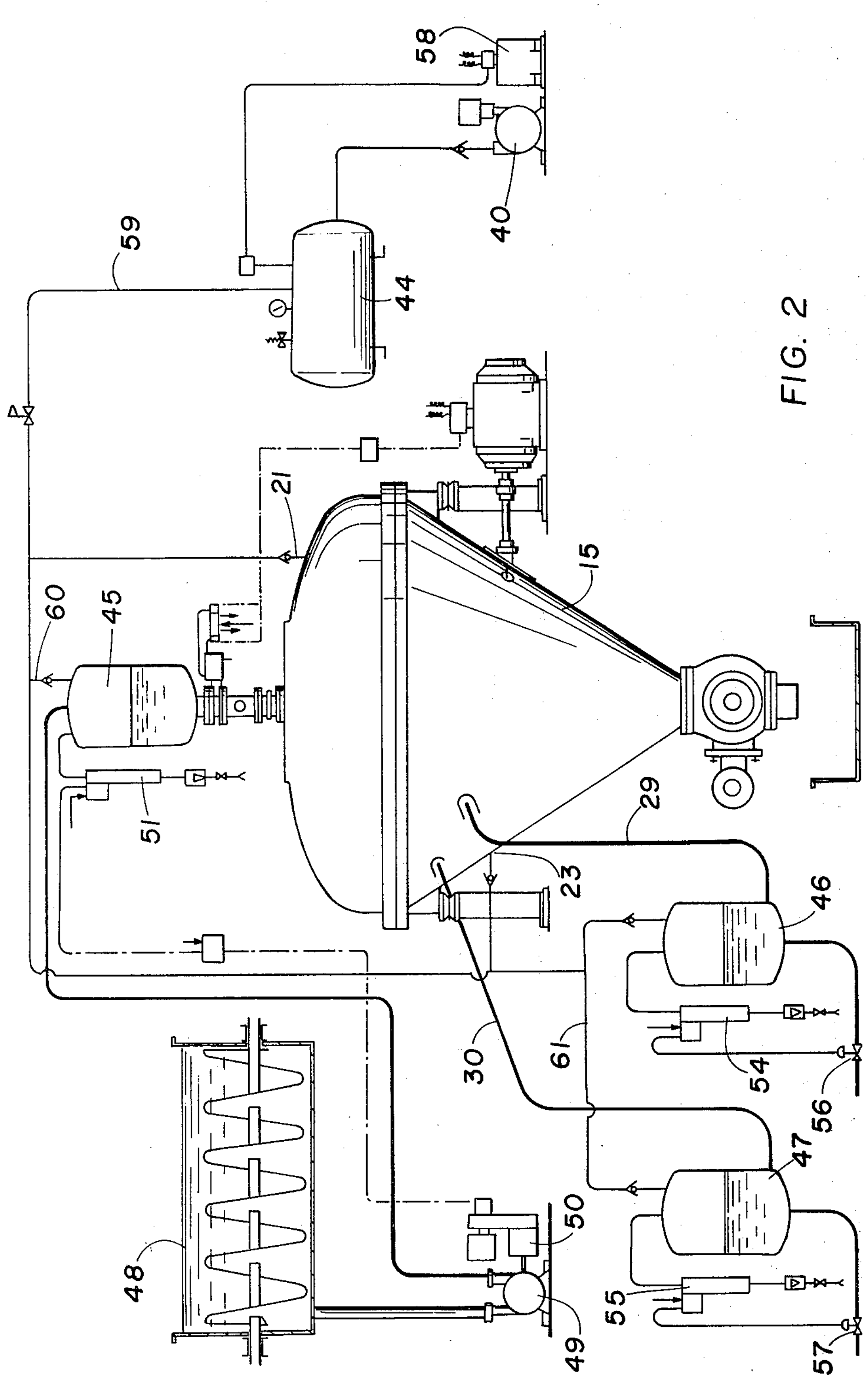

FIG. 2

CONTINUOUS DRYING OF SOLID PARTICLES

The present invention relates to improvements in the continuous drying of liquid-solid mixtures, such as sugar juice.

Centrifugal driers for such purposes are known, which comprise a rotary drying basket, conduit means for supplying the liquid-solid mixture to be dried to the basket, and a screen in the basket across which passes the liquid phase of the mixture to separate the same from the solid phase. The solid particles of the mixture glide along the wall of the rotary basket under centrifugal force or by means of a suitable extraction mechanism and are ejected from the basket at one end thereof.

An annular housing surrounds the basket and is arranged to receive the particles ejected from the basket at high speed so that they are thrown against the wall of the housing with considerable force, the basket turning in the housing. Under the impact, these particles are broken up, resulting in undesirable fines.

Generally, the extent of the impact may be reduced by increasing the size of the annular housing so that the ejected particles are slowed down by the air in the housing in their longer trajectory. However, the deceleration of the particles is diminished when their size increases so that their slowing down becomes insufficient for larger size particles unless the dimensions of the apparatus are unduly enlarged. This has been the case in connection with the drying of crystal sugar used in general commerce.

It has also been proposed to slow down the particles as they leave the basket by means of an air current directed against the end of the basket whence the particles are ejected. This, however, has two disadvantages: (1) it requires considerable amounts of air and, consequently, consumes additional energy for the operation of the apparatus. This disadvantage is further enhanced if the air must be heated to avoid undesirable cooling of the material to be dried, which is the case in sugar refineries where the cooling of the massecuite would lead to an increase in the viscosity of the mother liquid and thus reduce the efficiency of the drying process. (2) The directed air current entrains fine particles of the dried product, which must then be separated from the air current. Thus, it becomes necessary to provide a special separator, which increases the cost of the installation. Furthermore, if the dried particles are sticky, which is the case with humid sugar crystals, they encrust the air conduits which, therefore, must be cleaned frequently.

It is the primary object of this invention to slow down particles ejected from a drier to a considerable extent but in a limited space without notably increasing the energy or power requirements of the apparatus whereby continuous drying may be extended to materials which, due to their particular granular condition, could not be so treated before.

The invention is based on the fact that the advance of a solid particle in a fluid, i.e. its drag, is proportional to the density of the fluid in which it moves, all other operating conditions being equal.

In accordance with the present invention, solid particles are continuously dried by projecting the particles out of a rotary drying basket into a fluid-tight, closed chamber to form a trajectory of the projected particles along the periphery of the chamber, and filling the chamber completely with a dense and inert gaseous fluid, such as compressed air maintained at a substantially uniform pressure, to increase the drag on the projected particles and to brake them along the entire length of their trajectory.

The centrifugal drier of this invention comprises a rotary drying basket, conduit means for supplying a liquid solid mixture to be dried to the basket, and a screen in the basket for separating the liquid from the solid, as is conventional. An annular housing surrounds the basket, which is mounted in the housing for rotation, and is arranged to receive the separated liquid therefrom. A fluid-tight, closed casing defining a drying chamber surrounds the housing and is arranged to receive the solid particles centrifugally ejected from the basket at one end thereof. A source of a dense gaseous fluid is connected to the housing and to the casing, means being provided for delivering from this source a volume of the gaseous fluid into the chamber. The dried solid particles are removed from the casing through a gas-tight outlet.

The above and other objects, advantages and features of the invention will become more apparent from the following detailed description of one specific embodiment thereof, taken in conjunction with the accompanying drawing wherein

FIG. 1 is a transverse vertical section of a centrifugal drier according to the present invention, and

FIG. 2 schematically illustrates the operation of the apparatus.

Referring now to the drawing, which is merely illustrative of the invention by way of example and whose conventional parts are shown merely schematically, the drier is illustrated to comprise rotary drying bowl or basket **1** mounted for rotation on mount **2** which supports the basket for rotation about the vertical axis of the drier. The means for rotating the basket comprises motor **10** whose output shaft is connected by coupling rod **11** to shaft **6**, the shaft being coupled to the vertical driving shaft of basket **1** by transmission **3** which may be a reduction gear or a gearing designed to multiply the speed of the motor. A support frame **8** supports double bearing **7** wherein shaft **6** is journaled, and a gasket **9** provides a fluid-tight mounting for the shaft **6.**

Rotary basket **1** is surrounded by annular housing **22** which supports mount **2** for the basket on support structure **5** inwardly extending from the wall of housing **22,** the illustrated support structure consisting of a series of radially extending ribs which support the peripheral edge of the mount **2.** Conical tub or tank **15** surrounds annular housing **22** and is connected thereto by radial ribs **14** interconnecting the walls of the housing and the conical tank which forms a funnel. The tank is closed by cover **16** to constitute a fluid-tight, closed casing defining a drying chamber. Flanges **18** and **19** are respectively affixed to the tank and the cover, and gasket **17** is placed between the flanges to provide a fluid-tight seal therebetween.

As will be noted from the drawing, a housing **12** is provided in the walls of housing **22** and casing **15** to hold the shaft structure interconnecting the outside motor **10** with the transmission **3** for driving basket **1.** A series of columns **13** support the casing **15** and thus the entire drier.

The interior of annular housing **22** communicates with the drying chamber defined by casing **15** only through a narrow annular slot **41** defined between a flange at the upper end of basket **1** and the upper edge of housing **22.** In this manner, the interior of housing **22** is substantially shut off from the interior of the drying chamber so as to avoid air turbulences in the drying chamber caused by the rotation of basket **1** in housing **22.** For the same purpose, sleeve **20** is affixed to cover **16** and extends towards the upper flange of basket **1,** carrying a flexible skirt **42** at its lower end which reaches within a small distance from the basket flange. In this manner, the pressure is substantially uniform in the entire peripheral part of the fluid-tight casing.

The liquid-solid mixture to be dried is supplied to the basket along the axis thereof by input conduit **24** which is connected to the cover by a flexible sleeve **25.** A coaxially extending rotary distributor **26** in the basket assures the even distribution of the mixture in the basket. During rotation of the basket, the liquid phase of the mixture is separated or filtered through screen or sieve **4** mounted along the wall of the basket, the liquid being removed through ports in the basket wall leading into annular chambers **27** and **28** formed in housing **22** by suitable partitions. Outlet conduits **29** and **30** lead from annular chambers **27** and **28** through the walls of housing **22** and casing **15** to the outside to evacuate the liquid from the drier.

The solid particles separated on screen **4** from the liquid phase glide upwardly along the screen during rotation of basket **1** and are centrifugally ejected at the upper end of the basket into the drying chamber defined by casing **15,** passing through the small annular slot defined between the upper flange of basket **1** and flexible skirt **42.** A sleeve **31** of an elastic sheet material is mounted in the path of the trajectory of the ejected particles along the periphery of the drying chamber, the elastic sleeve cushioning the impact of the particles and deflecting them so that they fall by gravity into the bottom of the funnel-shaped casing wherefrom they are removed through an outlet illustrated, by way of example, as a rotary gas-tight gate **32.** If desired, a conventional valve could be mounted at the bottom to permit removal of the dried particles from the apparatus. The elastic sleeve **42** is mounted on a frame supported on cover **16.**

FIG. **2** schematically illustrates the operation of the drier according to the invention, i.e. the maintenance of a superatmospheric pressure in the drying chamber.

A compressor **40** of a gaseous fluid, such as air, delivers the compressed gaseous fluid to a storage vessel **44,** the pressure being regulated by control **58.** A main **59** delivers the pressure-controlled gaseous fluid at superatmospheric pressure to conduits **21** and **23** leading respectively to casing **15** and housing **22** to maintain a desired pressure in the drying chamber and in the liquid-receiving chamber defined by housing **22.** Another branch conduit **60** leads from the main into supply tank **45** which holds the liquid-solid mixture to be dried and is connected to input conduit **24** supplying the mixture to basket **1.** Yet another branch conduit **61** leads from the main into drainage tanks **46** and **47** respectively connected to outlet conduits **29** and **30** to receive the drained liquid. In this manner, a pressure equal to that in the drying chamber and in housing **22** is maintained in supply tank **45** and drainage tanks **46, 47.**

In a conventional manner, the liquid-solid mixture to be dried is held in storage in a conventional mixer **48** including a screw conveyor. It may be desirable to provide heating means for the mixer. A volumetric pump **49** delivers the well mixed liquid-solid mixture from mixer **48** to supply tank **45,** a pump speed control **50** being controlled by a level control **51** to keep the level of the mixture in tank **45** at a desired height by controlling the pump speed.

Similar liquid level controls **54, 55** are provided for drainage tanks **46, 47** to control valves **56** and **57** mounted in the outlet conduits of the tanks to permit controlled evacuation of the liquid from these tanks in correspondence to the liquid amounts received therein and so as to maintain the desired pressure in the tanks.

By maintaining a superatmospheric pressure in the drying chamber of casing **15,** the drag on the ejected particles is increased and they are slowed down along their trajectory. Thus, for example, a relative pressure of two atmospheres, i.e. three atmospheres of absolute pressure, permits tripling the volume of the air mass and, thus, considerably increases the deceleration to which the ejected particles are subjected during their trajectory, compared to the same operation under atmospheric pressure.

Since the gaseous fluid losses through rotary gate **32** are small, there is practically no movement of gaseous fluid, i.e. air, in the entire interior of the apparatus.

The casing **15** can be filled-up with a heavy gas, such as Krypton, at atmospheric or higher than atmospheric pressure, in place of compressed air.

I claim:

1. Process of continuously drying solid particles, comprising the steps of

1. projecting particles out of a rotary drying basket into a fluid-tight, closed chamber filled with a gaseous fluid, and
2. maintaining the pressure in the chamber at such a value that the density of the gaseous fluid filling the chamber is higher than that of air at atmospheric pressure to increase the drag on the projected particles along their trajectory in the chamber.

2. The process of claim **1,** wherein the gaseous fluid is a gas having a higher density than air.

3. A centrifugal drier for the continuous production of dried solid particles, comprising

1. a rotary drying basket,
2. first conduit means for supplying a liquid-solid mixture to be dried to the basket,
3. a screen in the basket for separating the liquid from the solid,
4. an annular housing surrounding the basket and arranged to receive the separated liquid therefrom,
5. a fluid-tight, closed casing defining a chamber surrounding the housing and arranged to receive the solid particles centrifugally ejected from the basket at an outlet end thereof,
6. second conduit means for removing separated liquid from the housing,
7. an outlet in the casing for removing dried solid particles from the chamber,
8. a source of gaseous fluid connected to the casing for maintaining a controlled pressure in the chamber, the fluid having a higher density than air at atmospheric pressure at the controlled pressure, and
9. means for preventing escape of the gaseous fluid from the casing through the first and second conduit means and the outlet.

4. The centrifugal drier of claim 3, wherein the source of gas is a source of compressed air, and further comprising means for controlling the air pressure, and reservoir means connected to the source of compressed air, the first and second conduit means being connected to the reservoir means.

5. The centrifugal drier of claim 4, wherein the reservoir means comprises a supply tank for the liquid-solid mixture connected to the conduit means for supplying the liquid-solid mixture, and further comprising a variable output pump for delivering the mixture from the supply tank to the basket, and a control regulating the pump output so as to maintained a predetermined level of the mixture in the tank.

6. The centrifugal drier of claim 4, wherein the reservoir means comprises a drainage tank for the liquid connected to the conduit means for removing the separated liquid, and further comprising an outlet conduit for the drainage tank and a control valve in the outlet conduit for maintaining a predetermined level of the liquid in the drainage tank.

7. The centrifugal drier of claim 3, wherein the housing has an upper edge and defines a chamber fully enclosing the basket, and further comprising a skirt affixed in a fluid-tight manner to one end wall of the casing, the skirt having a lower edge defining an annular space with the upper edge of the housing, and the basket having an outlet end on a level with the annular space.

8. The centrifugal drier of claim 7, further comprising an annular flange at the outlet end of the basket, the annular flange extending into the annular space and the upper edge of the housing and the lower edge of the skirt terminating close to the flange at opposite sides thereof.

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