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V. A. STEIMEL ET AL

2,851,792

DRUM DRYER

Filed April 27, 1955

2 Sheets-Sheet 1

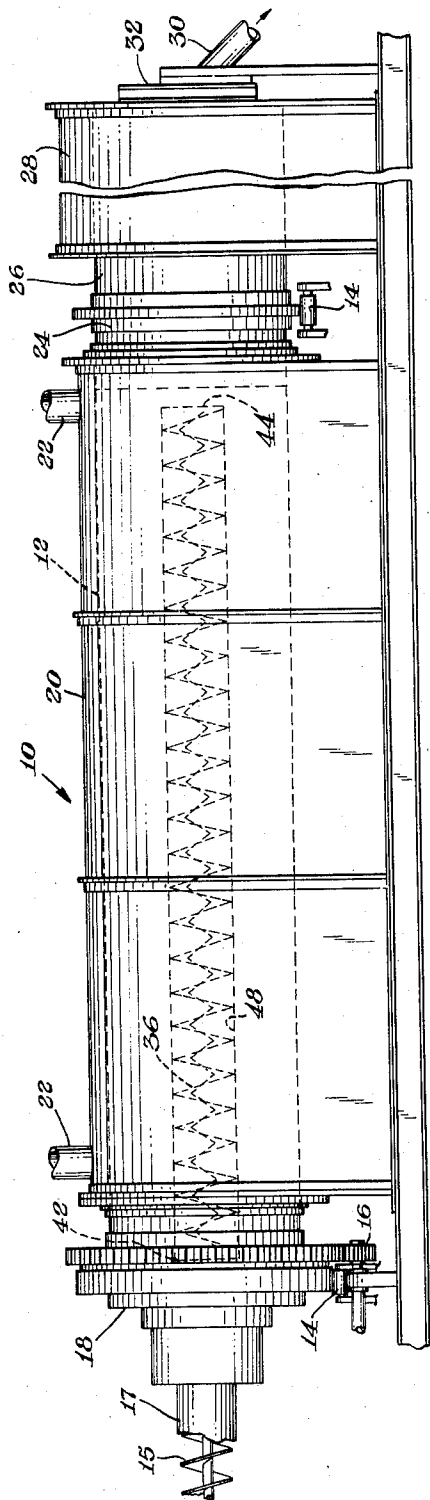


Fig. 1

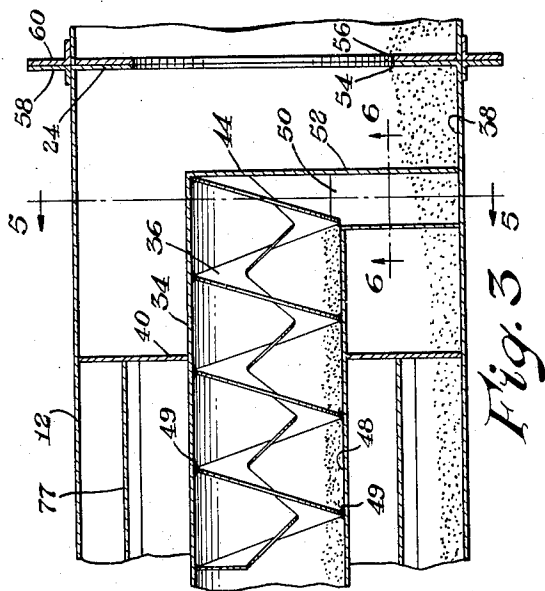


Fig. 3

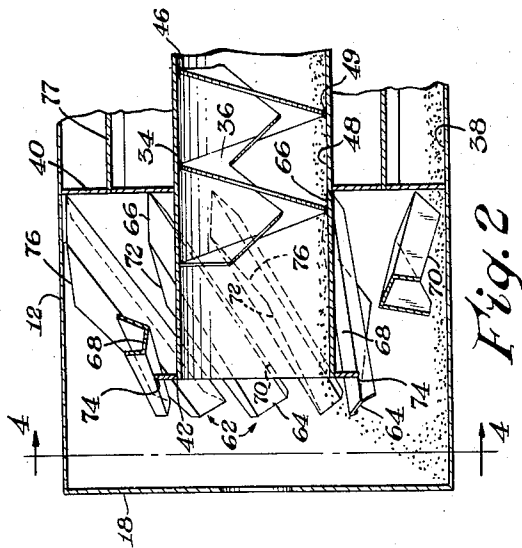


Fig. 2

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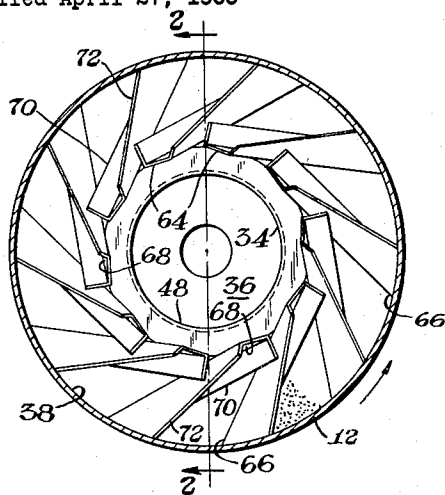


Fig. 4

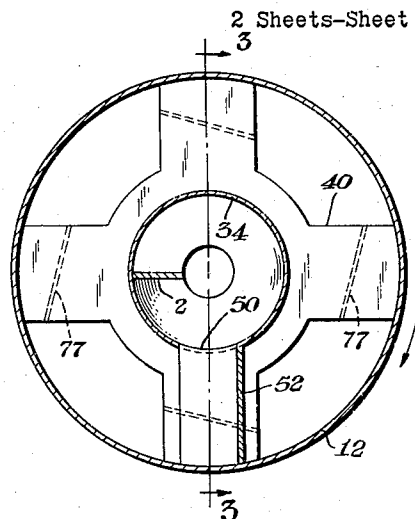


Fig. 5

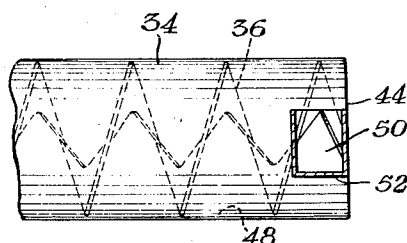


Fig. 6

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DRUM DRYER

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2 Claims. (Cl. 34—128)

This invention relates to rotary drum type dryers for drying particulated materials and particularly to such dryers in which a part of the dried particulated solids is continuously re-cycled to the input end of the drum.

Many particulated solids are dried by introducing a wet feed at one end of a heated rotating drum or cylinder, the wet feed then being dried as it tumbles and advances towards the output end of the drum. The time cycle for the passage of material through the drum and the operating temperature of the drum are controlled to assure a dry product being discharged from the output end of the drum.

However, many wet feed materials tend to cake onto the drum surface and eventually the caked material clogs the dryer or seriously affects its efficiency of operation.

In some types of drum dryers of particulated solids the caking problem at the feed end thereof has been solved by transporting in heated buckets a part of the dry, heated granular materials from the output end of the dryer to the feed end. When the wet feed and the dry materials are mixed, the resultant temperature is above the dew point and caking of the feed material on the drum surface does not occur. Such a solution to the caking problem, however, is expensive, is mechanically complex, and is not adapted to drum dryers where the output end of the dryer is directly coupled to the input end of a cooling drum.

Accordingly, an object of this invention is to provide an improved means for preventing caking of wet feed materials on interior surfaces of rotary drum dryers.

Another object of this invention is to provide an improved means for re-cycling a part of a mixture from the output end of a mixer to the input end thereof.

An additional object of this invention is to provide an improved rotary drum dryer having means incorporated therein for recycling materials from the output end thereof to the input end thereof.

A further object of this invention is to provide a recycling type rotary drum dryer in which wet feed material falls upon a bed of hot, dry material which has been re-cycled from the output end of the drum.

In accordance with this invention an elongated drum dryer is provided with a ribbon-like helix or screw which fits closely within and is secured to a hollow tube which extends from near the input end of the drum dryer to near the output end thereof. A scoop or series of scoops disposed near the output end of the dryer picks up a part of the dry, hot material and funnels it into the screw through an opening in the surrounding tube. In dryers in which the drum rotates counter-clockwise, as viewed from the input end thereof, the screw thread is a left hand thread in order to draw back materials from the output end of the dryer to the input end thereof. The tube containing the screw thread is axially mounted in a fixed manner and during operation does not move relative to the dryer cylinder. The output of the screw is applied to the input end of the dryer and is mixed with the incoming particulated solids by the help of a series of sym-

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metrically arranged scoops disposed between the screw containing tube and the inner side wall of the dryer.

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevational view of an encased rotary dryer in accordance with this invention and showing an attached cooling unit;

Fig. 2 is a fragmentary elevational view, on an enlarged scale and in section, of the input end of the dryer of Fig. 1, showing the open end of the axially disposed screw containing tube and the scoops disposed between the tube and the inner wall of the dryer cylinder;

Fig. 3 is a fragmentary view, in section and on an enlarged scale, of the output end of the dryer of Fig. 1, showing the scoop and input end of the screw containing tube;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 2;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 3, and

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 3.

Referring to Fig. 1, there is shown a rotary drum type dryer indicated generally by the numeral 10 comprising a rotatable hollow cylinder 12 which is supported at each end by a trunnion 14. A gear drive unit 16 near the feed end 18 of the cylinder provides the rotational power. The side part of the cylinder 12 is encased by a thermally insulating housing 20 which contains a plurality of gas fired heating units (not shown) which are directed towards one side of the rotating cylinder 12 of the dryer 10. Vents 22 near at the top of the housing (near each end of the cylinder) remove fumes from the housing 20.

The output end 24 of the dryer 10 is coupled to a rotatable drum cooling unit 26 which is also enclosed in a housing 28. Cool water is sprayed over the rotating cylinder of the cooler 26 which is also driven by the gear drive unit 16 of the dryer 10.

Particulated wet feed material is supplied to the feed or input end 18 of the dryer through a screw conveyer 15 disposed within the housing 17. Cooled, dry material is removed through a tubular member 30 at the output end 32 of the cooler 26 and is later packaged for shipment.

Referring now to Figs. 2 through 6 as well as to Fig. 1, the hollow dryer cylinder 12 has within it an axially disposed tube 34 which contains a screw 36, which may be rootless, as illustrated, and which is welded, brazed or otherwise secured to the wall of the tube 34. The tube 34 is slightly shorter than the dryer cylinder 12 and is secured by rivets, bolts or by welded connection to the inner surface or wall 38 of the cylinder 12 near each end of the tube 34 by a plurality of metal cross members 40. The end 42 of the tube 34 which lies nearest the input or feed end 18 of the cylinder 12 is open-ended. The screw 36 within the tube 34 is spaced from the open end 42 of the tube 34 a distance equal to about 10 percent of the length of the tube 34 and extends to the opposite end 44 of the tube 34 which is a closed end. The outer peripheral edge 46 of the screw 36 is secured to the inner wall 48 of the tube 34 by welded connections 49, for example, along the outer edge of the thread.

Referring especially to Figs. 3, 5 and 6, an opening 50 is provided in the side of the tube 34 near its closed end 44. A scoop 52 of generally U-shaped cross sectional configuration extends between and is secured to the inner wall 38 of the cylinder 12 and to the periphery of the opening 50, the scoop 52 being disposed generally perpendicularly with respect to longitudinal axis of the tube 34 and cylinder 12. The output end 24 of the dryer

10 has a circular discharge opening 54 of large diameter therein, the opening 54 being coaxial with the longitudinal axis of the dryer 12. The recycle rate of the dryer may be increased or decreased by changing the size of the discharge opening 54, thus controlling the depth of the inventory on the output end of the dryer. The cooler 26 also contains an entry opening (56 in Fig. 3) of similar size, shape, and position, thus enabling the inventory of hot, dry particulated materials to tumble from the dryer 12 into the cooler 26 as the units are rotated when the cooler and dryer are coupled together through their end flanges 58, 60.

In dryers 10 which are to be rotated counter-clockwise (as viewed when facing the input end 18), as is the dryer 10 illustrated in Figs. 1 through 6, the screw 36 in the tube 34 has a left handed thread lead. The screw 36 and tube 34 are fixed in position with respect to the dryer cylinder 12 and thus undergo no relative motion with respect to each other or to the cylinder 12 when the dryer cylinder 12 is rotated.

A cluster of scoops indicated generally by the numeral 62 is symmetrically arranged about the output end 42 of the screw containing tube 34. The discharge end 64 of each of the scoops 62 extends beyond the open end 42 of the tube 34. Each scoop 62 has a flat bottom 68 and sides 70, 72 which extend upwardly therefrom. The rear end 66 of each scoop plus the rear part of each side 70, 72, of each scoop are shaped to abut against the wall 38 of the cylinder 12 and are welded thereto although other means of securing the scoops 62 to the wall 38 may be used. The bottom 68 of each scoop 62 makes contact with and is welded to the open end edge 74 of the tube 34. Each side 72 of each scoop 62 is generally triangular in shape, the base of the triangle abutting against the bottom 68 of the scoop. One side 76 of the triangularly shaped side 72 (which is slightly curved in order that it fit closely against the wall 38 of the tube 12) is welded to the wall 38. The above described arrangement adds rigidity to the cluster of scoops 62. The side 72 "bites into" and loads each scoop with the particulated materials which lie near the bottom of the cylinder 12. That is, each scoop 62 is loaded, as the cylinder 12 rotates with re-cycled hot materials which have fallen from the open end of the tube 34, and with wet feed mixed with hot dry materials.

Ten such scoops 62 are provided in the dryer illustrated, but a greater or lesser number of scoops could be used, depending on specific needs. It has been found, however, that with particulated materials such as crystals of potassium bromide, for example, as a feed material, the scoops 62 drop a substantially continuous protective blanket of hot, dry materials over the surface of the dryer 10 on which wet feed materials impinge.

The dryer 10 is provided with a plurality (four are illustrated) of similarly mounted lifting vanes 77 extending between the cross braces 40. The vanes 77 each comprise a flat plank-like metal member which is secured to the inner wall 38 of the cylinder 12 (by cross members 40) to form in effect a "bottomless" bin which scoops up particulated solids as the vane 77 rotates with the cylinder 12. The solids are drawn up the side surface of the cylinder 12 as the drum rotates, but are continually released through the small space between the lower edge of each vane 77 and the wall 38. The result is that the particulated solids are subjected to the heated side of the cylinder 12 more evenly and for a longer period of time than would occur if no vanes 77 were provided.

The tube 34, screw 36, scoop 52, scoops 62 and other parts of the dryer to which the feed material is exposed may be made of nickel, Monel, or stainless steel, for example, in a dryer used for drying potassium bromide. Other structural materials may be used, however, with other materials to be dried, or to provide specified operating characteristics.

In operation wet feed material is dropped into the input end of the cylinder 12 from the screw conveyor in the housing 17. The wet feed material falls onto a blanket or bed of hot, dry material which has been re-cycled from the output end of the dryer 10 through the screw 36 in the tube 34. The material falling from the discharge end of the tube 34, along with part of the advancing feed material, is picked up by the scoops 62 and is then thrown onto the wall of the cylinder 12 to form the blanket of hot, dry material mentioned above.

The input end 18 of the cylinder 12 is elevated above the output end 24 of the cylinder 12. As the cylinder 12 rotates the particulated material mixture continually advances towards the output end 24 of the dryer 12 while the material is being dried. The dry, hot material which is not re-cycled builds up against the output end 24 of the dryer and spills out through the opening 54 in that end.

The feed material and the re-cycled hot, dry material mix together as the dryer is rotated, and the temperature of the mixture of the feed and blanketing material is such that the mixture has no tendency to cake on the wall 38 of the rotating cylinder 12. The re-cycling and dispersion of the hot, dry material is accomplished without the use of any mechanism which moves relative to the cylinder 12.

Thus, the re-cycling means is mechanically sturdy, does not require any driving means other than that already required to rotate the cylinder 12, requires little or no servicing, and accomplishes the re-cycling of hot, dry materials from the output end of the dryer to the input end of the dryer within the heated cylinder without the heat loss which would occur if external re-cycling means were used.

We claim:

1. A rotary drum type dryer for particulated materials comprising a rotatable drum having a wall, an input end and an output end, a hollow tube having an inner wall surface, said tube being coaxially disposed entirely within said drum and fixedly secured thereto, each end of the tube being disposed within said drum and spaced from the end of the drum, a ribbon-like helix disposed within and fixedly secured to said tube, said helix having an outer peripheral edge which abuts against the inner wall surface of said tube, means adjacent to the end of the tube which is closest to the output end of the drum for transferring part of any inventory of particulated materials in said drum to said tube, means for discharging said particulated materials from the end part of said tube which is closest to the input end of said drum, the end part of the tube which is closest to the input end of said drum being open ended, and a symmetrically arranged cluster of scoops disposed around said open end of the tube, each of said scoops being secured to said drum wall and to said tube.
2. A rotary drum type dryer in accordance with claim 1, wherein each of said scoops in said cluster has one side shaped generally as a triangle, said one side being in contact with said drum wall along one edge thereof, whereby as said drum dryer is rotated the one side of each scoop passes through any inventory in the drum and loads the scoop of which it is a part.

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