

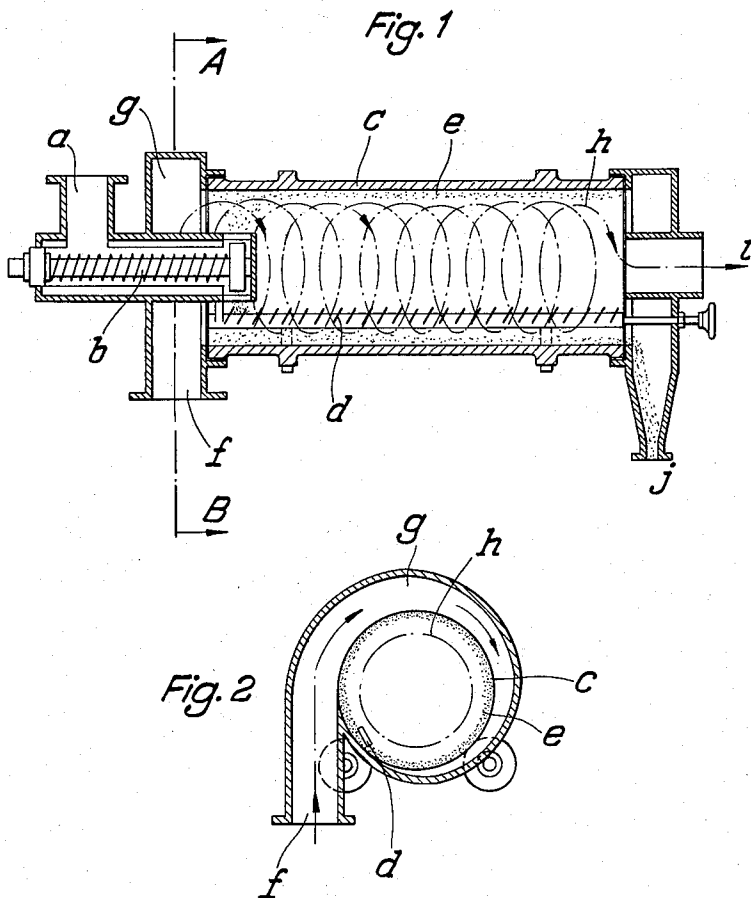
May 8, 1956

W. ROTHE

2,744,338

APPARATUS FOR DRYING FRIABLE MATERIAL

Filed May 7, 1953



Inventor:

WALTER ROTHE

by L. S. Saulsbury

ATTORNEY

1

2,744,338

APPARATUS FOR DRYING FRIABLE MATERIAL

Walter Rothe, Hamburg, Germany, assignor to Braunschweigische Maschinenbaustalt A. G., Braunschweig, Germany, a German Federal Republic

Application May 7, 1953, Serial No. 353,604

1 Claim. (Cl. 34—58)

The present invention relates to an apparatus for drying friable material of the type which comprises a rotary drum, and axially directed blades sweeping the inner surface of the drum, the material to be treated being inserted into the drum and dried by the passage of gases therethrough.

In apparatus of this type known heretofore the drying process is effected by inserting the material to be treated into the rotating drum which may or may not be provided with internal fittings, whereupon the material proceeds slowly with a trickling motion towards the discharge point, and is simultaneously dried by hot air or other gases passing axially through the drum parallel or counter to the direction of movement of the material.

Of particular importance in the process are the temperatures of the drying gases and the degree of contact thereof with the material, and further the relative velocities of the drying gases and the material. The temperature conditions must necessarily be limited by the possibility of injurious effect on the material, and the current velocity of the drying gases circulating through the material must not be so great as to make possible the expulsion of the material from the drum or from its internal fittings. The velocity of the drying gases in the drum is therefore relatively low in the known types of construction, amounting on average to approximately 2.5 per sec. These factors govern decisively the volumetric capacity of such rotary driers as a result of which the dimensions of a drier of a required capacity are relatively large.

In order to increase the drying efficiency in proportion to drum volume in this type of apparatus, various kinds of internal fittings have been provided therein for the purpose of ensuring as intimate contact as possible between gases and material. While such arrangements have certainly improved the efficiency considerably in relation to the simple drum construction, the periods of time required for drying are still excessive, so that the specific drying efficiency of a normal drum-type drying machine is as yet relatively low.

The object of the present invention is to obviate or mitigate the disadvantages of known apparatus of this type, and to provide a method of and apparatus for drying friable material efficiently.

The present invention provides an advantageous arrangement whereby efficiency is increased by causing the drying gases to pass through the drum in a free helical path co-axial with the drum and rotating at high velocity, and by increasing the rotary speed of the drum to such a degree that the material clings to the inner surface of the drum by the centrifugal force. The material is distributed over the entire inner wall surface of the drum by scraper blades in contact with the wall of the drum, and proceeds slowly towards the discharge point. The material thus forms in the drum a hollow cylinder within which the drying gas rotates at high velocity. On its course through the drum, the material is subjected to the

2

intense force of the rotating current and speedily dried.

An embodiment of the invention will now be described, by way of example with reference to the accompanying drawing, in which:

Fig. 1 is a longitudinal section through drying apparatus according to the invention; and

Fig. 2 is a cross-section on the line A—B of Fig. 1.

Referring now to the drawing, the friable material to be dried is fed by a conveyor mechanism *b* through a feed-funnel *a* into a rotating drum *c*. The rotary speed of the drum, which may be driven in any desired manner, is increased to such a degree that the material introduced is thrown by centrifugal force against the inner wall of the drum. Scraper blades *d* of a type known per se are arranged axially within the drum and are provided with ribs disposed obliquely to the direction of rotation of the drum, which ribs separate the material from the inner wall and distribute it evenly over the entire surface thereof. Resulting from the oblique positioning of the ribs, the material, as it passes over the surface of the blades, is displaced slightly in an axial direction towards the discharge point, thus ensuring even distribution of the material over the entire inner face of the drum as it is fed. Thus, the degree of obliqueness imparted to these ribs determines the speed of movement through the drum of the cylinder of material *e* thus formed. The period during which the material remains within the drum can therefore be adjusted to the required drying time very simply by appropriate adjustment of these guide-ribs.

The high-velocity drying gases enter at *f*, whereupon a rapid rotary motion as indicated by the dotted line *h* is imparted to said gases by a guiding means *g*, which may be of the form to be found in dust-removal apparatus of the cyclone type. The gases then move axially at moderate speed through the likewise rotating drum. The gas and drum rotate preferably in the same direction. The axial motion of the gas and of the material may be arranged to occur as desired in the same direction or in opposed directions. As is known the drying process employing like rotation of gases and material is by far the commoner and it is preferred therefore so to arrange the rotation in the present improved apparatus. Thus, in the description, the direction of rotation of the drum may be regarded as identical with that of the gas.

The rotary speed of the drying gas may be increased very considerably (above 20 m. per sec.) within the known aerodynamic limitations without the material clinging to the wall of the drum being forcibly removed by the current. On the other hand, the speed at which the drum rotates in order to exercise the required centrifugal force on the material, is relatively low. The consequent high ratio between the speed of the drying gas and that of the surface of the material effects a vigorous blast action on the surface of the material clinging to the wall of the drum, resulting in a striking increase in the efficiency of the drying process.

At each rotation of the drum, the material is lifted by the blades, is conveyed gradually further in the axial direction, and is then exposed to the action of the rapid current of gas as it leaves the blades, the rotary action of the gas pressing it once more against the inner wall. During this process, there necessarily occurs a continual turning over and re-exposure of the particles of the material which consequently experiences a constant stirring motion, the effect of which is to allow the current of gas to extract the surface moisture from the particles thus exposed from time to time. Whilst the said particles then remain unexposed due to subsequent rotation of the material, the internal moisture finds time to penetrate to the dry exterior, whereupon it is removed once more on

exposure to the gas current. The drying process is thus distributed evenly and thoroughly over the entire surface of the mass which, in the dry state, leaves the drum at *j*.

Moreover, the rotating stream of gas produces a sifting effect on the fine particles created during the process which is explained by the fact that the material, on leaving the scraper blades is scattered and remains momentarily in suspension in the gas, whereupon it is again beaten down by the centrifugal force of the rotating gas. The larger, that is, the moist particles are drawn down first of all whereupon the vigorous drying action resumes immediately, whilst the fined particles still remain suspended in the gas for a period corresponding to their degree of fineness. The relative speed at their surface falls therefore to very low values, whereby they are at the same time deprived to a considerable extent of the heat-effect of the drying gases. According to their fineness, these particles reach contact with the wall of the drum only after several revolutions of the rotating gases. In so doing, however, they are also drawn some little distance towards the discharge point by the axial motion of the rotating gases. These particles therefore never alight again in the zones in which they were created, but travel according to their weight more or less speedily in the direction of the end of the drum.

The fine dry particles therefore leave the hot drying zones of the drum more rapidly than the moist heavy particles. Thus, the dust created during the drying process is constantly extracted from the mass, is quickly expelled from the drum and is advantageously removed from the excessive heat action. The dried material leaves the drum at *j* whilst the drying gases are drawn off at *i* adjacent to the central axis. Here, the rotating current assumes a course directed radially towards the centre and which acts as a barrier to the fine particles, since the centrifugal forces acting upon these particles prevent any movement thereof towards the drum axis. The necessity for dust-removing means does not therefore arise, a necessity present in the known apparatus of this type, wherein the fine particles of material have to be recovered from the spent gases.

The present invention provides therefore a striking increase in the specific drying efficiency and, due to the reduced drying period combined with the effective sifting

action, produces an improvement in the quality of the treated material. The structural dimensions of the apparatus relative to its capacity are considerably reduced, resulting in an advantageous and economical decrease in weight and space factors.

I claim:

An apparatus for drying friable material comprising inlet and discharge housings, a horizontally-extending open-ended cylindrical drum mounted for high speed rotation between said inlet and discharge housings, a screw conveyor mechanism mounted in the inlet housing centrally thereof and extending in said drum, said conveyor mechanism having radial discharge openings to direct the flow of the material toward the inner wall surface of the drum, said inlet housing having a cycloidal formation surrounding said conveyor mechanism and a side opening adjacent the radial discharge openings of the conveyor mechanism for directing a flow of gas under high pressure into the end of said drum and the material from said radial openings of the conveyor mechanism horizontally and spirally toward the inner wall surface of said drum while said drum is under high speed rotation, said discharge housing having a centrally-disposed discharge tube communicating with the other end of the drum to discharge the gas stream therefrom, a scraper device extending longitudinally through said drum and between the inlet and outlet housings for scraping the material from the inner surface of the drum and for advancing the material toward the discharge housing, said discharge housing having an opening surrounding the centrally-disposed discharge tube through which the material is delivered to the discharge housing.

References Cited in the file of this patent

UNITED STATES PATENTS

748,894	Trump	Jan. 5, 1904
776,581	Angus	Dec. 6, 1904
1,510,693	Mulligan et al.	Oct. 7, 1924
2,311,824	Gautreau	Feb. 23, 1943
2,460,008	Heller	Jan. 25, 1949

FOREIGN PATENTS

665,185	Great Britain	Jan. 16, 1952
---------	---------------	---------------