

Dec. 11, 1951

C. E. BILL

2,578,166

ROTARY DRIER

Filed March 21, 1950

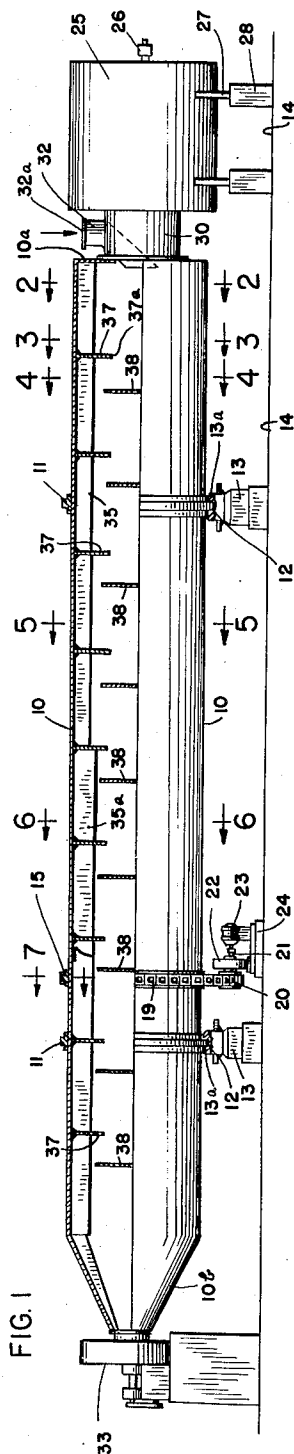


FIG. 1

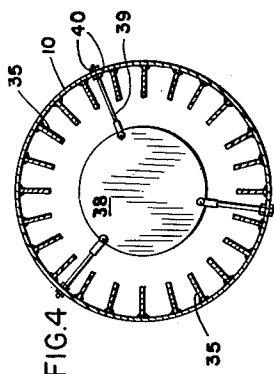


FIG. 4

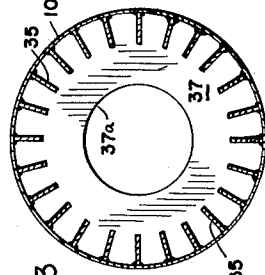


FIG. 3

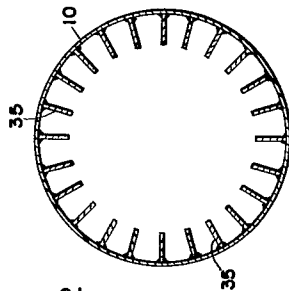


FIG. 2

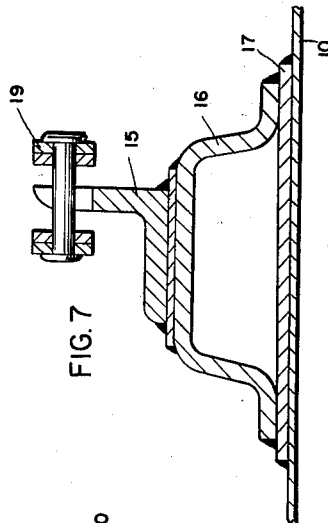


FIG. 7

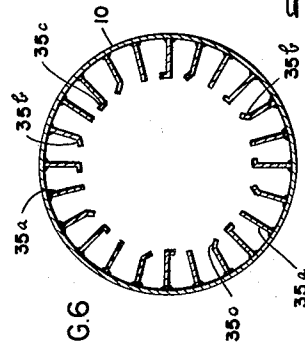


FIG. 6

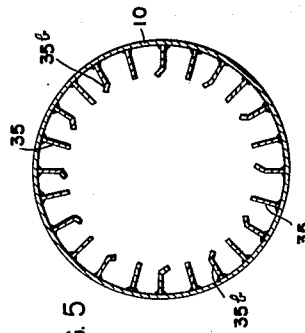


FIG. 5

INVENTOR:  
CLIFFORD E. BILL  
BY

*Smith, Allen & Baird,*

ATT'YS

## UNITED STATES PATENT OFFICE

2,578,166

## ROTARY DRIER

Clifford E. Bill, Louisville, Ky., assignor to General American Transportation Corporation, Chicago, Ill., a corporation of New York

Application March 21, 1950, Serial No. 150,909

3 Claims. (Cl. 34-136)

1

This invention relates to improvements in rotary dryers adapted for use in drying various organic and inorganic materials including those of a granular, crystalline, finely divided or friable nature as well as chopped hay, grasses, vegetable crops and the like.

Rotary dryers of various forms have heretofore been used in many types of drying operations but, so far as is known, they have not been satisfactory in many respects, notably in that they have been bulky, cumbersome, expensive and inefficient and have frequently caused damage to the materials being dried because of overheating, particularly in the case of direct fire dryers where the hot air and gases employed for drying purposes contact the materials directly.

The principal object of the present invention is to provide an improved dryer of a simple, compact and inexpensive form which may be operated more efficiently than those heretofore known and without damage to the materials being dried. The present invention is preferably embodied in a rotary dryer of the direct fire parallel flow type wherein the hot gases and the materials to be dried move in the same direction through the drying chamber and in direct contact with each other. By means of a novel form and arrangement of lifting vanes, intercepting disks and baffles in the chamber, the materials to be dried are caused to have a maximum intimate contact of the materials with the gases. The contact or retention time between the particles and the gases is decreased as compared with former practice because a substantially higher velocity of flow of the gases is employed. An important feature is that this tremendous increase in the velocity of the hot gases in relation to the material flow gives a proportionately higher increase in dryer capacity. By reason of the more effective use of the hot gases, a more complete removal of the water or other liquid from the materials is effected. These advantages lead to a further one in that it is possible to employ a smaller dryer for a particular task, thereby effecting a saving in cost and operation.

Because of the low retention time for the materials in the dryer, in the practice of the present invention, the temperature of the dried product is comparatively low so that the requirements for cooling the product are less than formerly. These and other objects and advantages of the invention will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one embodiment is illustrated. In the drawings,

2

Figure 1 shows a side elevation of the improved rotary dryer and associated parts with the upper part of the dryer shown in longitudinal section and with some of the longitudinal lifting vanes removed;

Fig. 2 shows a vertical section taken on the line 2-2 of Fig. 1;

Fig. 3 shows a sectional view taken on the line 3-3 of Fig. 1;

Fig. 4 shows a sectional view taken on the line 4-4 of Fig. 1;

Fig. 5 shows a sectional view taken on the line 5-5 of Fig. 1;

Fig. 6 shows a sectional view taken on the line 6-6 of Fig. 1; and

Fig. 7 shows a sectional view taken on the line 7-7 of Fig. 1.

As illustrated in the drawing the invention comprises a rotary cylindrical drum 10 formed of sheet metal and provided at the inlet end thereof with a transverse end wall 10a and, at the outlet end thereof, with a cone-shaped wall 10b. This cylindrical drum is provided on its outer side with two relatively fixed annular tires or bearing members 11 which are adapted to be engaged by supporting rollers 12 mounted on bearing blocks 13 fixed upon the floor or other support 14. The blocks 13 have rollers 13a which extend on opposite sides of the associated tire 11 to hold the rotary drum against endwise movement. The drum is preferably mounted to rotate about a horizontal axis, as illustrated in the drawings, and its rotation is effected through power applied to a ring gear 15 which extends around and is secured to the wall of the drum adjacent one of the tires 11. This ring gear is attached to the wall of the drum through brackets 16 and an annular plate 17, as shown particularly in Fig. 7, and the gear is actuated to rotate the drum by an endless chain 19 which extends downwardly beneath the drum and meshes with a driving pinion 20 fixed upon a shaft 21. This shaft is journaled in a bearing 22 and is driven by an electric motor 23. The bearing 22 and the motor are mounted upon a supporting block 24 which is secured to the base 14. With this arrangement, the drum 10 is adapted to be rotated at a suitable speed for agitating the materials in the dryer and bringing them into contact with the hot gases of combustion which are employed for drying purposes.

The hot gases are supplied from a gas furnace 25 provided with a burner 26 through which the liquid or gaseous fuel is introduced into the combustion chamber. This furnace is supported upon saddle members 27 carried by the sup-

3

porting blocks 28 which rest upon the base 14. The hot gases of combustion pass from the furnace chamber through the outlet flue 30 which has a relatively close fit with the walls of a central opening formed in the end wall 10a of the rotary drum.

The materials to be dried are introduced into the drum 10 through the central opening in its end wall 10a by means of a feed chute 32 which has an upwardly directed inlet opening 32a and which has its lower part inclined downwardly and forwardly through the flue 30 to discharge at a point located centrally of the rotary drum 10 a short distance inwardly from the plane of the end wall 10a.

The hot air and gases and the dried materials are withdrawn at the discharge end of the drying drum 10 through the tapered portion 10b thereof and through a power driven centrifugal exhaust fan 33 which is adapted to discharge the mixture into a suitable settling chamber from which the air and gases escape and from which the solid dried materials settle by gravity to a discharge opening at the bottom.

As a part of the means for agitating the materials to be dried and maintaining a sufficient turbulence thereof to bring them into intimate contact with the hot drying gases, the cylindrical drum 10 is provided on its inner side with a plurality of spaced lifting vanes 35 which extend radially and which have their outer edges welded or otherwise secured to the wall 10. For a considerable distance, preferably about one-half of the length of the drum 10, the vanes 35 are of equal radial depth, as shown in Figs. 1 and 4, and all parts of each vane lie in one plane. From a point adjacent the middle of the drum 10 to the discharge end thereof, the vanes 35 are increased in radial depth as shown at 35a in Figs. 1 and 6. Toward the middle of the drum 10, some of the vanes 35 which have the shorter radial dimension have their inner edges bent at angles to the radial body portions thereof as shown at 35b in Fig. 5. Beyond the middle point of the drum where the radial vanes have an increased depth, an increased number of the vanes have their inner margins bent at angles to the body portions thereof as shown at 35c in Fig. 6. The purpose of angularity of the inner edges of some of the vanes is to enable these vanes more readily to pick up the materials being dried and to convey these materials around in the paths of travel of the vanes so they are dropped when the vanes reach or approach the upper parts of their paths. As the materials become dryer and perhaps more finely divided, it is usually desirable to have an increased number of vanes provided with inclined inner edges as the discharge end of the drying drum is approached.

The lifting vanes 35 are adapted to cooperate with a plurality of radially extending sheet metal rings 37 and a plurality of radially extending metal disks 38 which are arranged in pairs and spaced apart. The rings 37 are slotted at their outer margins to receive the vanes 35 and their outer edges are welded to the drum 10. Each ring 37 is provided with a central opening 37a and these openings are preferably of the same size throughout the length of the drum. Each ring 37 cooperates with an adjacent disk 38 which is circular in form and preferably of slightly larger diameter than the aperture 37a in the ring which is located on the inlet side thereof so that the gases and materials to be dried are compelled to follow a tortuous path in moving

4

from the inlet side of the ring 37 to the outlet side of the associated disk 38. These disks may be mounted as shown in Fig. 4 by a series of radially extending rods 39 which are securely attached to the outer part of the disk 38 and which have their outer threaded extremities extending through holes in the drum 10 where they are secured by nuts 40.

A considerable number of baffle rings 37 and disks or targets 38 are embodied in the construction and distributed preferably in a uniform manner throughout the length of the drying drum. Each ring 37 is associated with one of the disks 38 and these members constitute a pair which are spaced substantially from another similar pair so that each disk is closer to the ring 37 preceding it than it is to the next ring on the discharge side thereof. The distance between each disk 38 and the preceding ring 37 may preferably be about one-third of the distance between two adjacent rings 37 measured longitudinally of the dryer. For illustration, with a drum 10 which is sixty feet long, the first ring 37 is located six feet from the inlet end of the drum, is spaced two feet from the disk 38 which is associated therewith on its discharge side and is spaced six feet from the next following ring. In this particular embodiment, the drying drum 10 has an internal diameter of eight feet, the rings 37 have central openings which are four feet five inches in diameter and the disks 38 are five feet in diameter. These dimensions are given by way of illustration and not by way of limitation and are intended to indicate relative proportions which have been found to give very satisfactory results in practice.

With the foregoing construction and arrangement of apparatus, the materials to be dried are introduced more or less continuously through the feed chute 32 and they are drawn with the hot gases of combustion passing through the flue 30 and then through the chamber of the drying drum 10 by the action of the centrifugal blower 33 which has its suction inlet connected to the discharge end of the drying chamber. As the gases and materials are drawn through the chamber, the drum is rotated at a relatively low speed, for example, 8 revolutions per minute, and, as this rotation continues, the materials are carried around by the vanes 35 and continually dropped as the vanes reach their uppermost position while, at the same time, the current of hot air and gases causes the materials to impinge upon the rings 37 and upon the disks 38. The gases and materials must pass around disks 38 through the tortuous path which is provided by the spaced rings and disks and the gases and materials then have an opportunity to lose momentum on the discharge side of each disk 38 before they are accelerated again to contact with the next following ring 37 and disk 38. In this way the gases and materials are thoroughly intermingled with each other and are caused to move in tortuous paths and with constantly changing velocities so that the materials as well as the gases move both longitudinally and radially and in other directions in a manner adapted to bring about a thorough mingling of the gases and particles to be dried even though the gases and materials pass through the chamber of the drum 10 at relatively high speeds. As a consequence, very surprising results are obtained with respect to the thoroughness of the drying of the materials and the rapidity with which they are dried

5

during the short time interval of their passage through the drying chamber.

To obtain the desired results, a relatively large number of the flat rings 37 and the circular disks 38 should be employed, so that the materials to be dried will be caused to follow a tortuous path along with the hot gases, thereby bringing about intimate and repeated contacts of all surfaces of each particle with the hot drying medium. The number of baffle rings and cooperating disks will depend upon the length of the drying drum but desirable results may be obtained if the spacing of two successive rings is not greater than the diameter of the drum. The results are improved by arranging the rings in pairs, that is, with each disk closer to the next preceding ring than it is to the next following ring. This spacing is preferably followed throughout the length of the drum. It is believed that this spacing arrangement results in alternate increases and decreases in the velocity of the gases with a consequent tendency for the materials to drop from the gas current during the periods of decreased velocity, thereby further increasing the general turbulence and the intimate contact of the gases with the particles. The closely spaced vanes, rings and disks have the further advantage that they become heated by the passing hot gases and radiate their heat to the moving materials, thereby supplementing the direct action of the gases.

Although one form of the invention has been shown and described by way of illustration, it will be understood that it may be constructed in various other embodiments which come within the scope of the appended claims.

**I claim:**

1. A rotary dryer comprising a rotatable cylindrical drum having inlet and outlet openings, means for rotating said drum, means for introducing hot gases and materials to be dried through said inlet opening, means communicating with said outlet opening for drawing said gases and said materials through said drum, a series of longitudinally extending lifting vanes attached to the inner surface of said drum and extending inwardly therefrom, a plurality of flat radial rings attached to said drum and distributed throughout its length, and a plurality of disks each located opposite the opening of one of said rings on the discharge side thereof, said vanes increasing in radial depth toward the discharge end of said drum.

6

2. A rotary dryer comprising a rotatable cylindrical drum having inlet and outlet openings, means for rotating said drum, means for introducing hot gases and materials to be dried through said inlet opening, means communicating with said outlet opening for drawing said gases and said materials through said drum, a series of longitudinally extending lifting vanes attached to the inner surface of said drum and extending inwardly therefrom, a plurality of flat radial rings attached to said drum and distributed throughout its length, and a plurality of disks each located opposite the opening of one of said rings on the discharge side thereof, some of said vanes having their inner edges bent to form flanges directed at angles to radial planes, said flanges increasing in number toward the discharge end of said drum.

3. A rotary dryer comprising a rotatable cylindrical drum having inlet and outlet openings, means for rotating said drum, means for introducing hot gases and materials to be dried through said inlet opening, means communicating with said outlet opening for drawing said gases and said materials through said drum, a series of longitudinally extending lifting vanes attached to the inner surface of said drum and extending inwardly therefrom, a plurality of flat radial rings attached to said drum and distributed throughout its length, and a plurality of disks each located opposite the opening of one of said rings on the discharge side thereof, some of said vanes having their inner edges bent to form flanges directed at angles to radial planes, said flanges increasing in number and said vanes increasing in radial depth toward the discharge end of said drum.

CLIFFORD E. BILL.

**REFERENCES CITED**

The following references are of record in the file of this patent:

**UNITED STATES PATENTS**

| Number    | Name        | Date          |
|-----------|-------------|---------------|
| 1,299,492 | Mangelsdorf | Apr. 8, 1919  |
| 1,898,480 | Corkill     | Feb. 21, 1933 |
| 2,096,049 | Lissauer    | Oct. 19, 1937 |
| 2,341,101 | Howard      | Feb. 8, 1944  |

**FOREIGN PATENTS**

| Number  | Country       | Date          |
|---------|---------------|---------------|
| 605,221 | Great Britain | July 19, 1948 |