

Jan. 7, 1958

J. M. WOLFE
ROTARY DRYERS

2,818,657

Filed March 21, 1955

2 Sheets-Sheet 1

Fig. 1.

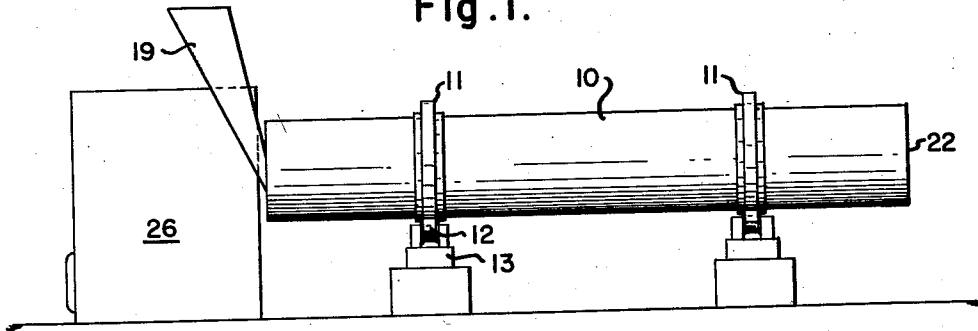


Fig. 4.

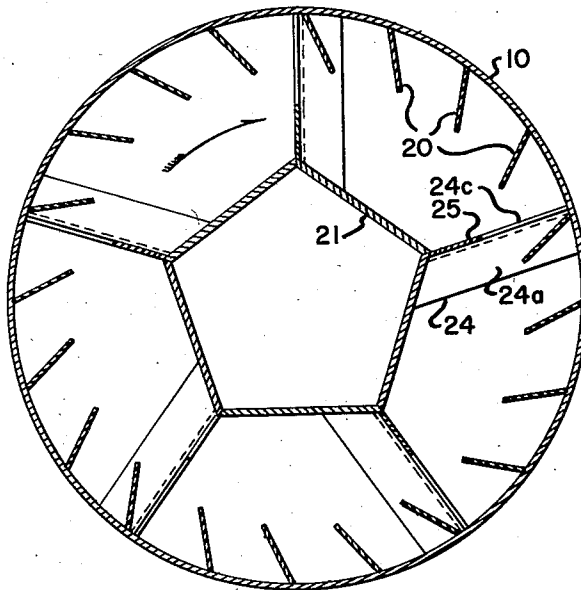


Fig. 5.

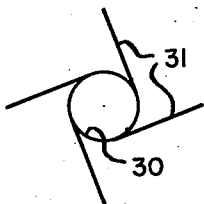


Fig. 6.

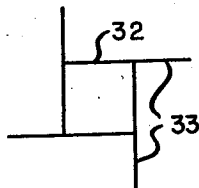
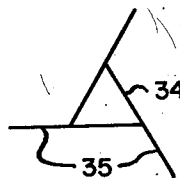


Fig. 7.



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Fig. 2.

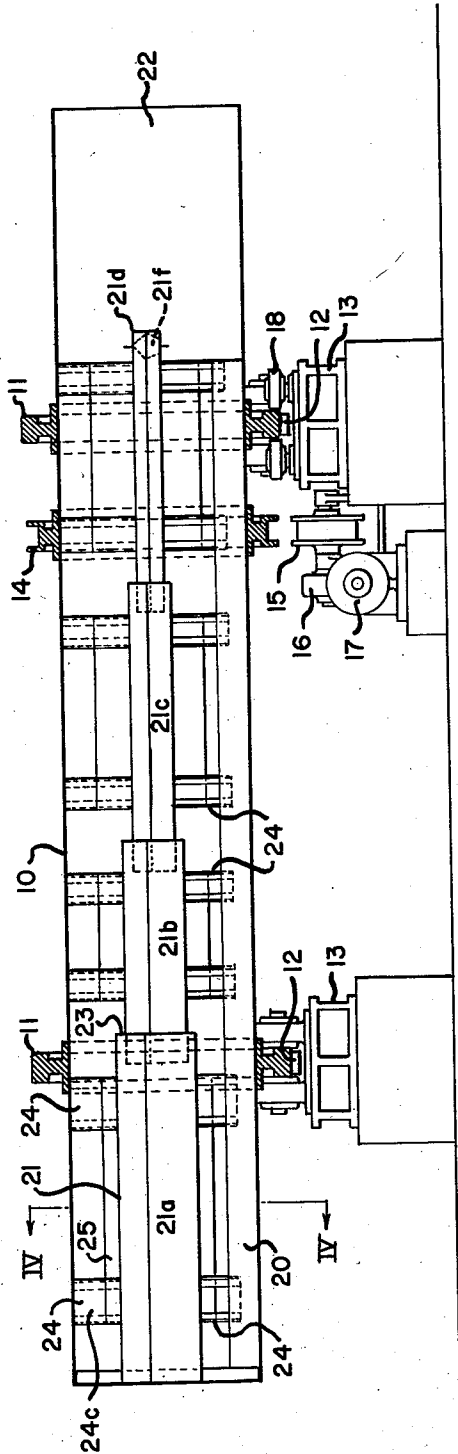


Fig. 8.

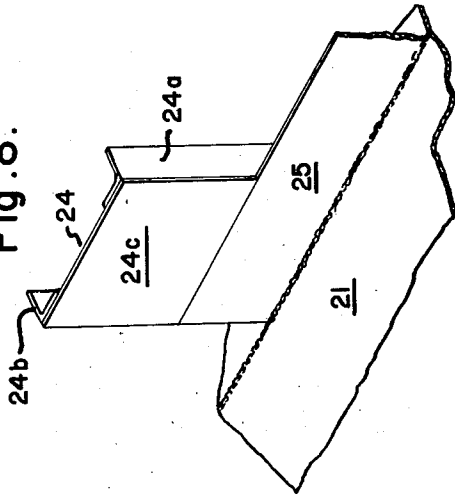
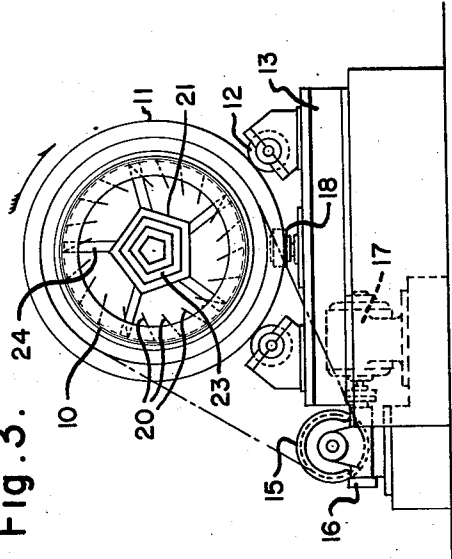


Fig. 3.



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2,818,657

ROTARY DRYERS

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8 Claims. (Cl. 34—109)

This invention relates to dryers and more particularly to rotary dryers adapted for use in the drying of heavy wet materials which are difficult to handle by ordinary drying methods. The drying of marl, wet ores, and similar wet, heavy and sticky materials has been a difficult problem in the past and the dryers which have been heretofore proposed have not been entirely satisfactory for the drying of such materials. Various types of dryers are known in the art and various types of rotary dryers in particular have been built and used for a variety of purposes. None of these dryers is, however, able to handle sticky, heavy wet materials in a single pass and with any degree of rapidity.

The present invention provides a dryer of the rotary type which is able to satisfactorily handle the heaviest wet and sticky materials presently known in commercial practices with speed and thoroughness. I provide a dryer preferably comprising an outer cylindrical shell, drive means operatively connected to said shell whereby the shell is rotated, a plurality of inner duct members of successively smaller cross section forming an axially extending duct within the shell, an opening into the interior of the shell at the end of each duct member, means connected to one end of said axially extending duct delivering heated air thereto, means on the interior of the shell raising material therein to deposit it on the duct members and means on the periphery of each duct member extending outwardly therefrom to a line equidistant from the said means on the drum interior for raising material. Preferably the drive means is a plurality of cable windings about a sheave on the outer periphery of the shell and a driven sheave spaced therefrom. This drive permits ready change in the speed of rotation as well as changes in the slope of the outer shell. Preferably the inner duct members are overlapped or telescoped at their ends to form a restricted passage between the inner and outer duct member. Preferably the shelf forming means on each duct is connected with the duct and extends outwardly therefrom to a line substantially parallel to the periphery of the shell, thus providing increasingly larger shelf areas as the ducts decrease in size. Preferably each shell is provided with a support brace at each end having a flange normal to the surface of the shelf, thereby providing closed ends and permitting material to be dried to lie on the shelves in considerable depth.

The foregoing statement has set out certain objects, purposes and advantages of the present invention. Other objects, purposes and advantages will be apparent from a consideration of the following description and the accompanying drawings in which:

Figure 1 is a side elevational view of a rotary dryer according to my invention.

Figure 2 is a longitudinal section through the dryer shell of the dryer of Figure 1 showing the inner duct in elevation.

Figure 3 is an end elevational view of the dryer of Figure 1 viewed at the entry end of the dryer shell.

Figure 4 is a section on the line IV—IV of Figure 2.

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Figures 5, 6 and 7 are schematic and elevational views of three different forms of inner duct which may be used in the dryer of this invention.

Figure 8 is a fragmentary isometric view of a brace member used in this invention.

Referring to the drawings, I have illustrated a cylindrical dryer shell 10 provided with tires 11 supported for rotation on rollers 12 rotatably mounted in a base 13. A peripheral sheave 14 is fitted on the exterior of the shell 10. A drive sheave 15 is spaced from and in line with the sheave 14 and is connected through a speed reducer 16 to a drive motor 17. A plurality of cables (not shown) pass around the sheaves 14 and 15 and act to drive the shell 10 for rotation. The cable drive permits easy, rapid changes in speed of rotation as well as changes in the slope of the dryer itself. This ease of change permits considerable variation in speed of feed-through as well as in time of contact with the drying areas of the dryer. Guide wheels 18 rotatably mounted on the base 13 contact the opposite edges of the tire 11 and maintain the shell 10 in alignment on the rollers 12. A loading chute 19 is provided at the entry end of the shell 10.

Lifting flights 20 are provided on the interior of the shell 10. These lifting flights are preferably placed at an angle to the radius of the shell to carry material in the shell upwardly along the path of rotation and then discharge the material through the center of the shell.

A heating duct generally indicated by the numeral 21 extends axially through the shell 10, terminating short of the end of the shell to provide an accumulating and discharge portion 22. The duct 21 is made up of a plurality of five sided hollow members 21a, 21b, 21c and 21d of successively smaller sizes. The ends of each successively smaller hollow member is preferably telescoped within the end of the adjacent larger member for a short distance to provide a passageway 23 therebetween through which hot drying gas is introduced into the interior of the shell 10 at spaced points intermediate its length. Each duct member 21a, 21b, 21c and 21d is provided at each end with a plurality of brace members 24, preferably made up of spaced angles 24a and 24b connected by a plate 24c forming an elongated pocket. Plates 25 are welded to each pair of braces and to the member to form shelves, which may be in effect continuations of the sides of the hollow members. Each such shelf forms with the angle of the brace member 24 and the rear of the preceding shelf, a pocket or trough which catches material falling from the lifting flights 20 and maintains it in contact with the hot duct surfaces as the dryer rotates until the rotation inverts the shelves and discharges the material to the shell wall. Hot, drying gases are introduced into the interior of the duct 21 from a furnace 26 which is of conventional design.

The operation of the dryer of this invention is as follows. The material to be dried is fed into the loading chute 19 from which it passes directly into the interior of the shell 10. The lifting flights 20 pick up the material to be dried and carry it upwardly about the circumference of rotation. As the material approaches the top of the circle of rotation it begins to cascade downwardly through the hot interior of the dryer. A large percentage of the cascading material is caught in the pockets or troughs formed by the ducts 21a, 21b, 21c and 21d and the shelves or plates 25 where the material is subject to the heat transmitted from the duct before dropping again to the lower part of the dryer. This cycle is repeated through the length of the heating duct until the material reaches the discharge portion 22. In the discharge portion 22 the material is rolled onwardly to final discharge.

The hot air or gases entering the duct 21 passes through

section 21a. A portion of the hot gases is permitted to enter into the interior of the shell 10 through the passage 23. The balance of the gases there passes through the next duct section 21b at the end of which another portion of the hot gases is permitted to enter into the interior of the shell 10 through passageway 23. This is repeated to the end of the duct 21. The introduction of hot air or gases into the shell maintains the vapors in the interior of the shell above the dew point and thereby prevents already dry material from absorbing moisture and aids in the removal of moisture from the cascading material which has not yet been dried.

A damper 21f may be installed at the end of the last duct member 21d to restrict the outflow of hot gases from the ducts and to vary the flow through the passageways 23 by building up the pressure in the duct.

The duct members 21a, 21b, 21c and 21d may take other forms than that of the five sided duct shown in Figures 1 through 4. The duct member may be in the form of a cylinder 30 with plates 31 extending tangentially outwardly from the periphery (see Figure 5). Alternatively the duct member 32 may be square in cross section with plates 33 forming extensions of the sides (see Figure 6) or the duct member 34 may be triangular in section with plates 35 forming extensions of the sides (see Figure 7).

The dryer of the present invention, because of its novel construction, subjects the material to be dried to a more thorough drying action, maintains the material in contact with the hot zone longer and more effectively prevents formation of condensate in the interior of the dryer than any of the dryers now known. As a result, materials which were difficult or impossible to handle in ordinary rotary dryers can be handled with ease in the present dryer.

While I have illustrated and described certain preferred embodiments of my invention, it will be understood that it may be otherwise embodied within the scope of the following claims.

I claim:

1. A rotary dryer comprising an outer cylindrical shell, drive means operatively connected to said shell whereby said shell is rotated, a plurality of inner duct members, each of successively smaller cross section forming an axially extending duct within and connected to said shell, an opening into the interior of the shell at the end of each such duct member, means connected to said duct members supplying heated air thereto and means on the periphery of each duct member extending outwardly from the periphery thereof to a line spaced from the interior of the shell and forming an axially extending trough with the duct wall, all of said means being substantially equally spaced from the interior of the shell.

2. A rotary dryer comprising an outer cylindrical shell, drive means operatively connected to said shell whereby said shell is rotated, a plurality of inner duct members, each of successively smaller cross section forming an axially extending duct within said shell, an opening into the interior of the shell at the end of each such duct member, means connected to said duct members supplying heated air thereto, spaced support members at each end of said duct members connecting said members with the interior wall of the shell and shelf means between

each pair of spaced support members on opposite ends of the duct, said shelf means extending outwardly from the exterior of the duct members to be equally spaced from the interior of the shell and forming an axially extending trough with the duct wall.

3. A rotary dryer as claimed in claim 2 wherein each spaced support member is provided with a flange normal to the plane of the shelf and forming a pocket with the trough formed by the shelf and duct.

4. A rotary dryer comprising an outer cylindrical shell, drive means operatively connected to said shell whereby said shell is rotated, a plurality of inner duct members, each of successively smaller cross section forming an axially extending duct within and connected to said shell, an opening into the interior of the shell at the end of each such duct member, means connected to said duct members supplying heated air thereto, means on the periphery of each duct member extending outwardly from the periphery thereof a common distance from the interior wall of the shell and lifting means on the interior wall of the shell and forming an axially extending trough with the duct wall for lifting material to be dried to a point above the bottom of the shell and discharging it downwardly into the interior of the shell.

5. A rotary dryer as claimed in claim 4 wherein the lifting means are spaced lateral projections on the inner periphery of the shell extending longitudinally thereof and substantially parallel to the axis of the shell.

6. A rotary dryer comprising an outer cylindrical shell, a plurality of inner duct members of successively smaller cross section forming an axially extending duct within and connected to said shell each said successively smaller duct member having one end telescoped with the end of the next adjacent larger member and spaced therefrom to form a passageway into the interior of the shell and means on the periphery of each duct member extending outwardly from the periphery thereof a common distance from the interior of the shell and forming an axially extending trough with the duct wall.

7. A rotary dryer comprising an outer cylindrical shell, a plurality of inner duct members of successively smaller cross section forming an axially extending duct within and connected to said shell each said successively smaller duct member having one end telescoped with the end of the next adjacent larger member and spaced therefrom to form a passageway into the interior of the shell, means on the periphery of each duct member extending outwardly from the periphery thereof a common distance from the interior of the shell and forming an axially extending trough with the duct wall, and lifting means on the interior of the shell raising material from the bottom of the shell and discharging on the duct members.

8. A rotary dryer as claimed in claim 7 wherein the lifting means are spaced, substantially parallel longitudinally extending vanes leading in the direction of rotation.

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U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,818,657

January 7, 1958

John M. Wolfe

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 55, for "each shell" read --each shelf--.

Signed and sealed this 27th day of May 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents