April 10, 1945. L. R. CHRISTIE 2,373,382

CONTINUOUS DRIER

Filed Feb. 27, 1943 2 Sheets-Sheet 1

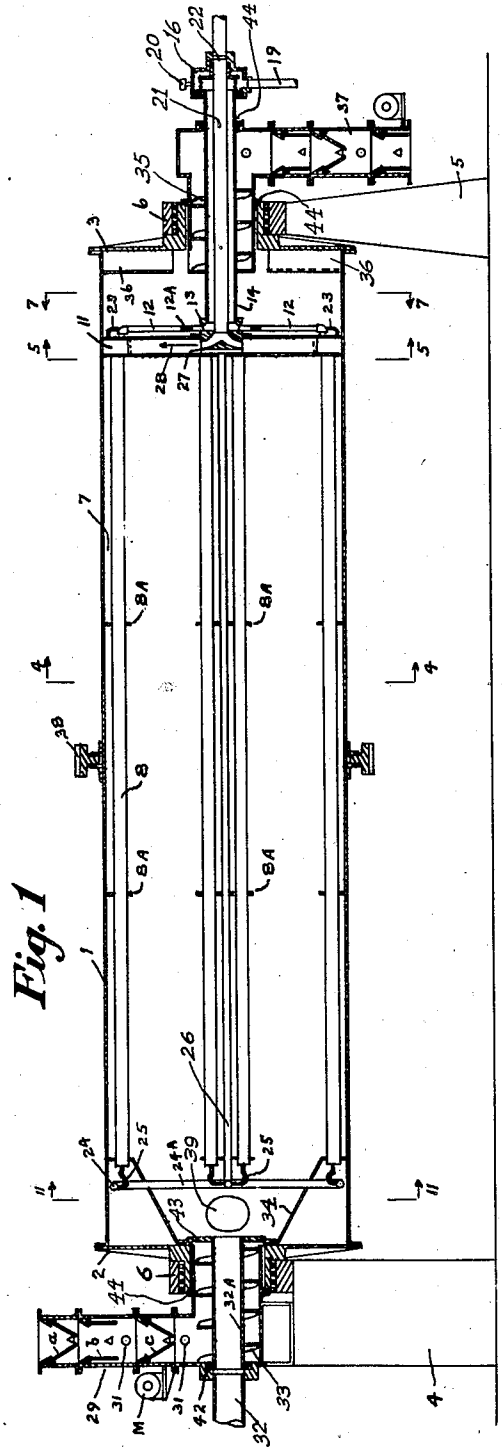


Fig. 1

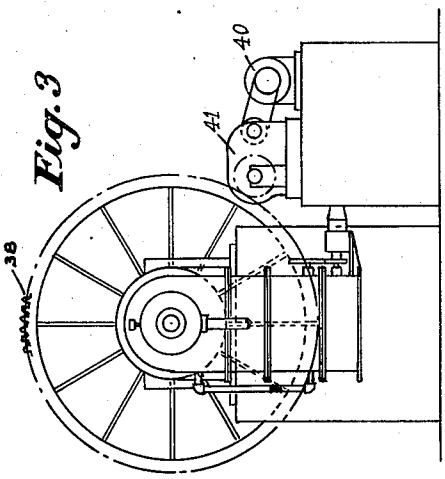


Fig. 3

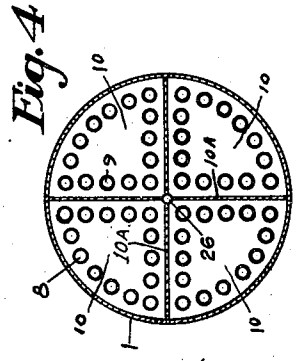


Fig. 4

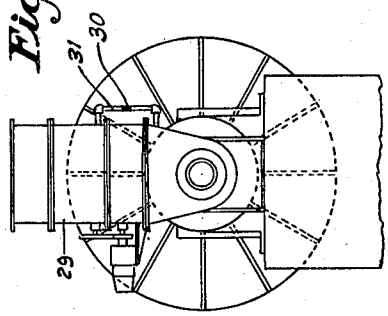


Fig. 2

LINDSAY R. CHRISTIE, INVENTOR

A. D. T. Libby

ATTORNEY

April 10, 1945. L. R. CHRISTIE 2,373,382

CONTINUOUS DRIER

Filed Feb. 27, 1943 2 Sheets-Sheet 2

Fig. 7

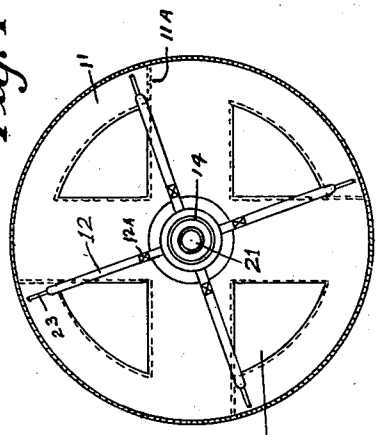


Fig. 6

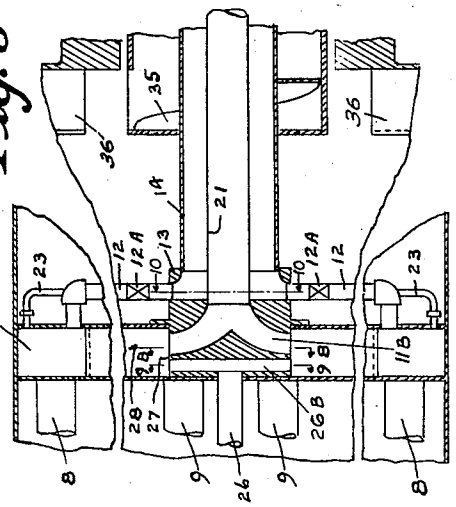


Fig. 5

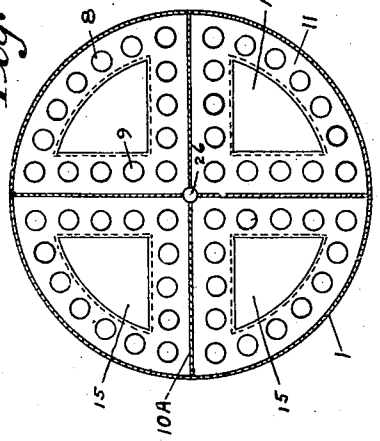


Fig. 10

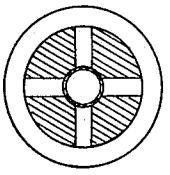


Fig. 8

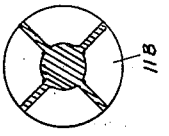


Fig. 9

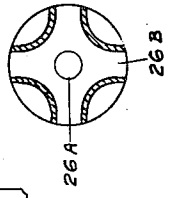


Fig. 11

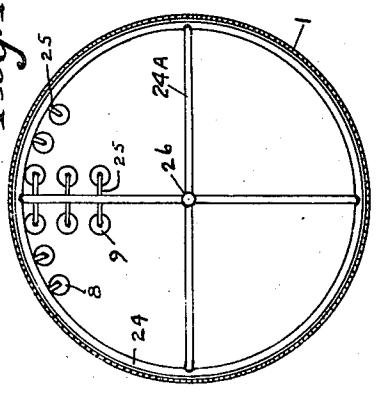
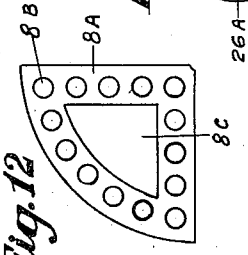


Fig. 12



LINDSAY R. CHRISTIE, INVENTOR

A. D. T. Libby

ATTORNEY

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2,373,382

CONTINUOUS DRIER

Lindsay R. Christie, New York, N. Y.

Application February 27, 1943, Serial No. 477,357

7 Claims. (Cl. 34—92)

This invention relates to a continuous drier which may be utilized for drying various materials, some of which may not require the use of a vacuum in connection with the apparatus, but I have chosen to show in the drawings, to which reference will be later made, means for applying a vacuum to the drier.

It is one of the objects of my present invention to provide a drier of the so called rotary type in which the heating means are so arranged that the material to be dried has a larger and more direct contact area with the heating means; or, stated in another way, a structure in which a maximum surface area of the drying means is provided for a given size of drum.

A further object of my invention is to provide a structure in which the heating means are so arranged as to make it much easier to clean out or keep the interior of the apparatus clean.

Another decided advantage which I have obtained by the construction hereinafter described is an arrangement in which the interior portion of the drier is, in effect, divided into compartments whereby the material being dried will contact the heating means throughout a considerable arcuate revolution of the drier, in contradistinction to the ordinary construction wherein the material falls from the top of the drier directly to the lower portion and does not contact with the relatively vertical portions or the sides.

By arranging the heating means within the shell or drum so as to get this large surface and substantially continuous contact with the heating means, I obtain an additional advantage in that this manner of distribution of the material within the drum tends to counter-balance the material being lifted up on the up-side of the revolution of the drum, thereby obtaining a more nearly balanced arrangement of the material within the drum and giving a more uniform distribution of power conveyed to the drum by the rotating means.

Another advantage of my present construction is the manner of taking air out of the pipes when steam pipes are used as the heating means, and a still further advantage is the means of removing the condensed steam from the heating pipes.

Other and further objects and advantages will appear to one skilled in this art from a reading of the following specification taken in connection with the annexed drawings, wherein:

Figure 1 is a longitudinal view of the apparatus partly in section and partly in elevation.

Figure 2 is a view of the left-hand end of the apparatus shown in Figure 1.

Figure 3 is a view of the right-hand end of the apparatus shown in Figure 1.

Figure 4 is a section on the line 4—4 of Figure 1.

Figure 5 is a section on the line 5—5 of Figure 1 on an enlarged scale from Figure 1.

Figure 6 is a part-elevational and part-sectional view of the header and associated parts, these being located to the right of the section 5—5 of Figure 1, the drawing being on an enlarged scale from that shown in Figure 1.

Figure 7 is a section on the line 7—7 of Figure 1 on an enlarged scale from Figure 1.

Figure 8 is a section on the line 8—8 of Figure 6.

Figure 9 is a section on the line 9—9 of Figure 6.

Figure 10 is a view on the line 10—10 of Figure 6.

Figure 11 is a view on the line 11—11 of Figure 1, but showing only a few of the pipes.

Figure 12 is a view of one of the quadrant supports used for supporting the pipes when used as heaters intermediate their ends.

In the drawings, wherein like numbers refer to corresponding parts, 1 is a shell or drum of suitable material such as steel preferably treated to prevent rusting. The shell or drum 1 is closed by heads 2 and 3 and may be rotatably mounted on supports 4 and 5 carrying bearings 6 having hollow journals forming parts of the heads 2 and 3. In the drawings I have illustrated the heating means as steam pipes or tubes and these are arranged within the shell 1 and arcuately spaced therefrom by a space 7. The tubes which are arranged around the inner peripheral portion of the shell 1 are numbered 8. Additional tubes 9 are arranged in the manner shown in Figure 4 in which the tubes 9 are arranged in two double rows on substantially near diameters at right angles to each other. In some cases I prefer to make a complete separation of the tubes by using plates 10A which are arranged longitudinally of the shell 1 and at right angles to each other, being fastened to the shell as by welding, thereby forming individual compartments 10. The tubes 8 terminate in and are suitably fastened to the interior portion of a circular header or steam chamber 11 which, it will be noted, is located at the discharge end of the drier and has vertical and horizontal cross-pieces conforming to the plates 10A to receive the tubes 9, which cross-pieces are provided with openings 15 to allow the material being dried to pass by the header 11.

Connected to the header or steam chamber 11, are pipes 12, there being four of these preferably arranged ninety degrees apart as shown in Figure 7. These pipes 12 terminate in a fitting or casting 13 to which is connected a pipe 14 that extends outwardly to a fitting 16 having a discharge pipe 19 which leads to a steam trap. An air vent 20 is provided in the fitting 16 for the purpose of letting out any entrapped air that may come through the pipe 14 to which reference will be later made. A steam inlet pipe 21 extends from a supply line or pipe 22 through a suitable fitting to the casting or fitting 13 and rotates therewith.

Each of the pipes 12, which may be termed drip pipes, serves to pass the condensed water or vapor returned to the header 11 from the pipes 8 and 9 into the discharge pipe 14. The pipes 12 are provided with steam outlets 23 which allow the steam which accumulates in the pipes 12 to go into the upper part of the header 11, thereby allowing the condensed steam or drip water—which may be picked up by the pipes 12 and 23 at their lowermost positions during the rotation of the drier, or forced into the pipes 12 by the steam pressure within the chamber—to pass downwardly in the pipes 12 when in their uppermost position, it being understood that the pipes 12 are provided with gravity-operated check valves 12A, the valves being constructed and arranged so that they open by gravity only when the pipes 12 are in the uppermost region, thereby passing the condensed steam or drip water into the pipe 14 and into the outlet 19 and preventing it from returning by gravity to the header 11. To direct the water into the pipes 12, shut-off plates 11A within the header are used at the points indicated in Figure 7.

In order to draw any air out of the pipes 8 or 9 at the loading or feeding end of the drier, I have provided a circular tube 24 having four branches 24A to conform to the vertical and horizontal positions of the tubes 9. The tubes 24 and 24A are connected preferably by flexible connectors 25, as shown, to each of the tubes 8 and 9. The four branches or leaders 24A from the circular pipe 24 feed into a centrally located pipe 26 which is positioned at the junction of the plates 10A and may be welded thereto.

The pipe 26 runs longitudinally of the drier back into the fitting 13 by way of the hole 26A (Figure 9). A partition plate 27 in the fitting 13 (Figure 6) helps to define four openings 26B (Figure 9) to pass radially from the axis of the pipe 26. Since the steam coming through the pipe 21 and the openings 11B (Figure 8) passes by the edges of the plate 27 in the direction of the arrow 28, this tends to draw the air out of the passages 26B into the header from which the air is passed through the pipes 12 into the pipe 14 and out through the automatic vent valve 20.

The material is fed to the drier through a structure generally referred to as 29 having a plurality of gate locks *a*, *b* and *c*. These gate locks are of standard construction and will not be described in detail herein, it simply being mentioned that they are operated by a motor M through the medium of cams in proper timed relation. The motor M operates a valve 30 (Figure 2) in the pipe 31 which connects to the interior of the feed hopper and produces a vacuum in the chamber between the gate locks *b* and *c* as required.

A vacuum is obtained in the drier, when desired, through the medium of pipes 32 and 32A. A worm or conveyor 33 is carried on the pipe 32A which is supported for rotation at its outer end by the bearing 42 and at its inner end by a bracket 43 fastened to the head 2 of the drier. Packing glands 44 are used at the points indicated to prevent leakage of any kind at these points. A conically shaped chamber 34 is used to feed the material from the conveyor 33 to the various compartments 10 of the drier as it is rotated. Since the drum is set at a slight angle, the material is carried through the compartments 10 to the discharge end beyond the header 11 where buckets 36 pick up the dried material and deposit the same on another worm or conveyor 35 mounted on and carried by the pipe 14. By this means the dried material is carried into a discharge structure 37 having lock gates the same as the structure 29. After passing through the discharge structure 37, the material is moved onto any suitable type of conveyor to be carried off to be packed or otherwise utilized.

The shell or drum 1 carries a gear 38 which is connected through a reducing gear mechanism 41 to a drive motor 40. The drier is preferably provided with a manhole 39 so that a person can get into the compartments 10 to do any cleaning or repairing required therein, it being understood that a drier of this type is of considerable diameter and length. Where the drier is of considerable length, I prefer to support the pipes 8 and 9 interiorly of the shell 1 at one or more points intermediate their ends, two such points being indicated in Figure 1, and such supports are illustrated in Figure 12 by the plates 8A which are in the form of sectors having holes 8B therein for the pipes 8 and 9 and openings 8C through which the material passes. The plates 8A are preferably tack-welded to the shell 1 and to the plates 10A.

At first glance it might appear that these support plates 8A act as obstructions to the passage of material through the drier, but, as a matter of fact, they serve as mixers, it being understood that the rotation of the drier is relatively slow, being of the order of four R. P. M. for certain materials.

It will be apparent that various changes may be made in the details without departing from the general purpose and construction herein described; for example, steam jackets or electric heating elements may be used in place of the steam tubes illustrated.

What I claim is:

1. A continuous drier comprising a drum rotatably mounted at an incline from the loading end downwardly to the discharge end, with means for rotating the drum, a header forming a steam chamber at the discharge end of the drum, plates positioned at right angles to each other and extending longitudinally of and fastened to the wall of the drum from said header to a point near the loading end of the drum, thereby forming a plurality of separate compartments, pipes fastened to and extending from the header longitudinally of the drum and arranged, some around the inner periphery of the drum but spaced a short distance therefrom, while the others are arranged in adjacent rows on two diameters at substantially right angles to each other in close proximity to said plates, means for closing off the ends of the pipes near the loading end of the drum, means for feeding the material to be dried into the loading end of the drum between and around said pipes, means for passing steam into the header and pipes, means for taking away any air or vapor at the said closure means and conveying said air and water or vapor to the dis-

charge end of the drum, means for discharging the air and water, and means for conveying the dried material from the drum.

2. A continuous drier comprising, an outer shell with means for rotatably supporting it and means for rotating it, plates within and extending longitudinally of the shell dividing it into compartments, pipes extending longitudinally of the shell and spaced adjacent from the shell and compartments, means including a header or chamber to which the pipes are attached for passing steam into the pipes at the discharge end of the drier, means at the charging end of the drier for closing the pipe ends, said closure means also assisting in removing any air that may be at these ends of the pipes, means for returning said air to said header, and further means for removing it from the header, means for feeding material to the charging end of the drier, and means for removing the dried material from the discharge end of the drier.

3. A continuous drier as defined in claim 2, further characterized in that said closing means comprises a circular tube fitting within the shell, with transverse leaders extending toward the axis of the shell, connectors extending from said pipe ends to the circular tube and leaders as described, and a pipe comprising said return means located at the axis of the shell into which said leaders extend.

4. A continuous drier comprising, an outer shell with means for rotatably supporting it in an inclined position and means for rotating it, plates within and extending longitudinally of the shell dividing it into quadrants having walls extending from the inner periphery of the shell to lines near the central longitudinal axis of the shell, pipes extending longitudinally of the shell and spaced from, but adjacent to the shell and along the entire width of said plates, means including a header or chamber to which the pipes are attached for passing steam into the pipes at the discharge end of the drier, means at the charging end of the drier for closing the pipe ends, said closure means also serving to remove any air that may be at these ends of the pipes, means for returning said air to said header, and further means for removing it from the header, means for feeding material to the charging end of the drier, means for applying a vacuum to the shell at a point where the material to be dried is about to pass into said quadrant, and means for removing the dried material from the discharge end of the drier.

5. A continuous drier comprising an outer shell with means for rotatably supporting it in an inclined position with means for rotating it, a header forming a steam chamber at the discharge end of the drier, pipes fastened to and extending from the header longitudinally of the shell and arranged, some around the inner periphery of the shell but spaced therefrom, while the others are arranged on near diameters, a centrally located fitting carried by the header with a steam feed pipe connected thereto, the fitting having passages leading from said feed pipe into said chamber, a discharge pipe surrounding said feed pipe, means for closing off the ends of the first-mentioned pipes near the loading end of the drier, means for taking away any air or vapor from said closure means and conveying said air and water or vapor to said fitting, the fitting having passages leading from said conveying means into said chamber, drip pipes having check valves therein extending from the chamber and leading into said discharge pipe to pass said air or water from said chamber to said discharge pipe, means for feeding the material to be dried to the loading end of the drier, and means for conveying the dried material from the drum.

6. A continuous drier as set forth in claim 5, further defined in that means are associated with said fitting for producing a suction on said air and water vapor conveying means.

7. A continuous drier as set forth in claim 5, further defined in that means are provided for removing steam from said drip pipes to allow air and water to readily pass through the drip pipes into said discharge pipe.

LINDSAY R. CHRISTIE.