Aug. 9, 1938. L. D. PARKER 2,126,029

APPARATUS FOR DRYING SLURRY AND OTHER MATERIALS

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Fig. 1.

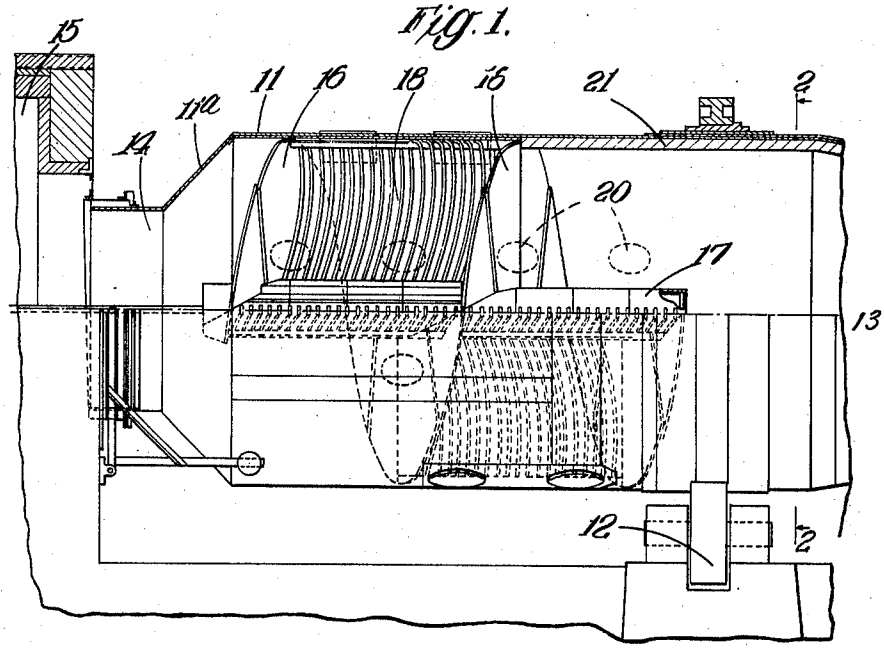
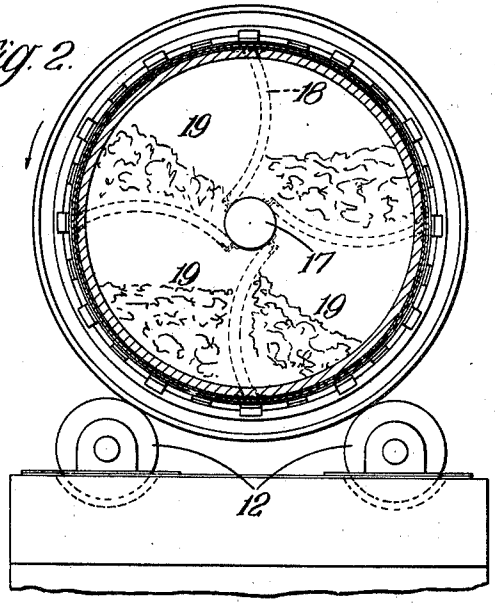


Fig. 2.



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Fig. 3.

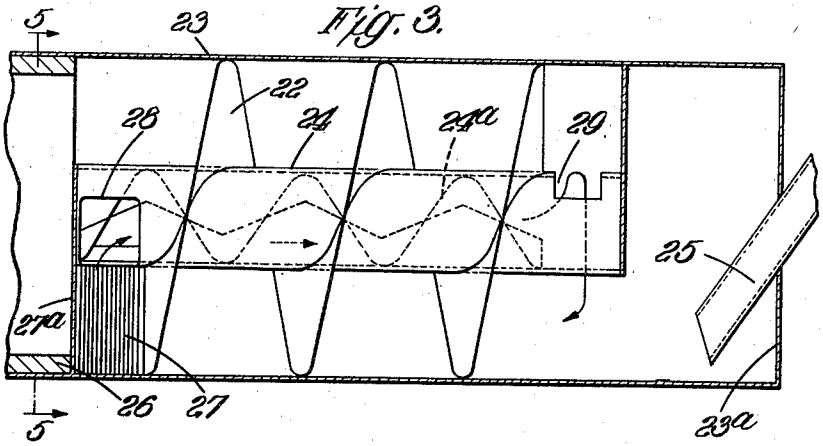


Fig. 4.

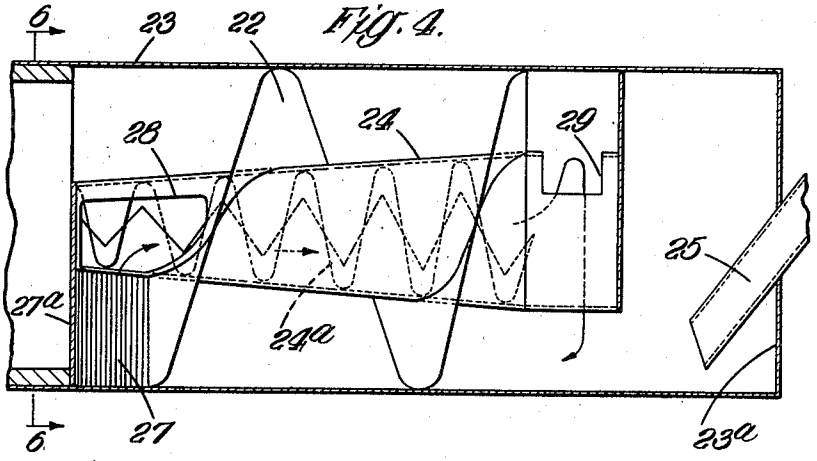


Fig. 5.

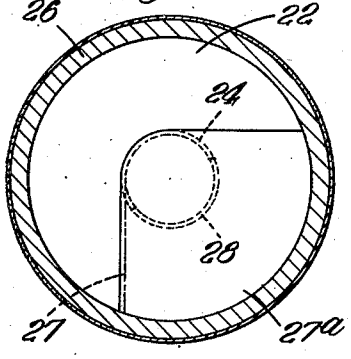
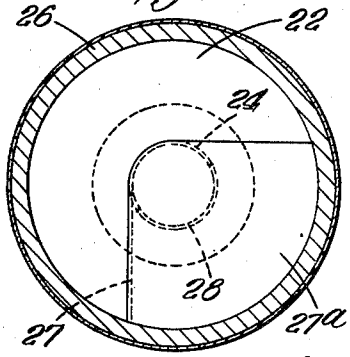


Fig. 6.



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APPARATUS FOR DRYING SLURRY AND OTHER MATERIALS

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Application October 31, 1935, Serial No. 47,605
In Great Britain November 13, 1934

12 Claims. (Cl. 34—6)

This invention relates to apparatus for drying slurry and other materials, for example materials of a plastic or semi-plastic nature, or materials of a solid nature, such as coal, limestone or the like.

An apparatus for drying cement slurry is known in which a gas permeable drum is employed mounted to rotate about a horizontal axis in a surrounding casing, the interior of the drum being provided with numerous filling bodies to which the slurry can adhere, the drum being mounted in such a manner that the exhaust gases from a cement kiln are caused to pass diametrically through the said drum. Such an arrangement is not altogether satisfactory since, in the first place, the fact that the filling bodies rest during rotation of the drum upon the lower surface thereof produces an unbalanced load which decreases the mechanical efficiency and increases power consumption. Furthermore, an appreciable proportion of the kiln gases and cement dust carried along thereby are deflected by the surface of the drum and are thus caused to pass between the periphery of the drum and the inner surface of the surrounding casing, and are therefore wasted, whilst if the cement dust is to be reclaimed a special extraction apparatus or separator is required. Also in this prior proposal it is important that a uniform flow of slurrry should occur in order to avoid agglomeration or caking of the slurry, particularly on the surface of the drum. In addition it is necessary to maintain the drying gases at a substantially constant temperature, otherwise the dried or partially dried material passing from the drum along a chute to the kiln is liable to cake or agglomerate on the surface of the chute.

It is the chief object of the present invention to provide an improved apparatus for drying slurry and other materials, (particularly cement slurry) with a view to avoiding in the preferred form of the invention the disadvantages referred to above.

It is a further object of the invention to provide an improved apparatus of the kind referred to which comprises a structure mounted to rotate about a horizontal or inclined axis, means integral with said structure to provide a closed helical or spiral channel therein along which a drying medium is constrained to flow, carrier bodies in the channel to which the material to be dried is fed and means for separating the dried material and the carrier bodies to enable the dried material to be discharged from said structure whilst retaining the carrier bodies therein. The said apparatus may be constructed as a unit for use in conjunction with a kiln, such as a rotary cement kiln, (working on either the wet or dry process of cement manufacture) or the apparatus may be mounted within the feed end of a rotary kiln or in an enlarged extension thereof. In all cases when used in the manufacture of cement the exhaust gases from the kiln are preferably employed to dry the material, although it will be appreciated that when the apparatus is employed (for example as a separate unit) for drying other materials other heating or drying gases or medium may be used.

Further the channel or compartment may be divided along its length into a number of sub-compartments each having filling or carrier bodies disposed therein, the sub-compartments being preferably formed by curved grids or webs of perforated form, enabling the material to pass from one sub-compartment to another but retaining the carrier bodies therein. Alternatively, the sub-compartments may be omitted and the carrier bodies and the material to be dried may pass simultaneously from one end of the said channel to the other and at the discharge end the material dried may pass to a suitable outlet whilst the carrier bodies may be discharged into a centrally disposed channel where they are conveyed to the feed end of the said channel.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings in which:

Figure 1 is an elevation partly in longitudinal section of an apparatus constructed in accordance with the preferred form of the invention;

Figure 2 is a cross-sectional view on the line 2—2 of Figure 1;

Figure 3 is a diagrammatic view illustrating another example of the invention;

Figure 4 is a diagrammatic view illustrating a modification of the construction shown in Figure 3;

Figures 5 and 6 are respectively cross-sectional views taken along the lines 5—5 and 6—6 of Figures 3 and 4 respectively.

Referring now more particularly to Figures 1 and 2 of the accompanying drawings which illustrate a form of the invention for use by way of example with an apparatus for drying cement slurry, the reference numeral 11 indicates a substantially cylindrical casing supported for rotation on bearings 12 about an axis slightly inclined to the horizontal. The apparatus shown in Figures 1 and 2 is adapted to be employed in con-

junction with a cement kiln for which purpose the discharge end 13 of the casing 11 is adapted to be rigidly connected with the feed end of a rotary kiln not shown which rotates with the casing 11. The exhaust gases from the kiln in the example shown are utilized for the purpose of drying the cement slurry which is fed to the casing 11 at the feed end indicated by the reference numeral 14. The drying gases are discharged from the casing 11 through the feed end 14 and pass into a flue structure 15 which is connected to the feed end 14 through the medium of any suitable or known gaseous sealing device. The interior of the casing 11 is formed to provide a helical passage for the flow of the drying gases, the drying gases thus passing axially from one end of the casing 11 to the other following the helical path formed in the said casing. As shown the helical path is constituted by the provision of a worm-like vane 16, which may be composed of a plurality of plates suitably connected together as shown, which extends from the inner surface of the casing 11 to which the outer edges of the worm-like vane are connected whilst the inner edges of the said vane are connected to a central support 17. The channel or compartment formed by the worm-like vane 16 is divided into a number of sub-compartments by the provision of substantially radially disposed grids 18 extending from the central support 17 to the inner surface of the casing 11. The grids may be formed of perforated material although in the example shown the grids comprise a series of bars suitably secured in position. The said grids are preferably curved as shown with the concave surfaces thereof facing the direction of rotation indicated by the arrow in Figure 2. In the example shown in the drawings four sub-compartments indicated by the reference numerals 19 are afforded by the grids 18. One of the grids 18 is disposed at the commencement of the said helical path whilst another grid is disposed at the end thereof. Each sub-compartment 19 is partially filled with filling or carrier bodies as shown in Figure 2 the grids 18 being so formed as to retain the filling or carrier bodies in the sub-compartments but permitting of the passage of the dried or partially dried slurry from one compartment to another.

The carrier or filling bodies in all examples of the invention may be of any suitable construction and they may comprise solid bodies of any suitable form, such as spherical, cylindrical or the like, or alternatively they may be hollow cylinders which may, if desired have apertures in the walls thereof, or they may be ring shaped elements or otherwise according to requirements. Also, if desired, the said bodies may comprise chains which may or may not be connected to the said compartments. Also the carrier bodies may comprise helices of rectangular or other suitable shape in cross-section. Due to the provision of the subcompartments the filling or carrier bodies therein are disposed about the axis of the casing 11 so that the carrier bodies in the several sub-compartments substantially counterbalance one another during rotation of the casing, thus avoiding the unbalanced load hereinbefore referred to. As above mentioned the material to be dried is fed into the end 14 and during rotation of the casing 11 the material passes through the first grid 18 into contact with the filling or carrier bodies therein which become coated with the slurry whilst the drying gases entering the end 13 of the casing flow through the helical channel drying the slurry which is coated on the said bodies. During rotation the carrier bodies constantly change their relative positions due to the cascading action which occurs, contact with one another and serve to prevent a caking or agglomeration of the material which is dislodged from the bodies and passes through the successive sub-compartments to the filling or carrier bodies therein and is finally discharged through the last grid 18 whence it passes through the discharge end 13 directly into the kiln for further treatment. The several sub-compartments maintain a mass of carrier or filling bodies in the path of the drying gases so as effectively to dry the material adhering to or intermingling with the carrier or filling bodies. In the example shown the drying gases flow in an opposite direction to that of the slurry flow although it is to be appreciated that if desired the drying gases may flow in the same direction as the slurry. The provision of the helical channel constituted by the vane 16 causes the material fed in at the end 14 to progress positively from such end to the discharge end of the helical channel. Man-holes 20 may be provided along the length of the casing 11 for inspection purposes or for inserting the carrier bodies in the several sub-compartments whilst the discharge end of the casing 11 may be provided with a lining of refractory material indicated by the reference numeral 21.

Figures 3 to 6 of the accompanying drawings illustrate diagrammatically modified constructions of the apparatus shown in Figures 1 and 2 the main distinction being that the radial grids 18 are omitted and the carrier bodies and the slurry progress simultaneously along a helical channel, at the discharge end of which the slurry and the filling or carrier bodies are separated the said bodies being returned to the feed end of the said channel. In these figures the reference numeral 22 indicates a solid worm-like vane extending from the inner surface of a drum or cylindrical casing 23 to a hollow central cylindrical support 24. The filling or carrier bodies are disposed at the lower portion of the casing 23 the level of the filling bodies preferably extending to approximately the underside of the hollow central support 24. The material to be dried is introduced through a nozzle 25 situated at one end of the casing 23, the material introduced and the carrier bodies being positively progressed by the action of the vane 22, during rotation of the casing from the feed end to the discharge end of the casing, which latter may be directly connected to a rotary kiln 26. In the example shown the exhaust gases from the kiln 26 are utilized to dry the material and due to the provision of the helical passage formed by the worm 22 the drying gases must pass through the mass of carrier bodies before reaching the outlet at the feed end of the casing 23. At the discharge end of the helical channel a grid 27 is provided extending between a plate 27a and the end of the vane 22 which grid is of sufficient size to permit the passage of the dried material but preventing the passage of the carrier bodies. By the time the carrier bodies and the material reach the grid 27 the material is sufficiently dried to become dislodged from the carrier bodies by the relative action of the bodies as they are progressed by the vane 22 the dislodged or dried material passing through the grid 27 directly into the kiln 26 whilst the carrier bodies during rotation of the casing 23 pass through an opening 28 in the hollow central support 24 where they are conveyed through the hollow support by means of a suitably constructed worm or other conveyor 24a

and discharged through an opening **29** at the feed end of the casing. The carrier bodies discharged from the opening **29** are in a heated condition in which state they become again coated with cold slurry fed through the nozzle **25**. In this example the material and the carrier bodies are progressively moved from one end of the casing **23** to the other during which movement the material is subjected to the action of the drying gases which flow axially of the casing **23** following the helical path defined by the worm **22** and when the grid **27** is reached the material passes into the kiln **26** whilst the carrier bodies are conveyed to the commencement of the helical path as aforesaid.

Figures 4 and 6 of the drawings illustrate a similar but slightly modified construction in which the central support **24** instead of being of cylindrical form as in Figure 3, is of a conical form with the smaller end disposed at the discharge end of the casing **23**. The general construction and operation of the apparatus shown in Figures 4 and 6 is similar to that described with reference to Figures 3 and 5.

In the embodiments illustrated the material to be dried is fed to extensions of the respective casings which form troughs from which the material passes into the helical channel. In Figures 1 and 2 the trough is formed by the conical wall **11***a* and in Figures 3 to 6 by the wall **23***a*.

Since the drying gases must pass through the mass of carrier bodies before reaching the outlet any cement dust carried along by the gases is abstracted by the slurry coated bodies.

Whilst the examples of the invention described above are adapted to rotate with a rotary kiln it will be understood that if desired the apparatus may be constructed as a unit for use independently of or in conjunction with a kiln or with any other apparatus, or alternatively the apparatus may be mounted in the feed end of a kiln or co-axially with the kiln and rotated independently thereof, in which latter case the drying apparatus may be connected to the feed end of the kiln through the medium of a suitable gland to prevent the escape of the kiln gases.

What I claim and desire to secure by Letters Patent of the United States, is:

1. Apparatus for drying slurry and other materials comprising a structure mounted to rotate about an axis disposed at an angle to the horizontal, means integral with said structure to provide a closed helical or spiral channel therein, along which a drying medium is constrained to flow, carrier bodies in the channel to which the material to be dried is fed and means for separating the dried material and the carrier bodies to enable the dried material to be discharged from said structure whilst retaining the carrier bodies therein.

2. Apparatus for drying slurry and other materials comprising a structure mounted to rotate about an axis disposed at an angle to the horizontal, means integral with said structure to provide a closed helical or spiral channel therein, along which a drying medium is constrained to flow, means to divide said channel into a plurality of sub-compartments, and carrier bodies in said sub-compartments to which the material to be dried is fed.

3. Apparatus for drying slurry and other materials as claimed in claim 2, in which the sub-compartments are substantially radially disposed.

4. Apparatus for drying slurry or other materials comprising a structure mounted to rotate about an axis disposed at an angle to the horizontal, means integral with said structure to provide a closed helical or spiral channel therein along which a drying medium is constrained to flow, a plurality of substantially radially disposed grids in said channel dividing the same into a number of sub-compartments, and carrier bodies in said sub-compartments to which the material to be dried is fed.

5. Apparatus for drying slurry and similar materials as claimed in claim 4, in which the grids are curved, the concave faces thereof projecting in the direction of rotation of the said structure.

6. Apparatus for drying slurry and similar materials comprising a structure mounted to rotate about an axis disposed at an angle to the horizontal, a hollow support within said structure having an inlet and an outlet, a worm-like vane mounted on said support and rigidly secured to the structure to form a closed helical channel, carrier bodies within the channel to which the material to be dried is fed, said carrier bodies being progressed simultaneously with said material along the structure from one end to the other, means for separating the carrier bodies and the dried material to enable the said dried material to be discharged from the structure whilst retaining the carrier bodies therein conveying means within said hollow support for causing the carrier bodies to be conveyed from the inlet of said support to the outlet thereof, and means for returning said carrier bodies to the inlet of said hollow support.

7. Apparatus for drying slurry as claimed in claim 6, wherein the hollow support is cylindrical.

8. Apparatus for drying slurry and similar materials as claimed in claim 6, wherein the hollow support is of a conical form with the smaller end disposed in the vicinity where the carrier bodies and the material are separated.

9. In a rotary kiln, a drying zone for material to be burnt in said kiln, means mounted within said zone to provide a closed helical or spiral channel therein along which gases from said kiln are constrained to flow in countercurrent to the material to be dried, means dividing said channel into a plurality of sub-compartments, and carrier bodies in said sub-compartments to which the material to be dried is fed.

10. A rotary kiln having a drying zone for material to be calcined in the kiln, characterized by the provision in the drying zone of a helical channel with loose bodies of heat-resistant material therein and a perforated wall preventing the passage of the bodies from the channel into the body of the kiln but allowing the kiln gases to pass through the channel in countercurrent to the material.

11. A rotary kiln according to claim 10, in which the helical channel is divided into a number of sections by perforated walls with a charge of loose bodies of heat-resistant material.

12. A rotary kiln according to claim 10, in which the partition forming the walls of the helical channel rotates with the kiln.

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