March 12, 1957 N. E. ANDERSEN 2,784,499

SLURRY PREHEATER

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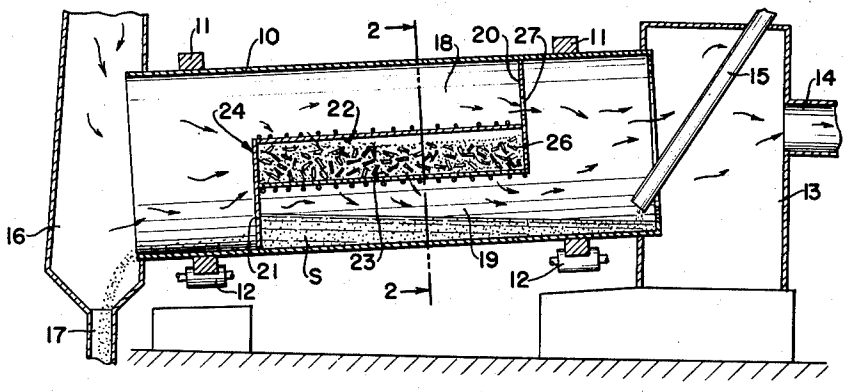
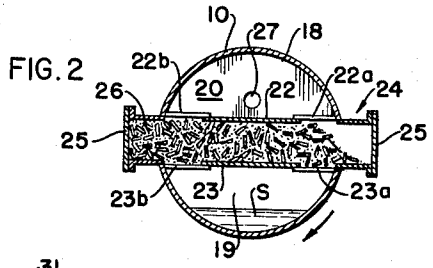


FIG. 1

FIG. 2



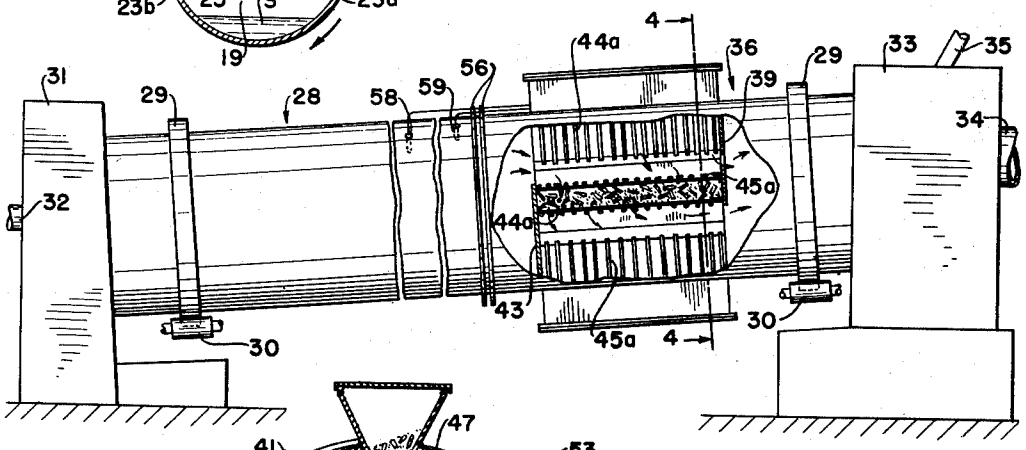


FIG. 3

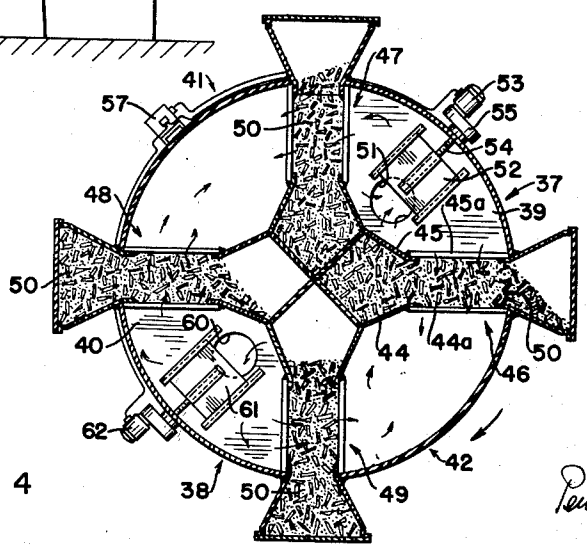


FIG. 4

INVENTOR
Niels Edvard Andersen
BY
Pennie Edmonds Morton Barrows Taylor
ATTORNEYS

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SLURRY PREHEATER

Niels Edvard Andersen, Copenhagen-Valby, Denmark, assignor to F. L. Smidth & Co., New York, N. Y., a corporation of New Jersey

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4 Claims. (Cl. 34—54)

This invention relates to apparatus for heating raw material slurry by means of hot gases preliminary to a final heating operation, as, for example, the burning of the slurry in the wet process of cement manufacture. More particularly, the invention is concerned with a novel slurry heating apparatus, in which the heating operation is controllable, so that, despite substantial variations in the temperature or the amount of the heating gases, overheating of the slurry with resultant excessive drying of the slurry and clogging of the apparatus are avoided. The new slurry heating apparatus may be constructed as a unit separate and apart from the apparatus, in which the final heating operation is performed, or, when the final apparatus is a rotary kiln, the slurry heating apparatus may be formed as part of the kiln.

The apparatus of the invention includes a tubular shell mounted for rotation with its axis horizontal or approximately so and means are provided for feeding slurry into the shell at one end and for receiving slurry discharged at the other end of the shell and supplying hot gases to the shell. The interior of the shell is subdivided by partition means forming at least one chamber, which contains a charge of loose bodies and through which the gases and slurry pass in opposite directions. The partition means are so constructed that only part of the gases flow countercurrent to the slurry through the compartment, while the remainder of the gases is by-passed around the chamber. The by-pass may be of such size that the quantity of gases passing in contact with the slurry in the chamber will not cause excessive drying of the slurry, regardless of the quantity of gases supplied to the apparatus, but, if preferred, the by-pass may be adjustable and may be varied in size in accordance with variations in the temperature of the gases being supplied to the apparatus.

For a better understanding of the invention, reference may be made to the accompanying drawing, in which:

Fig. 1 is a vertical longitudinal sectional view of one form of apparatus embodying the invention;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a view in side elevation with parts broken away of a rotary kiln provided with a slurry preheater section of the invention; and

Fig. 4 is a sectional view on the line 4—4 of Fig. 3.

The slurry preheater of Fig. 1 includes a tubular shell 10 provided with live rings 11 and supported for rotation with its axis inclined to the horizontal on rollers 12, on which the rings run. The upper end of the shell extends into a hood 13 having an outlet duct 14 for leading away the hot gases and the slurry is fed into the shell through a pipe 15 extending through the hood and into the upper end of the shell. The lower end of the shell extends into a duct 16, which conducts hot gases from a furnace, kiln, etc., into the shell and receives the slurry discharged from the shell, the slurry being led away through a pipe 17.

The interior of the shell is divided by partition means into a compartment 18 open at the discharge end of the shell and a compartment 19 open at the feed end of the shell, the compartments being longer than half the length of the shell and overlapping lengthwise of the shell. The compartments are closed at their upper and lower ends, respectively, by end walls 20 and 21, which are connected by a pair of spaced parallel side walls 22, 23 lying on opposite sides of the shell axis. The side walls extend through diametrical openings in the wall of the shell and the parts of the side walls outside the shell are connected by sections of the end walls. The side and end walls thus form a chamber 24 having extensions lying outside the shell and the extensions are closed by walls 25. The side walls 22, 23 have apertured sections 22*a*, 22*b*, 23*a*, 23*b*, respectively, lying inside the shell and adjacent the shell and the sections 22*a*, etc., may be advantageously formed of grids. The chamber contains a charge of loose bodies sufficient to cover both grids in at least one wall in any angular position of the shell.

In the operation of the apparatus, slurry is fed into compartments 19 through pipe 15 and is prevented by end wall 21 from escaping from the compartment. As the shell rotates 90° from the position shown in Fig. 2, the grid 23*a* in wall 23 enters the pool S of slurry in the bottom of compartment 19 and the slurry flows through the grid into chamber 24, where the slurry coats the loose bodies and takes up heat from them. As the shell rotates another 90°, the end of the chamber 24, which has passed through the slurry, rises, so that the chamber lies horizontal and the slurry flows from the chamber through grids 22*a*, 22*b* into the compartment 18. As the rotation of the shell continues, the slurry flows into chamber 24 from compartment 19, when the chamber has one end passing through the pool of slurry, and the slurry flows from the chamber through the grids in side wall 22 into compartment 18, when both grids are out of the pool. During the shell rotation, the hot gases entering the compartment 18 flow into the chamber 24 through the grids in wall 22 and pass across the chamber and escape through the grids in wall 23 into compartment 19, from which they escape through the hood 13. In their travel through the chamber, the gases give up heat to the loose bodies and the slurry thereon.

Under ordinary conditions, the slurry supplied to the apparatus has a temperature of 20° C. and the apparatus is of such dimensions that the slurry is heated to about 80° C. without being substantially dried. However, if the quantity of hot gases supplied to the shell or their temperature is increased during operation, the slurry may lose so large a part of its moisture while passing through chamber 24, that the slurry will adhere to the loose bodies and tend to clog the chamber. In order to avoid such excessive drying of the slurry, the end wall 20 is provided with a gas by-pass port 27 through which part of the gases entering compartment 18 may flow to by-pass chamber 24 and pass into compartment 19. The proportion of the gases supplied to compartment 18, which flows through the by-pass port, depends on the resistance to flow across chamber 24 offered by the loose bodies, and, if the slurry adheres to the bodies and tends to clog the chamber as a result of excessive drying, the quantity of gases by-passing the chamber and not giving up heat to the slurry increases automatically. As the charge of loose bodies does not fill chamber 24, the bodies move back and forth in the chamber as the shell rotates and such movement frees deposits of slurry from the bodies, so that the resistance to gas flow offered by the bodies decreases.

In the installation shown in Figs. 3 and 4, the rotary kiln **28** rotates on live rings **29** supported on rollers **30** and its lower end extends into a hood **31**, through which a burner tube **32** projects to terminate within the kiln. The upper end of the kiln lies within a dust chamber **33** having a gas exhaust duct **34** and the slurry is supplied to the kiln through a pipe **35** projecting through chamber **33** into the upper end of the kiln.

The kiln is provided with a slurry preheater section **36** adjacent its upper end and the interior of the section is subdivided by partitions into four compartments extending axially, of which compartments **37**, **38** are open at the lower end and closed at the upper end by walls **39**, **40**, while compartments **41**, **42** are open at the upper end and closed at the lower end by walls typified by wall **43**. The upper and lower end walls are connected by spaced pairs of side walls, such as the side walls **44**, **45**, to form four chambers **46**, **47**, **48** and **49** spaced 90° and having closed extensions outside the shell of the kiln section. The side walls have grids, such as grids **44***a*, **45***a*, lying within and close to the wall of the kiln shell and the chambers are partly filled by charges **50** of loose bodies.

The upper end wall **39** has a gas by-pass port **51**, the size of which may be varied by a sliding damper **52** movable across the opening by a reversible motor **53** driving a screw **54**, which engages the damper, through a speed reducer **55**. The motor is supplied with current through contact rings **56** encircling the kiln shell and it is controlled by a device **57** mounted on the kiln shell and controlled in turn by temperature-responsive elements **58**, **59** mounted at intervals along the kiln shell downward from section **36**. The upper end wall **40** has a similar gas by-pass port **60** with a damper **61** similar to damper **52** and similarly operable by a motor **62** receiving current from rings **56** and controlled by the device **57**.

In the operation of the kiln **28**, part of the hot gases passing upward through the kiln flow through the chambers **46**, **47**, **48** and **49** to give up heat to the loose bodies therein and the remainder of the gases by-pass the chambers and escape into the dust chamber **33**. Initially, the dampers **52**, **61** are set, so that the gases flowing through the chambers heat the slurry to the desired temperature without excessively drying it, but, if the temperature of the kiln rises, the temperature-responsive elements **58**, **59** act through the control device **57** to cause motors **53**, **62** to move the dampers **52**, **61** to increase the opening of the by-pass ports. In like manner, a decrease in kiln temperature results in a decrease in the by-pass port opening. The heating effect of the gases on the slurry is thus controlled, so that clogging of the slurry pre-heater as a result of excessive drying of the slurry is avoided.

I claim:

1. Apparatus for heating slurry by means of gases, which comprises a tubular shell mounted for rotation with its axis approximately horizontal, means for feeding slurry into the shell at one end, means for receiving slurry discharged from the other end of the shell and supplying hot gases to the shell at the discharge end, partition means within the shell dividing its interior into at least two compartments overlapping lengthwise of the shell and open at opposite ends of the shell, the partition means including end walls transverse to the shell axis and closing opposite ends of the compartments and at least one pair of spaced parallel side walls lying on opposite sides of the shell axis and connecting the end walls, the side walls having apertured sections within the shell and adjacent its wall and the side and end walls defining a chamber and extending through at least one opening through the shell wall to provide an extension of the chamber, a wall closing the end of the chamber extension, a charge of loose bodies partly filling the chamber, and a gas by-pass port in the end wall closing the end of one compartment at the feed end of the shell.

2. The slurry heating apparatus of claim 1, in which a movable closure for the gas escape port is mounted on the end wall at the feed end of the shell.

3. The slurry heating apparatus of claim 2 in which the movable closure is adjusted relative to the port by a motor and means responsive to the temperature of the gases entering the shell control the operation of the motor.

4. An inclined rotary kiln provided with the slurry heating apparatus of claim 3 with the shell forming a section of the kiln at its upper end and receiving hot gases directly from the kiln, in which the means controlling the motor include a thermo-responsive element mounted on the kiln wall downward from the shell.

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