April 24, 1934. K. E. E. HOLZAPFEL 1,955,914

APPARATUS FOR PRODUCING CEMENT AND SIMILAR SUBSTANCES

Filed May 27, 1930 2 Sheets-Sheet 1

Fig. 1.

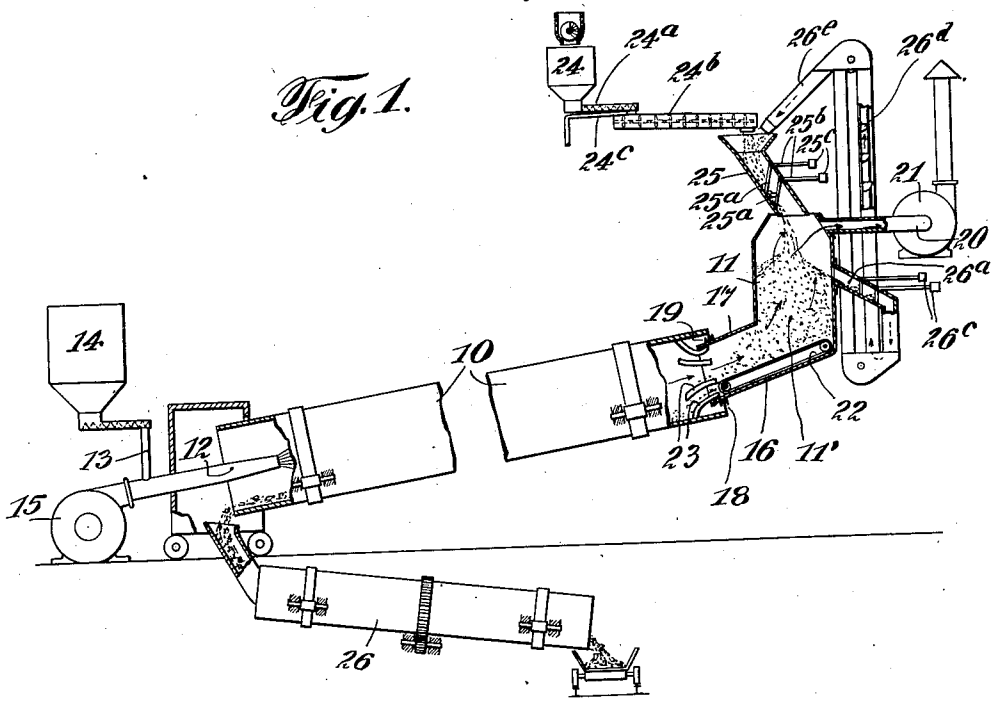

Fig. 2.

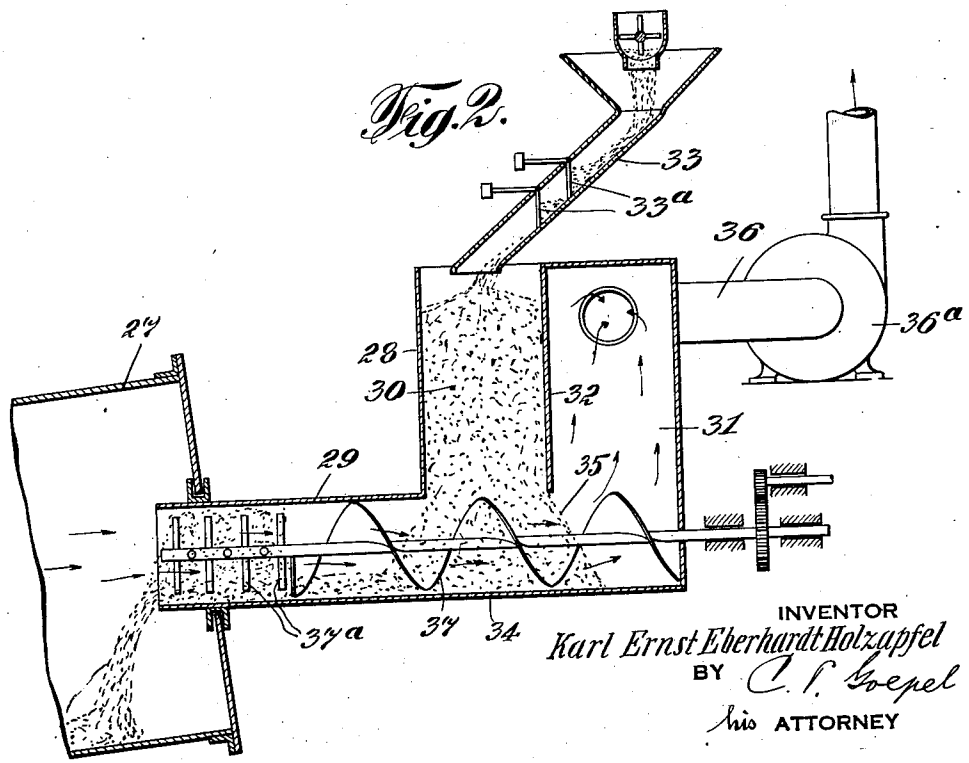

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Fig. 3.

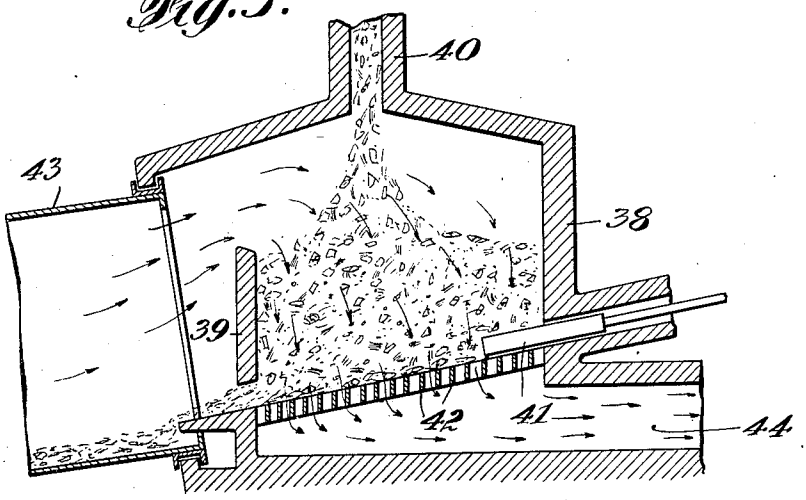
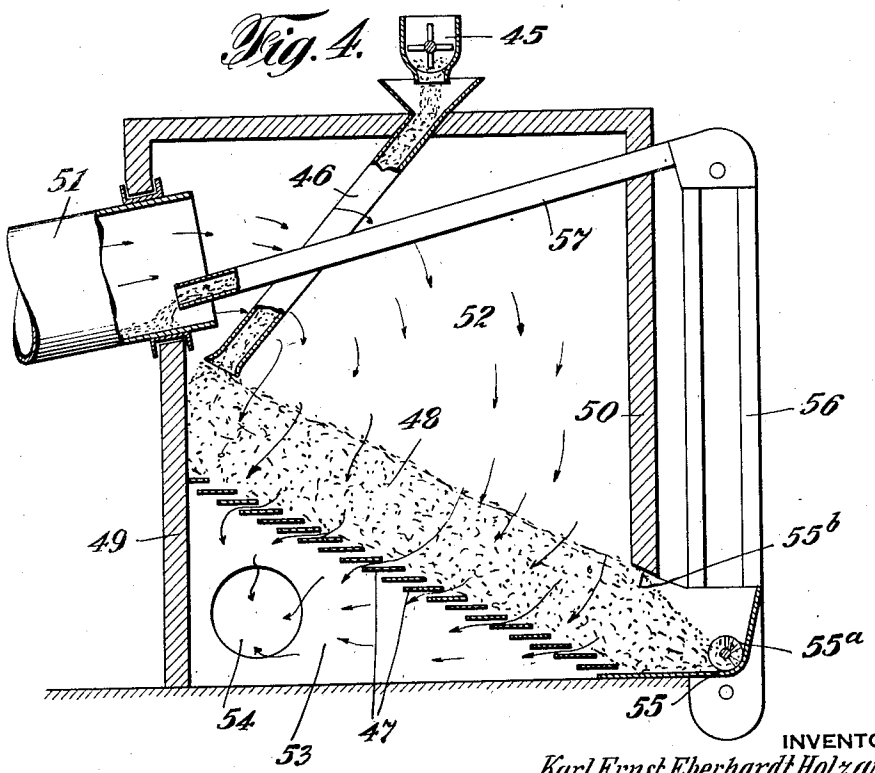


Fig. 4.



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UNITED STATES PATENT OFFICE

1,955,914

APPARATUS FOR PRODUCING CEMENT AND SIMILAR SUBSTANCES

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Application May 27, 1930, Serial No. 456,000
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3 Claims. (Cl. 222—7)

My invention relates to the production of cement and is adapted for general use in the manufacture of various calcined substances produced by a burning process, and the invention comprehends an improved apparatus or means peculiarly adapted for carrying out said method.

An object of the invention is to combine a rotary kiln of known type with a calcining shaft or pot. According to the invention, the shaft or pot is of relatively small size, for the inventor has found that a relatively small column or layer of material makes the best economic use of the exhaust gases coming from the rotary kiln for the pre-heating and preburning of the material. Further, by use of a relatively small column or layer of material, the exhaust gases meet with less resistance. It is especially important to maintain a constant or uniform volume of material moving in the calcining shaft, which is arranged in series with the rotary kiln. In this way, the exhaust gases always meet with the same resistance and a uniform firing of the rotary kiln, placed in series with the shaft, is made possible.

Among other objects in view or accomplished by my invention are the following:—

(1) To use a rotary kiln in series with a calcining shaft of relatively small height content, so that the layer or column of material under calcination will be limited as to thickness or height and be maintained substantially constant. (2) To realize an embodiment in which the hot gases of combustion issuing from the feeding end of the kiln will be drawn through a moving layer of material of uniform thickness within the calcining shaft. (3) To make possible an embodiment in which there is a uniform or constant mass within the calcining apparatus, which uniform or constant mass is conducive to steady calcination and oxidation, with a free and rapid escape of the volatile matter and carbonic acid. (4) To enable maintenance at all times of substantially the same height of material in the calcining apparatus, the improvement in this regard involving the provision of an intermediate wall which naturally commands the slope and hence the mass of the material. (5) To realize the incorporation of a stirring device in conjunction with the discharge of the calcined material into the rotary kiln. (6) To realize an embodiment wherein with the calcining shaft, there is associated a feeding device for receiving, distributing and drying the material under calcination. (7) To realize an embodiment in which the gases of combustion are directed or guided downwardly in the calcining apparatus from the top to the bottom of the material so that the gases will have to pass through the material and therefore lose much of their heat before reaching the grate, thereby affording a protection for the grate.

Other objects and aspects of the invention will appear hereinafter.

Several embodiments of my invention are illustrated herein, the purpose and object of each of which are to illustrate by practical example the application of my method in general, and of selected apparatus through the agency of which to carry the invention into effect in a practical way.

The principles of the invention and the preferred modes of carrying the same into effect in a practical way will best be understood by referring to the accompanying drawings, forming a material part of this application, and in which:—

Figure 1 represents a view, in elevation and section, of an apparatus made in accordance with my invention;

Fig. 2 represents a fragmentary vertical sectional view, showing a modified construction in which by reason of the arrangement of the walls in the calcining apparatus a uniform quantity of material is delivered for treatment by a screw and the exhaust gases;

Fig. 3 is a vertical sectional view showing a further modification whereby the gases of combustion are caused to flow from the top to the bottom of a moving uniform quantity of material within the calcining pot; and

Fig. 4 is a similar view of a still further modification, showing an inclined grate structure for feeding a moving uniform layer of material for treatment by the exhaust gases.

In carrying my invention into effect any suitable or approved furnace may be employed, that shown, by way of example in Fig. 1, comprising a longitudinally inclined rotary shaft kiln 10 and an upright calcining shaft 11, which is of relatively small height and which feeds directly into the rotary kiln at the feeding or elevated end thereof. The rotary kiln has therein the usual sintering zone or chamber wherein the material under treatment is burned; while the shaft 11, arranged in series with the kiln, provides a preheating or calcining chamber 11' wherein the material is heated so as to expell the volatile matter and carbonic acid. Arranged in the rear or discharge end of the rotary kiln is a burner apparatus 12 of any suitable or appropriate type, and by preference of a type adapted to employ fuel consisting of any suitable coal. For supplying the burning apparatus with fuel, there is a supply line 13 which leads from any suitable source

of supply such as a hopper 14; and suitably associated with such supply line 13 is a rotor or blower device 15 of any suitable or approved type adapted, under pressure, to supply the necessary combustion air along with the fuel fed to the burner 12.

According to an important feature of my invention, the calcining shaft 11 is characterized by the fact that the pre-heating or calcining chamber 11' therein holds a layer or mass of material which is relatively small in height or thickness, and further by the fact that the bottom portion 16 of the shaft inclines downwardly and rearwardly so that the material, as pre-heated or calcined, will be discharged directly into the rotary kiln, and also so that the gases of combustion issuing from the rotary kiln, will pass directly through the discharging pre-heated or calcined material and thence upwardly through the relatively small layer or mass of material undergoing pre-heating or calcination. In the present instance, the discharge outlet from the calcining chamber is represented as comprising a neck or spout outlet 17 which enters into the interior of the rotary kiln, the bottom of the spout consisting of a downwardly inclined continuation of the bottom 16 for the calcining chamber 11'. The front end 18 of the rotary kiln is closed with respect to the delivery neck or spout 17 in order to prevent the entrance of air at this junction point. The closure means is represented as consisting of annular bushing or packing portions 19 between which the front end 18 has turning fit.

Connected with the upper portion of the calcining shaft 11 is an exhaust gas line 20, in which is incorporated a suitable fan or blower device 21 for rapidly effecting the discharge of the gases. A downwardly inclined conveyor device 22 is operatively arranged upon the downwardly inclined bottom 16, such device being arranged to receive thereon material as it settles downwardly in the calcining chamber 11' and to convey the material downwardly over the bottom to a point adjacent the rear end of the spout 17, where the material enters the rotary kiln. At the rear end of the conveyor, there is arranged within the delivery spout 17, a stirring or discharging apparatus preferably consisting of a plurality of curved vanes 23, which are carried by the rotary kiln. By the operation of the stirring or discharging vanes 23 in conjunction with the operation of the conveyor 22, the material is kept constantly traveling from the calcining chamber 11 into the rotary kiln. An advantage of this arrangement is that the material is prevented from sticking and at the same time it is kept loose and in motion whereby to enable rapid travel of the combustion gases therethrough. Attention is here called especially to the fact that under the instant arrangement, the rotary kiln is placed in series with a calcining shaft, the height of which is limited so that the layer or mass of material therein will be of small height or thickness. Under this arrangement, there is no pronounced fluctuation in the layer or mass of material undergoing the calcining process. Uniform calcination is, therefore, obtained, and in view of the conveying and stirring devices associated with the outlet for the calcining shaft, there is no sticking or accumulation of the material, the calcining operation is hastened and the output is, therefore, increased.

The raw material may be introduced into the calcining shaft by any suitable or approved means, that herein shown consisting of a hopper 24 and a feed screw 24*a* which conveys the material to the mixing screw 24*b* where the material is moistened by water issuing from a water pipe 24*c*. By mixing it with water, the material is formed in small bodies or crumbs. The material falls from the mixing screw 24*b* into a chute 25 having a pair of gate valves 25*a* which open downwardly so as to feed the material into the calcining shaft and in a manner to avoid in so far as possible the admission of air into the calcining shaft. Associated with each of the gate valves 25*a* is an arm 25*b* weighted at 25*c*, whereby normally to urge the valve to closed position. In order to maintain a constantly uniform layer of material within the calcining shaft, a downwardly and outwardly inclined overflow pipe or channel 26*a* is provided, and this pipe is equipped with weight operated gate valves 26*c* similar to the gate valves 25*a*. The material passing through the overflow pipe or channel 26*a* is taken up by a conveyor 26*d* for redelivery through the channel 26*e* into the chute 25. At the rear end of the rotary kiln, I may provide any suitable rotary cooling drum 26 for receiving the clinkers as they fall from the rear or discharge end of the rotary kiln.

In the exemplification shown in Fig. 2, 27 designates the rotary kiln and the upright calcining container or pot 28, which feeds into the rotary kiln through the spout 29, is divided into two parts 30 and 31 by a vertical wall 32. The material to be pre-heated or calcined enters the top of the part 30 through an air-tight feeding supply 33, equipped with a pair of weighted gate valves 33*a* similar to those hereinbefore described. The lower end of the part 30 is open so that the material will fall therefrom to produce or tend to produce upon the bottom 34 a cone-shaped mass or layer of material 35, through which the hot gases of combustion must pass in order to reach the part 31, with the top of which is connected a gas outlet line 36. For drawing out the gases, a suction fan 36*a* is incorporated in the outlet line 36. Arranged above the bottom 34 is a screw 37 for discharging the material through the spout 29 into the rotary kiln. By this arrangement, the same thickness of material is maintained at all times in the calcining pot, since the cone-shaped mass naturally passing to the screw 37 upon the bottom 34 tends always to constitute a determinate quantity. If desired, the wall 32 may be made vertically adjustable in order to increase or decrease the quantity of the cone-shaped mass tending to assemble upon the bottom 34. As represented in the drawings, the discharge screw 37 is shown as provided in advance of the screw threads with a plurality of pins 37*a* adapted to stir the discharging material and whirl the same into a loose condition. The drying of the material, the passage of the exhaust gases therethrough and the delivery of the material into the kiln are thus facilitated. Moreover, by the whirling action, the exhaust gases come into contact with greatly increased surfaces of the material, a condition which is conducive to a rapid exchange of heat.

In Figs. 3 and 4, I have disclosed arrangements whereby the hot gases of combustion are guided downwardly from the top to the bottom of layers of material within the calcining pot. In the specific instance illustrated in Fig. 3, the combustion gases, in passing through the pot 38, are required to descend through the layer of material maintained constant and uniform by the wall or baffle 39. The material is supplied through the inlet 40 and a plunger device 41, arranged to operate

across the downwardly inclined grate 42, serves as the instrumentality for feeding the material into the rotary kiln 43, the plunger device operating in a path to push the material under the wall 39 for delivery into the kiln. After passing downwardly through the layer of material, the gases leave through the downwardly inclined grate 42 and escape through the smoke outlet 44.

In the particular form of construction illustrated in Fig. 4, the material is supplied by a feeding screw 45 into the chute 46 for delivery onto the elevated end of a grate 47 made in the form of a descending series of steps, as shown, in order that a layer of material 48 will move downwardly from the front wall 49 of the calcining pot to the rear wall 50 thereof. The hot gases of combustion leave the feeding end of the rotary kiln 51 and enter the pre-heating chamber 52, thence being drawn or sucked downwardly through the relatively thin layer of moving material 48 and through the grate 47 into the chamber 53 therebelow. Said chamber 53 is in communication with an outlet channel 54 for the gases. At the rear end of the calcining pot, the material feeds into a pocket 55 in which a screw conveyer 55*a* operates to transport continuously a certain amount of material from the layer 48 to the elevator or conveyer 56, which in turn carries the material upwardly for delivery into a downwardly and forwardly inclined chute 57 for delivery into the rotary kiln 51. The pocket 55 always holds a definite quantity of material which enters from the moving layer 48 through a prescribed open 55*b*, but the quantity of material passing through the pocket 55 naturally depends upon the speed of the screw 55*a*. These parts are proportioned and regulated so that always a constantly uniform quantity of material will be conveyed by the elevator 56 to the chute 57 for delivery into the kiln. In this construction, the material within the calcining pot, as it travels slowly down the descending grate 47, is spread into a relatively thin layer as shown, so that the surfaces of the moving material are very considerably exposed to the action of the hot gases of combustion. In this form of construction, it is to be understood that the chute or supply pipe 46 will constantly be kept full of material so as to exclude the outside atmosphere without the use of gate valves such as illustrated and described in connection with Figs. 1 and 2.

In all courses the material is preferably fed into the calcining pot in such condition that it will greatly facilitate the passing therethrough of the exhaust gases. For this purpose the material may be formed into bricks or into any suitable shape. Also, if desired, the material may be pre-heated in any customary or approved manner and in granulated form, either a drum or a mixing screw of appropriately approved type being used for handling or mixing the granulated material in this condition.

While I have described my invention as comprising a certain mode of treatment and have illustrated it with the aid of certain selected forms for carrying it into effect, it will be understood that the invention may be variously embodied. It has been sought herein to illustrate only such embodiments as will suffice to exhibit the character of the invention. Reservation is, therefore, made to the right and privilege of changing the form of detail set forth or otherwise altering the arrangement of the parts without departing from he spirit or scope of the invention or the scope of the appended claims.

I claim:—

1. In combination, a rotory kiln, a substantially horizontal feed shaft having one end in communication with the kiln for discharging material thereinto and receiving gas therefrom, separate compartments associated with the opposite end of the feed shaft, one for passing material downwardly into the feed shaft and the other for receiving gas flowing through the feed shaft and material fed into the same, means for withdrawing gas from the gas compartment, means for feeding material into the first named compartment in an amount sufficient to keep the same cross sectionally filled with material, a screw in the feed shaft for moving received material therethrough and into the kiln, and a material stirring device associated with said screw adjacent the discharge end of the feed shaft.

2. In a kiln feeding device, a horizontally disposed feed shaft having an outlet end adapted to be associated with a kiln to discharge material thereinto and to receive the combustion gases therefrom, mechanical means operating in the shaft for feeding material to the outlet end for discharge from the latter, an inlet feed for the shaft, connected thereto from a lateral direction for supplying material to the mechanical means and adapted to supply material to maintain a section of the shaft substantially filled cross-sectionally with a mass of material and during the operation of the mechanical means, and means for maintaining a continuous flow of the combustion gases reversely through the material being fed and the mass cross-sectionally filling the section of the shaft.

3. In a feeding device for kilns adapted to receive the hot gases from the kiln for conditioning the material being fed, a feed shaft adapted to be disposed horizontally and having an outlet end through which to discharge material and receive the gases, a suction chamber associated with the remote end of the shaft, means for drawing the gases from the outlet end to said suction chamber, an inlet feed connected with the shaft from a lateral direction at a point between the outlet end and suction chamber, operating means in the shaft for feeding material from the inlet feed to the outlet end for discharge from the latter and through the gases moving to the suction chamber, said inlet feed being adapted to supply material to maintain a section of the shaft substantially filled cross-sectionally with a mass of material through which the gases are required to pass on their way to the suction chamber.

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