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PROCESS FOR FIRING AND COOLING PARTICULATE SOLIDS

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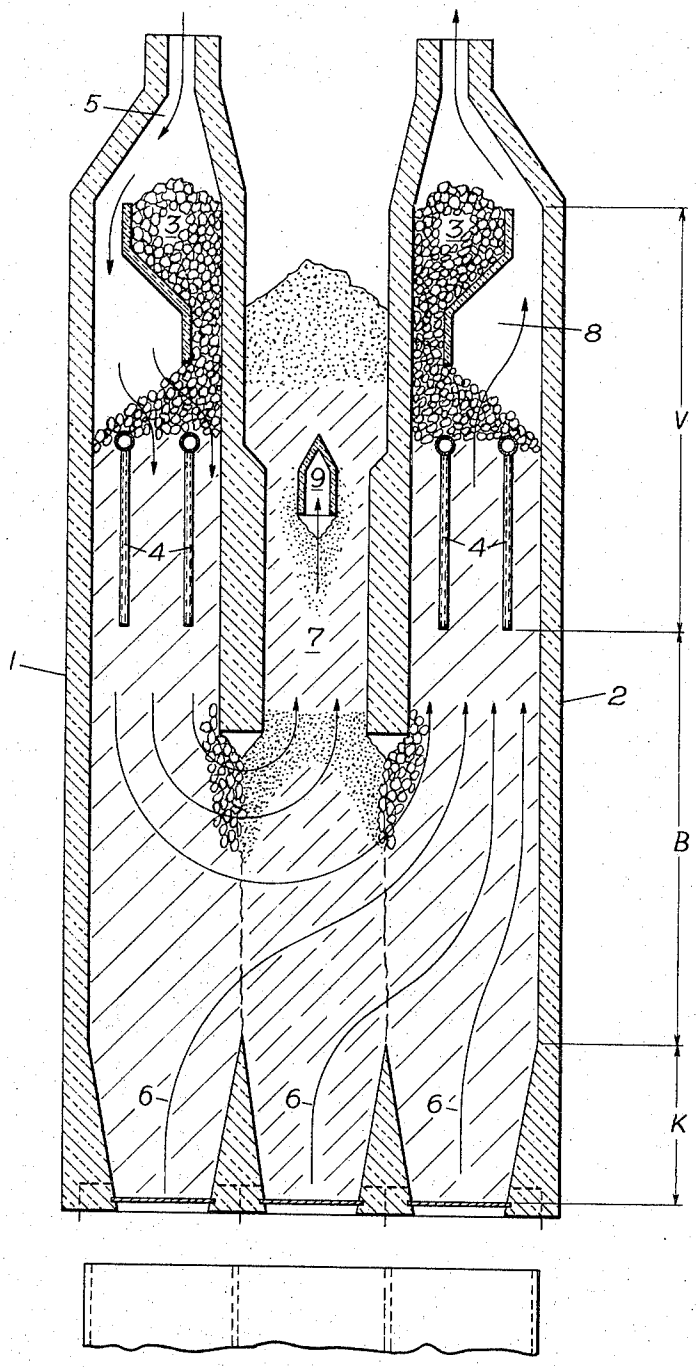

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PROCESS FOR FIRING AND COOLING PARTICULATE SOLIDS

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ABSTRACT OF THE DISCLOSURE

Particulate solids, such as ground limestone, are fired and cooled in a vertical kiln which comprises at least two wells. During firing hot gases pass in periodic alternation through the firing zone of each well in co-current and counter-current flows. Those layers of the piles which are disposed above the firing zone are passed through in periodic alternation by the exhaust gases in one vertical direction and by another heat transfer fluid, such as air, in the other vertical direction.

This invention relates to an improvement in a process of firing and cooling particulate solids, such as ground limestone. This process is carried out in a vertical kiln which comprises at least two wells. During the firing operation, the hot gases pass in periodic alternation through the firing zone of each well in co-current and counter-current flows. Those layers of the piles of material which are disposed above the firing zone are passed through in periodic alternation by the exhaust gases in one vertical direction and by another heat transfer fluid, such as air, in the other vertical direction.

This process may be used, e.g., for firing ground limestone having a certain particle size, which must not vary excessively.

It is an object of the invention to enable the firing of particles within a larger particle size range, e.g., from 10 millimeters to 150 millimeters. According to the invention, this is accomplished essentially in that the material to be fired is divided into two fractions, the coarser one of these fractions, having a particle size range, e.g., of 60–150 mm., being charged together with the fuel to a known vertical kiln system consisting of two wells, which are periodically operated with co-current and counter-current flows, and the fine fraction, having a particle size range of, e.g., 10–60 millimeters, being charged without addition of fuel to a third well, gases being withdrawn from the firing zone of each well of the vertical kiln system containing the coarse fraction and being fed to the other well of said system, secondary air being passed upwardly through the layers disposed below the firing zone, said gases and secondary air being passed in a cross-current flow through the pile formed by the fine fraction, said pile being disposed between the piles formed by the coarse fraction.

Part of the gases may be diverted from the cross-current flow and may be passed upwardly, if desired after throttling, through the pile of material in the third well so that the material of this pile is preheated to the reaction temperature.

The kiln provided according to the invention for carrying out the process comprises in known manner two wells, each of which contains a preheating zone, a firing zone and a cooling zone, said wells being interconnected and having openings for feeding the material to be fired, for withdrawing the fired material, and for feeding the fuel and primary and secondary air, and is characterized in that a further well is provided between the two wells and has openings which communicate with at least part of

the firing zones of the two other wells. The third well may be provided at the lower end of its cooling zone with inlet openings for secondary air, and may be provided in its upper portion with variable outlet openings for the exhaust gases which are passed upwardly in said well.

An illustrative embodiment of the invention will now be explained more fully with reference to the accompanying drawing.

With reference to the drawing, a double-well kiln comprises wells **1** and **2**. Each of these wells comprises a preheating zone V for the material to be fired, a firing zone B and a cooling zone K for the fired material.

The material to be fired having a particle size of 60–150 millimeters is charged to the two wells at **3**, moves through these wells in the form of a pile and is withdrawn in alternation from the lower end of the pile.

In a gas-fired kiln, the fuel gas is supplied with the aid of long pipes **4**, the lower end of which defines the beginning of the firing zone.

The combustion air which is required is also supplied to the top of the wells (arrow **5**), and is heated to the reaction temperature by the preheated material and then supports the combustion of the gas which emerges from the pipes **4**. The combustion gases and any unburnt gas, as well as secondary air, which is supplied from below in a counter-current flow (arrow **6**), emerge laterally from the well **1** and pass in a cross-current flow through the pile of material contained in an intervening well **7** into the well **2**, where they are passed upwardly while the remaining gases are burnt in a counter-current flow. The combustion of these gases results in a fitting of the material in the firing zone and in a preheating of the newly supplied material. The exhaust gases are cooled below 100° C. at the newly fed material and are discharged from this well through a flue **8**.

The process which has been outlined hereinbefore is carried out in known manner in periodic alternation with co-current and counter-current flows (see U.S. Patent 3,074,706), and the change to the next phase is effected when the exhaust gas temperature has become excessive.

Part of the hot gases or exhaust gases are passed upwardly in a counter-current flow in the intermediate well **7** and are withdrawn through a flue **9**. A regulating valve may be provided for regulating the rate at which gases are passed upwardly in counter-current flow in this well **7** so that the preheating of the newly fed fines may be controlled.

Secondary air may be continuously supplied to all three wells from below during the operation.

What is claimed is:

1. A process of firing and cooling particulate solids, which comprises dividing said solids into a coarse fraction and a fine fraction, causing said coarse fraction to descend in the form of first and second coarse-fraction piles disposed one beside, and spaced from the other, causing said fine fraction to descend in the form of a third pile disposed between said coarse-fraction piles, burning fuel in said first and second piles to produce hot gas, passing said hot gas, in periodic alternation, upwardly in one of said coarse-fraction piles and downwardly in the other of said coarse-fraction piles, and then downwardly in said one coarse-fraction pile and upwardly in said other coarse-fraction pile, whereby a preheating zone, a firing zone, and a cooling zone are formed, from top to bottom, in each of said coarse-fraction piles, passing secondary air upwardly in both said coarse-fraction piles below said firing zone thereof, withdrawing gas emerging from said firing zone of said coarse-fraction pile in which gas is passed downwardly, passing said withdrawn gas and secondary air from the same coarse-fraction pile, transversely through said third pile, feeding at least part of said withdrawn gas and secondary air, which have been passed

through said third pile, into that one of said first and second piles in which said hot gas is passed upwardly, and heating said third pile by said withdrawn hot gas passed therethrough and in the absence of a supply of fuel to said third pile.

2. A process as set forth in claim 1, in which said particulate solids comprise ground limestone.

3. A process as set forth in claim 1, in which said particulate solids have a particle size range of 10–150 millimeters.

4. A process as set forth in claim 1, in which said fine fraction has a particle size range between 10 and 60 millimeters.

5. A process as set forth in claim 1, in which part of said withdrawn gas is passed upwardly in said third pile.

6. A process as set forth in claim 5, in which said part of said withdrawn gas is throttled before being passed upwardly in said third pile.

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