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METHOD OF AND APPARATUS FOR TREATING CEMENT AND SIMILAR MATERIALS

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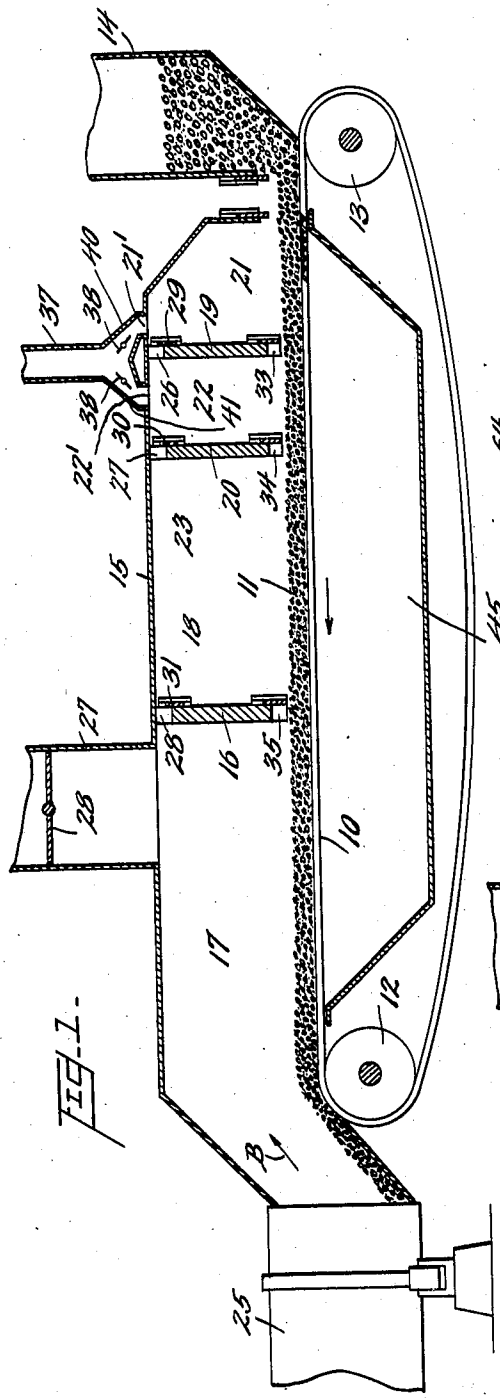


FIG. 1.

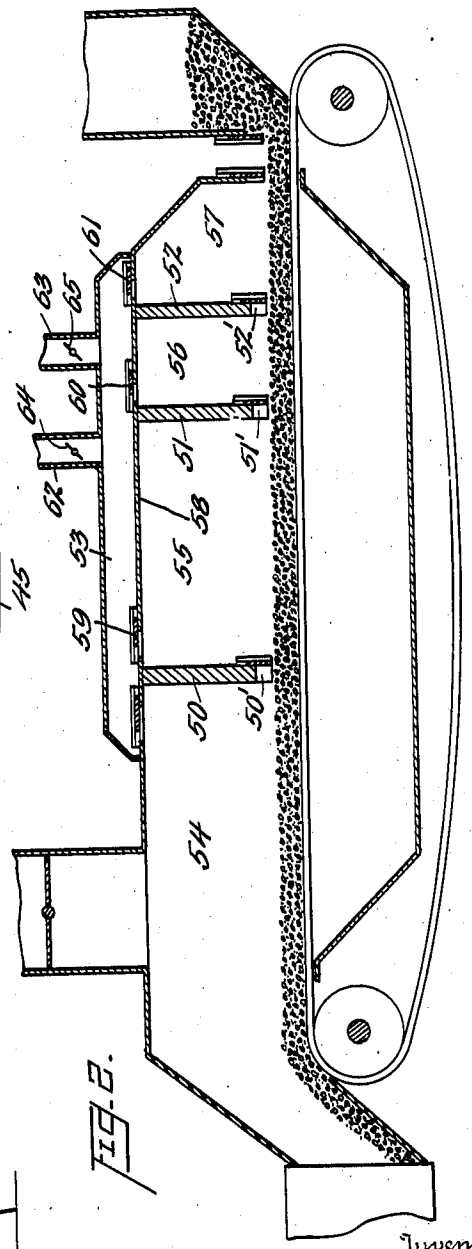


FIG. 2.

Inventor

Franz Schubert,

By Watson, Cole, Grindle & Watson

Attorneys

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METHOD OF AND APPARATUS FOR TREATING CEMENT AND SIMILAR MATERIALS

Franz Schubert, Dessau, Anhalt, Germany, assignor to G. Polysius Aktiengesellschaft, Dessau, Anhalt, Germany, a corporation of Germany

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10 Claims. (Cl. 263—28)

In Letters Patent 1,775,313, issued to Otto Lellep, September 9, 1930, is disclosed an apparatus for and process of manufacturing cement and in Letters Patent 1,992,704, issued to the same inventor February 26, 1935, is disclosed an improvement upon one of the major portions of the mechanism of the first mentioned patent and an improved method of treating cementitious and other materials by the use of such improved apparatus.

The present invention comprises an improvement upon the inventions disclosed in both of the aforementioned patents but it relates more particularly to an improvement upon the apparatus and method which comprise the subject matter of Patent 1,992,704.

In the manufacture of Portland cement, other hydraulic cements, and in the treatment of such materials as limestone, it has been found to be advantageous to subject the raw material to a preliminary treatment prior to introduction of such material into a kiln. Thus, by depositing the material to be burned or sintered in the form of a layer upon a gas pervious supporting structure, such as the upper reach of a travelling grate, and passing hot gases through such material, its temperature may be raised in a rapid manner from room or ordinary temperatures to a relatively high temperature, quite ready for introduction into a kiln in which the final burning operation is to be performed. It is essential, of course, that the raw material undergoing such preliminary treatment shall maintain its granular or lump form while gases are passing through it since, should the lumps disintegrate into dust, the gas passages through the body will be obstructed. This makes it essential to carefully regulate the process of heating in accordance with the characteristics of the material which is undergoing treatment, particularly when the raw material is in the form of nodules or small lumps of cement of the character described in Patent 1,775,313, in order that the lumps or nodules may not be exploded by the too sudden application of highly heated gases. In Patent 1,992,704 it has been suggested that this pretreatment of the raw material may be divided into two stages, a preliminary or drying stage in which gases of relatively low temperature are passed through the lump material until such material is dry, and a final stage in which the already dried material is subjected to the action of a gaseous stream of much higher temperature, resulting in the precalcining or partial burning or sintering of the material.

The object of the present invention is to provide a method and apparatus by means of which the pretreatment of the raw materials may be effected in a more precise and carefully controlled manner than has heretofore been possible, a plurality of streams of gases of different temperatures being successively passed through a body of material undergoing treatment and whereby such body is successively raised in temperature from a cold state to a partially or wholly burned state without being subjected at any time to the action of a stream of gases which is hotter than it should be, having in mind the physical condition of the material undergoing treatment, but which nevertheless greatly facilitates the pretreatment of the material, permits such treatment to be more rapidly carried out, and results in greater economy in the use of fuel consumed in the operation of the process as a whole, including the final burning or sintering step of the process. Thus it is now proposed that a body of lump or nodular material be subjected first to the action of a stream of gases which may be designated a pre-drying stream, and the function of which is to remove the major portion of the water content of the lumps or nodules without, however, greatly raising the temperature of these nodules. Secondly, it is subjected to the action of a gaseous stream having a somewhat higher temperature, sufficiently high to ensure complete removal of all moisture from the body of material but without raising any of it to a calcining temperature. The material is then subjected to the action of a third gaseous stream which is of such temperature as to raise all or portion thereof to what may be designated a precalcining temperature or a temperature in which partial calcination of the material occurs. Finally, highly heated gases are passed through the partially calcined material to burn the material either completely or in part. After this final step of the process has been performed the material is ready to be introduced into a kiln, and is promptly so introduced, the final sintering operation being performed in the kiln. In accordance with the process, therefore, the raw material in lump or nodular form is very carefully raised in temperature in a plurality of successive operations, preferably in four distinct stages, and by controlling the temperatures of the several gaseous streams, and the rate of flow of each through the material, highly improved results are obtainable, both from the standpoint of economy and effective treatment of the material.

In order to carry out the novel method various types of apparatus may be employed. Each embodies a travelling grate the upper reach of which

comprises the gas pervious support for the layer of material undergoing treatment. Positioned above the gas pervious grate are a plurality of chambers, together with means for conducting gases at the desired temperatures and in the desired volumes to the respective chambers, suction means being positioned below the grate to draw the heated gaseous streams downwardly through the body of material. Means is provided for controlling the flow of heated gases and likewise means is also preferably provided for cooling one or more of the gaseous streams prior to the time that it reaches the material undergoing treatment. The means just described may, however, be embodied in apparatus of widely different types and varying greatly in appearance, as will be apparent to one skilled in the art.

In the accompanying drawing two forms of such apparatus are illustrated by way of example:

Figure 1 is a rather diagrammatic showing of a vertical longitudinal section through one form of apparatus; and

Figure 2 is a similar view through a modified form of apparatus.

The gas pervious member which is to serve as a support for the body of granular, lump or nodular material to be treated may conveniently comprise an endless grate such as indicated at 10 in the drawing, which grate is so mounted that its upper reach is horizontally disposed in order to receive and support a layer of such material which is indicated at 11. The grate is mounted upon drums 12 and 13, one or both of which may be driven, in order to advance the grate at the desired speed in the direction of the arrow A shown in Figure 1. A hopper 14 is positioned at one end of the upper reach of the grate, this hopper being designed and intended to receive raw material in bulk and to discharge this material onto the end of the grate at a predetermined rate so that, as the grate is advanced, a layer of nodular material is formed thereon, which layer has a definite thickness.

Supported above the grate is a stationary metallic hood 15, this hood being divided by partitions 16 into a burning chamber 17, or chamber for the reception of gases which are sufficiently high in temperature thereby to at least partially sinter granular material of the type undergoing treatment, and a preparing chamber which is generally indicated at 18, the preparing chamber being in turn divided by means of additional vertically disposed partitions 19 and 20 into three smaller chambers, a pre-drying chamber 21, a drying chamber 22, and a pre-calcining chamber 23, the precalcining chamber 23 being considerably longer than either of the drying chambers 21 and 22. The material intake and gas discharge end of a rotary kiln is indicated at 25 and it will be perceived that this kiln is in communication with the end of an inclined conduit or duct, so that hot gases of combustion issuing from kiln 25 are conducted upwardly, as indicated by the arrow B, into one end of the burning chamber 17.

Leading upwardly from the top or roof of chamber 17 is a stack 27, normally closed by means of a valve 28 after the apparatus has been placed in operation, which damper may be opened when the kiln is first fired to permit the products of combustion from the kiln to pass directly to the atmosphere until such gases are sufficiently hot to perform their intended functions, after which the damper 28 is closed. Partitions 16, 19 and 20 are supported within the hood 15 in any suitable manner and it will be perceived that each partition is provided at its upper end with a notch or aperture, these apertures being indicated at 26, 27 and 28 respectively. The flow of gases through these apertures are controlled by means of manually operable damping devices 29, 30 and 31 respectively. Likewise apertures or ports 33, 34 and 35 are formed in the lower edges of the partitions 19, 20 and 16, respectively, these ports being also damper controlled. An air inlet duct or conduit is indicated at 37 and is shown to have a branched lower end in communication with the two drying chambers 21 and 22, respectively. Dampers for controlling the inflow of air at atmospheric temperature into chambers 21 and 22 are indicated at 38.

Circulation of gases through the apparatus is substantially as follows: Gases flowing upwardly from the kiln, and which are highly heated, flow first into the burning chamber 17. They then flow, in part, through apertures 28 and 35 of partition 16 to the calcining chamber 23. Such gases as reach the pre-calcining chamber 23, and are not drawn downwardly through the material upon the upper reach of the grate 10, will then pass through openings 27 and 34, or either of them, into drying chamber 22 and such gases which pass into this chamber, and are not drawn through the grate 10 and superposed material, will pass through openings 26 and 33 into the pre-drying chamber 21. Each of chambers 21 and 22 has an opening in its top or roof, the openings being indicated at 21' and 22'. These openings register with the lower ends of inclined downtakes 40 and 41, both of which are connected at their upper ends to the vertically disposed duct 37 the upper end of which is open to the atmosphere.

By means of dampers 38 the downflow of air into chambers 21 and 22, respectively, may be carefully regulated so that the temperatures of the gases passing through these chambers may be controlled with accuracy. As has been previously mentioned, suction means, not wholly illustrated, but which includes the upwardly opening trough-like hood 45, is positioned beneath the grate 10, and by establishing a sub-atmospheric pressure in this hood, as by means of a suction fan, gas is drawn downwardly through the layer of material 11, and through the gas pervious grate 10, from each of the chambers above the grate. The temperatures of the gases in these four chambers is carefully regulated by the manipulation of the damper means described so that the first stream of gas to which the raw material is subjected, i. e., the gaseous stream passing downwardly from chamber 21, is of relatively low temperature and adapted to effect only partial drying of the material on the grate passing beneath it, a large proportion of its contained moisture being removed without, however, subjecting the material to such temperature as might cause the development of steam and disintegration of the nodules or steam by explosion. When passing through the next succeeding chamber, i. e., the drying chamber 22, the granular or lump material is subjected to a downwardly penetrating gaseous stream of higher temperature and which will effect complete drying of the material passing beneath this chamber without, however, effecting any actual burning or calcining thereof. Under the next succeeding chamber 23 the material will be considerably raised in temperature and partial calcining is effected. After it passes beneath partition 16 into the

burning chamber 17 the material will be subjected to the action of very hot gases but, by reason of the preparatory treatment which it has received prior to entry into the burning chamber, the very hot gases in that chamber will not, as they pass through the material, tend to destroy its granular and nodular form.

The temperature of the gases within the burning chamber may be quite high, sufficiently high in fact to effect partial burning or sintering of this material, complete burning or sintering of a large part of the material in the chamber being carried out in the event that the grate 10 is not heated to the point of destruction. If special precautions are taken, and another source of highly heated gases is available, the process can be carried out in the absence of a kiln, but in the ordinary case economy is realized by the use of the highly heated exhaust kiln gases. Hence it is desirable to make use of the apparatus in association with a kiln.

In the apparatus shown in Figure 2 of the drawing the same process may be practiced and the arrangement of mechanical elements is essentially the same. In this case, however, the partitions 50, 51 and 52 are not provided with gas ports adjacent their upper edges, although damper controlled ports 50', 51' and 52' are provided in the lower edges thereof, and a gas duct 53 is provided for effecting transfer of gas from the burning chamber 54 to the pre-calcining chamber 55, the drying chamber 56, and the pre-drying chamber 57. Thus each of the four chambers is in communication with the duct 53 through a suitable port in the floor of this duct, this floor conveniently comprising the common roof 58 of all of the gas chambers. A manually operable valve or damper 59 controls the flow of gas downwardly into chamber 55 and similar dampers 60 and 61 control the downward flow of heated gases into the chambers 56 and 57. Downtakes for air from the atmosphere are indicated at 62 and 63 and valves controlling the inflow of air through these ducts are indicated respectively at 64 and 65. By the use of a manifold or duct 53 a somewhat more precise control over the temperatures of the several gaseous streams may be added since the gas which is introduced into the drying chamber 56, for instance, has not previously passed through the pre-calcining chamber 55.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for preparing cementitious and similar materials in lump form for introduction into a kiln comprising in combination, a gas permeable support for a layer of such material, and means for passing gas downwardly through such layer and its support, said means including a plurality of bottomless gas retaining chambers above the said support including separate chambers for gases at drying, pre-calcining and burning temperatures, and means for supplying said chambers respectively with gases at said temperatures.

2. Apparatus for preparing cementitious and similar materials in lump form for introduction into a kiln comprising in combination, a gas permeable support for a layer of such material, and means for passing gas downwardly through such layer and its support, said means including a plurality of bottomless gas retaining chambers above the said support including separate chambers for gases at drying, pre-calcining and burning temperatures, means for supplying one of said chambers with gases at burning temperatures, and means for leading portions of the gases introduced into the burning chamber from said chamber to the pre-calcining and drying chambers respectively.

3. Apparatus for preparing cementitious and similar materials in lump form for introduction into a kiln comprising in combination, a gas permeable support for a layer of such material, and means for passing gas downwardly through such layer and its support, said means including a plurality of bottomless gas retaining chambers above the said support including separate chambers for gases at drying, pre-calcining and burning temperatures, means for supplying one of said chambers with gases at burning temperatures, and means for leading portions of the gases introduced into the burning chamber from said chamber to the pre-calcining and drying chambers respectively, said last mentioned means including gas flow regulating devices, whereby the volume of gas entering the pre-calcining and drying chambers may be controlled.

4. Apparatus for preparing cementitious and similar materials in lump form for introduction into a kiln comprising in combination, a gas permeable support for a layer of such material, and means for passing gas downwardly through such layer and its support, said means including a plurality of bottomless gas retaining chambers above the said support including separate chambers, defined in part by vertically disposed intermediate partitions, for the reception of gases at drying, pre-calcining and burning temperatures, each such partition having a port formed therein and a damper device associated with said port, and means for supplying gases at burning temperatures to one of said chambers, the remaining chambers being supplied with controlled volumes of gas from said first chamber through said ports.

5. Apparatus for preparing cementitious and similar materials in lump form for introduction into a kiln comprising in combination, a gas permeable support for a layer of such material, and means for passing gas downwardly through such layer and its support, said means including a plurality of bottomless gas retaining chambers above the said support including separate chambers, defined in part by vertically disposed intermediate partitions for the reception of gases at drying, pre-calcining and burning temperatures, each such partition having a port formed therein and a damper device associated with said port, means for supplying one of said chambers with gas at burning temperatures, a portion of said gas passing to the preburning chamber through the port in the intermediate wall, and a portion of the preburning gas passing to the drying chamber, and means for introducing controlled volumes of air into the drying chamber.

6. Apparatus for preparing cementitious and similar materials in lump form for introduction into a kiln comprising in combination, a gas permeable support for a layer of such material, a series of downwardly opening gas chambers above the support, means for introducing gas at burning temperatures into the first of said chambers, a duct or conduit leading from said first chamber to the remaining chambers, and means for introducing atmospheric air into said duct.

7. The method of preparing cementitious and similar materials in lump form for introduction into a kiln which comprises, passing successively through a mass of such materials a series of streams of gases of different temperatures, the first being a stream of gas at a relatively low tem-

perature for pre-drying the material, the second being a stream at a higher or drying temperature, the third being at a pre-calcining temperature and the last gaseous stream having a burning temperature.

8. The method of preparing cementitious and similar materials in lump form for introduction into a kiln which comprises dividing a stream of hot kiln gases in smaller streams of different temperatures and passing said streams successively through a body of such lump material, and cooling the first of such streams by introducing atmospheric air thereinto so as to reduce its temperature and to thereby render it effective for pre-drying purposes only.

9. The method of preparing cementitious and similar materials in lump form for introduction into a kiln which comprises dividing a stream of hot kiln gases in smaller streams of different temperatures and passing said streams successively through a body of such lump material, and cooling the first two streams by introducing atmospheric air into them respectively, whereby the first stream is rendered effective only for pre-drying purposes and the second for drying purposes.

10. An apparatus for the heat treatment of materials of all kinds comprising a gas permeable travelling grate, and an elongated chamber above the grate being divided into burning and preparing chambers by a partition or wall, one such chamber being for burning gases and the second chamber being in turn divided into three chambers by additional partitions, for the reception of gases of different temperatures, respectively.

FRANZ SCHUBERT.