METHOD OF BURNING CARBONATES AND APPARATUS THEREFOR

Original Filed Oct. 28, 1931

Inventors:

William E. Moore,
George R. Simpson,
Stone, Boyden, Mack, Aheiu,
McGregor.
This invention relates to the burning of lime and other carbonates, and more particularly to a method of and means for the burning of carbonates and recovering of gaseous by-products therefore.

The primary object of the invention is to provide a method whereby the heat applied to the lime or other carbonate may be uniformly distributed and accurately controlled, so that the insufficient heating of one part of the mass and excessive heating of another may be avoided.

Another object is to devise a method whereby the carbon dioxide resulting from the decomposition of the carbonate may be recovered in substantially pure state, uncontaminated with any products of combustion or with air.

With the above objects in view, the invention comprises the production of the required heat electrically and the application of such heat over a relatively large area. More specifically, the invention contemplates the passing of a travelling column or mass of carbonates over and in actual contact with electrical heating elements in the nature of a resistor or resistors, so that all parts of the mass are subjected to substantially the same heating effect.

In order that metallic resistor elements may be successfully used, we further propose to reduce the temperature necessary for the decomposition of the carbonates by carrying out the process in a closed retort, and maintaining a relatively low pressure in such retort by continuously drawing off therefrom the gaseous products by means of a vacuum pump or the like. By this means, the temperature of decomposition may be kept well within the safe working limits of metallic resistors.

Reducing the temperature of decomposition of the carbonates by lowering the pressure as above mentioned has the additional advantage of more efficient and economical operation, since less energy is required and the heat losses will be smaller.

In order that the invention may be readily understood, reference is had to the accompanying drawing, forming part of this specification, and in which:

Figure 1 is a vertical sectional view through one form of furnace, which may be employed for carrying out the invention; and

Figure 2 is a similar fragmentary view on an enlarged scale showing certain details.

Referring to the drawing in detail, the furnace illustrated therein by way of example comprises an outer shell or casing 1, shown as cylindrical, and supported above the ground, as by means of legs 2. Top and bottom plates or heads 11 and 12 are secured to the cylindrical body 1, as by means of bolts or rivets, a suitable packing 6 being interposed between the parts to make a substantially air tight joint.

The interior of the furnace shell or casing is lined with a heavy wall 3 of refractory insulating material, and at the center of this wall or lining is an annular cylindrical chamber 4, extending the full height of the furnace casing.

Extending downwardly through the center of the annular chamber 4 is a core 5, also of refractory heat insulating material, and around this core is wound a metallic resistor element 7 in the form of a vertically disposed helix, the two ends of the resistor 7 being secured to suitably insulated terminals or binding posts 8 projecting from the top and bottom plates of the furnace.

Conductors for supplying electric current to the resistor are attached to these terminals, and the current may be of any suitable character. It will, of course, be understood that the conductors are associated with regulating apparatus of any suitable kind by means of which the amount of current and hence the temperature of the resistor may be accurately controlled, as desired.

Projecting upwardly from the top of the annular chamber 4 is a feed pipe or conduit 9, surrounded by a closed receiving chamber or hopper 10, this in turn being surrounded by an open top hopper 11, into which the crushed limestone or other material to be treated is delivered. A gate in the form of a bell 12, operated by a handle 13, controls the passage of material from the hopper 11 to the hopper 10, and a gate or bell 14, operated by a handle 15 controls the passage of material from the hopper 10 to the feed pipe 9. One method of mounting the control handles for these bells in the walls of the conduit is shown in Figure 2, in which we have illustrated a swivelled or ball and socket joint 16, by means of which the operating handle, such as 15, may be supported, while at the same time it is capable of free movement so that the bell may be manipulated, as desired.

In order that the material may flow uniformly down through the annular chamber 4, which, it will be seen, is relatively thin, a discharge chute or opening 18 is provided at a point diametrically opposite the feed pipe 9, and the floor or bottom of the chamber is sloped downwardly toward this discharge opening, as indicated at 17. The opening 18 is controlled by means of a bell 19, which governs the flow of material into a closed discharge chamber or hopper 20, and the discharge 21.
of material from this closed hopper into the delivery spout 22 is in turn controlled by a second bell 21.

It will be understood that the arrangement of parts 9 to 14 and 18 to 22, respectively, constitutes in each instance what is known as double bell apparatus, the purpose of which is to permit the passage of solid material, while at the same time substantially preventing flow of air or gas.

In order to reduce the pressure in the furnace chamber 4, and thus enable the decomposition to take place at a lower temperature, and at the same time, to collect and recover the carbon dioxide gas given off, a gas pipe 23 extends from the upper end of the chamber 4 and is preferably provided with a three-way valve 24. This valve, in one position, establishes communication between the furnace chamber and a pipe 25 leading to atmosphere, while in another position, as shown in the drawing, it establishes communication between the furnace chamber and a pipe 26 leading to suitable gas storage apparatus, in which pipe 26 is interposed a rotary or other suitable type of vacuum pump 27. It will thus be clear that when the pump is being operated, and the valve 24 is turned to the position shown in the drawing, the gases will be continuously exhausted from the furnace chamber and a partial vacuum maintained therein.

Suction pipes 28 and 29 are also connected respectively with the closed supply and discharge hoppers 10 and 20, and these pipes are likewise connected to a vacuum pump or other suction producing apparatus, so that any air which may enter the closed hoppers 10 and 20 is removed before it can reach the furnace chamber. In other words, a partial vacuum is also independently maintained in the closed chambers or hoppers 10 and 20, and this relieves the pressure which would otherwise be exerted on gates 14 and 18, and which would cause them to leak more or less. It also tends to cause a flow of carbon dioxide gas from the furnace chamber toward and through these hoppers, thus effectively preventing air from entering the furnace chamber.

Furthermore, the exhaustion of receiving chamber 10 serves to draw off and remove any air which may adhere to or be entrapped in the limestone, before such stone is introduced into the furnace chamber. In this way, the carbon dioxide gas given off from the carbonates and removed from the furnace chamber through the pipe 26 and pump 27 is substantially pure, and is suitable for employment for any purpose for which commercially pure carbon dioxide gas is adapted.

In operation, the resistor 7 is brought to a suitable temperature and the raw carbonates are fed intermittently into the furnace chamber through the hopper 10, while the burned product is intermittently removed through the hopper 20, a column of material being maintained in the furnace chamber 4 and travelling gradually downward therethrough. It will be thus observed that this column or mass of material passes down over and around the helical resistor, and in actual contact therewith, so that all parts of the mass are uniformly heated, and no part is raised to an excessive temperature such as might cause overburning. Moreover, the heat is distributed throughout the height of the entire column, instead of being concentrated at some one point, as has heretofore often been the case with previous types of apparatus.

It is well known that a reduced pressure results in the decomposition of carbonates at a lower temperature than at atmospheric pressure, and we find that it is possible to reduce the pressure within the furnace chamber to such an extent that decomposition will readily take place at a temperature well within the operating limits of metallic resistor elements.

While we have illustrated and described a method in which the carbonates travel over and in actual contact with an electrical heating element, it will be understood that our invention is by no means limited to such an arrangement, since, as will be obvious, the material may travel in proximity to the heating element without actually coming in contact therewith, and may be heated by convection or radiation therefrom.

Furthermore, while we have referred to the use of an electric resistor element, we may, in some cases, prefer to use one or more electric arcs; or we may employ as the heating means a metallic body or core heated by induction.

Finally, although we have illustrated by way of example, a vertically disposed furnace through which the material flows downward by gravity, we likewise contemplate, as falling within the scope of our invention, the rate of decomposition. It may be of a furnace of the horizontal type having means for causing the material to travel therethrough, and also the use of an inclined cylindrical retort of the well known rotary kiln type. In this latter case, the heating elements could be located on the inner walls, or might even take the form of a central axially extending core, positioned as in Fig. 1. While our improved process is particularly useful in the burning of lime, it will, of course, be understood that it is equally applicable to the burning of other carbonates such as those of magnesia and barium.

What we claim is:
1. The method of burning carbonates which comprises bringing the material into direct contact with a metallic electrical resistor in a closed chamber, and maintaining a reduced pressure in said chamber to such a degree that decomposition takes place at a safe operating temperature for such metallic resistor.
2. The method of burning carbonates which comprises introducing the material first into a preliminary closed chamber, subjecting it to the action of a vacuum while in such chamber to remove the air therefrom, then delivering it to a closed furnace chamber, decomposing it by the application of heat while drawing off the carbon dioxide from such furnace chamber, whereby a substantially pure product is obtained.
3. An electric furnace comprising a closed furnace chamber and electrical heating means within the same, a separate closed chamber adapted to receive the material to be treated and communicating with the furnace chamber, substantially air tight gates controlling communication between said receiving chamber and atmosphere, and between said chamber and said furnace chamber, and means for independently drawing off gases from both of said chambers.
4. An electric furnace comprising a closed furnace chamber, and electrical heating means within the same, a separate closed chamber adapted to receive the material to be treated, a second separate closed chamber into which the material from the furnace chamber may be discharged, both said separate chambers communicating with said furnace chamber admitting air tight gates controlling communication between each of said separate receiving and dis-
charge chambers and atmosphere, and between said chambers and the furnace chamber, and means for independently drawing off gases from each of said chambers.

5. The method of burning carbonates which comprises passing the material progressively down through a closed chamber in the form of a column, causing it to travel over and in contact with metallic electrical heating means distributed along the length of the column, and maintaining in said chamber a pressure so low that decomposition takes place at a safe operating temperature for said metallic heating means.

WILLIAM E. MOORE.
GEORGE L. SIMPSON.