Oct. 23, 1928.

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R. W. HYDE

PROCESS OF TREATING EARTHY MINERALS

Filed April 4, 1925

2 Sheets-Sheet 1

Fig 1

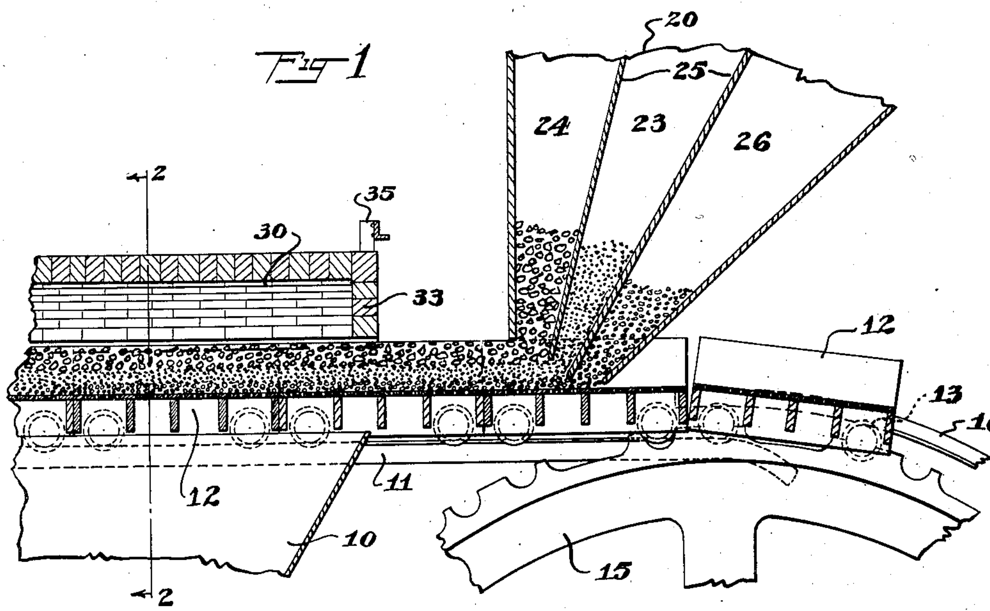


Fig 2

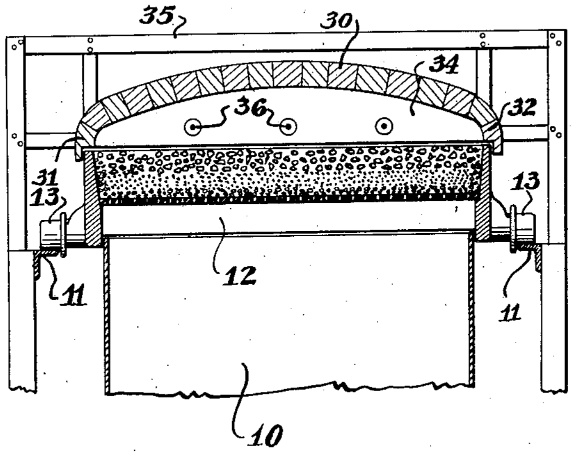


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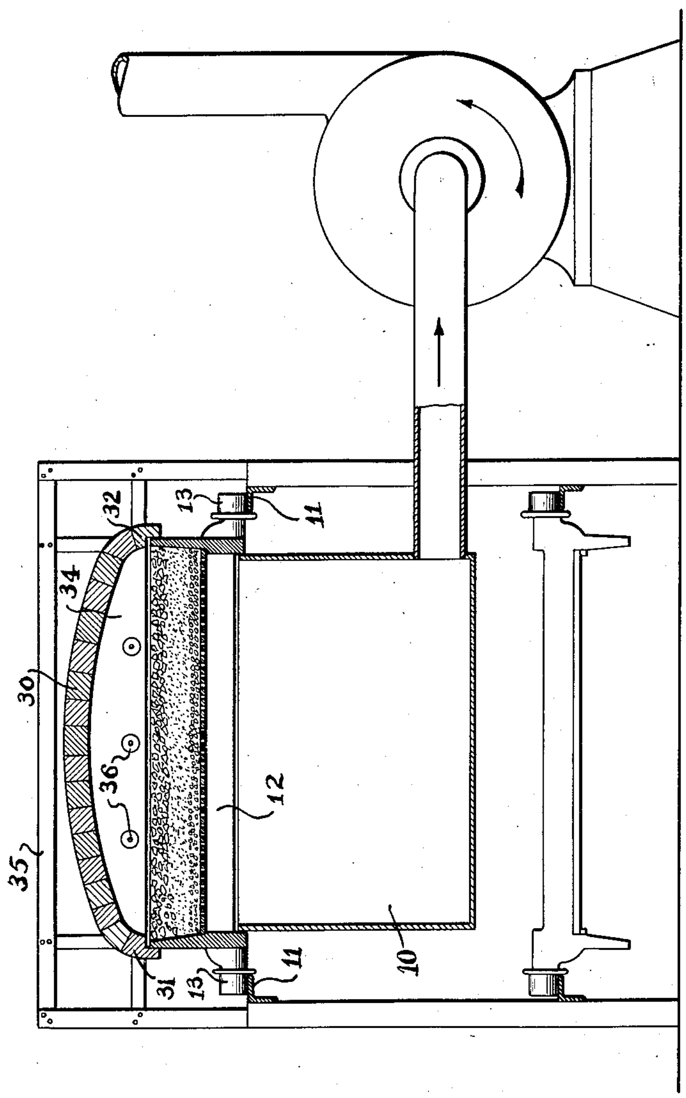
Fig. 3.

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# UNITED STATES PATENT OFFICE.

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## PROCESS OF TREATING EARTHY MINERALS.

Application filed April 4, 1925. Serial No. 20,763.

This invention relates generally to the burning of earthy minerals and particularly to the burning of carbonates, such as lime rock, dolomite and magnesite, in comparatively small masses or units spread in a relatively thin layer upon a support or supports capable of continuous or intermittent movement into and through a heated zone or area whereby carbonic dioxide is removed from such material.

The invention relates especially to the treatment of finely divided material commonly known as fines. The small, relatively minute particles in this grade of material tend to pack into an almost solid and impervious mass. Also this grade of material gives off such large quantities of dust under ordinary methods of treatment as practically to prohibit its economical treatment on a commercial scale by any of the methods heretofore known. In a shaft furnace for example there is constant downward movement of the material through the stack and if fines are present in the charge they pack and choke the draft through the stack. The heavy draft that is necessary to carry away the carbonic acid and products of combustion through a high column stack makes excessive quantities of dust if fines are fed. The sustained heat also causes the fines to burn or to fuse and glaze which destroys the commercial value of the resulting product. For these reasons high column shafts are limited to the calcination of 2½″ or 3″ stone. In a rotary kiln, for example, where the stone is constantly agitated, the use of fines likewise causes excessive quantities of dust and interferences with the proper working of the apparatus and the quality of the product so that this apparatus is limited commercially to the calcination of larger than three-quarter inch stone.

The invention further consists in securing a product of uniform grade from particles of different size within a definite time limit. In treating a mixture of particles that vary considerably in size, if the smaller particles are subjected to the same temperature for the period required to produce a desirable product from the larger particles, the quality of the smaller particles will be impaired or destroyed. Therefore, I propose to arrange the particles in strata so that the larger particles will be on top and the finer particles at the bottom of the layer. Gases of combustion from a burner, grate or other source of heat are caused to play upon the surface of the layer and these gases are drawn through the layer by forced or natural draft. Since the finer particles are near the bottom of the layer they are insulated to an extent from the heat and as the larger particles are subjected to the gases of combustion for a longer period they burn to the same degree as the finer particles notwithstanding their larger volume, whereby a uniform product is produced.

In practicing my invention the small particles which may vary in size from dust particles up to particles which will pass through a one-half or three-quarter inch mesh screen are spread in a layer of uniform thickness and permeability upon a porous support. Preferably, a series of such supports are provided capable of continuous or intermittent movement. The individual particles comprising the layer of material being treated remain motionless, however, relative to each other and to the support. Preferably the particles are insulated from contact with the metal portions of the support by interposing a lining of heat insulating material, such as burnt lime, to avoid under burning of the particles adjacent to the metal. Each support with its layer of material is brought successively within a zone of combustion at or above the dissociation temperature of the carbonate and below the temperature of incipient fusion of the particles and a forced draft is maintained to draw these products of combustion through the layer at a rate sufficient to remove the carbonic dioxide as rapidly as dissociated from the material. This increases the speed of calcination and prevents reversal of the reaction which may occur in the presence of an excess of carbon dioxide. If the particles comprising the mass or layer are of unequal size they are preferably graded so that the finer particles will be near the bottom of the layer and the top surface of the layer will be formed of larger particles up to one-half inch or three-quarter inch to equalize the rate of burning and produce a finished product of uniform grade.

In the accompanying drawing I have indicated diagrammatically one form of apparatus suitable for carrying out mv invention but it will be understood that various other forms of apparatus may be employed.

Referring to the drawing:

Figure 1 is a central, longitudinal section of so much of a calcining machine as is necessary to an understanding of the invention, and by means of which the invention may be practiced;

Figure 2 is a section on the line 2—2 of Figure 1; and

Fig. 3 is a longitudinal section of a sintering machine showing the suction fan.

Referring to Figure 1 there is shown an air or wind box 10 suitably supported in any well known manner and connected by suitable piping to the usual suction fan. A track comprising a pair of spaced rails 11, 11 or flanges extends longitudinally alongside the wind box, which as shown are affixed to the outer walls of the wind box 10, but which it is understood may be supported independently of the wind box or in any other manner as may be desired. The track 11 constitutes a fixed support for movable charge carriers or pallets such as 12. The pallets are preferably alike in construction and each consists of a pervious support for charge carriers and having wheels 13 to support the same on the track 11. The pallets are capable of being moved continuously or intermittently.

For imparting motion to the support or carrier, there may be provided a pair of sprocket wheels, such as the sprocket 15 having peripheral teeth to engage the wheels of the cars of pallets 12. The sprockets 15 serve to push the cars in an end to end series or train along the track 11, and also to elevate them to the track. Fixed curved guides, such as guide 16, partially encircle the sprockets 15 and assist in holding the pallets in engagement therewith while being elevated.

For filling the pallets 12 after having been elevated to the track 11 there may be provided a hopper 20 having sections of any desired number, three being shown by way of example.

The lower end of the hopper 20 is in alinement with the sides of the pallets 12. The interior is divided vertically into compartments 23, 24 and 26 by partitions such as the partitions 25. By providing each compartment with material of different size, it is evident that the pallets can be charged with material arranged in strata and that the charging operation proceeds automatically with the movement of the pallets along the track. When it is desired to arrange the finer particles on the bottom and the larger particles at the top, the fines are placed in the compartment 23 towards the right of Figure 1 and the larger particles in the compartment 24 toward the left. It is evident that any desired number of layers of various sized materials may be placed continuously on the pallets. The compartment 26 may be provided to hold burnt lime for covering the grates prior to receiving the charge but it may be omitted if desired. Over the track 11 traversed by the pallets 12 after having been filed, there is positioned a reverberatory arch 30 having opposed side walls 31 and 32 in close proximity to the upper edges of the pallets, and having end walls 33, 34 in similar alinement. The reverberatory arch may be supported in any suitable manner, as by brackets such as 35, and is constructed of refractory material of conventional type. In the rear end wall 34 there is provided a plurality of burners or grates such as 36, or other source of heat for applying heat to the charge on the pallets.

Calcination may be said to take place in two stages, a preliminary heating to raise the temperature of the particles of limestone to the calcining or burning point (approximately 850° C. for high calcium stone) and second, maintenance of the temperature at or above the burning point for such a period of time as may be necessary to eliminate carbon dioxide completely from the particle. It is well known that, other conditions being the same, the time required to calcine a given material depends on the size of the individual particles, the larger pieces requiring a longer time.

In the herein described process of calcining material such as limestone, for example, the pallets having been charged while passing under the hoppers as hereinbefore described, are propelled forward into and through the space (herein called the heating chamber) under the arch or roof. Highly heated combustion gases from the burners fill this space and, under the suction induced by the fan, pass down through the charge into the wind box and out through the fan, transferring heat to the relatively colder particles of charge during the passage. The hot combustion gases as they are drawn down through the bed first come in contact with the larger particles of stone which form the upper layers of the bed as hereinbefore described and give up large portions of their heat to them. The partially cooled gases then contact with the finer particles below and give up further amounts of heat to them. Consequently, the larger particles are first brought to dissociation temperature and are partially calcined before dissociation of the finer particles commences.

Once heated to calcining temperature, the limestone is maintained at the burning point by the continued passage through the bed of the combustion gases until dissociation is complete and the carbonate is entirely converted to oxide, the carbon dioxide being withdrawn in the stream of spent gases. In that portion of the combustion chamber near the head end of the arch 33 preheating mainly is accomplished, while in the portion nearer the burners the stone is calcined. Of course, these preheating and calcining zones, as they may be called, overlap, so that no sharp line of distinction need be drawn between them.

Thus, by charging the larger particles of stone into the upper portion of the bed and the smaller particles below, the larger particles are preheated first and are kept at dissociation temperature for the longer period of time that they require, although all of the charge actually remains in the heating chamber the same length of time. The temperature and volume of the combustion gases may be regulated to the necessary extent by adjusting the burners in well known ways. Preferably, the material is heated to a temperature above the dissociation point (which varies with different material, being approximately 850° C. for high calcium limestone) but below the fusing or overburning point. After having been calcined, the material is passed out and discharged from the pallets in the conventional manner.

It will be seen that during the treatment the finely divided particles of material have not been mechanically disturbed, but have been maintained on the pallets without agitation or displacement. The fines have been protected from direct application of heat by the larger particles over them, and the larger particles have been exposed to the high temperature for the longer period of time which they need in order to obtain a product of uniform character and quality throughout.

The utilization of fines makes profitable the disposal of the smaller sizes of limestone, dolomite and magnesite, which are being produced in constantly increasing quantity due to modern methods of blasting and the use of crushers in the quarries. With prior methods of treatment the amount of small stone which could be utilized is only a small fraction of the total output of small stone from the average quarry.

Although I have set forth and described one process for producing my improved production, it is obvious that various changes may be made in the process or in the separate steps thereof without modifying or changing the essential features and characteristics of the product produced and that such product remains substantially the same, although slight modifications may be made in its appearance, texture and in its physical and chemical characteristics.

Having thus described my invention I claim:

1. The continuous process of calcining finely divided alkaline earth carbonate material out of direct contact with solid fuel which consists in arranging said material in a pervious moving layer in which the coarser particles are superimposed upon the finer particles, continuously passing currents of heated gases down through the entire portion of the layer undergoing calcination, whereby the heated gases are caused to contact with the coarser particles before the finer particles and the entire layer is heated to a temperature above the dissociation temperature of the carbonate and below the fusion temperature of the material to calcine the carbonate.

2. The continuous process of calcining alkaline earth carbonate material which consists in arranging the material on a moving support in a relatively thin pervious layer, exposing the entire upper surface of such layer undergoing calcination simultaneously to highly heated gases, passing said gases through said layer, thereby to heat the entire layer to a temperature above the dissociation temperature of the carbonate and to maintain a temperature above the dissociation point of said carbonate until the material is calcined.

3. The continuous process of burning alkaline earth carbonate material out of direct contact with solid fuel which consists in arranging the material on a moving support in a relatively thin layer, uniform as to thickness and permeability and in which the coarser particles are superposed on the finer particles, insulating the layer from its support by a pervious layer of heat insulating material, exposing the entire upper surface of the first mentioned layer undergoing calcination to heated gases, passing said gases through the said layers to heat the entire carbonate layer to a temperature above the dissociation temperature of the carbonate and to maintain the temperature above the dissociation point of said carbonate until the material is calcined.

4. The continuous process of burning untreated limerock fines comprising particles less than ¾″ in diameter to produce a caustic lime, which consists in arranging the material, without admixture of fuel, in a continuous pervious layer of approximately uniform depth on a moving support, causing heated gases of combustion to pass through the entire layer undergoing calcination, thereby to raise the temperature of the particles up to a point above the dissociation temperature of the carbonate and to maintain the temperature above the dissociation point and below the fusion point of the material until substantially all of the carbonic acid gas has been dissociated from the material.

5. The continuous process of treating limerock fines comprising particles less than ¾″ in diameter to produce caustic lime, which consists in charging the fines on perforate bottom moving supports in pervious layers according to the size of the particles, with the finer particles covered by the coarser particles, passing heated gases above the entire surface of the upper layer and through the layers to heat the particles to a temperature above the dissociation point of the carbonate

but below the fusion temperature of the material until substantially all of the carbonic acid gas has been dissociated therefrom.

6. The process of calcining fine particles alkaline earth carbonate material comprising particles less than ¾″ in diameter to drive off carbonic acid gas and to produce the oxide, which consists in placing the fine particles in a pervious moving layer without admixture of solid combustible constituents, and causing a body of heated gases to pass through the entire layer, thereby to heat the particles to a temperature above the dissociation temperature of the carbonate but below the fusion temperature of the particles until the carbonic acid gas has been expelled.

7. The continuous process of calcining finely divided alkaline earth carbonate material, which consists in arranging said material above a pervious layer of heat insulating material in a pervious moving layer in which the coarser particles are superimposed upon the finer particles, continuously passing currents of heated gases down through the entire portion of the layer undergoing calcination, whereby the heated gases are caused to contact with the coarser particles before the finer particles and the entire layer is heated to a temperature above the dissociation temperature of the carbonate and below the fusion temperature of the material to calcine the carbonate.

In testimony whereof I have hereunto set my hand.

REED W. HYDE.