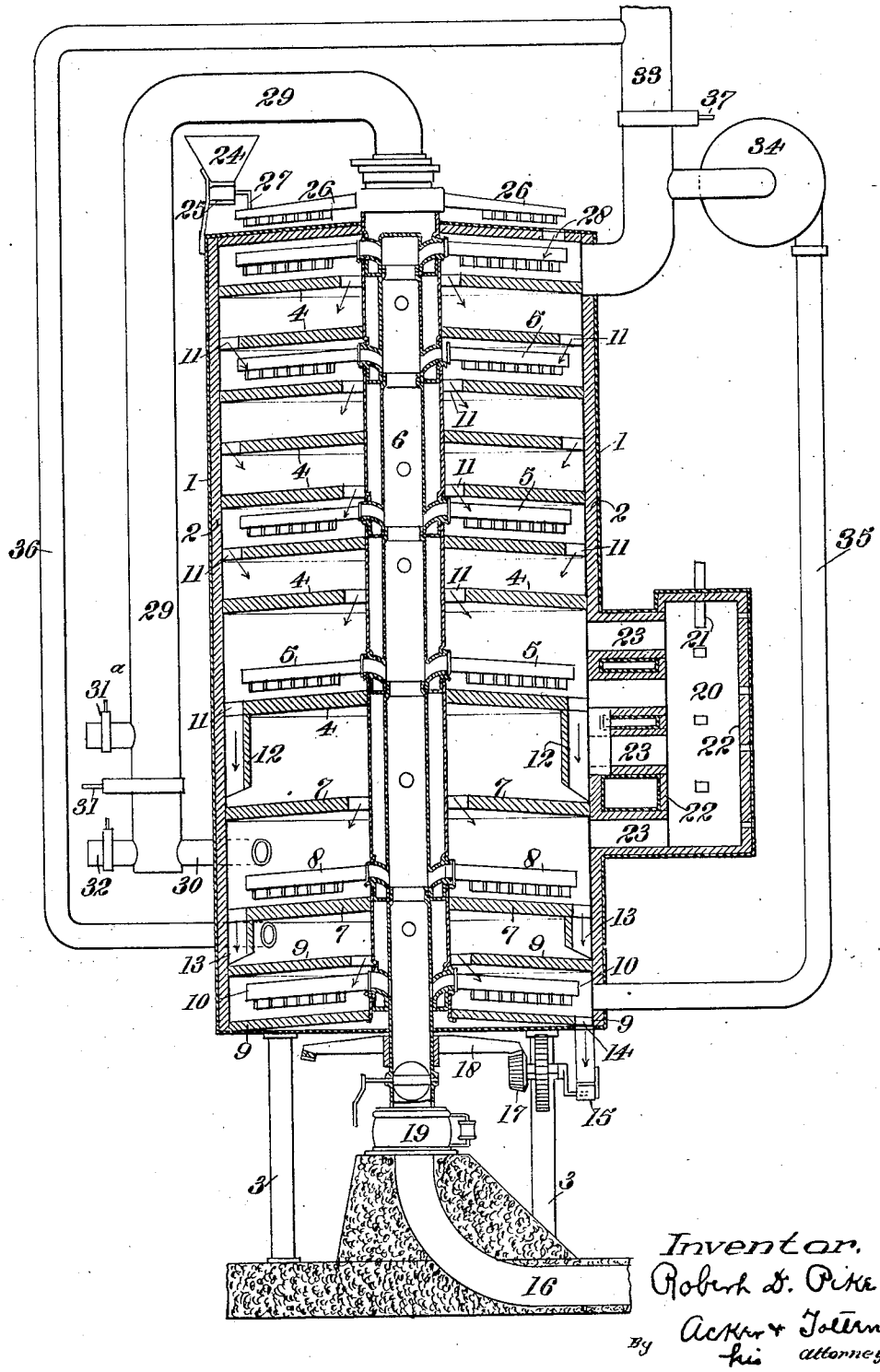
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CALCINING AND RECARBONATING APPARATUS

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UNITED STATES PATENT OFFICE.

ROBERT D. PIKE, OF SAN FRANCISCO, CALIFORNIA.

CALCINING AND RECARBONATING APPARATUS.

Application filed November 1, 1921. Serial No. 512,131.

To all whom it may concern:

Be it known that I, ROBERT D. PIKE, a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Calcining and Recarbonating Apparatus, of which the following is a specification.

The hereinafter described invention relates to an apparatus for the carrying out of the method invention for the treatment of magnesite and dolomite set forth and described in my pending application Serial Number 438,662, filed in the United States Patent Office under date of January 20, 1921, for method of treating magnesite; the object of the present invention being to provide a furnace wherein magnesite and dolomite may be calcined and recarbonated as a single operation, the recarbonization of the calcined material during its passage through the apparatus being for the purpose of reducing the free or water soluble lime contained therein to a minimum per cent or a negligible quantity in the use of said material for the manufacture therefrom of oxychloride cement, mortars and concretes, while at the same time producing an apparatus simple of construction, inexpensive as to manufacture, efficient and durable in operation.

The advantages derived from the treatment of magnesite and dolomite for the elimination or reduction of its free or water soluble lime content is fully set forth and described in my said pending application Serial Number 438,662, and need not be set forth in detail herein.

The apparatus in general, so far as relates to the calcining feature thereof, is substantially the same in structural arrangement as the apparatus set forth and described in my pending application Serial Number 460,979, filed in the United States Patent Office under date of April 13, 1921 for United States Letters Patent for an improved ore roasting furnace, and to which application specific reference is hereto made.

In order to comprehend the invention reference should be had to the accompanying sheet of drawing, wherein the calcining and recarbonating furnace is illustrated in vertical section.

In the drawing the numeral 1 is used to designate a suitable metallic outer shell provided with an interior lining 2 of refractory material, the said outer shell being suitably supported by the uprights 3. The said shell is preferably circular in cross section and interiorly provided with a plurality of furnace hearths 4, over each of which works a series of rabble arms 5. The said rabble arms 5 are of hollow construction and project radially from a centrally disposed hollow rotating column 6. Each rabble arm communicates with the interior chamber of the central column, the air admitted into the said column passing therefrom into and through one passage-way of the hollow rabble arms 5 for cooling purposes and air returning to the outer annular chamber of the centrally disposed rotating column, said column being formed of the two concentrically disposed shells or members held in spaced relation. The hearths 4 are arranged in staggered relation, so that the material traveling downwardly through the calcining furnace moves in a zigzag path of travel.

Located within the furnace and situated below the lowermost furnace hearth 4 are arranged the cooling hearths 7 and associated with each cooling hearth is arranged a series of rabble arms 8, only one of such series being disclosed in the drawing, and below the lowermost cooling hearth 7 is located two hearths 9, and associated with each of said hearths 9 is arranged a series of rabble arms 10, only one series of said rabble arms being illustrated.

The construction of the respective hearths within the furnace is such that the outlets 11 thereof for the material undergoing treatment are so arranged as to cause the material to pass through the apparatus in a staggered or zig-zag path of travel, as set forth in my said pending application Serial Number 460,979, there being a sealed communication 12 between the lowermost furnace hearth 4 and the uppermost of the cooling hearths 7, and through a similar seal 13 the material passes from the lowermost cooling hearth onto the uppermost of the hearths 9, while the material escapes from the lowermost hearth 9 through the outlet 14, the escape therefrom being controlled by any suitable form of discharge gate 15.

As in my former application Serial Number 460,979, air is admitted to the central

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rotating column 6 by means of the air inlet pipe 16 and the said central supporting column for the rabble arms of the respective hearths is driven from a drive pinion 17 which intermeshes with a gear 18 secured to the lower projecting end portion of the central supporting column 6, said central supporting column being connected with the air inlet pipe 16 by means of the running joint 19.

Equally spaced around the furnace and at the outside thereof are arranged the vertically disposed fire boxes 20, only one of said boxes being disclosed in the drawing, and said box is provided with a hydrocarbon burner 21 projected therein, the interior of the fire box being lined with refractory material 22. The products of combustion from the fire box pass into the furnace over certain of the hearths therein through the horizontally disposed ports 23.

The charge of material to be treated and fed into the apparatus is in more or less of a pulverulent form and is delivered into the furnace from the feed hopper 24 by means of an automatic feeder 25, of any suitable form, and which is acted upon intermittently by the rabble arms 26, which trips the lever extension 27 of the automatic feeder for delivering the material to be treated onto the upper surface of the furnace and from which the same is swept by the movement of the rabble arms 26 into the furnace through the ore inlet opening 28.

The air circulating upwardly within the furnace escapes therefrom through the downwardly extended pipe 29, which at its lower end communicates with an air inlet pipe 30 extended into the furnace above the lowermost of the cooling hearths 7, and such air is utilized for maintaining cool said cooling hearths. The pipe 29 is provided adjacent its lower end with a controlling damper 31 in order that the flow of air through the said pipe toward the cooling hearths may be regulated as desired, and above the damper 31 is provided a relief valve 31^a. The air inlet pipe 30 is also provided with a valved controlled inlet 32 through which air from the outside atmosphere may be admitted directly to the pipe 30. By manipulating the damper 31, the relief valve 31^a and the air inlet valve 32, the proportion of the hot air and cold air admitted to the cooling hearths may be properly regulated or controlled. For the re-carbonation of the calcined material discharged from the cooling hearths onto the recarbonating hearths, a portion of the stack gases are withdrawn from the outlet stack 33 by means of a suction fan 34, from the suction chamber of which is extended the pipe 35, connected at its lower end with the furnace for discharge of such gases above the lowermost of the recarbonating hearths 9.

The CO_2 contained in the flue gas thus admitted into the furnace above the recarbonating hearth attacks the free or water soluble lime (CaO) of the magnesite or dolomite under treatment and converts it into carbonate and renders the same substantially insoluble in water, so that the resulting product discharged from the apparatus has a minimum per cent or a negligible quantity of soluble lime therein and a uniform standard product is the result, so that the calcined magnesite or dolomite discharged from the outlet 14 of the furnace is practically free of soluble lime and this regardless of the lime which may have been present in the material when delivered into the furnace or kiln for treatment.

As is well known in the treatment of the crude or raw material, the same is subjected to a heating temperature of approximately 800° to 950° C., and in the present case the same leaves the furnace or kiln structure as calcined magnesite or dolomite containing the soluble lime converted into a carbonate. The flue gases withdrawn from the outlet stack and discharged into the furnace above the lower recarbonating hearth for the conversion of the soluble lime content of the material into insoluble lime makes its escape from within the furnace from above the uppermost of the recarbonating hearths through the outlet pipe 36, which extends upwardly and communicates with the outlet stack 33 at a point beyond the point from which they were originally taken, and in order that the amount of the withdrawal of the flue stack may be regulated, the outlet stack is provided with a controlling damper 37.

The material undergoing treatment is calcined during the flow thereof over the furnace hearths 4 and is cooled as calcined material as conveyed over the hearths 7, the recarbonation of the calcined material taking place as the same is moved over the recarbonating hearths 9, and at which point within the furnace the calcined material is subjected to the counter-flowing stream of the flue gases discharged therein and above the lowermost of the recarbonating hearths by the suction fan 34.

The quantity of stack gas to be supplied to the recarbonating hearths will vary with the percentage of free lime in the freshly calcined and cooled material and this in turn will depend upon the nature of the crude rock and the degree of calcination necessary, to put the magnesite into the best condition for the manufacture of oxychloride cements. In some cases as much as 50% of the total stack gases will be returned to the recarbonating hearths. Suitable means are provided for varying the quantity so that it will be just sufficient in any given case to get a free or water soluble lime content in the material

discharging from the lowermost hearth of the furnace of not more than .5%. This material after being cooled and ground is ready for the manufacture of oxychloride cements without further treatment.

This invention provides an apparatus which will receive magnesite high in content of calcium carbonate and dolomites and will discharge a finished product which after cooling and grinding may be used for the manufacture of high grade oxychloride cements, mortars and plasters. Such an apparatus will lead to economy and convenience of control in carrying out the combined process of calcination and recarbonation.

A preferred embodiment of an apparatus for the carrying out of the invention has been shown and described, but I do not wish to be understood as restricting the invention to such detailed constructed apparatus, for the invention resides broadly in an apparatus provided with primary means for the calcination of the material to be treated, secondary means for cooling the calcined material, and associated means for receiving and subjecting the cooled calcined material to a flowing body of flue gases for the recarbonation of said material for the conversion of its soluble lime contents to insoluble lime.

In the illustrated and described apparatus, that portion occupied by the furnace hearths 4 constitutes the zone of calcination; the portion occupied by the hearths 7, the zone of cooling, while the portion occupied by the hearths 9 constitutes the zone of recarbonation. Preferably, these three zones are embodied in a single structural device, but if so desired three associated units may be utilized as disclosed in my pending application Serial Number 438,662, filed in the United States Patent Office under date of January 20, 1921 for method of treating magnesite.

Having thus described my invention what I claim as new and desire to protect by Letters Patent is:—

1. An apparatus for calcining and recarbonating magnesite and dolomite, the same comprising means for receiving and calcining the material to be treated, means associated therewith for receiving and cooling the calcined material, and recarbonating means for receiving and subjecting the said cooled calcined material to the action of a flowing body of stack gases.

2. An apparatus for calcining and recarbonating magnesite and dolomite, the same comprising a furnace provided with an outlet stack for the escape of gases, means within the furnace for receiving and calcining material to be treated, cooling means for receiving the calcined material, recarbonating hearths situated below the cooling means, and means for withdrawing a portion of the flue gases and discharging the same for intermixing with the cooled calcined material flowing over the recarbonating hearths.

3. An apparatus for calcining and recarbonating magnesite and dolomite, the same comprising a furnace provided with an outlet stack and having its interior provided with a plurality of calcining hearths, a plurality of cooling hearths situated beneath the calcining hearths, recarbonating hearths arranged beneath the cooling hearths, a controlled air supply pipe for admitting air into the furnace adjacent the cooling hearths, rotary means within the furnace for advancing material therein over the respective hearths, and means for withdrawing gases from the furnace stack and discharging the same into the furnace adjacent the recarbonating hearths.

4. An apparatus for calcining material to be treated, the same comprising a closed heating structure provided with a fire box and an outlet stack for the products of combustion, means within the structure for receiving and propelling material to be treated therethrough, a pipe connection between the outlet stack and the bottom portion of said structure, and means introduced within said connection for withdrawing a portion of the gases flowing through the outlet stack and forcing the same into the closed structure through said pipe connection, said products of combustion adapted to circulate upwardly within the apparatus without passing through the fire box.

5. An apparatus for calcining and recarbonating magnesite and dolomite, the same comprising a closed structure provided with an outlet stack and divided interiorly into calcining, cooling and recarbonation zones, rotary means for conveying material successively through said zones, and means for withdrawing from the outlet stack a portion of the gases flowing therethrough and discharging the same into the re-carbonation zone of the apparatus for intermixing with the calcined material conveyed therethrough.

6. An apparatus for calcining and recarbonating magnesite and dolomite, the same comprising associated calcining, cooling and recarbonating elements, devices for progressively advancing material for treatment over said elements, and means for discharging a gaseous body containing CO_2 onto the calcined material for intermixing therewith as advanced over the recarbonating element of the apparatus for converting the soluble lime contents thereof into insoluble lime.

7. In an apparatus for calcining, cooling and recarbonating magnesite and dolomite for the purpose described, the combination with mechanism for advancing material to be treated therethrough, of devices for withdrawing a portion of the stack gases of the

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apparatus and discharging the same for intermingling with the cooled calcined material for converting the soluble lime contents thereof to insoluble lime, and means for leading said gases from the furnace.

8. In an apparatus for calcining, cooling and recarbonating magnesite and dolomite, the same comprising a closed structure, mechanism therein for advancing material to be treated therethrough, means for admitting air into the structure at a given point for the cooling of the calcined material passing therethrough, devices for supplying a gaseous body containing CO_2 into the structure for intermingling with the cooled calcined material for converting the soluble lime contents thereof to insoluble lime, and means for leading said gas from the structure.

In testimony whereof I have signed my name to this specification.

ROBERT D. PIKE.

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