July 31, 1934. H. M. ROBERTSON 1,968,775

RETORT

Filed June 9, 1931 3 Sheets-Sheet 1

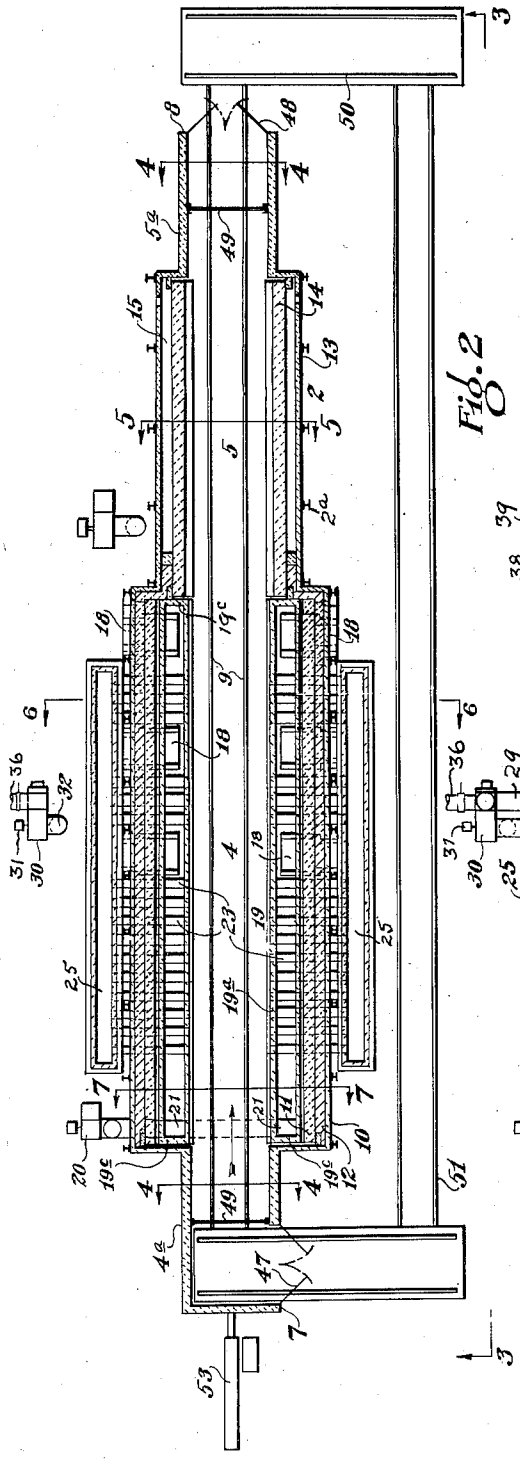


Fig. 2

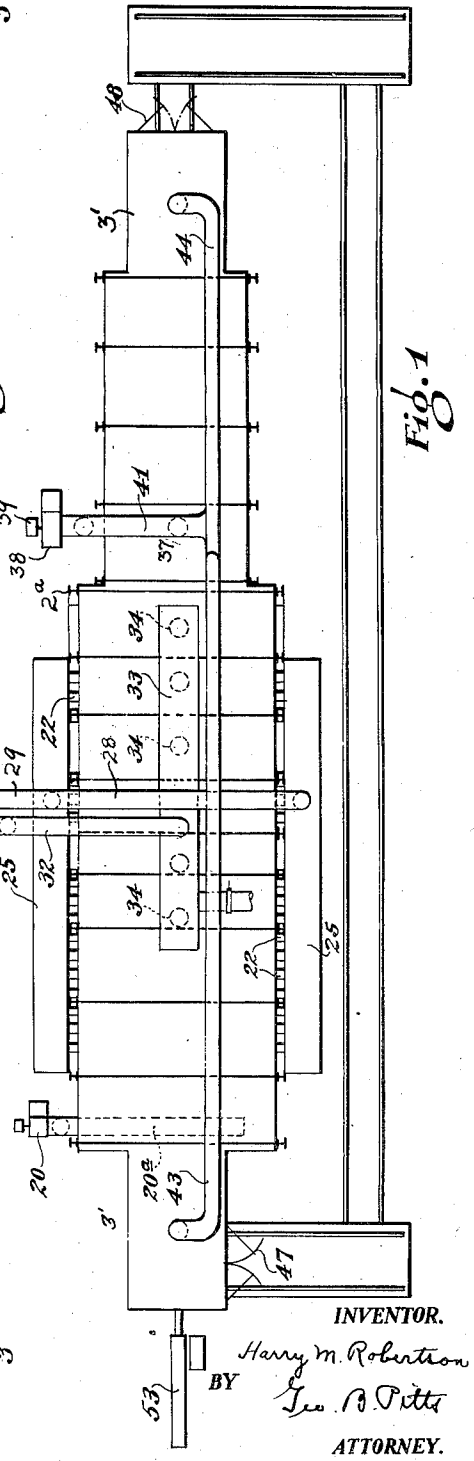


Fig. 1

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RETORT

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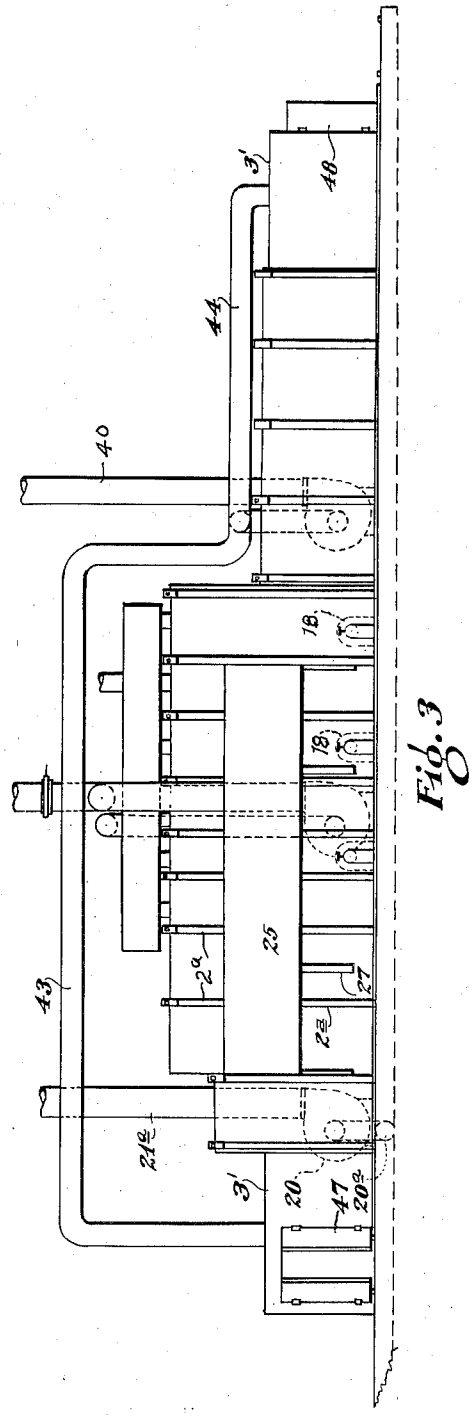


Fig. 3

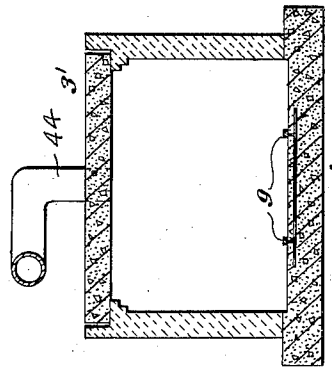


Fig. 4

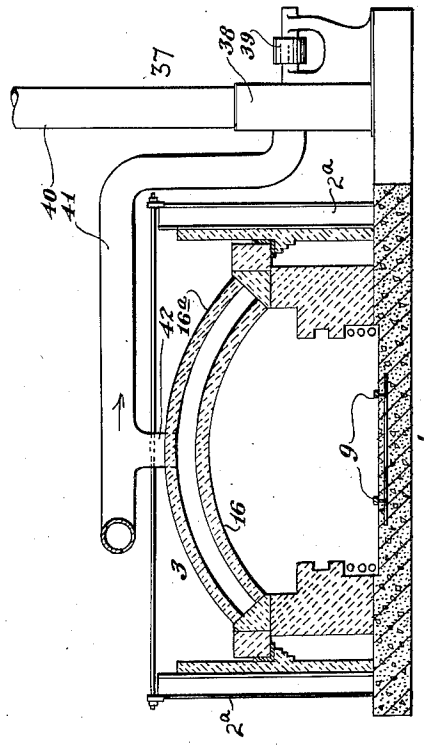


Fig. 5

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RETORT

Filed June 9, 1931 3 Sheets-Sheet 3

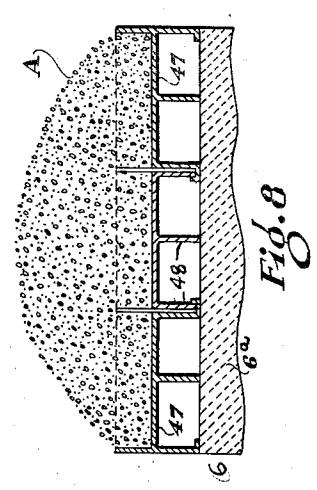


Fig. 8

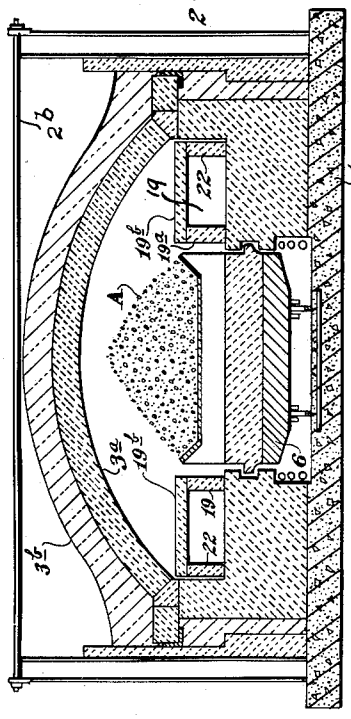


Fig. 7

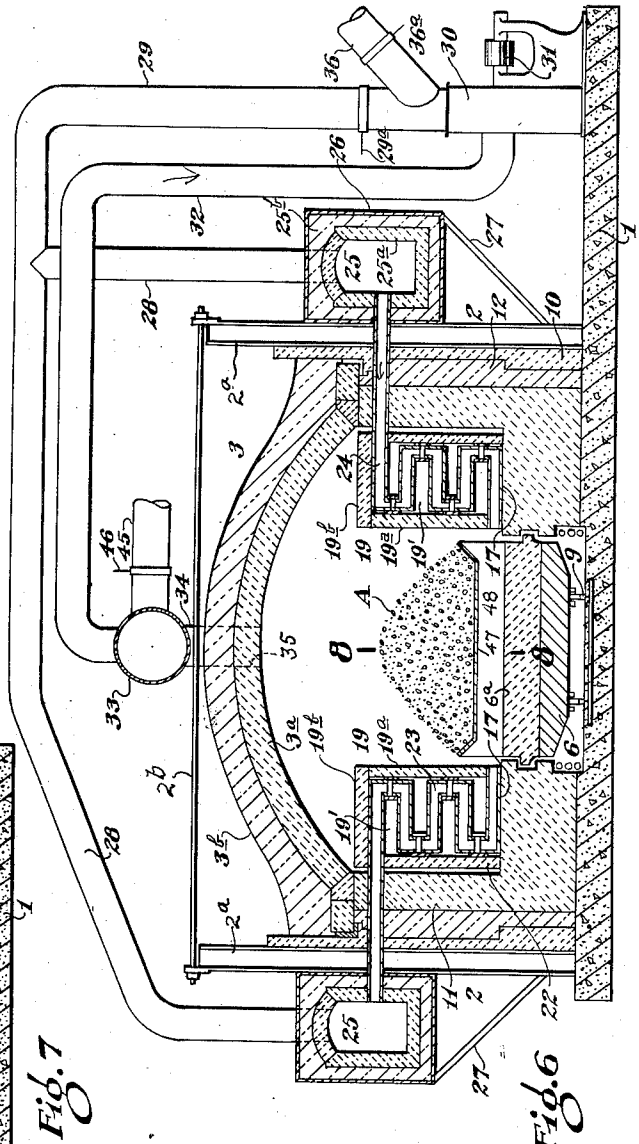


Fig. 6

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Patented July 31, 1934 1,968,775

UNITED STATES PATENT OFFICE

1,968,775

RETORT

Harry M. Robertson, Cleveland, Ohio

Application June 9, 1931, Serial No. 543,127

12 Claims. (Cl. 222—4)

This invention relates to apparatus for heating materials to gasify therefrom gaseous products, whereby the latter may be collected and stored for use; more particularly the invention relates to a continuous retort, into which loads of material may be successively introduced and then successively removed therefrom.

The apparatus disclosed herein is particularly adapted for generating or recovering carbon dioxide (CO_2) from rock or ore containing magnesium.

One object of the invention is to provide an improved retort in which portions of the generated gases are utilized to heat the green or fresh material and to also maintain an excess pressure in the space for the material, to thereby exclude free oxygen therefrom.

Another object of the invention is to provide a retort having a heating chamber through which portions of the gaseous products are passed and then discharged into the heating zone of the retort to more effectively heat the material passing therethrough.

Another object of the invention is to construct a retort in which provision is made to control the flow of vapors generated from the materials passing through the retort, so that any desired portion of the vapors exhausted from the material space may be returned thereto.

A further object of the invention is to provide an improved retort for generating gases from materials in an economical manner.

Another object of the invention is to provide an improved retort of simple construction for heating ore, rock and other materials to recover therefrom relatively pure carbon dioxide gas.

Another object of the invention is to provide an improved process of recovering from ore, rock and other materials carbon dioxide in a substantially pure state.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a plan view of a retort embodying my invention.

Fig. 2 is a horizontal section through the retort.

Fig. 3 is a side elevation.

Figs. 4, 5, 6 and 7 are sections on the lines 4—4, 5—5, 6—6, and 7—7 of Fig. 2, respectively.

Fig. 8 is a fragmentary section on the line 8—8 of Fig. 6.

In the drawings, 1 indicates a suitable bed, preferably formed of concrete, on which the retort structure is built. The structure comprises sides 2 and an arch 3 forming contiguous heating and cooling chambers 4, 5, also an inlet section 4a and an outlet section 5a through which suitable wheel mounted trucks 6, in end to end relation and loaded with the rock or ore A, are moved, the trucks 6 being successively introduced at the inlet end 7 of the retort and successively removed from the exit end 8 thereof at predetermined intervals. Tracks 9 are provided on the bed 1 for the wheels of the trucks 6.

Each side 2 for the heating zone comprises an outer wall 10 preferably constructed of bricks, an inner wall 11 formed of refractory bricks or tile and an intermediate insulating wall 12, preferably formed of diatomaceous earth. The arch 3 over the heating zone 4 is formed of refractory bricks 3a preferably covered with diatomaceous earth 3b. Each side 2 for the cooling zone consists of an outer wall 13 formed of bricks and an inner wall 14 formed of refractory bricks, these walls being spaced to form an air chamber 15. The arch 3 for the cooling zone consists of spaced arch members 16, 16a, forming between them an air space from which the air heated by conduction is exhausted as will be later set forth. The sides 2 are reinforced by upright beams 2a embedded at their lower ends in the bed 1 and connected at their upper ends by the rods 2b. The lower portions of the inner side walls 11 are extended inwardly to provide benches 17, between which the trucks 6 move, the body portions of the trucks having a width substantially equal to the space between the benches and the opposed side walls of the trucks and benches having overlapping portions, as shown in Figs. 6 and 7, to prevent heat radiating downwardly and leakage of air into the heating zone.

18 indicates a plurality of fire boxes, preferably three in number, incorporated in each side wall 2 and communicating at their inner ends through the adjacent bench with a chamber 19 supported upon and extending longitudinally of the adjacent bench 17. The fire boxes 18 may be of any desired construction to burn coal, coke, powdered coal, oil or gas. One fire box is arranged adjacent the inner end of the heating zone 4 and the remaining fire boxes are disposed relatively close to the same end, so as to provide the hottest portion of the heating zone at that end thereof remote from the inlet 7. The products of combustion and heating gases flow through the chambers 19 in a direction opposite to the direction of movement of the trucks 6 through the

zone 4, so that the material A enters the coolest portion of the heating zone and passes to the hotter portions thereof, thereby more or less gradually bringing the temperature of the material up to the maximum temperature, the effect of which is to more uniformly heat the entire body of material on each truck. The flow of the products of combustion and heating gases through the chambers 19 is induced by a power driven suction device, such as a suitable fan mounted in a casing 20, the intake end of which is connected to a conduit 20*a* extending transversely through the bed 1, as shown in dotted lines in Fig. 1, and connected by vertical outlets 21 with the outer ends of the chambers 19, as shown in Fig. 2. The spent products and gases are drawn through the outlets 21 and conduit 20*a*, and are discharged into a chimney 21*a* (Fig. 3).

Each chamber 19 comprises a front wall 19*a*, a top wall 19*b* and end walls 19*c*. These walls may be related to the inner wall 11 above the adjacent bench; but in the preferred form of construction I provide an inner side wall 22 spaced from the wall 11. As shown, the walls 19*a* and 22 are supported on the bench 17 and the top wall 19*b* rests on the walls 19*a*, 22. These walls of the chambers 19 are formed of refractory materials capable of resisting a relatively high temperature.

23 indicates a plurality of conduits, through which gases or vapor flow, as will be later set forth, disposed within each chamber 19, the discharge end of each conduit leading through the wall 19*a* for discharging the gas or vapor into the heating zone 4. The intake end of each conduit is connected to a pipe 24, which is formed of refractory material and which leads through the wall 2, being connected at its outer end to a supply chamber 25. Each conduit 23 is of circuitous form, whereby the gas flowing therethrough will be adequately heated by the products of combustion and heating gases flowing through the adjacent heating chamber and these products and gases will be broken up and caused to traverse circuitous paths, so that substantially all of the B. t. u.'s therein may be taken up by and conducted through the walls of the conduits to heat the gas or vapor therein. In the preferred arrangement each conduit 23 comprises a series of substantially S-shaped tubular sections connected end to end by sleeve sections and disposed transversely of the heating chamber in a vertical plane, the sleeves also serving to space the horizontal portions of the sections to form passages 19' for the products and heating gases, which passages by reason of the use of S-shaped conduit sections, are in staggered relation (see Fig. 6). The conduit sections may be suitably molded from refractory material. The conduits 23 are in spaced relation throughout the length of the heating chambers, except for the portion utilized by the fire box openings; the spacing of the conduits providing for the contact of the products of combustion with the maximum area of the conduit walls.

The supply chambers 25 extend along the walls 2, having a length equal to that of the heating chambers 19, to provide for the maximum number of conduits 23. Each chamber 25 has an inner wall 25*a* of refractory material, surrounded by walls of suitable insulating material 25*b*. The surrounding walls 25*b* may be encased in sheet metal 26. Each chamber 25 is suitably secured to the uprights 2*a* and braced by props 27. The roof or top of each chamber 25 has an inlet connected to a branch supply conduit 28, which is connected to a main supply conduit 29. The conduit 29 is connected to the outlet of a casing 30 containing a fan operated by a power element 31. The inlet for the fan casing is connected to an exhaust conduit 32, connected to a manifold 33, the manifold being connected by a plurality of pipes 34 to outlets 35 formed in the arch 3. 36 indicates a discharge conduit connected to the conduit 29 and leading to a chimney. The conduits 29 and 36 are provided with valves or dampers 29*a*, 36*a*, respectively, preferably of the slide type, to control the flow of the generated gas through either one or proportioned to flow through both, as will later be set forth.

37 indicates a supplemental exhaust system comprising a fan mounted in a casing 38 and driven by a power element 39. The outlet from the casing 38 is connected to a chimney 40. The inlet for the casing is connected to a conduit 41, which has one branch 42 connected to an exhaust opening formed in the arch 16*a* to remove from the space below the arch 16*a* heated air and separated branches 43, 44, connected to outlets formed in the top walls 3' of the inlet and outlet sections 4*a*, 5*a*, respectively, to exhaust free air leaking in at the inlet and exit ends when the trucks 6 are introduced and removed and also to exhaust air carried in with the materials and contained in the spaces within the material.

45 indicates a pipe leading from the manifold 33 to a gasometer (not shown), the flow through the pipe being controlled by a slide valve 46.

The trucks 6 carry receivers 47 extending transversely and supported by transverse walls 48 mounted on the body portions 6*a* of the trucks 6, to form channels or spaces below the bottoms of the receivers and to elevate the bottoms above the discharge ends of the conduits 23, as shown in Fig. 6.

The inlet end 7 is provided with doors 47' and the outlet end 8 is provided with doors 48. Each section 4*a*, 5*a* may also be provided with a door 49, which slides vertically. The trucks 6 when removed from the section 5*a* are transferred to a truck (not shown) mounted on tracks 50, then the trucks 6 are transferred to tracks 51 and moved to the inlet end 7. The trucks are then transferred to a truck (not shown) mounted on tracks 52. The trucks 6 are then re-loaded and run into the section 4*a* and then transferred to the tracks 9 by a pusher mechanism indicated at 53, of any desired construction, which mechanism is used to move the entire line of trucks through the zones 4 and 5.

The retort herein disclosed is particularly adapted for heating rock containing magnesium to generate carbon dioxide gas therefrom and operates as follows: first, the retort is fired or brought up to the desired heating temperature of approximately 1850 degrees F, by effecting combustion of fuel in the boxes 18. In firing the retort, the exhaust fan within the casing 30 may be operated to exhaust air from the zones 4 and 5, the valves 29*a* and 46 being closed and the valve 36*a* being open to discharge the air into the chimney 36, and the exhaust system 37 may also be set in operation; the effect of these operations will be to cause a circulation of the air within the material space and the air which replaces that which is exhausted. As this circulating air is subject to the radiant heat from the walls of the chambers 19, firing may be readily accomplished; also, a portion of the air may be returned through the conduits 23 to be heated therein and discharged into the goods space,

thereby supplementing the heating action of the chambers 19. Next, trucks 6 loaded with rock material containing magnesium, are introduced successively and moved through the zones 4 and 5 at predetermined intervals. In this preliminary step, the valve 46 is left closed, the valve 29*a* is closed and the valve 36*a* is opened, since it is desired to exhaust from the material space all oxygen and nitrogen as well as other gases (except carbon dioxide). As this operation continues the rock is heated, the effect of which is to generate or recover therefrom carbon dioxide gas, which and together with all air in the zones 4 and 5 are exhausted therefrom. During this operation, tests of the exhausted atmosphere are made from time to time until such tests show that the exhausted atmosphere is found to be commercially pure carbon dioxide. The valve 36*a* is then closed and the valves 46 and 29*a* are then adjusted so that a portion of the carbon dioxide gas, approximately 90%, will flow into the conduit 45 and the remaining portion thereof will be exhausted through the conduit 32 by the fan in the casing 30 and conveyed under pressure to the supply chambers 25, from which the carbon dioxide gas will flow through the conduits 23 in the heating chambers 19 and be discharged into the zone 4 below the rock receivers 47. This gas supplied to the zone 4 is heated to the maximum temperature while passing through the heating chambers 19 and supplements the radiant heat from the walls thereof to heat the rock material A. The gas discharged into the zone 4 mixes with the gas generated by the heating of the rock material and is exhausted from the zone 4 therewith. The discharge of the carbon dioxide gas into the zone 4 also maintains a pressure therein and thus prevents leakage of air into the zone 4 at either side of the trucks or drift of air into this zone when the inlet and exit doors are opened. As a result of this operation, the retort may be operated for an indefinite period to generate carbon dioxide gas substantially free from oxygen and nitrogen.

In my construction of retort, the products of combustion and heating gases are conveyed through the heating zone in closed chambers; at the same time, by conducting portions of the gasified products in conduits through these chambers, and discharging the latter products into the goods space and particularly in effective relation to the material, I advantageously supplement the heating action on the material by the heat radiating from the walls of the chambers 19. As each of the conduits 32, 29 and 28, 28, may be insulated, it will be seen that portions of the carbon dioxide gas may be returned at a high temperature before entering the chambers 19 and may therefore be readily raised in temperature while passing therethrough.

In my form of construction I provide both radiant and direct heating action on the material, the heat radiating from the walls 19*a* being applied to the exposed portions of the materials and the direct heating action, namely, the highly heated gas from the discharge ends of the conduits, being applied below the bottoms of the loads. As the receivers 47 and supporting walls are constructed to permit of the effective application of the heated gas, the material constituting each load is readily brought up to that degree of temperature necessary to generate carbon dioxide.

It will be apparent that since the heat generated by the combustion of fuel is utilized in the dual manner above set forth, the retort is operated in a relatively economical manner.

It will also be apparent that since portions of the generated carbon dioxide are returned to the material space under pressure and utilized to maintain a pressure in such space, danger of inflow of air is eliminated and relatively pure carbon dioxide gas results. The operation may be carried on continuously.

To those skilled in the art to which my invention relates many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope thereof. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. In a retort for heating materials, the combination of a heating zone having an inlet and an outlet for loads of materials, exhaust means connected to said zone, a chamber within the retort and extending along side the space through which the loads of materials move and providing an upstanding wall from which heat radiates into said heating zone, said chamber having an exhaust port at one end, a conduit leading from the outlet side of said exhaust means through said chamber for discharging a gaseous medium into said zone, and means for supplying heat into said chamber.

2. In a retort for heating materials, the combination of a heating zone having an inlet and an outlet for loads of materials, a discharge conduit leading from said zone, an exhaust means, said discharge conduit having a branch connected to the inlet side of said exhaust means and a branch adapted to be connected to a storing chamber, a heating chamber within said retort and extending along side the path of travel of the loads of materials, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, a conduit leading through said heating chamber and having its discharge end extending into said zone, a connection between the outlet side of said exhaust means and the outer end of said conduit, and means for supplying heat into said chamber.

3. In a retort for heating materials, the combination of a heating zone having an inlet and an outlet for loads of materials, a discharge conduit leading from said zone, an exhaust means, said conduit having a branch connected to the inlet side of said exhaust means and a branch adapted to be connected to a storing chamber, a heating chamber within said retort and extending along side the path of travel of the loads of materials, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, a plurality of conduits leading through said heating chamber and disposed in spaced relation and having their discharge ends extending into said zone, a connection between the outlet side of said exhaust means and the outer ends of said conduits, and means for supplying heat into said chamber.

4. In a retort for heating materials, the combination of a heating zone having an inlet and an outlet for loads of materials, a discharge conduit leading from said zone, an exhaust means, said conduit having a branch connected to the inlet side of said exhaust means and a branch adapted to be connected to a storing chamber, a heating chamber within said retort and extending along side the path of travel of the loads of

materials, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, a plurality of conduits leading through said heating chamber and disposed in spaced relation and each extending in a circuitous direction and having its discharge end extending into said zone, a connection between the outlet side of said exhaust means and the outer ends of said conduits, and means for supplying heat into said chamber.

5. In a retort for heating materials, the combination of a heating zone having an inlet and an outlet for loads of materials, a discharge conduit leading from said zone, an exhaust means, said conduit having a branch connected to the inlet side of said exhaust means and a branch adapted to be connected to a storing chamber, a heating chamber within said retort and extending along side the path of travel of the loads of materials, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, a plurality of conduits leading through said heating chamber and disposed transversely thereof and in spaced relation and having their discharge ends extending into said zone, a connection between the outlet side of said exhaust means and the outer ends of said conduits, and means for supplying heat into said chamber.

6. In a retort for heating materials, the combination of a heating zone having an inlet and an outlet for loads of materials, an exhaust means, a discharge conduit leading from said zone, said conduit having a branch connected to the inlet side of said exhaust means and a branch adapted to be connected to a storing chamber, a heating chamber within the retort and extending parallel to the path of travel of the loads of materials, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, a chamber disposed exteriorly of said zone, a connection between the outlet side of said exhaust means and said chamber, a plurality of spaced conduits connected at their outer ends to said exterior chamber and leading through said heating chamber, the inner ends of said last named conduits extending into said zone, and means for supplying heat into said heating chamber.

7. In a retort for heating materials, the combination of a heating zone through which trucks having receivers for materials are adapted to travel, said zone having an inlet and an outlet, exhaust means connected to said zone, a chamber within the retort and extending along side the space through which the loads of materials move and providing an up-standing wall from which heat radiates into said heating zone, said chamber having an exhaust port at one end, conduits leading from the outlet side of said exhaust means through said chamber, the discharge ends of said conduits being disposed in a plane below the bottoms of the receivers and arranged to discharge gaseous medium into said zone, and means for supplying heat into said chamber.

8. A retort having side walls and a roof forming a heating zone and an inlet and an outlet for loads of material, said roof having a discharge port, benches extending along the inner sides of said walls and forming a space between them for the loads of material, a heating chamber on each bench, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, a plurality of conduits leading through each said chamber and having their inner ends extending into said zone, connections between said discharge port and the outer ends of said conduits, and means in said connections for exhausting gases from said zone through said discharge port and supplying the same under pressure to said conduits.

9. A retort having side walls and a roof forming a heating zone and an inlet and an outlet for loads of material, said roof having a discharge port, benches extending along the inner sides of said walls and forming a space between them for the loads of material, a heating chamber on each bench, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, trucks having receivers for the material, adapted to be moved through said zone, a plurality of conduits leading through each said chamber and having their inner ends disposed in a plane below the bottoms of said receivers, connections between said discharge port and the outer ends of said conduits, and means in said connections for exhausting gases from said zone through said discharge port and supplying the same under pressure to said conduits.

10. A retort having side walls and a roof forming contiguous heating and cooling zones, an inlet and an outlet for loads of material, said roof for the heating zone having a discharge port and said roof for the cooling zone having a chamber formed with an exhaust port, a heating chamber at either side of the path of travel of the loads, through said heating zone, the front wall of said chamber extending vertically and serving to radiate heat into said heating zone, an exhaust means connected to the port for the chamber in the roof for said cooling zone, a plurality of conduits leading through each said heating chamber and having their inner ends arranged to discharge gaseous medium into said heating zone, connections between the discharge port for said heating zone and the outer ends of conduits, and means in said connections for exhausting gases from said heating zone through said discharge port and supplying the same under pressure to said conduits.

11. In a retort, the combination of a heating zone having an inlet and an outlet for loads of material, said zone having an exhaust port, a heating chamber in said zone extending parallel to the path of travel of the loads therethrough, an exhaust means, a conduit connected to said exhaust port and having a branch connected to the inlet side of said exhaust means and a branch adapted to be connected to a storing chamber, pipes connected to the outlet side of said exhaust means, one of said pipes leading to the atmosphere, a plurality of spaced conduits leading through said heating chamber, the outer ends of said conduits being connected to the other pipe and the inner ends thereof being arranged to discharge gaseous medium into said heating zone, and means for supplying heating to said heating chamber.

12. In a retort for heating materials, the combination of a zone having a discharge port in its roof and an inlet and an outlet for loads of materials, a chamber within the zone parallel to the path of travel of the loads, a conduit for gas leading from said port and having a branch leading to a storing chamber and a branch leading into said zone, power means in the last mentioned branch for discharging gas into said zone under pressure, and means for supplying heat into said chamber.

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