July 26, 1927. 1,636,975

P. C. ZUYDERHOUDT

RETORT OVEN FOR LOW TEMPERATURE CARBONIZATION

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Fig. 1.

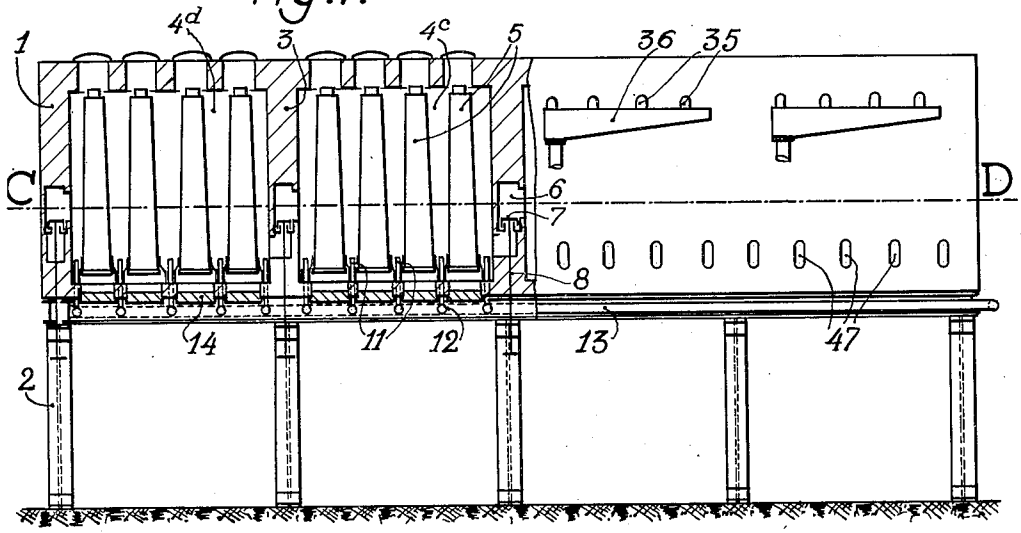
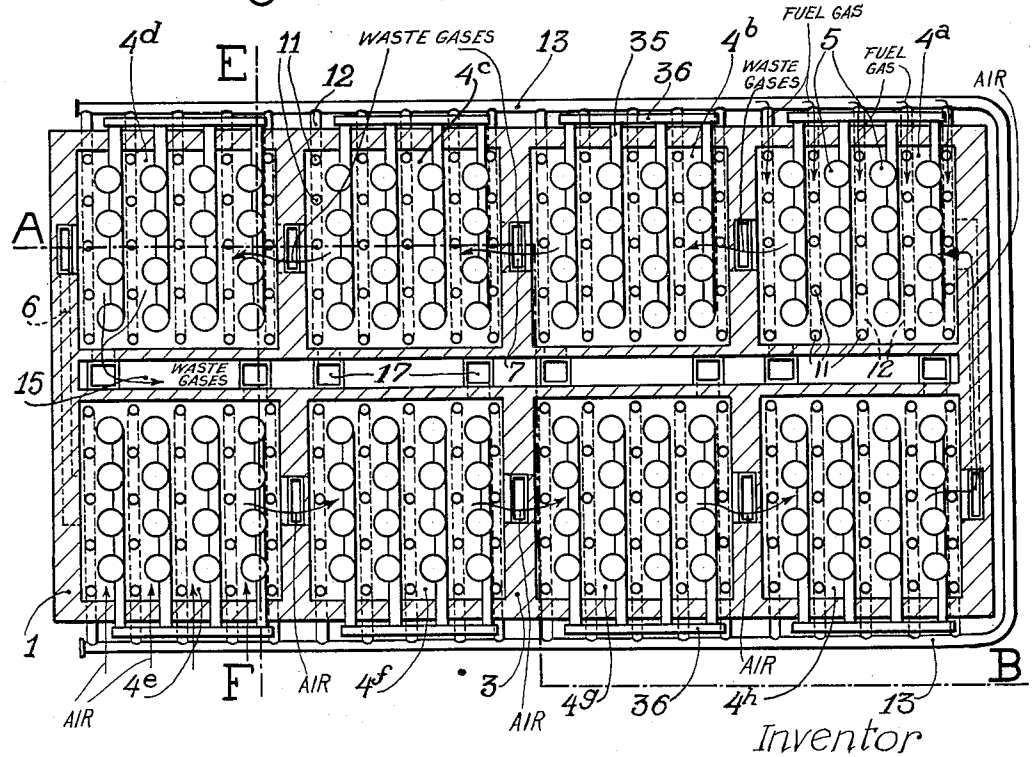


Fig. 2.



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Fig.3.

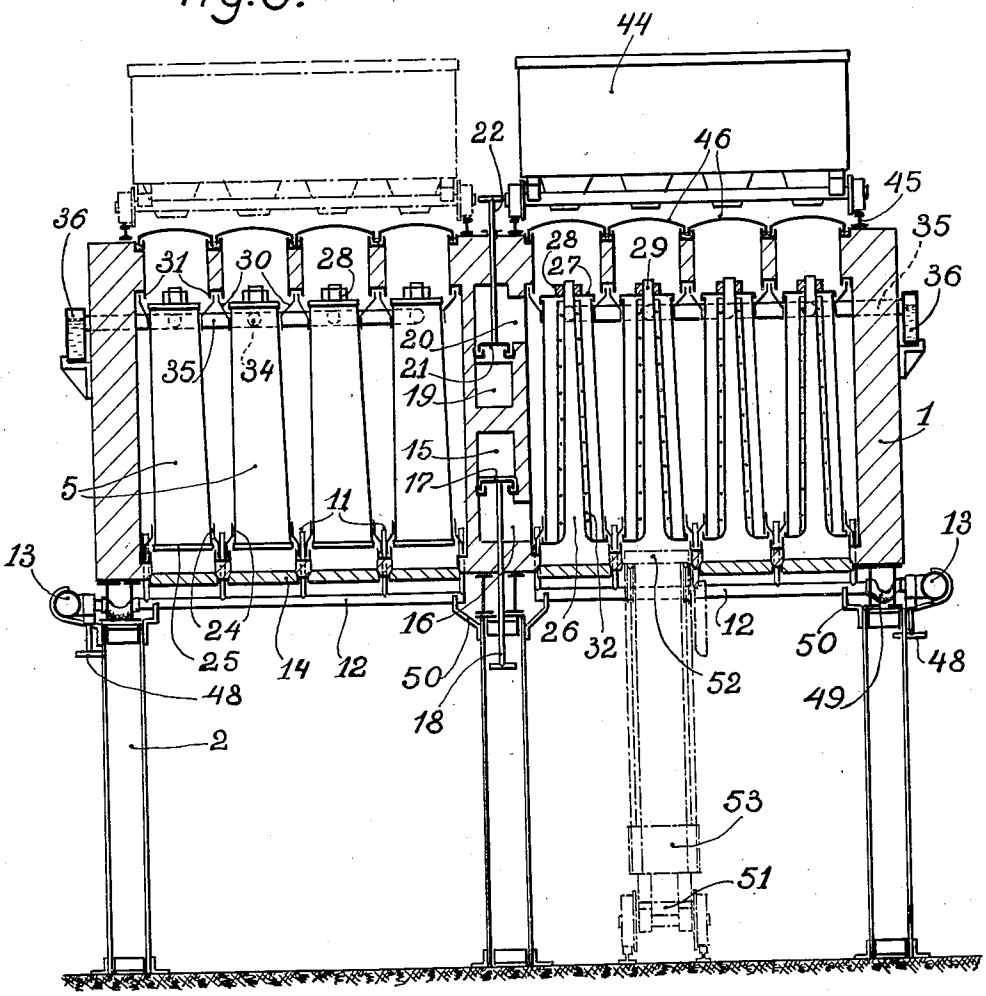
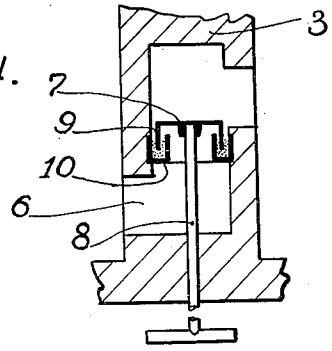


Fig.4.



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Fig. 5.

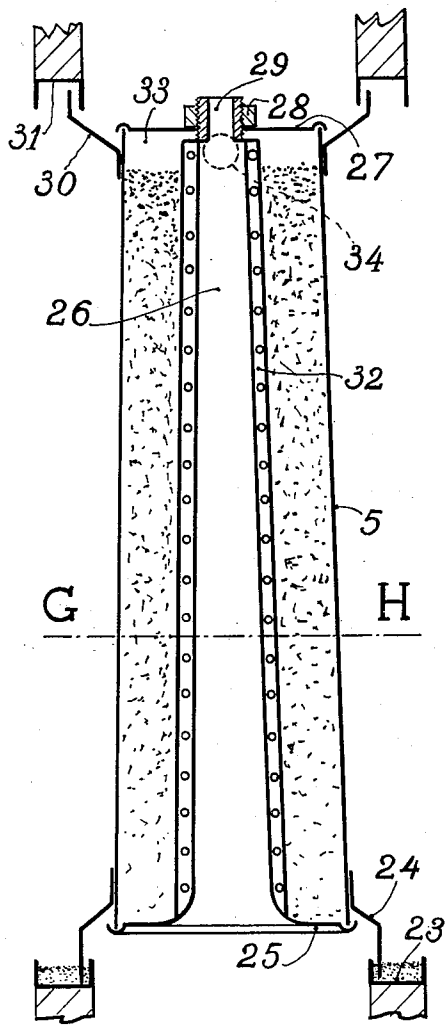


Fig. 6.

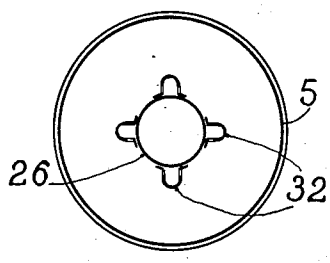


Fig. 7.

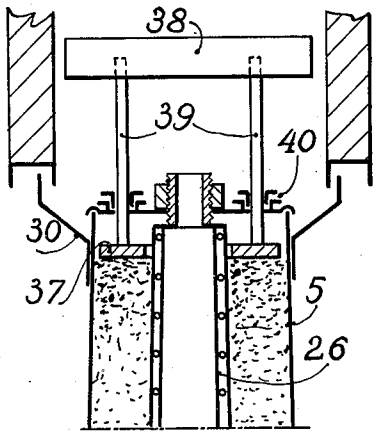
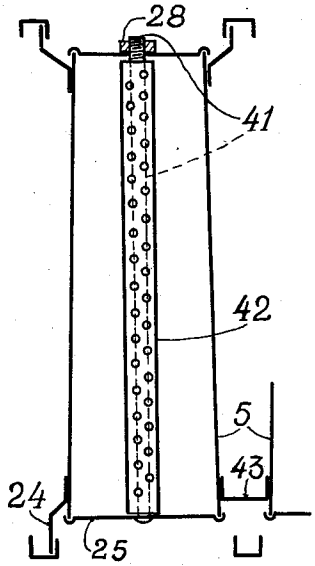


Fig. 8.



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UNITED STATES PATENT OFFICE.

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RETORT OVEN FOR LOW-TEMPERATURE CARBONIZATION.

Application filed September 27, 1924, Serial No. 740,238, and in Belgium October 22, 1923.

The present invention relates to the low temperature carbonization of carbonaceous materials and its object is to provide an oven for producing in a continuous and most economical manner low temperature coke (also known as coalite) in the form of solid cakes, and for recovering the distilled products.

The study and practice of low temperature carbonization in recent years have shown the considerable advantages deriving from this operation, and various types of ovens have been devised for this purpose. Retort ovens provided with gas burners were used at first, but the coke produced was very friable and difficulties arose in connection with the unloading of the retorts and their disjointing by the action of expansion. More satisfactory results were obtained with ovens similar to the usual coke ovens having coking chambers alternating with heating flues, the products of distillation being withdrawn from each chamber through a central compartment formed within the chamber by two partitions of perforated sheet iron. Muffle ovens are also used, through which coal in a divided condition is slowly conveyed by suitable means, but the resulting coke is in a divided condition like the coal from which it is produced.

My present invention is based on the observation that the known retort ovens were not devised so as to realize low temperature carbonization in a rational manner, and on experiments which have proved that cokefaction by the retort process has considerable advantages and permits of obtaining coke in the form of solid cakes or blocks, without waste or dust, when heating is effected methodically and the withdrawal of the distilled products and of the coke is carried out so as to avoid breaking up of the charge.

These conditions are fulfilled by the oven according to my invention which comprises an annular enclosure divided by partitions into successive chambers in which are located the retorts containing the material to be carbonized. Openings provided with suitable valves permit of connecting each chamber as required with the adjacent chambers, with the outside air and with a waste gas collecting flue.

The method of operating this oven consists in heating one or more chambers to the highest temperature desired for example by means of gas burners, in causing the combustion gases to pass through the following chambers to subject these to preliminary heating, and in causing the air required for the combustion to pass through the chambers preceding the directly heated chambers to heat such air by contact with previously heated retorts. Each chamber is successively subjected to direct heating by the burners and, as the chambers are connected in an endless series, each chamber is gradually heated until it reaches the maximum temperature, whereupon it is gradually cooled while preheating the air until the retorts are discharged.

The chambers of the oven are conveniently arranged in two rows connected with each other at their ends, thus forming an endless series which, as described later, may be interrupted at any chamber by opening that chamber to the atmosphere. Between these rows of chambers is the waste gas collecting flue. A second flue extending preferably parallel to the waste gas flue is also adapted to be connected with each chamber, whereby one or more chambers may be cut out of circuit, in case of repairs for example, without interrupting the operation of the oven.

The retorts are slightly conical and their cross-section may be of circular or other shape, the larger retorts being preferably annular. They stand vertically on feet resting on the sole of the oven, while at the top they are held by guiding means adapted to allow for their free expansion. In operation the retorts are entirely surrounded with the heating atmosphere of the chambers, whereby a homogeneous cokefaction of their contents is obtained.

The withdrawal of the distilled products is effected by means of one or more collecting conduits arranged, so far as possible, axially of the retort so that the gases have only a short path to follow within the mass undergoing treatment, thus avoiding the risk of decomposition by a prolonged contact therewith and the formation within said mass of free spaces or cracks liable to impair its capacity. The mass agglomerating as it cokefies forms a compact block which is bodily removed from the retort.

For unloading purposes a free space at

least as high as a retort is provided below the sole of the oven. Each retort has a removable bottom and a cover which in operation are fastened together by a central connection whereby they are firmly clamped against the conical retort body. This central connection may be combined with the gas collecting conduits or, in retorts of annular cross-section it may be formed by the inner wall of the retort. Whatever be the construction adopted, the retort is unloaded by freeing its removable bottom and lowering the same with the charge supported thereby. The collecting conduit preferably remains within the charge from which it can easily be withdrawn subsequently. The coke is thus discharged from each retort as a single solid cake, without waste or dust.

In the accompanying drawings which illustrate diagrammatically, by way of example, an oven in accordance with my invention:

Fig. 1 is a side elevation of the oven partly in section on line A—B of Fig. 2.

Fig. 2 is a horizontal section on line C—D of Fig. 1.

Fig. 3 is a cross-section, on a larger scale, on line E—F of Fig. 2.

Fig. 4 is a partial vertical section showing the connection between two adjacent chambers.

Fig. 5 shows on a larger scale a retort in axial section.

Fig. 6 is a cross-section on line G—H of Fig. 5.

Fig. 7 is a partial section similar to Fig. 5, showing a modification of the retort.

Fig. 8 is an axial section through a retort of smaller size.

The oven illustrated comprises a structure 1 of masonry resting on pillars 2 and divided by partitions 3 into a series of chambers 4^a, 4^b, 4^c . . . 4^h (Fig. 2) containing each a battery of vertical retorts 5. The successive chambers are connected with each other by flues 6 fitted with valves 7 provided with operating rods 8 accessible from below (Fig. 4). These valves preferably comprise each a plate having a depending flange 9 adapted to form a gas-tight joint with a mass of sand in an annular receptacle 10 secured to the wall of the flue 6.

At the bottom each chamber 4 is provided with a suitable number of burners 11 fed by pipes 12 (Fig. 3) branched on a gas main 13. Under each retort or under each row of retorts in each chamber is a door 14 for the purpose both of admitting air into the oven and of discharging the coke as will be explained later.

Between the two rows of chambers 4 is a waste gas flue 15 which may be connected to a chimney or preferably to the suction pipe of a fan. Each chamber may be put into communication with this flue 15 through a flue 16 provided with a valve 17 with sand joint and operating rod 18 (Fig. 3).

Parallel to flue 15 extends a flue 19 having no connection to the outside. This blind flue may be connected to any of the chambers 4 by flues 20 with valves 21 and their operating rods 22, and is used to cut any chamber out of the series when such chamber must be dispensed with, for example in case of repairs. This is done by opening the proper valves 21 to put the flue 19 in communication with the chambers on each side of the chamber to be cut out.

The retorts illustrated in Figs. 3 and 5 each have a conical body of sheet iron 5 standing on suitable feet 24 resting on the beams 23 of the oven floor or sole. They are provided with a removable bottom 25 rigidly connected with a conical inner wall 26 extending over the whole depth of the retort so that the latter has an annular cross-section. Against the conical retort body 5 is clamped a cover 27 which is secured to the inner cone 26 for example by means of a nut 28 screwed on a threaded sleeve 29 welded or secured otherwise to the top of the cone 26. At or near the top the conical body 5 has upwardly extending arms 30 adapted to engage the beams 31 of the oven roof so as to keep the retort in a vertical position while allowing sufficient play to provide for its free expansion. In operation the cone 26 and sleeve 29 form within the retort a chimney open at both ends through which the surrounding atmosphere may freely circulate.

Upon the inner cone 26 are secured strips of perforated sheet iron bent into U-shaped cross-section (Fig. 6) so as to form along the whole depth of the retort ascending conduits 32 for collecting the distilled gases as they are evolved within the charge. These gases escape through the top of the conduits 32 into a space 33 below the cover 27 and thence, through a nozzle 34 and pipe 35, into an external collector 36 (Figs. 1 and 3) which receives the products of distillation from all the retorts pertaining to one chamber.

When treating extremely bituminous coals such as Scotch bogheads it is advantageous to compress the charge being carbonized, and to this end I place on the charge a ring 37 loaded with weights 38 carried by rods 39 extending through stuffing boxes 40 mounted in the retort cover. The coal tending to agglomerate I may leave between the ring 37 and the walls 5 and 26 sufficient clearance to permit of the ring 37 and weights 38 sinking as the charge decreases in weight.

The construction of retorts of small capacity may be somewhat simplified as shown in Fig. 8. In this structure the inner cone 26 is dispensed with and the removable bottom 25 is secured to a central rod 41 having

a threaded upper end for receiving the nut 28, while the gas collecting conduit is formed of a perforated pipe 42 loosely surrounding the rod 41. The bodies 5 of two or more retorts may be interconnected by lugs such as 43.

For charging the retorts I may use any suitable means. In Fig. 3 I have shown a charging hopper 44 mounted on wheels and movable on rails 45 provided on the roof of the oven. Above each retort is an opening in the roof having a removable cover 46 with sand joint. During the charging operation the bottom of the retort may be temporarily supported by a cross-bar resting on the beams of the sole.

The burners 11 may be ignited through peep holes 47 provided in the side walls of the oven (Fig. 1), the delivery of gas through each pipe 12 being regulated by a suitable valve 48. The pipes 12 may also conveniently be connected to the gas main 13 by flexible connections 49 and supported by hooks 50 (Fig. 3) so that each pipe 12 may be unhooked and lowered in order to permit of igniting the burners from below, thus eliminating any danger of explosion.

To unload the retorts the doors 14 of the chamber under consideration are opened and the nuts 28 of the successive retorts are unscrewed. A truck 51 having a vertically movable platform 52 balanced by suitable weights 53 is then brought under the retort or retorts to be unloaded. The platform 52 being raised, the charge forming a solid cake of coke is released by striking a few blows on the retort body and it is received, with the bottom 25 and cone 26, by the platform 52 which is then slowly lowered and conveyed on the truck 51 to be stored away or broken up. By reason of its conical shape the appliance 25, 26 can easily be disengaged from the cake without first breaking up the latter.

With the oven hereinbefore described the carbonization of coal can be carried out in a continuous and most economical manner, the chambers 4^a, 4^b, 4^c . . . being successively subjected to direct heating by their burners while some of the other chambers are being preheated and others are in the process of cooling or discharging. The arrows and legends in Figure 2 show the arrangement when chamber 4^a is receiving the highest heat. In that case the burners of chamber 4^a will be operating, the doors 14 of chamber 4^e will be opened for admitting air into the oven and for discharging the retorts, the valves 7 between the chambers will be open except that between 4^d and 4^e and the valves 17 will be closed except that of chamber 4^d, so that the air entering 4^e will be preheated as it flows through the chambers 4^f, 4^g, 4^h, the preheated air then supporting the combustion in chamber 4^a, whence the burnt gases are led through and caused to preheat chambers 4^b, 4^c, 4^d before escaping through the flue 15. When the treatment in 4^a is completed 4^b will be subjected to direct heating while the retorts in 4^f will be discharged and so on. The heat evolved in the oven is thus completely utilized and the charges in each chamber uniformly subjected to heating of gradually increasing intensity.

The valves 21 are normally closed but if, for any reason, a chamber is put out of commission, the adjacent chambers can be put into communication through the flue 19 by opening their valves 21 without having to interrupt the operation of the entire oven.

It will be understood that while the invention has been described with particular reference to certain details of construction, the same is not to be considered as limited thereto, as various changes can be made without departing from the scope of the invention.

I claim:

1. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in an endless series, means for heating said chambers, a battery of retorts in each of said chambers, means for connecting each chamber with the two adjoining chambers, an air inlet and a gas outlet for each chamber, and under said chambers a discharging room at least as high as said retorts.

2. In a retort oven for low temperature carbonization, the combination of a series of chambers arranged in two parallel rows, a battery of retorts in each of said chambers, burners for heating each of said chambers, a waste gas flue located between said rows of chambers, and separately controllable means for connecting each chamber with the two adjoining chambers, with the outside air and with said waste gas flue.

3. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in an endless series, a battery of retorts in each of said chambers, burners for directly heating any of said chambers, means for leading the combustion gases through chambers following the directly heated chamber, a discharging room extending under said chambers means for leading air for supporting the combustion from said room to any of said chambers, and means for leading said air through chambers preceding the directly heated chamber.

4. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in series, a battery of retorts in each of said chambers, means for heating each chamber, a waste gas flue, a blind flue, and separately controllable means for connecting each chamber with the adjacent chambers, with the outside air, with said waste gas flue and with said blind flue.

5. In a retort oven for low temperature carbonization, the combination of an endless series of chambers arranged in two parallel rows, a battery of retorts in each of said chambers, burners for heating each of said chambers, a waste gas flue, a blind flue, both said flues being located between said rows of chambers, and separately controllable means for connecting each chamber with the two adjoining chambers, with the outside air, with said waste gas flue and with said blind flue.

6. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in series, a battery of vertical retorts in each of said chambers, means for heating said chambers, means for connecting each chamber with the two adjoining chambers, a gas outlet for each chamber, doors under the retorts of each chamber, and a discharging room under said chambers, said discharging room being at least as deep as said retorts.

7. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in an endless series, a battery of vertical retorts in each of said chambers, means for heating said chambers, a gas off-take for each retort, a collector connected to the gas off-takes of each battery of retorts, a discharging room immediately under said chambers, a waste gas flue, and means for connecting each chamber with the two adjoining chambers, with said discharging room and with said waste gas flue.

8. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in an endless series, a battery of vertical retorts in each of said chambers, each of said retorts having a frusto-conical body, a cover, a removable bottom suspended from said cover, and a central element for collecting the products distilled within the retort, means for connecting each chamber with the two adjoining chambers, a gas outlet for each chamber, and doors under the retorts of each chamber.

9. In a retort oven for low temperature carbonization, a vertical retort comprising a conical body, a cover, a removable bottom, a perforated element for collecting the products distilled within the retort, and a central connection for clamping both said cover and removable bottom against said retort body.

10. In a retort oven for low temperature carbonization, a vertical retort comprising a conical body, a cover, a removable bottom, a perforated element for collecting the products distilled within the retort, said element being independent of said retort body and cover, a central connecting member secured to said removable bottom, and means for securing said member to said cover.

11. In a retort oven for low temperature carbonization, a vertical retort comprising a conical body, a cover, a removable bottom, an inner conical wall secured to said removable bottom, perforated conduits on said inner wall, and means for fastening said inner conical wall to said cover.

12. In a retort oven for low temperature carbonization, a vertical retort comprising a conical body, a cover, a removable bottom, an inner conical wall secured to said removable bottom, perforated conduits on said inner wall, a threaded sleeve secured to the top of said inner wall, a nut for fastening said sleeve to said cover.

13. In a retort oven for low temperature carbonization, a vertical retort comprising a conical body, a cover, a removable bottom, an inner conical wall secured to said removable bottom, said inner wall forming within the retort a central chimney open at both ends, perforated conduits on said inner wall, and means for securing said inner wall to said cover.

14. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in an endless series, metal retorts freely supported in said chambers, said retorts having each a conical body, a cover, a removable bottom, a central element for collecting the products distilled within the retorts and means for clamping said cover and removable bottom against said retort body, doors under the retorts of each chamber adapted to allow of said removable bottoms being lowered therethrough, and a discharging room under said chambers, said discharging room being at least as deep as said retorts.

15. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in series, a battery of retorts in each of said chambers, gas burners for heating said chambers, pipes carrying said gas burners, a gas main for feeding said pipes, flexible connections between said pipes and gas main, said pipes and burners being adapted to be lowered bodily out of said chambers, doors under the retorts of each chamber, a waste gas flue, means for connecting said chambers with said waste gas flue.

16. In a retort oven for low temperature carbonization, the combination of a plurality of chambers connected in an endless series, a battery of vertical retorts in each of said chambers, said retorts having each a conical body, a cover, a removable bottom and a central element for collecting the products distilled within the retort, said element being integral with said removable bottom, burners for directly heating any of said chambers, means for leading the combustion gases through chambers following the directly heated chamber, means for leading air for supporting the combustion through chambers preceding the directly

heated chamber, doors under the retorts of each chamber, and a discharging room under said chambers, said discharging room being at least as deep as said retorts.

17. In a retort coking oven, the combination of a plurality of chambers, retorts in said chambers, burners for selectively heating any one of said chambers, conduits connecting said chambers in an endless series, and doors under the retorts of each chamber, for selectively opening any of said chambers to atmosphere, to thereby cause the conduits to conduct air from such chamber to the burners, and to conduct combustion gases from the burners to others of said chambers.

18. In a retort coking oven, a plurality of chambers connected in an endless series, a battery of vertical retorts in each of said chambers, each of said retorts having a frusto-conical body, a cover, a gas-collecting member detachably suspended from said cover and formed at its lower end into a bottom for said body, and means for preventing overturning of said body while permitting free expansion thereof.

19. A vertical retort for low temperature carbonization comprising a hollow, upwardly tapering body, a cover on said body, and a gas-collecting member detachably suspended from said cover, said member comprising perforated conduits for conducting gases to the upper part of said body and having a longitudinal passage for air, said member being formed at its lower end into a bottom for said body.

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