J. BECKER.

COKING RETORT OVEN.

APPLICATION FILED NOV. 8, 1920.

1,374,546.

Patented Apr. 12, 1921.

3 SHEETS—SHEET 1.

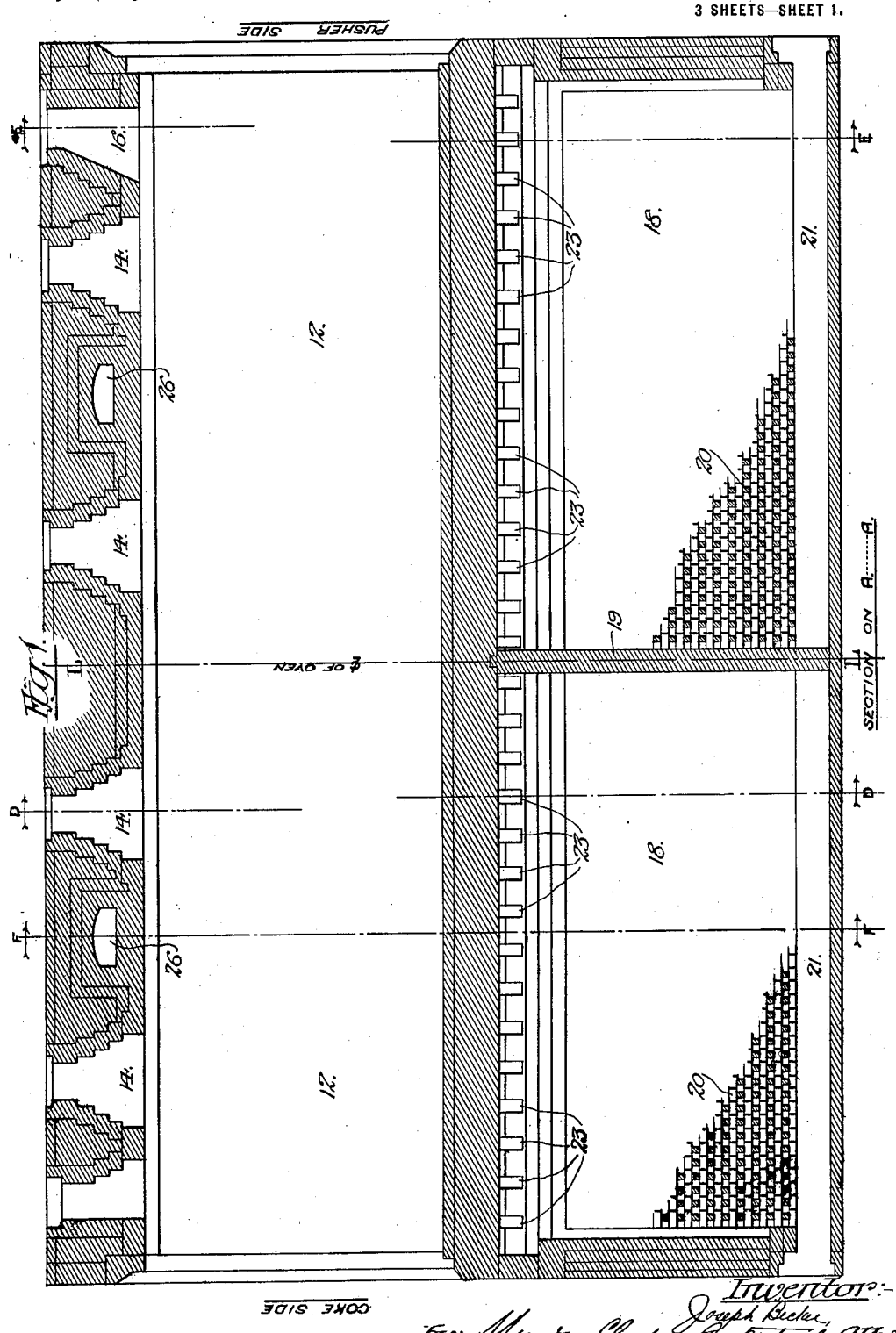


Fig. 1.

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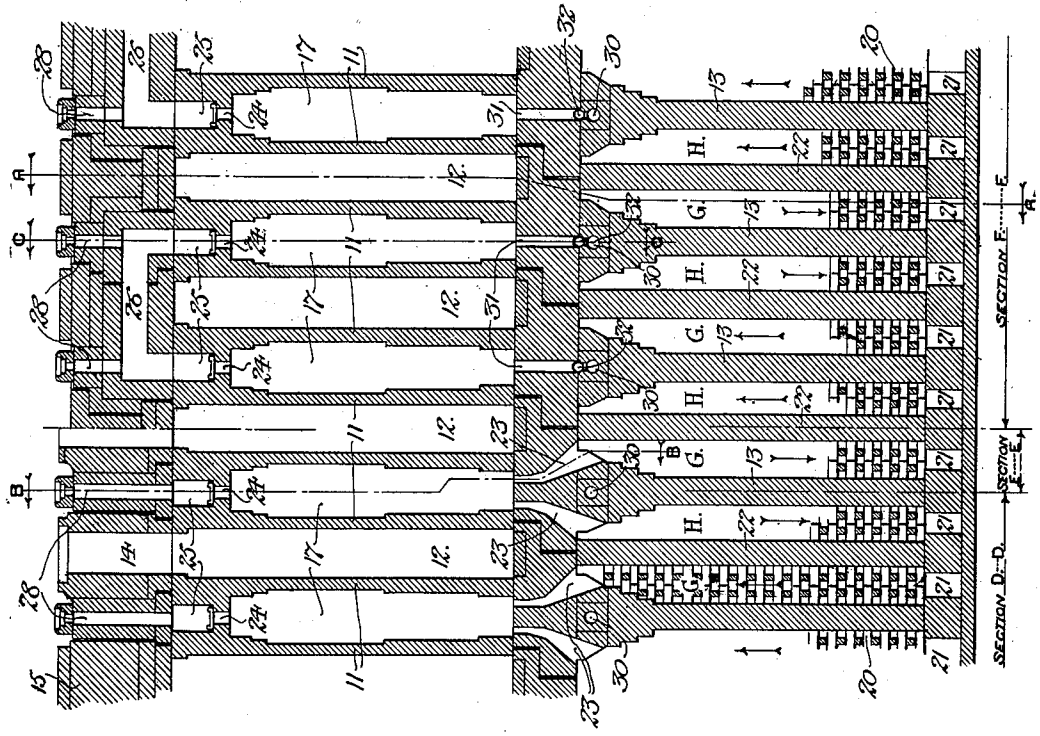
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

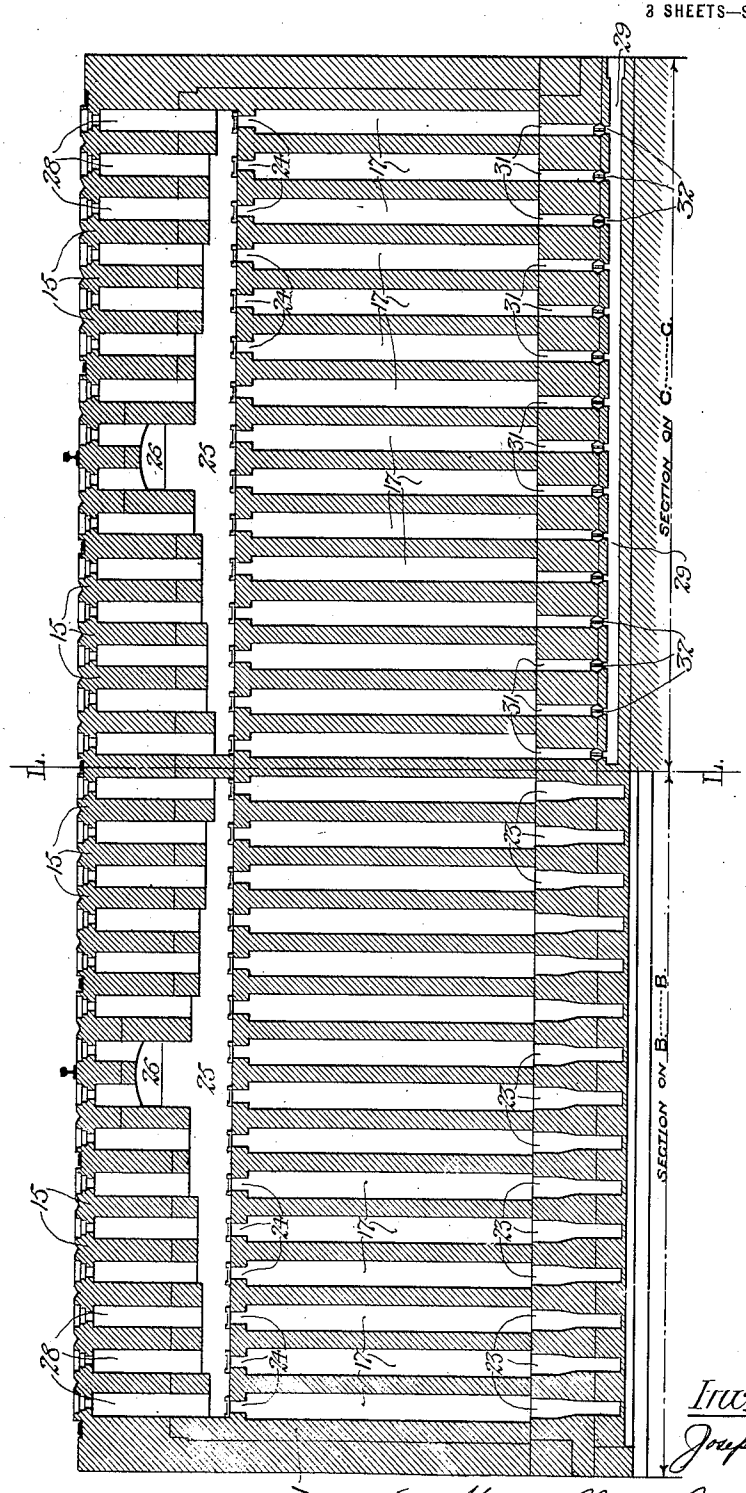


Fig. 3.

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UNITED STATES PATENT OFFICE.

JOSEPH BECKER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO THE KOPPERS COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

COKING RETORT-OVEN.

1,374,546. Specification of Letters Patent. Patented Apr. 12, 1921.

Application filed November 8, 1920. Serial No. 422,422.

To all whom it may concern:

Be it known that I, JOSEPH BECKER, a citizen of the United States, residing in Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Coking Retort-Ovens, of which the following is a specification.

This invention comprehends improvements of general utility in the coking retort oven art; and also comprehends certain improvements especially applicable to coking retort ovens of the well known cross-regenerative type exemplified in the patent to H. Koppers No. 818,033, dated April 17, 1906.

The invention has for objects the provision of a coking retort oven having, as important characteristics: a flue construction that permits a considerable reduction not only in the length but also in the cross sectional dimensions of the horizontal or bus flues located at the top of the vertical flame flues and connecting a plurality of the latter with each other; a supporting wall construction that provides heavy gas-tight supporting walls not only directly beneath the several heating walls but also directly beneath the coking chambers with checkerwork chambers between adjacent supporting walls, such construction permitting individual control of the flow through individual checkerwork chambers and flow under relatively different pressures or of different gaseous media in the checkerwork chambers that are respectively located on the opposite sides of any of said supporting walls; and, as a feature that may be secured by the above structural improvements, a novel system of control of the flow through the flame flues of the heating walls, permitting flow in the same direction through all the flame flues of each heating wall, with the result that all the flame flues of each heating wall are either simultaneously burning or simultaneously operating as downflow flues for carrying away the waste gases to outflow operating regenerators.

With regard to the novel flue construction, for example, a pair of horizontal flues in each heating wall may be substituted for the usual single horizontal flue which extends from end to end of the heating wall. With a pair of separate horizontal flues, each member of the pair need communicate with only approximately half the total number of flues of the heating wall and consequently the dimensions of each flue may be considerably decreased because of the consequent reduction in the volume of flow which must be maintained through the horizontal flue. The above stated reduction in size of the horizontal flues is an important advantage for the reason that it enables a considerable thickening and strengthening of the walls of the oven structure in the region of the horizontal flues. Moreover, the improved flue construction permits an increase in the height of the flame flues, with a corresponding increase in the height of the coking chambers so that the latter may be made narrower in width, a development greatly facilitating the coking of high volatile coals, and yet having adequate provision for taking care of the increased volume of combustion products, without making it necessary to enlarge the horizontal flue dimensions to sizes inconsistent with adequate strength of the wall construction in the region of such flues. The flue construction of the invention is furthermore of great importance in oven batteries fired with extraneously-derived gas, such as producer gas, since the employment of such gas results in an increased volume of combustion products and adequate flue spaces must be provided to collect and feed to the downflow operating flues this increased volume of combustion products. By the invention, the flue construction may be adequately accommodated to such increased volume of combustion products, without introducing elements of weakness into the wall structure.

In addition to the objects recited above, the invention comprehends a novel regenerator construction and system of flow therethrough and through the flues, promoting uniformity of distribution, and has for other objects such other improvements or advantages in construction and operation as are found to obtain in the structures and devices hereinafter described or claimed.

In the accompanying drawings, forming a part of this specification, and showing for purposes of exemplification, a preferred form and manner in which the invention

may be embodied and practised, but without limiting the claimed invention to such illustrative instance or instances:

Figure 1 is a crosswise vertical section through a coke oven battery embodying features above specified and equipped with the improvements of the present invention, the view being taken longitudinally through a coking chamber and a pair of regenerators, in planes indicated by the line A—A of Fig. 2;

Fig. 2 is a composite vertical sectional elevation taken longitudinally of a coke oven battery, in planes indicated by the lines D—D, E—E, and F—F of Fig. 1; and

Fig. 3 is a composite vertical sectional elevation taken transversely of a coke oven battery, in planes indicated by the lines B—B and C—C of Fig. 2.

The same characters of reference indicate the same parts throughout the several views.

In the embodiment illustrated in the drawings, the invention is incorporated in a combination coke oven battery, *i. e.*, a battery having provision for being operated either with producer gas as a fuel, or with coke oven gas burned in an atmosphere of ordinary preheated air, such as is utilized in ordinary coke ovens, or with coke oven gas burned in an atmosphere containing both air and a neutral gaseous diluent which is introduced into the flame flues separately from the air. A combination coke oven battery having these features is described and claimed in my application for patent for a coking retort oven filed April 23, 1920, Serial No. 376,126. For convenience, the present description will be confined to the present illustrated embodiment of the invention in such a combination oven battery; the novel features and improvements made by the invention, are susceptible of other applications, such, for example, as ordinary so-called "coke ovens" employing coke oven gas as a fuel, or ordinary so-called "gas ovens" employing producer gas as a fuel; hence, the scope of the invention is not confined to the specific use and specific embodiment herein described as an illustrative example.

Referring to the drawings, there are illustrated views of a coke oven battery or plant of the by-product type, having features above specified; said oven battery embodies in its construction a plurality of crosswise elongated heating walls 11, 11 and a plurality of intermediate crosswise elongated vertical coking chambers 12, 12. The heating walls 11 form the side walls of the respective coking chambers 12, as shown more particularly in Fig. 2, and, in the present instance, are directly supported by the heavy supporting or pillar walls 13, 13 which extend crosswise of the battery and are located, as shown in Fig. 2, beneath the respective heating walls 11, 11. These pillar walls, together with other walls, hereinafter described, collectively form the main support for the entire super-structure of the oven battery and are themselves supported upon a flat mat or platform which constitutes the sub-foundation on which the entire battery rests. The coal to be coked is charged into the several coking chambers or ovens through charging holes 14 located in the top 15 of the oven battery and positioned directly above the oven or chambers 12, as shown in Figs. 1 and 2. These charging holes 14 are equipped with the usual removable covers, which are removed during charging of the individual ovens or coking chambers and are placed in position to close the tops of such coking chambers during the entire coking or distilling operation. The gases of distillation pass from the tops of the several coking chambers 12 through gas outlets 16 and thence through ascension pipes (not shown) into the usual gas collecting main which carries the distillation products to the by-product recovery apparatus.

Heat for coking the charges of coal in the several ovens or chambers 12 is derived from the heating walls 11, which, as above mentioned, extend crosswise of the battery at the sides of the coking chambers. Referring now more particularly to Figs. 2 and 3, each heating wall 11 is constituted of a plurality of flame or combustion flues 17. The flame flues of each heating wall are, in accordance with the invention, operatively disposed into a single group, that is to say all of the flues of each heating wall operate concurrently as upflow or downflow flues, as will be hereinafter more fully explained. When the flame flues on one side of a coking chamber are burning, that is to say, operating for upflow, the flame flues on the opposite side of the same coking chamber are operating for downflow to permit exhaust of the waste gases. Consequently heating is maintained continuously from end to end on one side of a charge of coking coal in each coking chamber, the heat being applied to the full length of one side of such charge during an entire period and, then, after reversal, being applied to the full length of the opposite side of the charge, until a subsequent reversal is effected.

The crosswise regenerators 18 of the retort oven or battery are located in planes beneath the planes of the aforesaid heating walls 11 and coking chambers 12, and, in the present instance, extend in parallelism between the pillar walls 13, and the other heavy supporting walls, hereinafter described. Located in the middle lengthwise vertical plane of the coke oven battery, is a

vertical partition 19, as shown in Fig. 1, which partition extends all the way up from the mat of the battery to the bottom of the overlying coking chamber and from one to the other of the pillar walls 13, and the other walls which are between the pillar walls. The regenerators, which are respectively located on opposite sides of the battery extend inwardly to said partition 19 and are separated thereby as clearly shown in Fig. 1. This arrangement permits control from opposite sides of the battery of the flow through the regenerators, thereby assisting the novel flue arrangement in promoting uniformity of distribution. Each regenerator 18 is a chamber containing open brick work, commonly called checker work, and indicated at 20, with a distributing sole channel 21 underneath such checker work, the channels forming the soles of such chambers and opening up into the checker work. In accordance with the invention, a heavy vertical gas-tight supporting wall 22 extends directly beneath the coke chamber in parallelism between each two adjacent pillar walls 13 and such supporting walls 22 provide two regenerators G and H located respectively on the opposite sides of such walls 22 and between adjacent pillar walls 13. The several walls 22 also have the function with the pillar walls 13 of supporting the weight of the battery super-structure.

This supporting wall construction provides two series of crosswise-extending parallel gas-tight load-carrying walls located below the coking chambers and intermediate heating walls, the supporting walls of one series 13 being directly beneath the heating walls and the supporting walls of the other series 22 being directly beneath the coking chambers. The walls 22 which are beneath the coking chambers are constructed and function not as mere partitions commonly employed, but as true load-carrying gas-tight walls, permitting relatively different pressures to be maintained in the checkerwork chambers on the opposite sides of such walls, or the flow of different media in the checkerwork chambers separated by these walls, without leakages from one checkerwork chamber into another and without danger of mixing gases in the checkerwork chambers which must be kept separate in this region of the battery.

The regenerators G and H are heated, in alternation, by the hot combustion products that draw off from the flame or combustion flues hereinbefore mentioned and then impart such heat to the medium that they feed into these flame flues; in the present instance, the flow through the regenerators G, H between each two adjacent pillar walls is maintained concurrently in opposite directions, for example, when the flow is passing up through a regenerator G, downflow is being maintained concurrently through the other regenerator H. Each regenerator is provided with a series of ducts 23 all of which lead respectively to individual flame flues 17 of the same heating wall, whereas the ducts 23 of the other regenerator between the same pillar walls 13 lead respectively to individual flame flues 17 of the next adjacent heating wall, as clearly shown in Fig. 2. With this construction, each flame flue 17 communicates by a pair of ducts 23 with adjacent separate regenerators H, G, and the flow through the regenerators H, G which are respectively located on opposite sides of a pillar wall 13, is maintained concurrently in the same direction, that is to say both said regenerators are either operating for inflow or for outflow.

In the present embodiment of the invention, the entire series of flame flues 17 of each heating wall 11 is either burning or operating for downflow to convey waste products to the regenerators beneath and consequently the regenerators alined on opposite sides of the central longitudinal partition 19 operate concurrently for flow in the same direction and in the same manner. The reversal in flow through the flame flues 17 on opposite sides of a coking chamber, and their communicably connected regenerators may thus be said to take place longitudinally of the oven battery, instead of transversely thereof, as has heretofore been a common practice in this art. The reversal of the oven is effected at the end of an operating period determined by practice, and by means of any preferred type of reversing mechanism. The function of such reversal is as follows: The regenerators that prior to the reversal operated as inflow regenerators become outflow regenerators, and the outflow operating regenerators become inflow operating regenerators; the upburning series of flue switches function with the downburning series of flues of the next adjacent heating wall, and the supply of gas is turned off from the previously upburning flues and turned on into the mains of the previously downburning flues.

Each flame flue 17 of each heating wall has at its top a port or opening 24 for draft and the passage of combustion products or waste gas from the flame within the flue. These ports 24 open up into horizontal or bus flues 25 formed in the heating walls and connecting all of the vertical flues that communicate with such horizontal flues 25 by means of the ports 24. According to the invention, there are in each heating wall a plurality of, in the present instance, two of such horizontal flues 25 positioned end to end with respect to each other and respectively located on opposite sides of the

central dividing line L. By reason of the fact that there is a plurality of such horizontal flues 25, these flues 25 are not required to be of so great capacity as that necessary in present practice and consequently the cross-sectional area of each horizontal flue 25 may be materially reduced proportionately with the length of such flue, with the result that the thickness and strength of the heating walls are substantially increased in the region of the horizontal flues. Moreover, because of the fact that each horizontal flue 25 communicates with a substantially reduced number of vertical flues, in the present instance, half of the flues of a heating wall, uniformity in distribution of the flow through the vertical flues and the communicating regenerators is greatly promoted.

As shown in Fig. 3, each such horizontal flue 25 tapers from its middle toward its opposite ends in such manner that the smallest cross-sectional areas of each flue are located at its opposite extremities. The tapering channel thus formed serves to distribute the flow equally through the several vertical flues 17 with which such channel communicates. As shown, the two horizontal flues 25 of each heating wall are communicably connected by means of passageways 26 respectively with the corresponding horizontal flues of one of the next adjacent heating walls. These channels 26 preferably open up into substantially the middle portions of their respective connected flues 25, as shown in Fig. 3, and extend longitudinally of the oven battery, as shown in Fig. 2. Thus the entire flow from a heating wall, within the flues of which combustion is being maintained passes through and downwardly through all of the flues of the next adjacent heating wall and each reversal operation is accompanied by a reversal in direction inflow of all of the flues of each heating wall.

The draft through the ports 24 may be regulated by means of the usual movable dampers or sliding bricks 27, positioned in the ordinary way in the bottoms of the horizontal flues 25 and adapted to be reached by access flues 28 which extend from the top of the horizontal flues 25 in each heating wall to the top 15 of the battery, there being an access flue positioned over each flame or combustion flue of each heating wall.

Extending crosswise of the battery in each pillar wall 13 and located beneath the heating wall 11 thereabove, is a pair of gas-supply channels 29 and 30. These channels 29 and 30 are for the purpose of supplying coke oven gas to the several flame flues on each side of the central line L, and to accomplish this end, the channel 29 communicates with the individual flues 17 on the near side of said line L by means of ducts 31 that lead from such channel 29 individually into the bottoms of individual flues; and the channel 30 which supplies the several flues that are located on the far side of the aforementioned dividing line L communicates therewith by means of similarly connecting ducts. Within the several ducts are disposed the usual nozzles 32. The supply of coke oven gas to the respective channels 29 and 30 is derived from coke oven gas mains of the usual type and respectively located on the opposite sides of the battery and extending longitudinally therealong. Suitable means is provided for admitting or cutting off the supply of gas with respect to each pair of channels 29 and 30, it being understood that the gas supply is either concurrently maintained or concurrently shut off from both channels of each pair. For operating the battery alternatively with the use of a special generator gas, such as producer gas as a fuel, the several regenerators H may be optionally connected with a producer gas main, by mechanism such as is disclosed in my beforementioned application Serial No. 376,126, so that the producer gas may be directed into such of the regenerators H as are operating for inflow and conveyed through these regenerators into burning flame flues 17.

The operation of the retort oven or battery, when using a special generator gas, such as ordinary producer gas as a fuel, is as follows: The supply of coke oven gas to the coke oven gas main and to all of the coke oven gas channels 29, 30 is cut off. A supply of producer gas is permitted to flow into the alternate regenerators H, such as are operating for inflow and passing through said regenerators is preheated before being delivered into the burning flame flues. During the inflow of producer gas through such alternate regenerators H waste gas from the downburning flues is flowing out through the other regenerators G as well as through the regenerators H that are intermediate such alternate regenerators. In the intermediate regenerators G, inflow of air is maintained and passing upwardly through such regenerators finally enters the burning flame flues to support the combustion of the producer gas that is delivered thereto by the alternate regenerators H. On reversal of the flow, the inflow operating regenerators become outflow regenerators and concurrently the outflow operating regenerators become inflow regenerators.

In operating the battery with coke oven gas in the ordinary manner, the supply of producer gas to alternate regenerators H is shut off and air is permitted to flow into such regenerators in place of the producer gas. During coke oven gas operation, a supply of coke oven gas is maintained in the channels

29 and 30 which feed the upburning flues. The reversing mechanism is operated at each reversal to place all of the inflow operating regenerators in communication with the outer air and concurrently all of the outflow operating regenerators in communication with the exhaust. A further mode of operation is with coke oven gas as a fuel, combined with a supply of neutral gaseous diluent to the upburning flues. In so operating the battery, the supply of producer gas is turned off and the supply of coke oven gas is turned on. Instead however of permitting air to flow into alternate regenerators of the series H that serve for producer gas, during the latter operation, waste gas is permitted to flow into such regenerators and be delivered thereby to the upburning flame flues. The admission into each of the upburning flues of a supply of the neutral gaseous diluent, such as waste gas, is effective to lengthen greatly the flames within such flues and to prevent the localization of the hottest flame temperature in the extreme lower portions of the flues.

The invention as hereinabove set forth is embodied in a particular form of construction but may be variously embodied within the scope of the claims hereinafter made.

I claim:

1. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; tapered horizontal flues in each heating wall and respectively connecting a plurality of the combustion flues of their respective heating walls; the horizontal flues being also communicably connected with the corresponding horizontal flues of an adjacent heating wall; individually regulable and reversible crosswise-extending regenerators parallel with the coking chamber and the heating walls, such regenerators being communicably connected in pairs with combustion flues of a single heating wall; and means for separately controlling the individual flow through individual regenerators and their connected groups of combustion flues; substantially as specified.

2. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; horizontal flues in each heating wall and respectively connecting a plurality of the combustion flues of their respective heating walls; the horizontal flues being also communicably connected with the corresponding horizontal flues of an adjacent heating wall; individually regulable and reversible crosswise-extending regenerators parallel with the coking chamber and the heating walls, such regenerators being communicably connected in pairs with combustion flues of a single heating wall; and means for separably controlling the individual flow through individual regenerators and their connected groups of combustion flues; substantially as specified.

3. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; horizontal flues in each heating wall and respectively connecting a plurality of the combustion flues of their respective heating walls; the horizontal flues being also communicably connected with the corresponding horizontal flues of an adjacent heating wall; individually regulable and reversible regenerators, said regenerators being communicably connected in pairs with combustion flues of a single heating wall; and means for separately controlling the individual flow through individual regenerators and their connected groups of combustion flues; substantially as specified.

4. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; a plurality of tapered horizontal collecting flues in each heating wall and respectively connecting a plurality of the combustion flues of their respective heating walls; the horizontal flues being also communicably connected with the corresponding horizontal flues of an adjacent heating wall; and regenerators communicating with said combustion flues; substantially as specified.

5. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; a plurality of horizontal collecting flues in each heating wall and respectively connecting a plurality of the combustion flues of their respective heating walls; the horizontal flues being also communicably connected with the corresponding horizontal flues of an adjacent heating wall; and regenerators communicating with said combustion flues; substantially as specified.

6. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; a pair of horizontal collecting flues in each heating wall and respectively connecting a plurality of the combustion flues of their respective heating walls; the horizontal flues being also communicably connected with the corresponding horizontal flues of an adjacent heating wall; and regenerators communicating with said combustion flues; substantially as specified.

7. In a coking retort oven, in combina-

tion: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues operable reversibly for upflow and downflow; all of the combustion flues of a heating wall being communicably connected with the combustion flues of an adjacent heating wall; and crosswise-extending regenerators parallel with the coking chamber and the heating wall, said regenerators communicating with such combustion flues; substantially as specified.

8. In a coke oven battery, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; individually regulable and reversible crosswise-extending regenerators parallel with the coking chamber and the heating walls; said regenerators being grouped into pairs reversible longitudinally of the battery, and each pair of such regenerators being communicably connected with combustion flues of a single heating wall; and means for separately controlling the individual flow through individual regenerators and their connected combustion flues; substantially as specified.

9. In a coke oven battery, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues, all of the combustion flues of a heating wall being communicably connected with the combustion flues of an adjacent heating wall; individually regulable and reversible crosswise-extending regenerators parallel with the coking chamber and the heating walls; said regenerators being grouped into pairs reversible longitudinally of the battery, and each pair of such regenerators being communicably connected with combustion flues of a single heating wall; and means for separately controlling the individual flow through individual regenerators and their connected combustion flues; substantially as specified.

10. In a coke oven battery, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues, all of the combustion flues of a heating wall being communicably connected with the combustion flues of an adjacent heating wall; and individually regulable and reversible crosswise-extending regenerators parallel with the coking chamber and the heating walls, said regenerators being located on opposite sides of the battery and being grouped into pairs reversible longitudinally of the battery, each pair of such regenerators being communicably connected with combustion flues of a single heating wall; substantially as specified.

11. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; a plurality of horizontal flues in each heating wall, the horizontal flues respectively connecting a plurality of the combustion flues of their respective heating walls, each horizontal flue being tapered toward its opposite ends from a portion of such flue between such ends and the horizontal flues being also communicably connected with other horizontal flues; and regenerators communicating with said combustion flues; substantially as specified.

12. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; a plurality of horizontal flues in each heating wall, the horizontal flues respectively connecting a plurality of the combustion flues of their respective heating walls, each horizontal flue being tapered from its middle portion toward its opposite ends and the horizontal flues being also communicably connected at their said middle portions with the corresponding horizontal flues of an adjacent heating wall; substantially as specified.

13. In a coking retort oven, in combination: a plurality of coking chambers; heating walls contiguous to such coking chambers and respectively constituted of vertical combustion flues; two horizontal flues in each heating wall, such flues being positioned end-to-end with respect to each other and respectively connecting substantially half of the combustion flues of the heating wall, each horizontal flue being tapered toward its opposite ends from a portion of such flue between such ends and the horizontal flues being also communicably connected with other horizontal flues; and regenerators communicating with said combustion flues; substantially as specified.

14. In a coking retort oven, in combination: a plurality of parallel crosswise-extending coking chambers; intermediate heating walls contiguous to such coking chambers and parallel therewith; two series of crosswise-extending parallel gas-tight supporting walls located below the coking chambers and intermediate heating walls, the supporting walls of one series being directly beneath the heating walls and the supporting walls of the other series being directly beneath the coking chambers; and checkerwork chambers between adjacent supporting walls; substantially as specified.

15. In a coking retort oven, in combination: a series of coking chambers; heating walls intermediate the coking chambers and each having a plurality of vertical flame-flues disposed in groups; a connection conduit common to and connecting, over the ad-

joining coking chambers, the flues of each group in each heating-wall and the flues of a corresponding group in an adjacent heating-wall; and series of regenerators below and parallel with the coking chambers and heating-walls and arranged to provide for concurrent inflow to and outflow from alternate heating-walls; substantially as specified.

16. In combination with a coking chamber, flued heating walls respectively constituting the opposite side walls of said coking chamber, the flues of the heating walls being communicably connected with each other by duct means extending over the top of the coking chamber, reversible means for maintaining combustion in alternation in said heating walls, the exhaust gases produced by the combustion in one heating wall being drawn off through the other, and reversible regenerators respectively connected with said heating walls; substantially as specified.

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