Aug. 20, 1935. W. REPPEKUS 2,011,592

REGENERATIVE COKE OVEN

Filed April 11, 1932 2 Sheets-Sheet 1

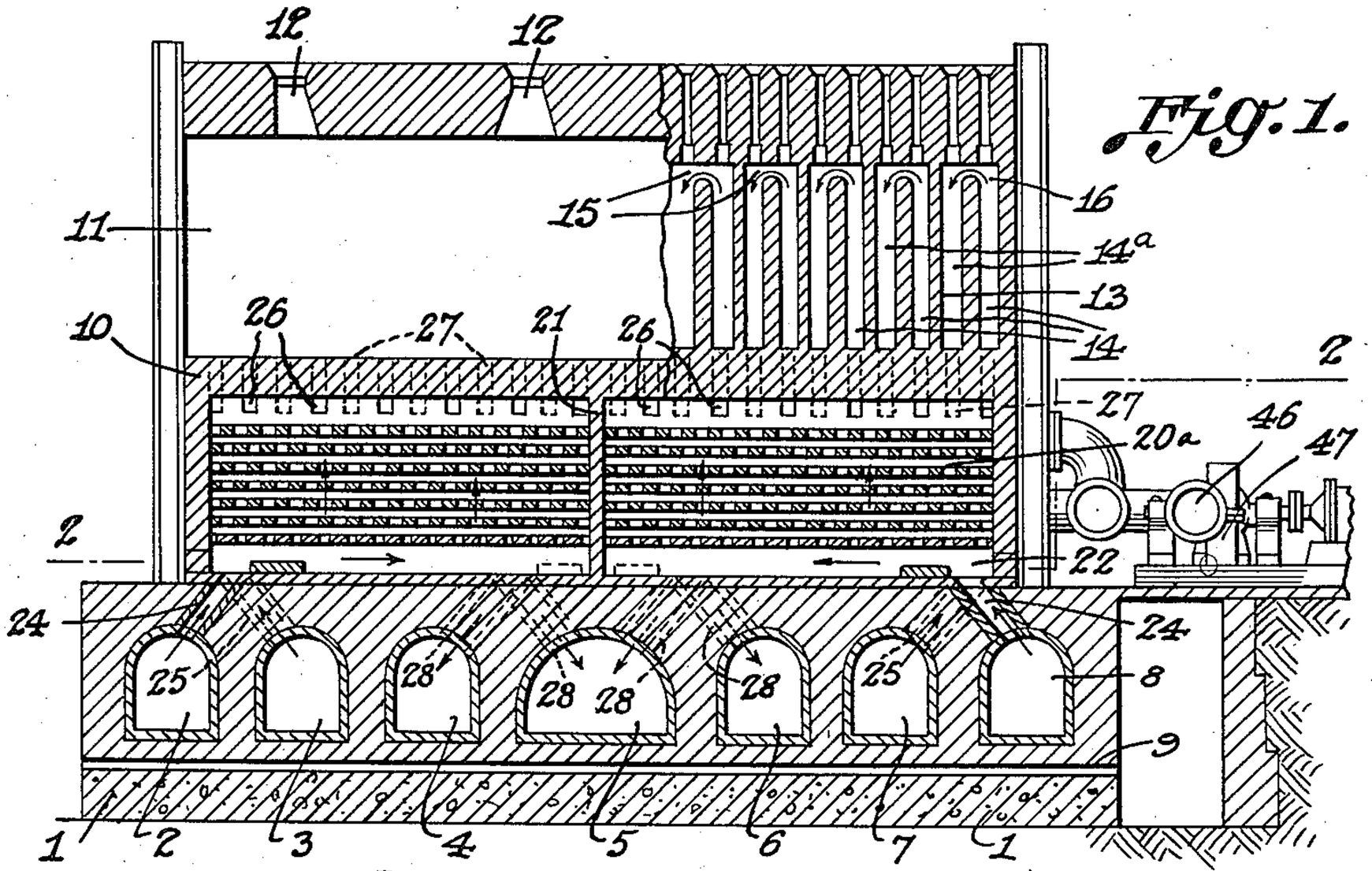

Fig. 1.

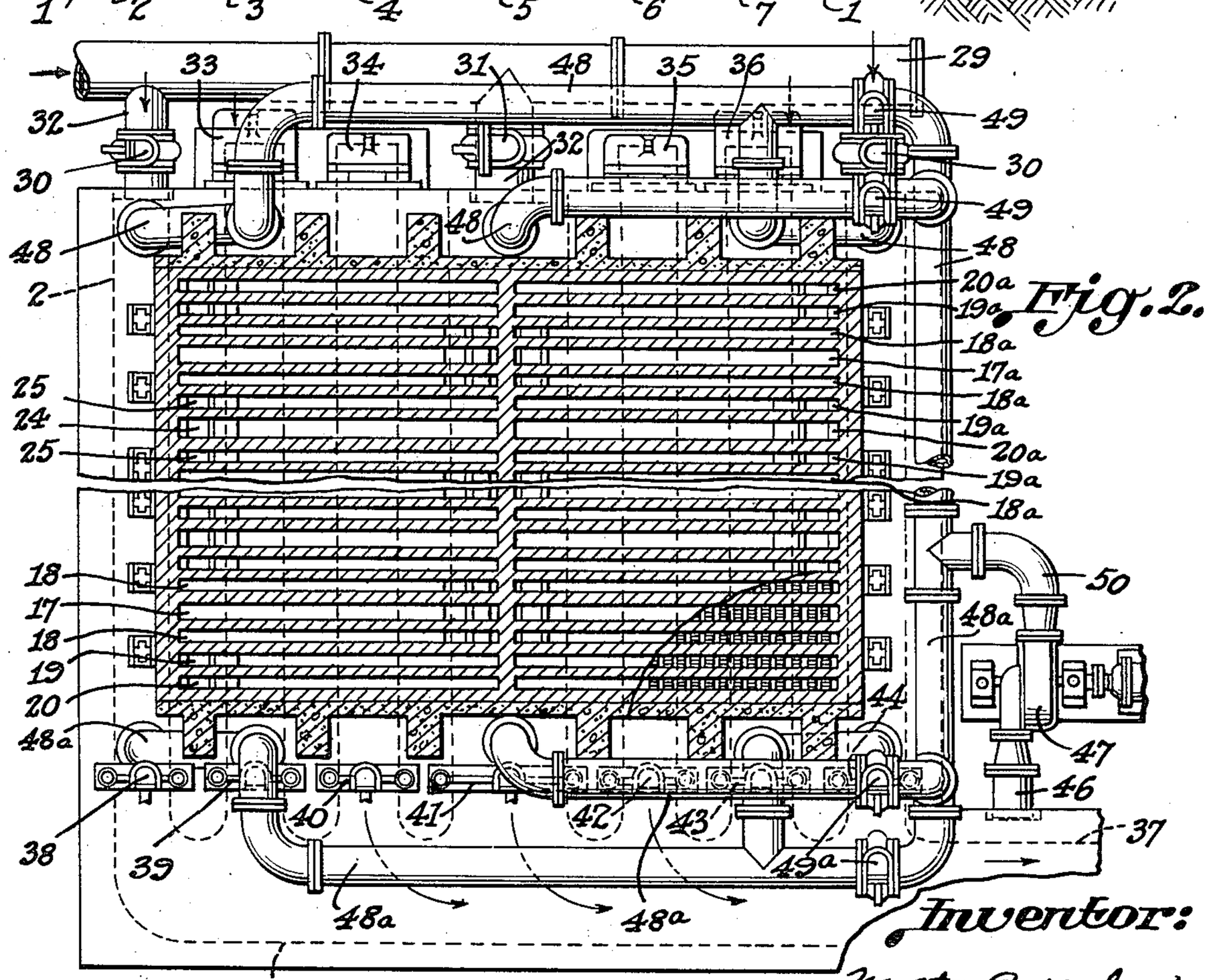

Fig. 2.

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Filed April 11, 1932 2 Sheets-Sheet 2

Fig. 3.

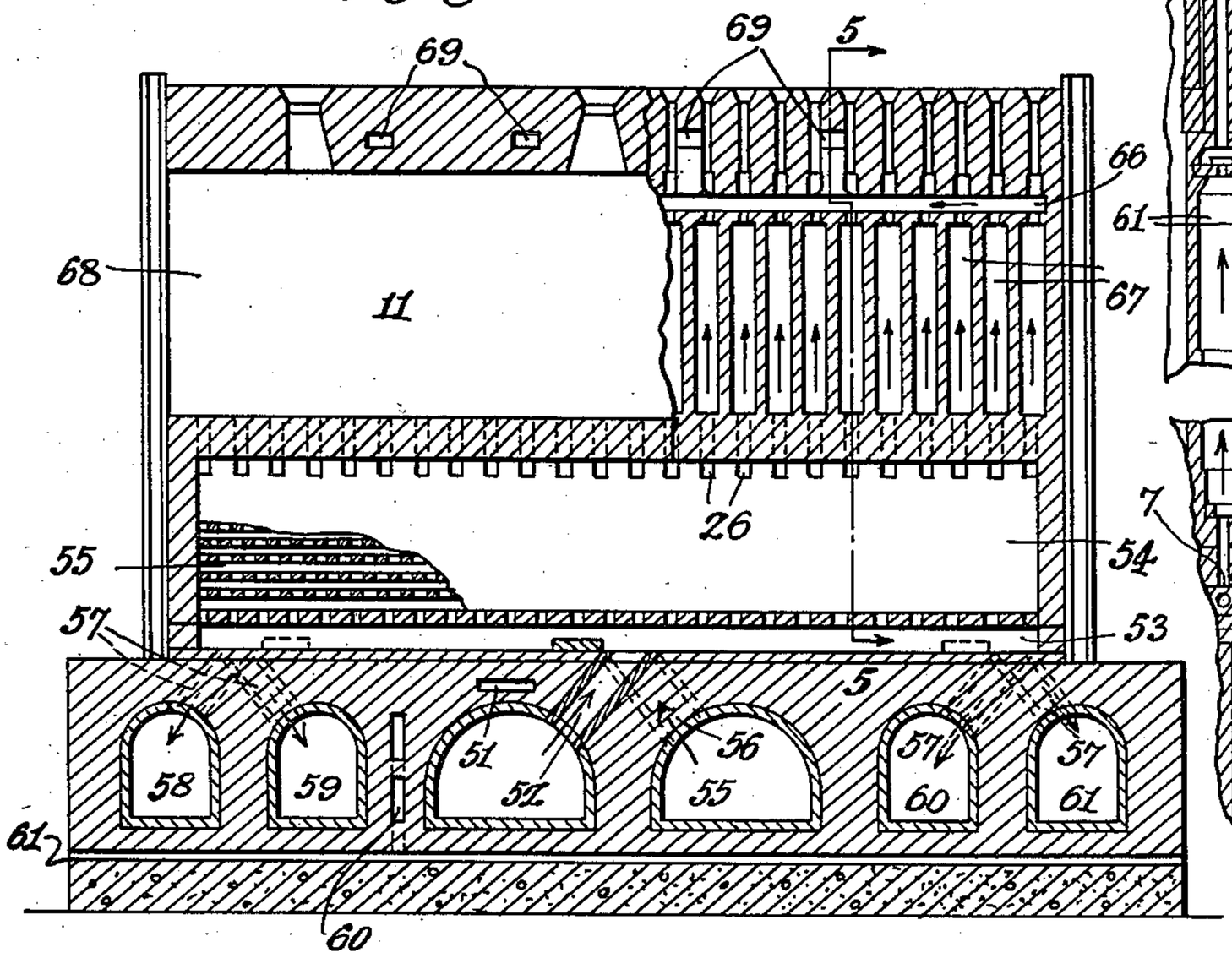
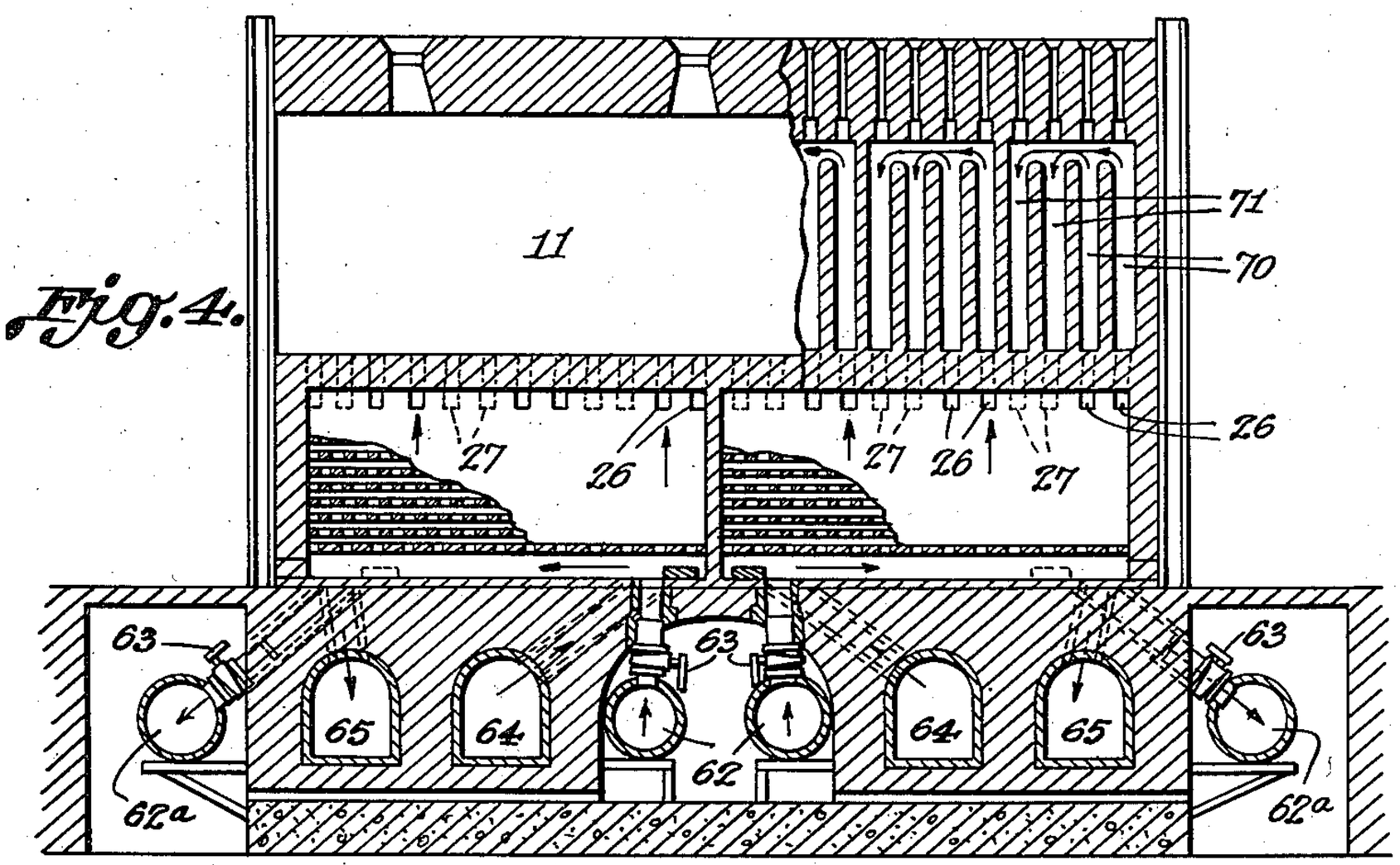


Fig. 5.

Fig. 4.



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REGENERATIVE COKE OVEN

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8 Claims. (Cl. 202—143)

This invention relates to regenerative coke ovens having regenerator chambers beneath the base of the oven running longitudinally of the coking chambers through which hot waste gases on the one hand and air and combustion gas on the other hand are passed alternately and relates more particularly to regenerative coke ovens of the type which are heated by lean gas.

In coke ovens, as is well known, the uniform heating of the coking chambers plays a leading part in the production of high-grade coke. It is important that the entire contents of a coking chamber be coked as far as possible in the same period of time in order to prevent any parts of the coke cake staying in the chamber too long and being overdone. Uneven baking of the contents of the chamber also lowers considerably the efficiency of a coke oven.

In order to attain a uniform heating of the walls of the chambers of a coke oven the flued heating walls of the coking chambers through which the heating gases are passed are divided up by a plurality of transverse partitions in such a manner that a series of vertical channels or combustion flues is formed in which the combustion of gas and air takes place so that heating flames pass over the entire length of the chamber wall. In order that the heat produced in each of these heating channels shall be as uniform as possible regulating valves are often provided at the gas and air inlet openings thereto by means of which the quantity of incoming combustion media can be varied. By means of these regulating valves it is certainly possible to obtain a sufficiently uniform distribution of gas and air to all the heating channels of a coke oven, but such regulating valves usually have the defect that the total flow of air and combustion gas on the one hand and of waste gases on the other hand is not inconsiderably throttled down, whereby considerable loss of draught is caused in the coke oven which renders necessary the provision of expensive apparatus for setting up an artificial draught.

The principal object of my invention is to provide a regenerative coke oven heated by weak or lean gas which is so constructed as to do away with individual regulating or control of the quantities of gas and air flowing into the heating channels of the coking chamber walls.

A further object of my invention is to provide a coke oven battery wherein the means usually employed for controlling the supply of heating media to the individual coking ovens or the heating walls thereof are done away with.

A still further object of my invention is to provide a coke oven wherein the passage of combustion gas into the waste heat channels is prevented.

A final object of my invention is to provide improvements in a coke oven battery for preventing loss of combustion gas caused when the direction of draught is changed.

With the above and other objects of my invention in view I will now describe the nature of the present invention with particular reference to the accompanying drawings:—

Figure 1 is a vertical longitudinal section through a coke oven battery constructed in accordance with my invention.

Figure 2 is a horizontal section along the line II—II of Figure 1.

Figure 3 is a vertical cross section through another embodiment of my invention.

Figure 4 is a vertical cross section through a still further embodiment of my invention, and

Figure 5 is a vertical cross-sectional view taken longitudinally of the battery on line 5—5 of Fig. 3.

Referring first to Figures 1 and 2 there is provided on a base plate 1 of concrete or the like a number of channels 2, 3, 4, 5, 6, 7, and 8 composed of brickwork or the like which run parallel to one another longitudinal of the oven battery. Between these channels and the base plate 1 channels 9 are provided through which cold air can be passed for the purpose of cooling the base plate. This air is warmed thereby and can if required be used as combustion air for the heating gas of the coke oven.

On the brick work forming the channels 2—8 the coke oven battery 10 is erected which has a series of coking chambers 11 running perpendicularly to the channels 2—8 in which the coal to be coked is introduced from above through openings 12. On the right hand side of Figure 1 the construction of the walls 13 of the coking chamber 11 is clearly illustrated. The walls 12 have a series of vertical channels 14, 14*a* connected together in pairs at the upper end by openings 15. In one period of operation gas and air are introduced separately at the lower end of the channels 14 in which they burn and rise up to pass into the channels 14*a* at the lower end of which they are withdrawn. The path of the gases in the period of operation just described is indicated in Figure 1 by the arrow 16. In the next period of operation the direction of flow of the gas is altered, i. e. gas and air are

introduced into the flues 14*a* and the waste gases removed from the flues 14.

The heating gas and combustion air are preheated by regenerator chambers 17, 17*a*, 18, 18*a*, 19, 19*a*, 20, 20*a* provided with the ordinary chequer brickwork and disposed beneath the coking chamber 11 and heating walls 12. These regenerator chambers run parallel to the coking chambers as shown in Figure 2. The regenerator chambers 17, 18, 19, 20 are separated from the regenerators 17*a*, 18*a*, 19*a*, 20*a* by a wall 21 which serves to facilitate the distribution of the gas over the whole length of the regenerators provided beneath the coking chambers. In their function however the regenerators lying on either side of the oven battery are similar so that in certain cases the partition walls 21 could be omitted. The regenerator chambers are provided at the bottom with channels 22 and at the top with distribution channels 23.

Gas and air are introduced into the regenerator base channels 22 from the channels 2—8 and distributed by the channels 23 to the heating flues 14, 14*a*. The way in which the regenerators are connected with the base channels and the heating channels of the heating walls according to my invention may best be understood by following the path taken by the gases in one period of operation. Assume that in one period of operation weak gas is supplied to the base channels 2 and 8 and cold air to the base channels 3 and 7. The weak gas passes from the base channels 2 and 8 to connecting channels 24 into the channel 22 or the regenerator chambers 20, 20*a*. The air flows from the base channels 3 and 7 through the channels 25 into the air regenerators 19, 19*a* disposed on either side of the gas regenerators 20, 20*a*. The cold media rise in the regenerators which have been previously heating by waste gas and become warm thereby. The hot gas then passes into the upper distribution channel 23 of the regenerators 20, 20*a* and thence through the channels 26 into the lower end of the heating channels 14. In a similar manner the hot air passes through the channels which for the sake of clearness are not shown in Figure 1 from the regenerators 19, 19*a* into heating channels 14.

The gas and air are burned in the channels 14 and the hot waste gases then flow through the heating channels 14*a* from which they are withdrawn through channels 27 into the regenerators 17, 17*a*, 18, 18*a*. These latter regenerators are each situated near an air regenerator 19, 19*a*, as shown in Figure 2. This arrangement of the regenerators renders impossible the escape of heating gas into the waste gas channels through crevices in the brickwork separating the regenerators, because there is no difference in pressure between the heating gas regenerators and the air regenerators. Finally the waste gases flow from the regenerators 17, 17*a*, 18, 18*a* through the channels 28 into the base channels 4, 5, 6.

As shown in Figure 1 the connecting channels 24, 25, of the base channels 1, 3, 7, 8, open into the regenerator chambers at the outer end of same next to the longitudinal side of the battery, while the connecting channels 28 to the base channels 4, 5, 6, emerge from the inner end of the regenerator chambers at the longitudinal median line of the battery. This disposition of the openings of the connecting channels 24, 25, 28 has the consequence that the path of the gases through the various heating channels in either direction of flow is always the same. Consequently during one period of operation the same draught always exists in all the heating channels 14 so that practically equal quantities of gas and air are sucked into all the channels 14 from the regenerators connected therewith, without the necessity for providing regulating valves exerting a throttling effect at the front of the heating channels.

In the next period of operation which begins when the temperature of the chequer brickwork in the gas and air regenerators has fallen below the point required for heating the heating air and gas, the path of the gases through the coke oven and regenerators is reversed. The heating gas is then introduced into the base channel 5, the combustion air into the base channels 4, 6, while the waste gases are withdrawn into the base channels 2, 3, 7, 8.

Then in the following period of operation the path of the gases is exactly the same as that first described.

In the coke oven battery illustrated in Figs. 1 and 2 the heating gas is supplied through the pipe 29 and selectively supplied to the base channels 2, 5, 8, through branch pipes 32 controlled by valves 30, 31. Air is selectively admitted into the channels 3, 4, 6, 7, through air flaps 33, 34, 35, 36, provided at one end of the oven battery.

The waste gases pass from the base channel into a collecting channel 37, the openings of the base channels into this channel 37 being controlled by valves 38, 39, 40, 41, 42, 43.

The position of the heating gas and waste gas valves and of the air flaps in the various periods of operation will be easily understood from the above. In the periods of operation which have been described in detail the gas valves 30 are opened and the gas valves 32 closed. The air flaps 33, 36, opened and the air flaps 34, 35, closed, and finally the waste gas valves 38, 39, 43, 44 closed and the waste gas valves 40, 41, 42 opened. When the direction of heating is changed these gas, air and waste gas valves are set in reverse position.

The arrangement of the gas and waste gas valves and of the air flaps described above and illustrated in the drawings yields the important advantage that when the direction of heating is changed for the whole oven battery no matter how many coke ovens it may comprise only fourteen reversing members have to be actuated. All the regulating members provided in the usual coke oven battery for controlling the entry of gas and air into the regenerators and the escape of waste gas from the regenerators are done away with, thus substantially lowering the cost of the battery.

A further advantage of the oven construction herein described resides in the fact that not only are the paths of the gases within the individual coke ovens the same, but they are also the same in respect of the whole oven battery because gas and air are always supplied at one end of the battery whilst the waste gases are only withdrawn into the chimney at the other end of the battery. The similarity of the gas paths in respect of the whole oven battery permits the usual individual regulation of the quantities of gas and air for each regenerator to be done away with as owing to the similarity of the gas paths in all the functionally similar regenerators in each period of operation the same draught exists so that practically similar quantities of gas are sucked into all the regenerators.

Preferably in the coke oven battery illustrated

in Figs. 1 and 2 I provide a further arrangement for preventing loss of heating gas when the direction of heating is changed. For this purpose I withdraw a small quantity of waste gas from the collecting channels 37 through a pipe 46 by means of a ventilator 47 and I force this quantity of waste gas into the base channels through which heating gas has previously flowed before opening the heating gas valves, 30 or 32. The base channels 2, 5, 8, are connected for this purpose by pipes 48, 48*a* controlled by valves 49, 49*a* with the pressure pipe 50 of the ventilator 47. Waste gas is introduced into the base channels through which heating gas has previously flowed when the direction of heating is changed until the heating gas is substantially completely removed from the regenerators into the heating channels and there burnt. At this time the air flaps and waste gas valves are also closed, and then the introduction of waste gas by means of the ventilator 47 is arrested. Then the heating gas and waste gas valves and air flaps for the other direction of heating are opened.

In the construction of the oven battery illustrated in Figure 1 the base channels carrying the heating gas are separated from those carrying the waste gas by channels containing air so that it is practically impossible for heating gas to be lost in the base channels.

Instead of this arrangement of the base channels I can also employ another which is illustrated in Figure 3. In the oven according to Figure 3 in one period of operation heating gas is supplied to the base channel 51 which is connected by the channel 52 with the middle of the bottom channel 53 of one of the regenerators 54. As usual the regenerators are provided with refractory brickwork 55. In the construction illustrated in Figure 3 the regenerators extend throughout the whole length of the oven.

In the oven according to Figure 3 air is admitted in this period of operation into the base channel 55 which is connected by the channel 56 with air regenerators situated besides the gas regenerators 54. The waste gases are withdrawn from the ends of the regenerator chambers through channels 57 into the base channels 58, 59, 60, 61 from groups of regenerators adjoined on both sides by air regenerators. The connection of the regenerator chambers with the base channels thus corresponds to the arrangement according to Figure 2.

As shown from Figure 3 in one period of operation the base channel 51 carrying the heating gas is adjoined by a base channel 59 carrying waste gas. For the purpose of preventing escape of heating gas from the channel 51 through crevices in the brickwork into the waste gas channel 59 compensating channels 60 are provided which are connected by the cooling channel 61 to the outer air.

In the oven according to Figure 3 when the direction of heating has changed heating gas is introduced into the base channels 58, 61, air into the base channels 59, 60 and waste gas into the base channels 51, 55. As the base channels are alternately connected to the outer end and the middle of the regenerator gas paths of equal length are again formed inside the coke oven. By providing heating gas valves and air flaps according to Figure 2 the gas paths can also be equalized in relation to the whole oven battery.

Another method of insulating the base channels carrying the heating gas from those carrying the waste gas is illustrated in Figure 4.

In the oven battery according to Figure 4 waste gas is supplied in one period of operation by the pipes 62 and in the other period of operation by the pipes 62*a*, the pipes 62 being connected with the middle end of the regenerator chambers and the pipes 62*a* with the outer end of the regenerators. Regulating cocks 63 can be provided in the connecting pipe between the pipes 62, 62*a* and the regenerators. In one period of operation air is introduced through the base channels 64 whilst waste gas is withdrawn through the base channels 65 and pipes 62*a*. In the other periods of operation gas is passed through the pipes 62*a*, air through the base channels 65 and waste gas through the base channels 64 and pipes 62.

The disposition of the regenerators and their connection with the base channels and pipes on the one hand and with the channels of the heating walls on the other hand is similar to the construction according to Figure 2 so that in this case also gas paths of equal length are obtained in each coke oven together with an effective insolation of the gas carrying regenerators from the waste heat carrying regenerators by the regenerators carrying air.

My present invention can be applied to all coke ovens wherein the heating channels of the heating walls co-operate in pairs or groups. Whilst in Figure 1 a so-called twin-draught oven is illustrated as an example in which the vertical heating channels of each heating wall co-operate in pairs, Figure 3 illustrates an embodiment of the invention wherein the heating channels of two different heating walls co-operate. For this purpose the horizontal channel 66 into which the heating flues 67 open are connected with the adjacent or another heating wall by a roof channel 69 passing over the oven chamber 68. Then in one period of operation gas and air are introduced into the heating flue 61 and withdrawn through the roof channels 69 into the heating channels of the other wall, and in the other period of operation the waste gases flowing through the roof channels 69 into the vertical channels 67 are withdrawn from the latter.

Finally in Figure 4 the invention is shown as applied to a coke oven in which two heating flues 70 co-operate with two heating flues 71 in such manner that in one period of operation gas and air are burnt in the flues 70 and withdrawn from the flues 71 and vice versa in the other period of operation.

Finally the provision of the base channels or pipes with a covering which is a bad conductor of heat for the purpose of reducing loss of heat is common to all the embodiments illustrated in the drawings.

I do not desire my present invention to be restricted to the details illustrated in the drawings and described above on the contrary the invention may be variously embodied within the scope of the claims hereinafter made.

I claim:—

1. A coking retort oven battery comprising a series of alternate horizontal coking chambers and heating walls therefor arranged laterally of each other in a row, each of said heating walls comprising heating flues, a series of regenerative means disposed beneath said coking chambers and heating walls and operatively disposed in two sets operable in alternation for simultaneous separate inflow preheating of heating gas and air and concurrent waste gas outflow, the regenerative means of one set alternating in position with those of the other set longitudinally of the bat-

tery, each of said regenerative means communicating with the heating flues and running parallel to the coking chambers and being substantially coextensive in length with the whole length of the coking chambers, longitudinal channels extending longitudinally of the battery beneath said regenerative means and operatively disposed in two sets operable in alternation for simultaneous separate inflow of fuel gas and air and concurrent outflow of waste gas, said channels running transversely to the coking chambers, connecting channels communicably connecting the regenerative means of the series thereof with the longitudinal channels, the openings of the connecting channels from the longitudinal channels of one of the sets thereof opening into the regenerative means of one of the sets thereof substantially only adjacent the two opposite sides of the battery, and the openings of the connecting channels from the longitudinal channels of the other of the two sets thereof opening into the regenerative means of the other of the two sets thereof substantially only adjacent the longitudinal median line of the battery.

2. A coking retort oven battery comprising a series of alternate horizontal coking chambers and heating walls therefor arranged laterally of each other in a row, each of said heating walls comprising heating flues, regenerators disposed beneath said coking chambers and heating walls and operatively disposed in two sets operable in alternation for simultaneous separate inflow preheating of heating gas and air and concurrent waste gas outflow, the regenerators of one set alternating in position with those of the other set longitudinally of the battery, said regenerators communicating with the heating flues and running parallel to the coking chambers throughout the whole length thereof, longitudinal channels extending longitudinally of the battery beneath said regenerators and operatively disposed in two sets operable in alternation for simultaneous separate inflow of fuel gas and air and concurrent outflow of waste gas, said channels running transversely to the coking chambers, connecting channels communicably connecting the regenerators with the longitudinal channels, the openings of the connecting channels from the longitudinal channels of one of the sets thereof opening into the regenerators of one of the sets thereof substantially only adjacent the two opposite sides of the battery, and the openings of the connecting channels from the longitudinal channels of the other of the two sets thereof opening into the regenerators of the other of the two sets thereof substantially only adjacent the longitudinal median line of the battery.

3. A regenerative battery as claimed in claim 1 and wherein each of the regenerative means comprises a pair of regenerator chambers end to end and separated by upright partition walls at the longitudinal middle thereof, and the connecting channels communicably connecting the regenerators of said one of said sets thereof with the longitudinal channels of said one of said sets thereof open into the sections of said regenerators substantially only adjacent the longitudinal sides of the battery, and the connecting channels communicably connecting the regenerators of said other of the two sets thereof with the longitudinal channels of said other of the two sets thereof open into the sections of said regenerators substantially only adjacent the longitudinal median line of the battery.

4. A coking retort oven battery comprising, a series of alternate horizontal coking chambers and heating walls therefor arranged laterally of each other in a row, each of said heating walls comprising heating flues, regenerators disposed beneath said coking chambers and heating walls and operatively disposed in two sets operable in alternation for simultaneous separate inflow preheating of heating gas and air and concurrent waste gas outflow, said regenerators communicating with the heating flues, and regenerators of one set alternating in position with those of the other longitudinally of the battery, there being regenerators of each set throughout the length of the coking chambers, at least six longitudinal channels beneath the regenerators and extending side-by-side longitudinally of the battery, each four outer longitudinal channels being connected to the regenerators of one of the two sets thereof substantially only adjacent the longitudinal sides of the battery and two inner longitudinal channels being connected with regenerators of the other of the two sets thereof substantially only adjacent the longitudinal median line of the battery.

5. A coking retort oven battery comprising, a series of alternate horizontal coking chambers and heating walls therefor arranged laterally of each other in a row, each of said heating walls comprising heating flues, regenerators disposed beneath said coking chambers and heating walls and operatively disposed in two sets operable in alternation for simultaneous separate inflow preheating of heating gas and air and concurrent waste gas outflow, said regenerators communicating with the heating flues, and regenerators of one set alternating in position with those of the other longitudinally of the battery, there being regenerators of each set throughout the length of the coking chambers, at least six longitudinal channels beneath the regenerators and extending side-by-side longitudinally of the battery, each four outer longitudinal channels being connected to the regenerators of one of the two sets thereof substantially only adjacent the longitudinal sides of the battery and two inner longitudinal channels being connected with regenerators of the other of the two sets thereof substantially only adjacent the longitudinal median line of the battery, means adapted in one regenerative period of operation of the regenerators to pass heating gas through the outermost of each of the four outer longitudinal channels and air through the others thereof simultaneously and concurrently flow off waste gas through the aforesaid two inner longitudinal channels, and said means being adapted in the next regenerative period of operation of the regenerators to flow off waste gas through each four outer longitudinal channels and pass heating gas and air separately and simultaneously through the two inner longitudinal channels.

6. A regenerative coke oven according to claim 4 having seven of the longitudinal channels beneath the regenerators, each four outermost longitudinal channels being connected to the regenerators of one of the two sets thereof as aforesaid and the three inner channels being connected to the regenerators of the other of the two sets thereof as aforesaid, means adapted in one regenerative period of operation of the regenerators to pass heating gas through the two outermost longitudinal channels, air through the next adjacent channels and waste gases through the three inner channels, and in the other regenerative period of operation of the regenerators to

pass waste gases through each four outer longitudinal channels, heating gas through the middle channel and air through the channels lying between the middle channel and the four outer channels.

7. A regenerative coke oven battery as claimed in claim 4 and in which the longitudinal channels are provided with means for supplying heating gas and air at one end of the oven battery and withdrawing the waste gases from the longitudinal channels at the other end of the battery, and means for bringing the said longitudinal channels into communication with the means for supplying the heating gas and the air on the one hand and with the waste gas withdrawal means on the other hand in such a manner that in one regenerative period of operation of the regenerators some of the transverse channels may be flowed through by heating gas or air and the others by waste gases.

8. A regenerative coke oven as set forth in claim 5 wherein all the regenerators are arranged in groups of three, the members of each group being side by side along the battery, said regenerators being so connected with the said longitudinal channels that in each regenerative period of operation the regenerators of the groups of one set of regenerators are operable for outflow of waste gases and the outermost of the regenerators of each of the groups of the other set of regenerators are operable for inflow of air and the inner regenerator of the group for heating gas.

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