May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

Filed July 20, 1928 7 Sheets-Sheet 1

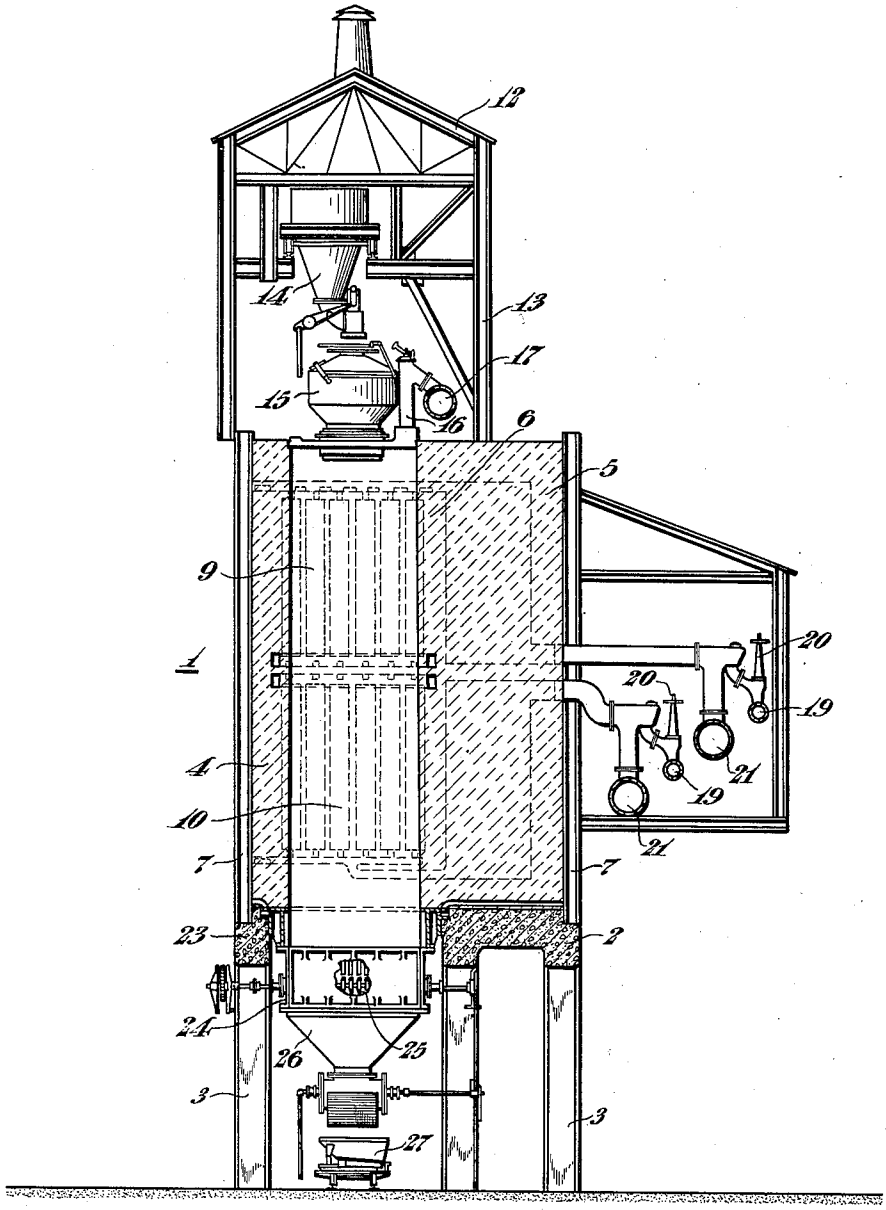

Fig. 1

INVENTOR.
Joseph van Ackeren.
BY Jesse R. Langley
ATTORNEY.

May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

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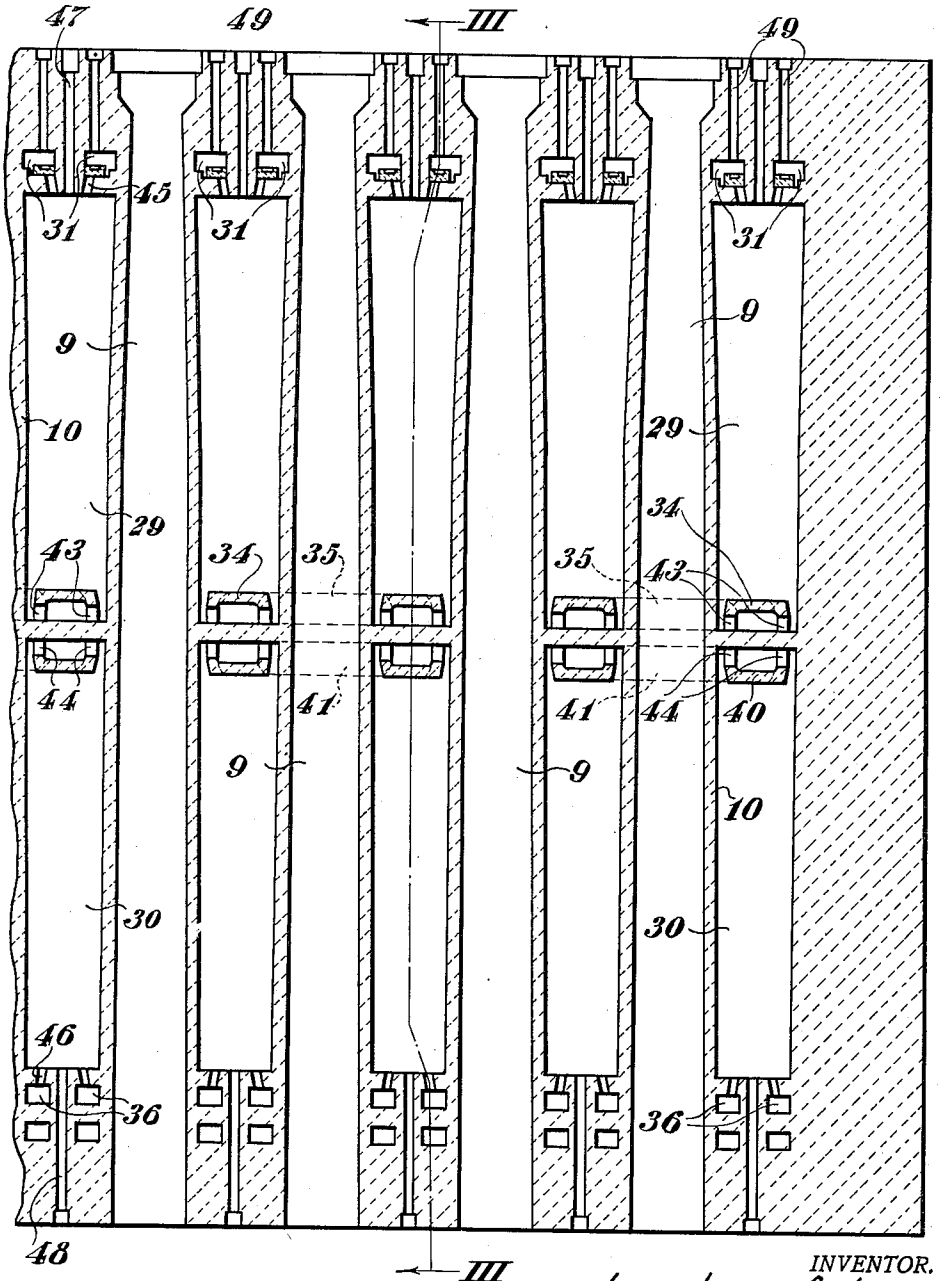

Fig. 2

INVENTOR.
Joseph van Ackeren.
BY
Jesse R. Langley
ATTORNEY.

May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

Filed July 20, 1928 7 Sheets-Sheet 3

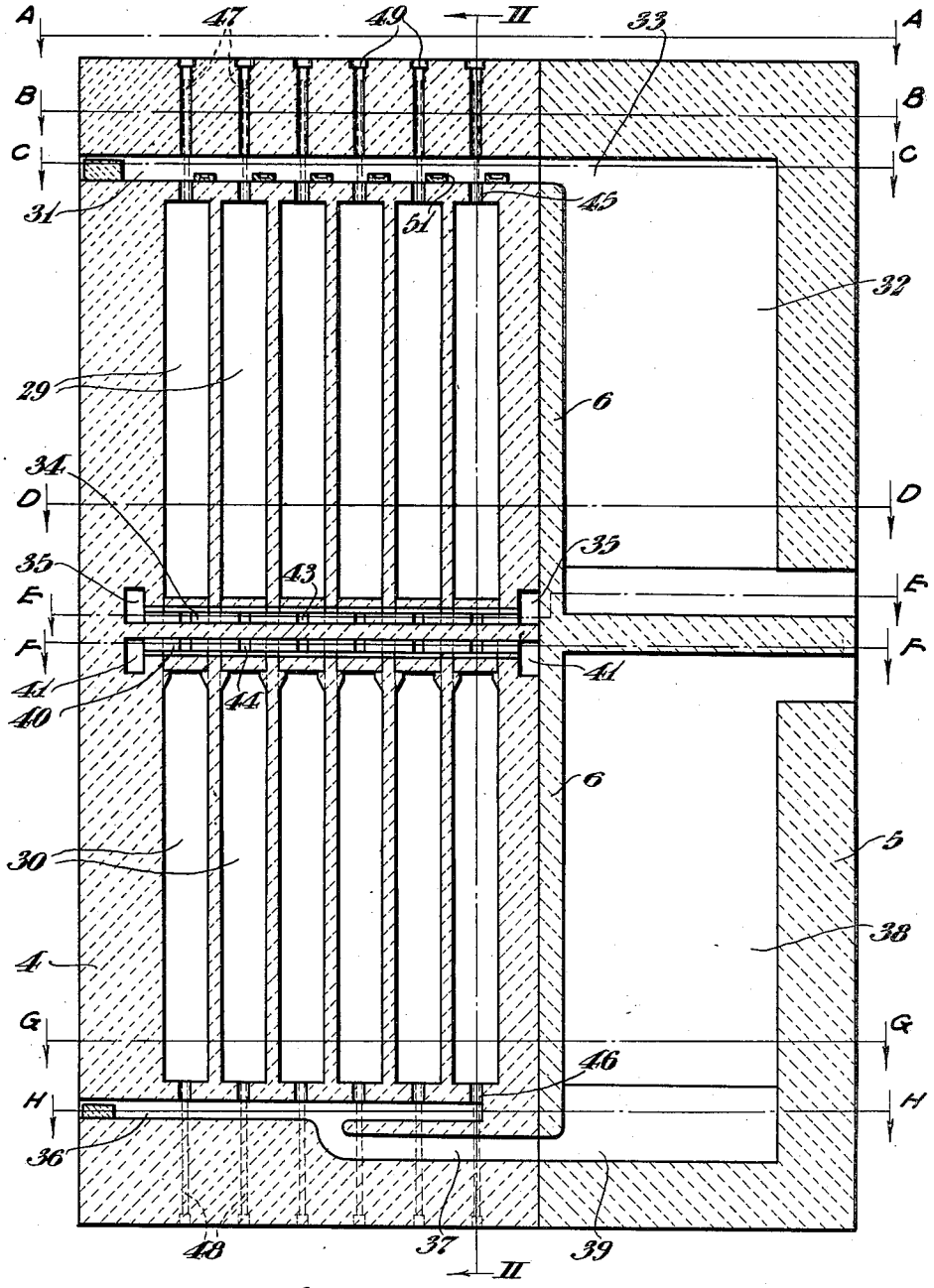

Fig. 3

INVENTOR.
Joseph van Ackeren
BY
Jesse R. Langley
ATTORNEY.

May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

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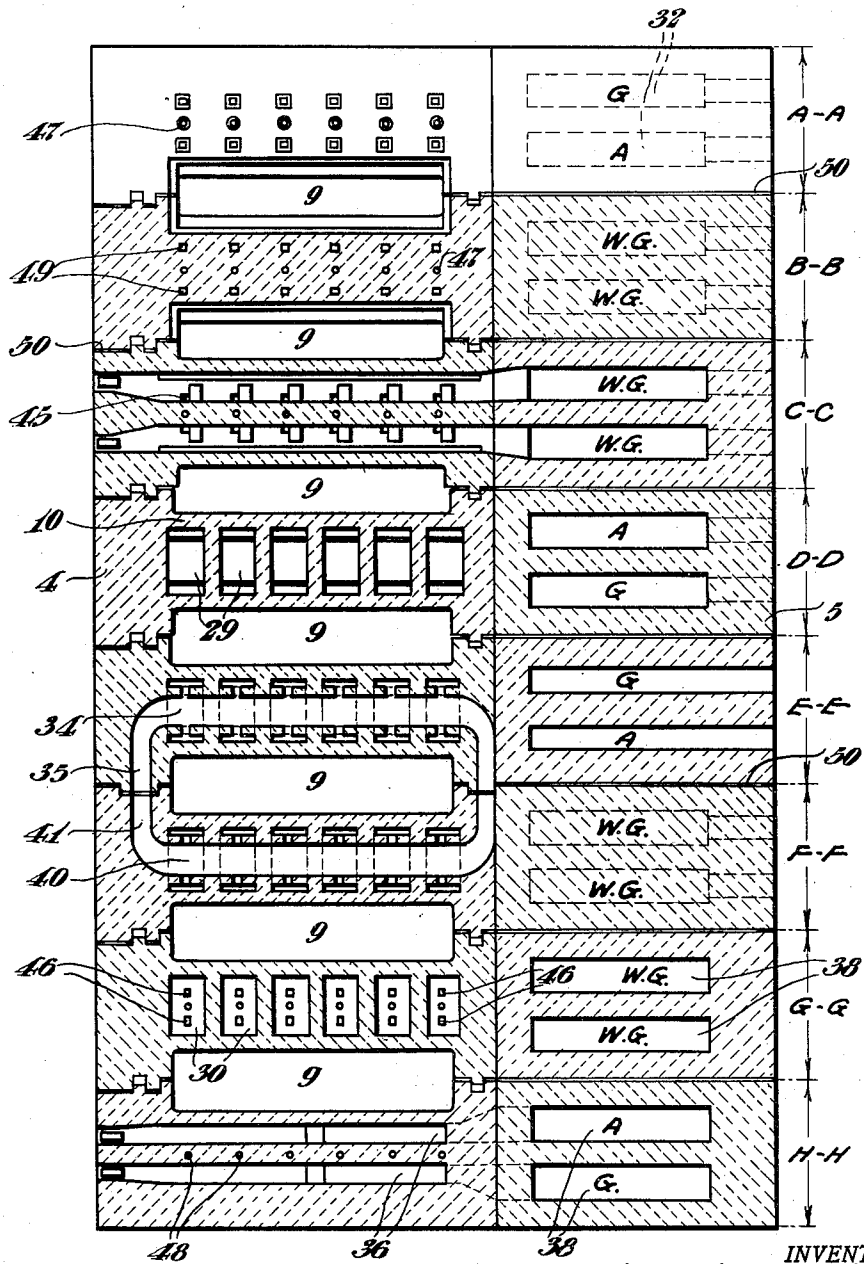

Fig. 4

INVENTOR.
Joseph van Ackeren
BY Jesse Q. Langley
ATTORNEY

May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

Filed July 20, 1928 7 Sheets-Sheet 5

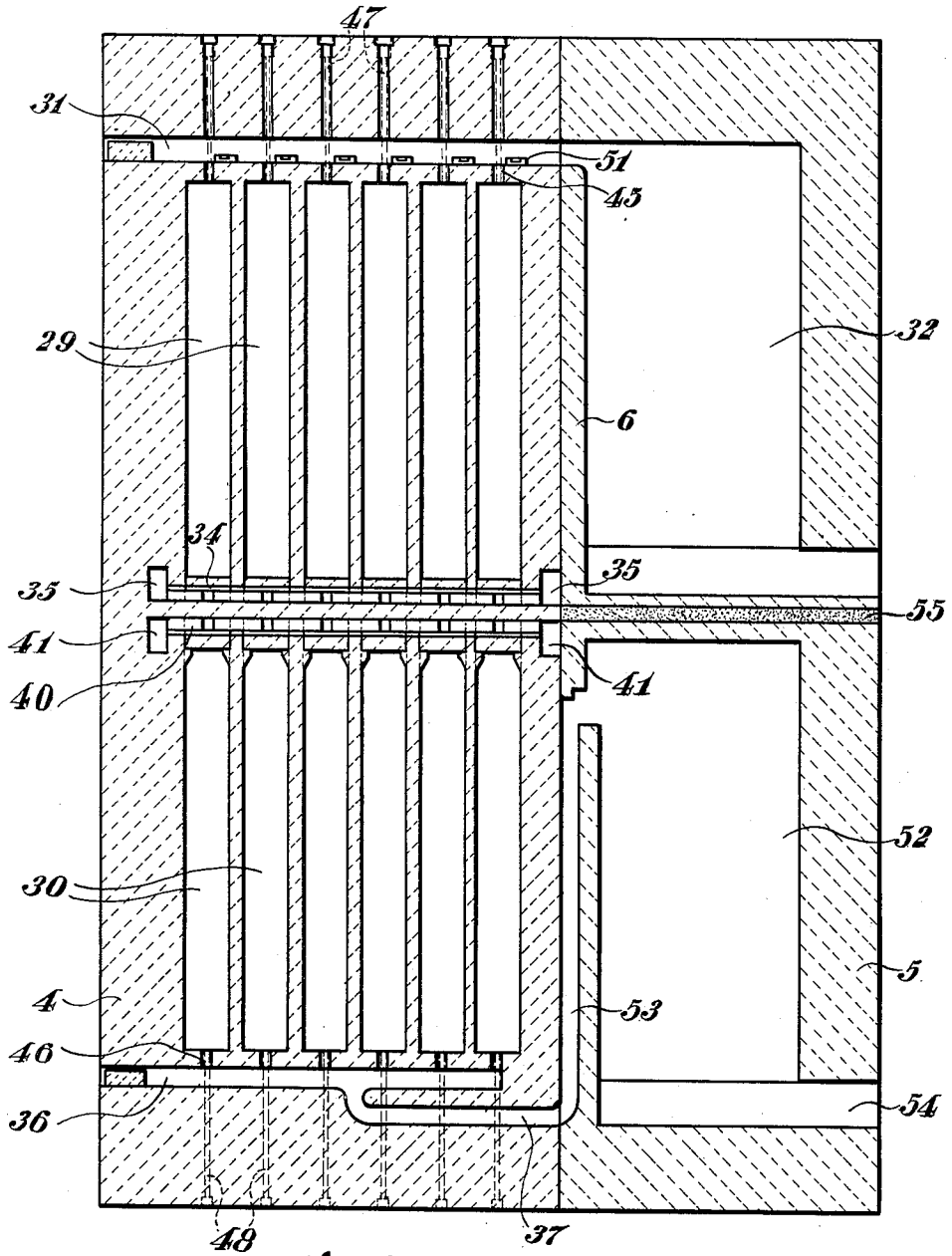

Fig. 5

INVENTOR.
Joseph van Ackeren.
BY
Jesse R. Langley
ATTORNEY.

May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

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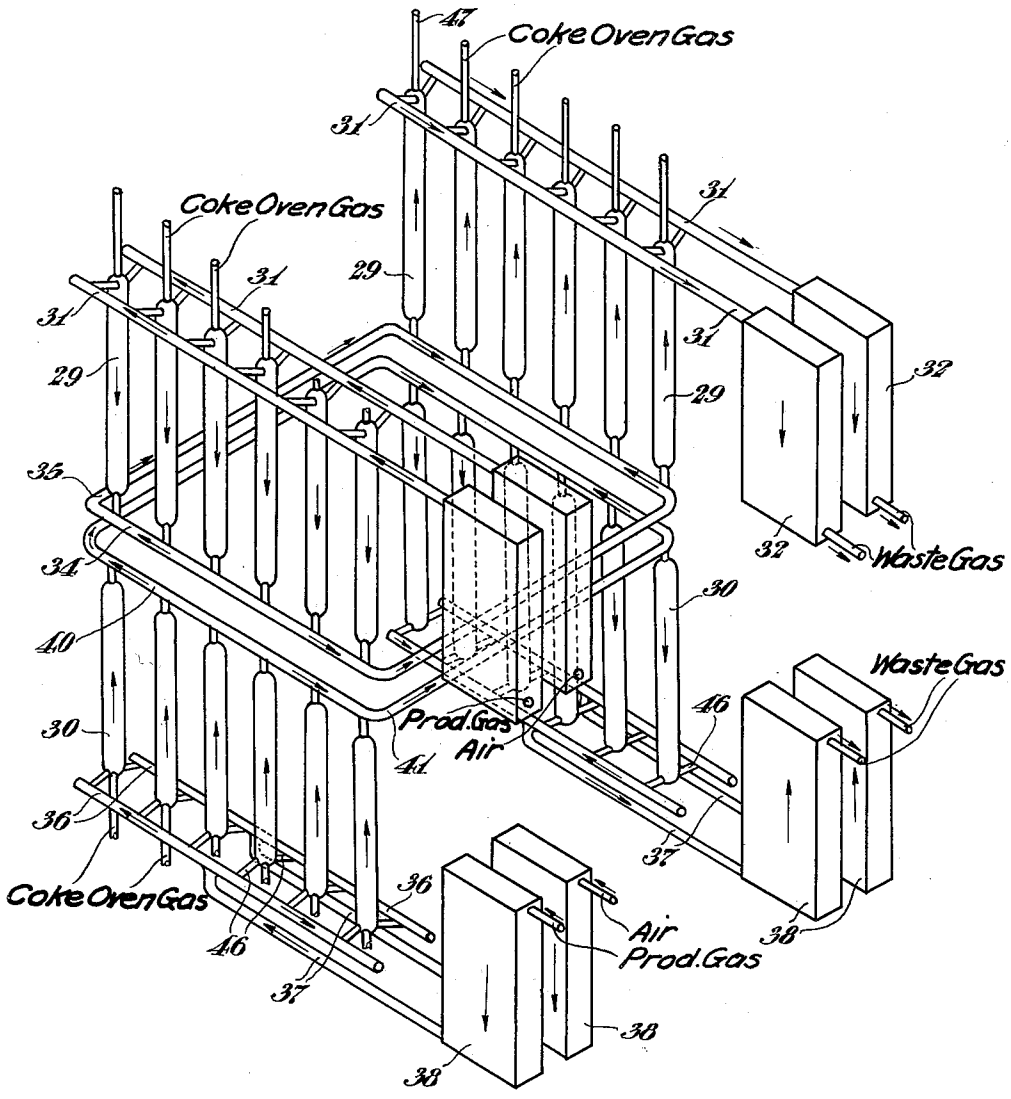

Fig. 6

INVENTOR.
Joseph van Ackeren.
BY Jesse R. Langley
ATTORNEY.

May 9, 1933. J. VAN ACKEREN 1,908,576

COKING RETORT OVEN

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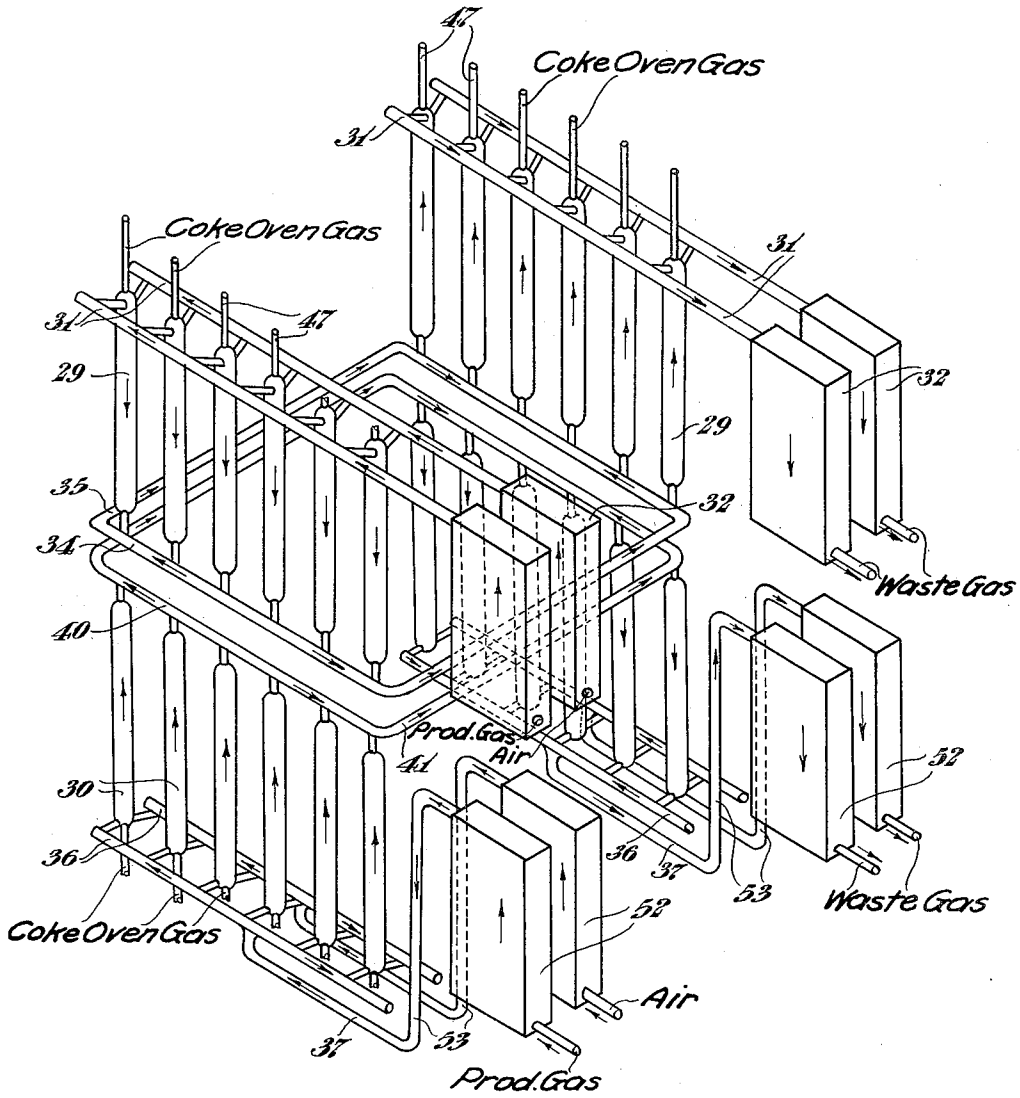

Fig. 7

INVENTOR.
Joseph van Ackeren.
BY
Jesse R. Langley
ATTORNEY

Patented May 9, 1933 1,908,576

UNITED STATES PATENT OFFICE

JOSEPH VAN ACKEREN, OF O'HARA TOWNSHIP, ALLEGHENY COUNTY, PENNSYLVANIA, ASSIGNOR TO THE KOPPERS COMPANY OF DELAWARE, A CORPORATION OF DELAWARE

COKING RETORT OVEN

Application filed July 20, 1928. Serial No. 294,147.

My invention relates to coking retort ovens and particularly to combination coke ovens of the continuous vertical type.

An object of my invention is to provide an improved heating arrangement for continuous vertical coke ovens by means of which the relative temperatures of the upper and the lower portions of the coking chambers may be regulated, as desired.

A further object of my invention is to provide in a battery of vertical coke ovens an improved arrangement in which the friction losses of the gases traversing the heating systems of the ovens are materially reduced.

A further object of my invention is to provide an arrangement for heating coke ovens whereby either lean gas or rich gas may be supplied easily and conveniently to the initial points of combustion in the several flame flues.

A still further object of my invention is to provide a coke-oven battery in which the structure is greatly simplified by the elimination of complicated flue brickwork and intermediate horizontal brickwork.

In the operation of coking retort ovens and particularly of the continuous vertical type, it is extremely desirable that the regulation of the heating of the ovens be sufficiently flexible that a greater amount of heat may be supplied to the upper portions of the ovens than to the lower portions, or that these conditions may be reversed.

It is customary in the operation of vertical coke ovens to generate, by introducing steam into the lower portion thereof, an amount of water gas that is usually dependent upon the desired B. t. u. value of the resultant mixture of coke-oven gas and water gas. The lower the permissible B. t. u. value, the greater is the amount of water gas that is generated.

It will be appreciated that, in coking coal in a continuous vertical oven where little or no water gas is generated, it is desirable to supply less heat to the lower portions of the coking chambers relative to that supplied to the upper portions for the reason that less heat is required to complete the coking operation. If, however, water gas is manufactured in considerable quantities, the lower portions of the oven must receive an additional amount of heat to compensate for the losses caused by the generation of the water gas.

In an intermittent vertical oven, on the other hand, it is necessary to supply more heat to the lower than to the upper portion even when no water gas is generated because a greater amount of coal must be coked simultaneously with that in the upper portion. In case water gas is generated, the supply of heat must be correspondingly increased.

It is desirable, in the operation of combination ovens, that the producer gas and the coke-oven gas be supplied to the same initial points of combustion in order that substantially similar conditions may obtain when using the respective fuels. This is particularly true with regard to the feature of all of the flame flues being occupied at all times by hot gases either in the form of flames or of products of combustion, regardless of the type of fuel.

In accordance with the present invention, I provide heating walls that are connected to operate in pairs. Each heating wall is provided with two superposed groups or series of vertical flame flues that are connected at their respective top and bottom portions by horizontal flues.

Each pair of associated walls has two heating systems that are separate and independent from each other. One comprises the upper groups of flame flues of the two walls that are connected in series with each other and with regenerators that are substantially in extension of the same portion of the heating wall as is occupied by the flame flues. The second system comprises the lower groups of flame flues of the two walls that are similarly connected for operation in series with each other and with regenerators upon which the regenerators for the upper groups are superposed. The regenerators are connected in pairs to each end of each heating system.

By reason of the provision of separate and

independent heating systems, the respective amounts of gas and air supplied to the top portions and the bottom portions of the heating walls may be regulated as desired at the inlets to the regenerators. Inasmuch as the same regenerators are always connected to the same groups of flame flues, the heat balance of each heating system will be maintained since air and gas will always enter through regenerators that have been heated by waste gases traversing them in the opposite direction.

The total path of the gases through the heating system is reduced to substantially half that of a system having high heating walls with continuous flues since the path comprises approximately one-half the height of each of two heating walls. Also, approximately half of the total volume of the gases passes through each of the two heating systems. The friction losses will, therefore, be approximately one-fourth the losses incident to a heating system in which all of the gases traverse a path that is double the length of that of the present arrangement. This construction enables the gases to travel at a comparatively low velocity since their volume has been reduced.

By reason of the facts that the superposed vertical flame flues are entirely separate and independent of each other and the intermediate horizontal flues are of improved construction, the horizontal brickwork for separating them may be of simple and substantial construction. The flame flues may be square in cross-section. These features materially simplify the construction of the battery of coke ovens for the reason that many forms of special bricks are thus eliminated.

The regenerators that are connected to the respective heating systems are in two superposed rows along one side of the battery and each row is in extension of the group of flame flues to which it is connected. In the preferred form of my invention, the tops of the upper regenerators are connected to the upper horizontal flues for connecting the upper portions of the upper group of flame flues. The regenerators of the lower row are connected at their bottom portions to the bottom horizontal flue of the lower group of flame flues. This arrangement very materially simplifies the regenerator connections.

In a modification, the lower regenerators are connected at their top portion to the lower horizontal flues of the lower groups whereby the regenerators of both systems operate in the same manner in that the cold air and fuel gas always enter at the bottoms of the regenerators and the hot waste gases always enter the regenerators at their tops.

The details of my invention will be described in connection with the accompanying drawings, in which

Figure 1 is a view in vertical section of a battery of continuous vertical coke ovens of the combination type constructed in accordance with my invention;

Fig. 2 is a view in vertical longitudinal section, taken on line II—II of Fig. 3 of a portion of a coke-oven battery embodying my invention;

Fig. 3 is a transverse sectional view taken on line III—III of Fig. 2;

Fig. 4 is a view partially in plan, indicated at A—A, and partially in horizontal sections taken on lines B—B, C—C, D—D, E—E, F—F, G—G and H—H of Fig. 3;

Fig. 5 is a view similar to Fig. 3 of a modification;

Fig. 6 is a flow diagram of the heating systems of two adjacent walls of the preferred form of my invention; and

Fig. 7 is a similar diagram of the modification of Fig. 5.

Referring particularly to Fig. 1, a battery 1 of combination vertical coking retort ovens of the continuous type comprises a foundation 2 that is supported by a series of columns 3. Upon the foundation 2 is mounted an oven structure comprising outer walls 4 and 5 and an inner wall 6 that separates the regenerators from the remainder of the battery structure. The battery is provided with the usual buckstays 7 for supporting the respective outer walls of the battery.

Between the walls 4 and 6 are a series of vertical coking retorts or oven chambers 9, through one of which the sectional view is taken, one of the heating walls 10 which alternate with the retorts 9 appearing in this view with its various flues shown in dotted lines.

A superstructure 12 that is supported by framework 13 provides a support for a movable charging car 14 that supplies coal magazines 15 for the several retort ovens 9. Each of the ovens 9 is provided with a gas offtake 16 that is connected to a gas collecting main 17. Producer gas or other lean gas is supplied to the heating walls 10 of the battery through gas mains 19 that are each provided with suitable regulating valves 20. Two waste gas mains 21 conduct waste gases from the regenerators to the stack.

The structure surrounding each of the retort ovens 9 is supported by a hollow metallic frame 23 that is suitably connected to the foundation. Suspended from the frame 23 is a hollow casing 24 within which is located a power-driven coke-extractor mechanism 25. A coke magazine 26 is suspended from the casing 24 and is arranged to discharge its contents into a coke-receiving car 27 that operates beneath the battery.

Reference may now be had to Figs. 2, 3 and 4, in which the details of the heating walls

and the connections of the flame flues and regenerators are illustrated. Each heating wall 10 is provided with two superposed series of vertical flame flues 29 and 30, respectively.

The upper series of flame flues 29 of the heating wall shown in Fig. 3 are connected to two upper horizontal flues 31 that are each connected to one of a pair of regenerators 32 through sole channels 33 at the tops of the regenerators. The lower ends of the flame flues 29 are connected to a single lower horizontal flue 34, each end of the lower horizontal flue 34 extending into a cross-around flue 35 by means of which the flue 34 is connected to a corresponding horizontal flue 34 in an adjacent heating wall 10.

The lower series of flame flues 30 of the heating wall 10 shown in Fig. 3 is similarly connected to two lower horizontal flues 36, substantially the central portions of which are respectively connected by a duct 37 to one of a pair of regenerators 38 through sole flues 39 at the bottoms of the regenerators. The upper ends of the flame flues 30 are connected to a single upper horizontal flue 40, each end of which extends into a cross-around flue 41 for connecting the horizontal flue 40 to a similar horizontal flue 40 in the adjacent wall.

Referring particularly to Fig. 2, it will be noted that the horizontal flues 34 and 40 of the respective upper and lower groups of flame flues are narrower than the corresponding flues and that the flues 29 and 30 are connected to the horizontal flues by pairs of horizontal ducts 43 and 44, respectively. This construction insures that hot gases traverse substantially the entire length of the heating wall and dead space is substantially eliminated. The bottle bricks of the flame flues extend to the horizontal brickwork. The structure is stronger than in the construction in which the bottle bricks extend only to the tops or the bottoms of the horizontal flues, as the case may be.

The foregoing system of connections provides an arrangement in which the heating walls are connected in pairs. The upper groups or series of flame flues of the pair of walls, together with the pairs of regenerators connected thereto, constitute one heating system. Similarly, the lower groups or series of flame flues of the associated walls constitute a similar but entirely separate and independent system for heating the lower portions of the adjacent coking chambers.

The regenerators 38 are arranged in a row along the side of the battery and they are in extension of substantially the same portion of the heating wall that is occupied by the lower group of flame flues. The regenerators 32 are superposed on the regenerators 38 and they are substantially in extension of the portion of the heating wall that is occupied by the upper group of flame flues. Inasmuch as the adjacent portions of the several regenerators are always subject to substantially the same temperature conditions, it is not necessary to provide an expansion joint between them.

Referring particularly to Fig. 4, it will be noted that the battery comprises, by way of example, seven retort ovens 9, and eight heating walls 10, although this number may be varied as desired. The heating walls 10 are connected in pairs by means of the pairs of cross-around flues 35 and 41, the arrangement for each heating system being similar at the intermediate portions of the walls. The horizontal flues 31 are connected to the flame flues 29 by inclined ducts 45. The horizontal flues 36 are similarly connected to the lower flame flues by ducts 46.

As shown in Figs. 2 and 3, the upper flame flues of the respective heating walls may be supplied with coke-oven gas and other rich gas through gas guns 47, which extend from the top of the battery through the brickwork between the horizontal flues 31 into the upper portions of the flame flues 29. The lower flame flues 30 are similarly provided with means for supplying rich gas by means of gas guns 48 that extend from the bottom of the battery through the brickwork between the horizontal flues 36 into the lower portions of the flame flues 30. The usual gas mains (not shown) for rich gas are, in practice, connected to the several gas guns 47 and 48. The lower gas guns 48 serve as inspection openings for the lower flame flues 30. The upper flame flues 29 are provided with inspection openings 49.

Referring to Fig. 4, the battery structure is provided with a series of expansion joints 50 that extend transversely of the battery through the walls 4, 5 and 6, between the adjacent regenerator units and into the oven chambers of the several coke ovens. By means of this construction, no combustible gases or waste gases are obliged to pass through the expansion joints, except through the cross-around flues, and leakage of the combustible gases and waste gases is, therefore, substantially entirely avoided. This arrangement is of advantage, also, in that the expansion of each unit, which comprises a system of regenerators and the corresponding heating wall, may be confined to that unit and such expansion is not transmitted to any portion of an adjacent unit.

The operation of the battery of vertical coking retort ovens shown in Figs. 1, 2, 3 and 4 will now be described with particular reference to the employment of lean gas as a fuel, the direction of the gases being that diagrammatically shown in Fig. 6.

It may be assumed that the several oven chambers 9 are being supplied with coal from their respective magazines 15 and that the coal in the various oven chambers is in vari-

ous stages of coking corresponding to the distance it has travelled from the tops of the ovens, finished coke being removed by the coke extractors 25.

Fuel gas such as producer gas is supplied from the gas mains 19 to a regenerator 32 corresponding to the upper group of flame flues of one wall of each associated pair, as indicated by legends in Fig. 6. Air is supplied to the other regenerator of the pair and fuel gas and air are supplied through the corresponding horizontal flues 31 and ducts 45 to each of the flame flues 29 for burning downwardly therein, as indicated by the arrows (Fig. 6). Sliding bricks 51 regulate the relative amounts of gas and air supplied to the several flame flues.

The products of combustion pass downwardly through the flame flues 29 and through the ports 43 into the lower horizontal flue 34. The gases pass outwardly in both directions in the horizontal flue 34 into the cross-around flues 35 and horizontal flue 34 of the adjacent wall, from which they are distributed to the several flame flues 29 and then pass outwardly through the connected ducts and horizontal flues and regenerators 32 connected thereto, as indicated in the flow diagram. The waste gases are then conducted to the stack in the usual manner through the corresponding waste gas main 21.

In a similar manner, fuel gas and air are supplied to the lower group of flame flues 30 through the regenerators 38 and ducts 37 to the lower horizontal flues 36 for distribution to the several flame flues 30 for burning upwardly therein. The connection of the regenerators to the mid-points of the horizontal flues 36 renders sliding bricks unnecessary. The products of combustion pass through the upper horizontal flue 40 and connected cross-around flues 41 for distribution through the flame flues 30 of the connected wall and thence outwardly through the horizontal flues 36, horizontal ducts 37 and regenerators 38 to the stack in the usual manner.

It will be noted that combustion occurs initially at the tops of the upper flame flues and at the bottoms of the lower flame flues of the wall in which combustion occurs and the gases pass in opposite directions toward the intermediate portion of the wall and then pass to the flame flues of the connected wall. The gases then pass in opposite directions toward the upper and lower portions of the wall and outward to the stack.

This operation is periodically reversed in that air and gas are supplied to the regenerators of the heating wall previously transmitting waste gases and waste gases are withdrawn through the regenerators that were previously cooled by the introduction of air and fuel gas. The regenerators are thus permanently connected to the groups of flame flues to which they either supply fuel gas and air or from which they are supplied with waste gases. The heat balance of the system is, therefore, maintained. The operation of one pair of heating walls which has been described above is typical of that of each pair of the battery.

It will be understood, also, that the various connections for the several pairs of heating walls are controlled simultaneously in order that uniform conditions may obtain throughout the battery. The connections of the regenerators in each row is preferably that indicated by the legends A, G and WG, Fig. 4, in which a regenerator for transmitting air is always between regenerators for transmitting fuel gas and waste gases, respectively, in order that there may be no leakage and resultant loss of fuel gas into the stack gases.

When it is desired to use rich gas, such, for example, as coke-oven gas, it is supplied to the several flame flues through the respective gas guns 47 and 48 while each of the inflow regenerators transmit air through the connected horizontal flues 31 and 36 to the same initial points of combustion as in the case of producer gas. The direction of flow of products of combustion is identical with that described in connection with lean gas. Accordingly, all of the flame flues are at all times traversed by hot gases regardless of whether rich gas or lean gas is employed as a fuel.

The operation of the regenerators 32 just described is not the normal method but the regenerators are so narrow in cross-section that the distribution of the gases traversing them is not a problem, as is the case when large regenerators are employed.

Reference may now be had to the modification shown in Fig. 5 and diagrammatically in Fig. 7, in which similar reference numerals are employed to designate like parts. In the modification, the system of connections is similar to that previously described. In the modification, however, the connections of the lower regenerators 52 are connected at their top portions to the lower horizontal flues 36 by means of a vertical duct 53.

This arrangement enables the lower regenerators 52 to operate in a normal manner in that the cold gases and air, as the case may be, always enter the regenerator at the bottom through a sole flue 54 and hot gases always enter the regenerators at the top portion. The operation otherwise is identical with that described in connection with the structure shown in Figs. 1 to 4 and 6.

In the modified construction, there is, however, a variation in temperature conditions between the adjacent portions of the upper and the lower regenerators by reason of the fact that the lower regenerators 52 are always traversed at their top portion by gases of considerably higher temperatures than those traversing the lower portion of the upper regenerators 32. Accordingly, it is

necessary to provide an expansion joint 55 extending horizontally between the rows of the regenerators to provide for the relative expansions of the adjacent walls. The expansion joints 55 are filled with rock wool which permits relative movements of the sides of the joint but effectually prevents any leakage of gases therethrough.

A battery of vertical coke ovens constructed in accordance with my invention possesses numerous advantages. The arrangement of the regenerators in superposed rows provides a compact construction by reason of which there is comparatively small radiation surface and heat losses from this cause are accordingly reduced.

The provision of separate and independent heating systems for each pair of associated walls enables the upper and the lower portions of the walls to be heated, as desired, in order to take care of various operating conditions, such, for example, as the manufacture of water gas.

The initial points of combustion are provided at the tops of the upper flame flues which should normally be at a higher temperature than the remaining portion of the upper flame flues since this portion of the wall first comes in contact with the relatively cold coal. Also, the initial points of combustion in the lower portion of the wall occur at the bottom of the wall and any variation in the heating of the lower portion would be a decrease toward the intermediate portion. Any variation in the heating of the upper portion of the wall would also be a decrease toward the intermediate portion of the wall. This condition is desirable as the intermediate portion should not receive more heat than the end portions and usually should receive less heat.

In the arrangement provided herein, the flames of combustion are entirely within the flame flues and passageways for connecting them to the flame flues of the associated wall. There is, accordingly, no difficulty attending their distribution throughout various portions of the heating system.

The heating walls of the battery of my invention have substantially no dead space since the hot gases traverse the entire length of the flame flues, the upper and lower flues being separated by a relatively thin partition wall of simple construction.

The foregoing and other advantages will be apparent to those skilled in the construction and operation of coking retort ovens. My invention may be variously modified and its scope is not limited to the embodiment shown and described herein except as expressed in the claims.

I claim as my invention:

1. A coking retort oven battery comprising a series of alternate coking chambers and heating walls therefor arranged side by side, each of said heating walls being provided with two superposed series of flame flues, pairs of regenerators communicating with each series of flame flues respectively at one of their ends, and means for communicably connecting each series of flame flues at their other ends to a series of an adjacent one of said walls.

2. A coking retort oven battery comprising two horizontally spaced co-operating heating walls, each of which is provided with two superposed series of vertical flame flues and horizontal flues for communicably connecting the end portions of the flues in each series, cross-around flues for communicably connecting the adjacent or inner horizontal flues of each wall to the corresponding horizontal flue of the other wall and a regenerator communicating with each of the other horizontal flues in each of said walls.

3. A coking retort oven battery comprising two horizontally spaced co-operating heating walls, each of which is provided with two superposed series of vertical flame flues and horizontal flues communicating with the end portions of the flues in each series, cross-around flues for communicably connecting the lower horizontal flues of the upper series of flame flues of said walls and for communicably connecting the upper horizontal flues of the lower series of flame flues of said walls and regenerators communicating with the other horizontal flues, the regenerators for each series being in pairs and disposed in alinement with the heating walls containing that series of flame flues.

4. A coking retort oven battery comprising two horizontally spaced co-operating heating walls, each of which is provided with two superposed series of vertical flame flues and horizontal flues for communicably connecting the end portions of the flues in each series, cross-around flues for communicably connecting the lower horizontal flues of the upper series of flame flues of said walls and for communicably connecting the upper horizontal flues of the lower series of flame flues of said walls and regenerators communicating with the other horizontal flues, the regenerators for the respective series of each wall being in pairs superposed in alinement with the heating wall containing the corresponding series.

5. A coking retort oven battery comprising two horizontally spaced heating walls, the upper and the lower portions of each wall being provided with separate groups of flame flues, means for connecting the upper groups of flame flues of said walls for operation in series and for connecting the lower groups of flame flues for similar operation, and separate means for supplying combustible gases to the respective series of groups through the upper and the lower groups of the same wall.

6. A coking retort oven battery comprising two horizontally spaced heating walls, the upper and the lower portions of each wall being provided with separate groups of vertical flame flues, means for connecting the upper groups of flame flues of said walls for operation in series and for connecting the lower groups of flame flues for similar operation, and means for supplying combustible gases to the respective series of groups of flame flues at the top of the upper group and the bottom of the lower group in one of said walls.

7. A coking retort oven battery comprising two heating walls each provided with two superposed groups of vertical flame flues and two pairs of superposed regenerators, means for connecting the upper groups of said walls in series and means for connecting the lower groups of said walls in series, each pair of regenerators being communicably connected to one of said groups of flame flues and being disposed substantially in horizontal alinement with the group to which they are connected.

8. A battery of vertical coking retort ovens comprising a series of oven chambers and heating walls therefor arranged side by side, each of said walls having two superposed groups of vertical flame flues, a series of regenerators along one side of the battery substantially in horizontal alinement with and communicating with the lower groups of flame flues, and a superposed series of regenerators having the same relation to the upper groups of flame flues.

9. A battery of vertical coking retort ovens comprising a series of oven chambers and heating walls therefor arranged side by side, each of said walls having two superposed groups of flame flues, means for connecting each group of flues in a series with a group of flues of another of said walls, a series of regenerators along one side of the battery substantially in horizontal alinement with the lower groups of flame flues, a superposed series of regenerators having the same relation to the upper groups of flame flues, and means for communicably connecting the top portions of the upper series of regenerators to the upper groups of flame flues and portions of the lower series of regenerators to the lower groups of flame flues.

10. A battery of vertical coking retort ovens comprising a series of oven chambers and heating walls therefor, each of said walls having two superposed groups of vertical flame flues, means for connecting each group of flues in series with a group of flues of another of said walls, a series of regenerators along one side of the battery substantially in horizontal alinement with the lower groups of flame flues, a superposed series of regenerators having the same relation to the upper groups of flame flues, and means for communicably connecting the top portions of the upper series of regenerators to the upper group of flame flues and portions of the lower series of regenerators to the lower group of flame flues.

11. A battery of vertical coking retort ovens comprising a series of alternate oven chambers and heating walls therefor arranged side by side, each of said walls having two groups of vertical flame flues in superposed relation, means for connecting each group of flues in series with a group of flues of another of said walls, two superposed series of regenerators respectively in alinement with approximately the upper and the lower half of the adjacent heating wall and means for communicably connecting one end of each regenerator to a corresponding portion of a group of flues.

12. A battery of vertical coking retort ovens comprising a series of alternate oven chambers and heating walls therefor arranged side by side, each of said walls having two groups of vertical flame flues in superposed relation, two superposed series of regenerators respectively in alinement with approximately the upper and the lower half of the adjacent heating wall and means comprising substantially horizontal ducts for communicably connecting one end of each regenerator to one of said groups of flame flues.

13. A coking retort oven battery comprising two heating systems each of which consists of two groups of flame flues connected in series, the connecting means for said groups comprising a flue for communicably connecting the corresponding end portions of the flame flues of each group and a passageway communicating with a connecting flue of each group and a corresponding flue of the other group in the system, and regenerators communicating with each of the other connecting flues of the several groups, each group of one system being in superposed relation with respect to a group of the other system, and the regenerators of one system being superposed with respect to the regenerators of the other system.

14. A battery of vertical coking retort ovens comprising heating walls arranged in co-operating pairs, each of said walls being provided with two superposed groups of flame flues, means for connecting each group of flues of said walls in series with a group of flues of another of said walls, means comprising regenerators permanently in series with the lower group of flame flues for transmitting combustion media thereto or transmitting waste gases therefrom according to the direction of flow through said flame flues, and means comprising other regenerators superposed on the regenerators for the lower group and permanently in series with flame flues of the upper group for similarly

but independently transmitting combustion media to or waste gases from said upper group.

15. A battery of vertical coking retort ovens comprising heating walls arranged in co-operating pairs, each of said walls being provided with two superposed groups of flame flues, means for connecting the upper groups of a pair of walls in series and means for similarly connecting the lower groups of said pair of walls, means comprising regenerators permanently in series with the lower groups of flame flues for transmitting combustion media thereto or transmitting waste gases therefrom according to the direction of flow through said flame flues, and means comprising other regenerators superposed on the regenerators for the lower groups and permanently in series with flame flues of the upper groups for similarly but independently transmitting combustion media to or waste gases from said upper groups.

16. A vertical coking retort oven battery comprising two horizontally spaced heating walls each of which is provided with two superposed groups of vertical flame flues and horizontal brickwork in each of the heating walls between the upper and lower groups of flame flues therein, horizontal flues in said brickwork and respectively communicably connected to the flame flues of the upper and the lower groups, cross-around flues for communicably connecting the corresponding horizontal flues of the two walls and thereby connecting the upper groups in series and similarly connecting the lower groups, and separate means for supplying combustible gases to each of said series of groups of flame flues.

17. A vertical coking retort over battery comprising two horizontally spaced heating walls each of which is provided with two superposed groups of vertical flame flues and horizontal brickwork in each of the heating walls between the upper and lower groups of flame flues therein, horizontal flues in said brickwork and respectively communicably connected to the flame flues of the upper and the lower groups, cross-around flues for connecting the corresponding horizontal flues of the two walls in series and thereby connecting the upper groups in series and similarly connecting the lower groups, and separate means for supplying combustion media to each of the series of groups of flame flues, said supplying means comprising regenerators arranged in superposed rows and permanently communicably connected to the respective series of groups.

18. A vertical coking retort oven battery comprising two horizontally spaced heating walls, the upper and the lower portions of each wall being provided with separate groups of vertical flame flues, means for connecting the upper groups of flame flues of said walls for operation in series and for connecting the lower groups of flame flues for similar operation and means for supplying combustible gases to the respective series of groups of flame flues at the top of the upper group and the bottom of the lower group in one of said walls, said supplying means comprising air regenerators and fuel gas regenerators for said groups of flame flues.

19. A vertical coking retort oven battery comprising two horizontally spaced heating walls, the upper and the lower portions of each wall being provided with separate groups of vertical flame flues, means for connecting the upper groups of flame flues of said walls for operation in series and for connecting the lower groups of flame flues for similar operation and means for supplying combustible gases to the respective series of groups of flame flues at the top of the upper group and the bottom of the lower group in one of said walls, said supplying means comprising air regenerators and passageways for supplying coke-oven gas or other rich gas to each of said groups.

20. A vertical coking retort oven battery comprising two horizontally spaced heating walls, the upper and the lower portions of each wall being provided with separate groups of vertical flame flues, means for connecting the upper groups of flame flues of said walls for operation in series and for connecting the lower groups of flame flues for similar operation and means for supplying combustible gases to the respective series of groups of flame flues at the top of the upper group and the bottom of the lower group in one of said walls, said supplying means comprising regenerators for air, or for air and gas, and means for supplying rich gas to said flame flues.

In testimony whereof, I have hereunto subscribed my name this 17th day of July 1928.

JOSEPH VAN ACKEREN.