June 5, 1934.

J. VAN ACKEREN

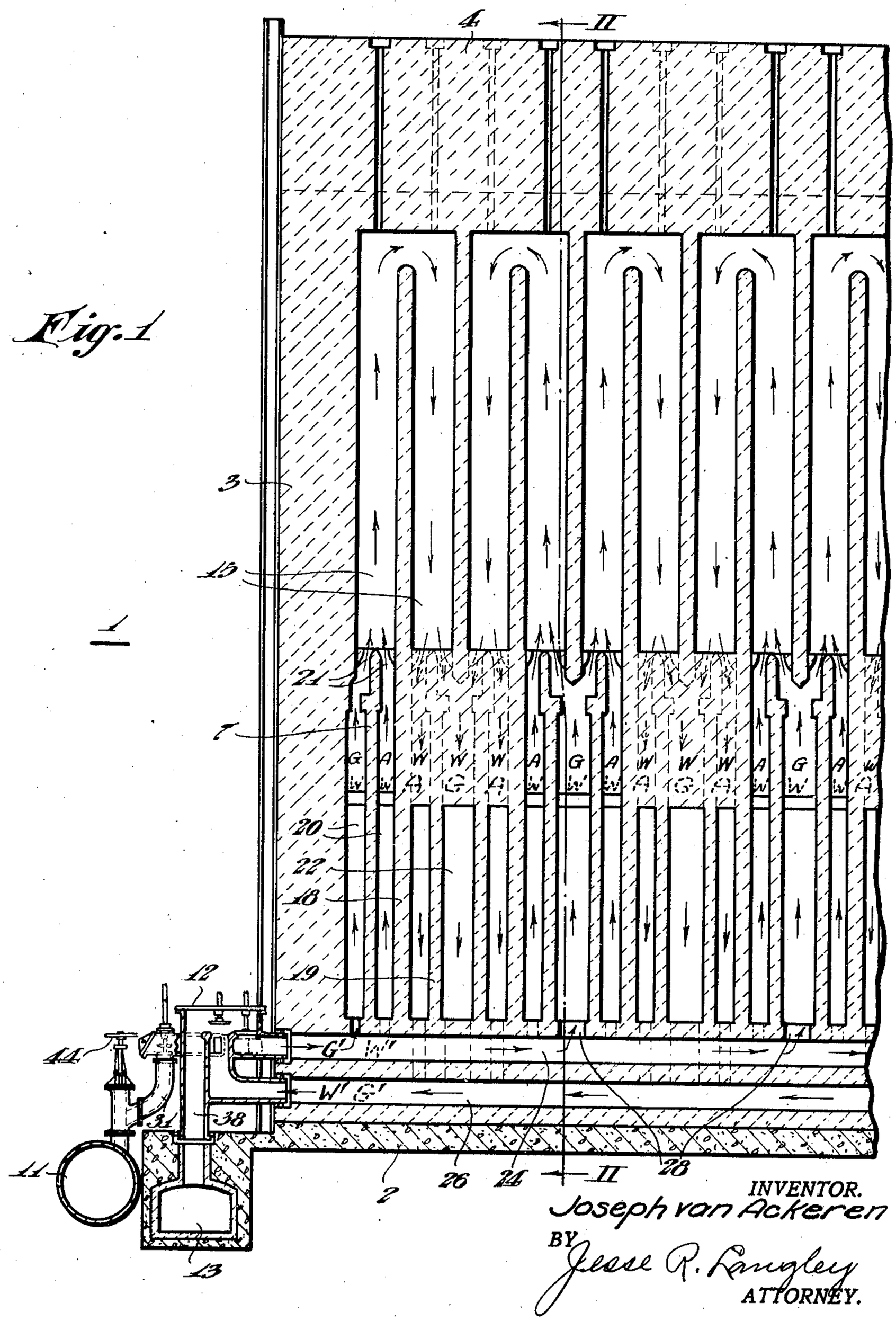
1,961,265

COKING RETORT OVEN

Filed Jan. 28, 1930

6 Sheets-Sheet 1

Fig. 1



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COKING RETORT OVEN

Filed Jan. 28, 1930 6 Sheets-Sheet 2

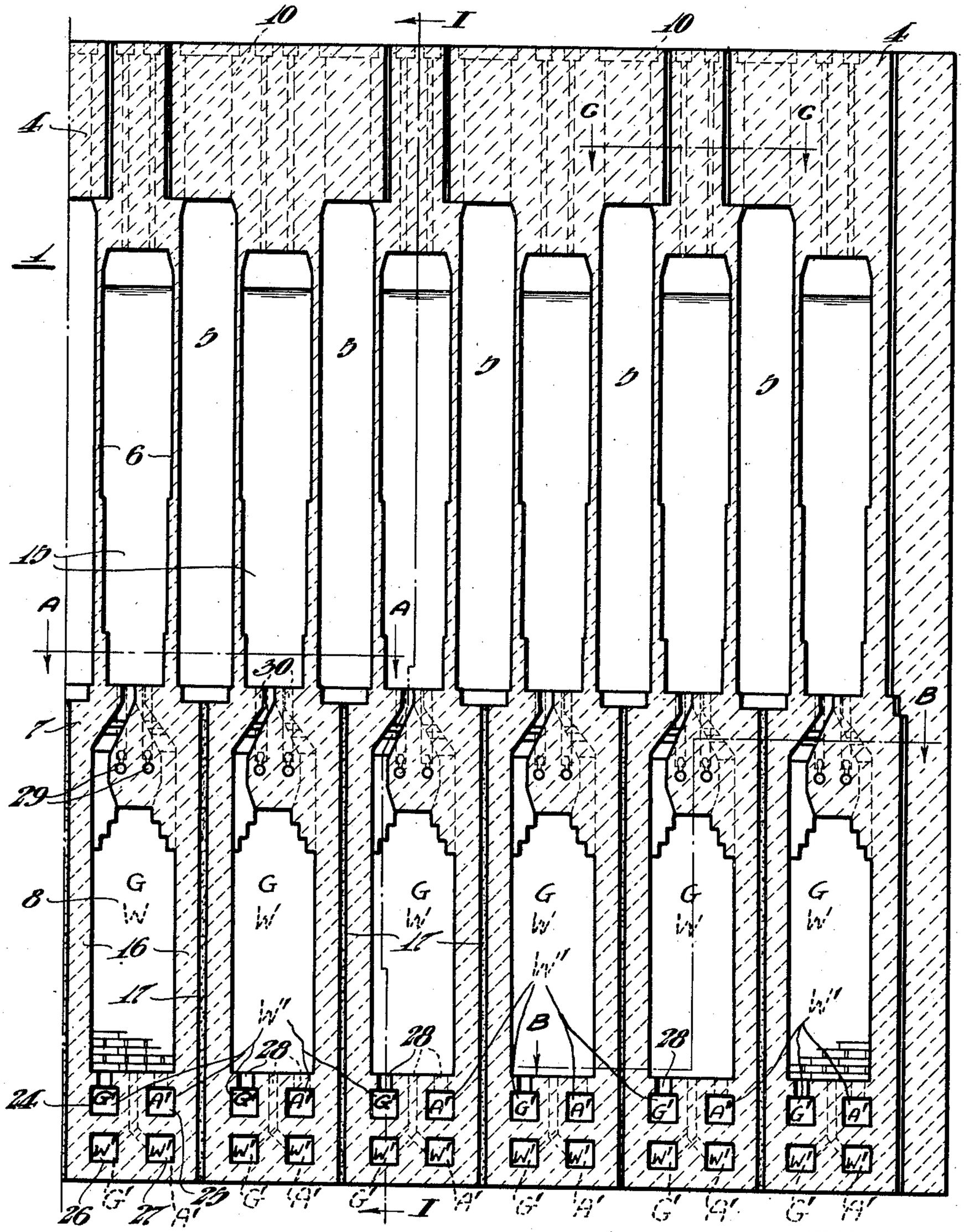

Fig. 2

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6 Sheets-Sheet 3

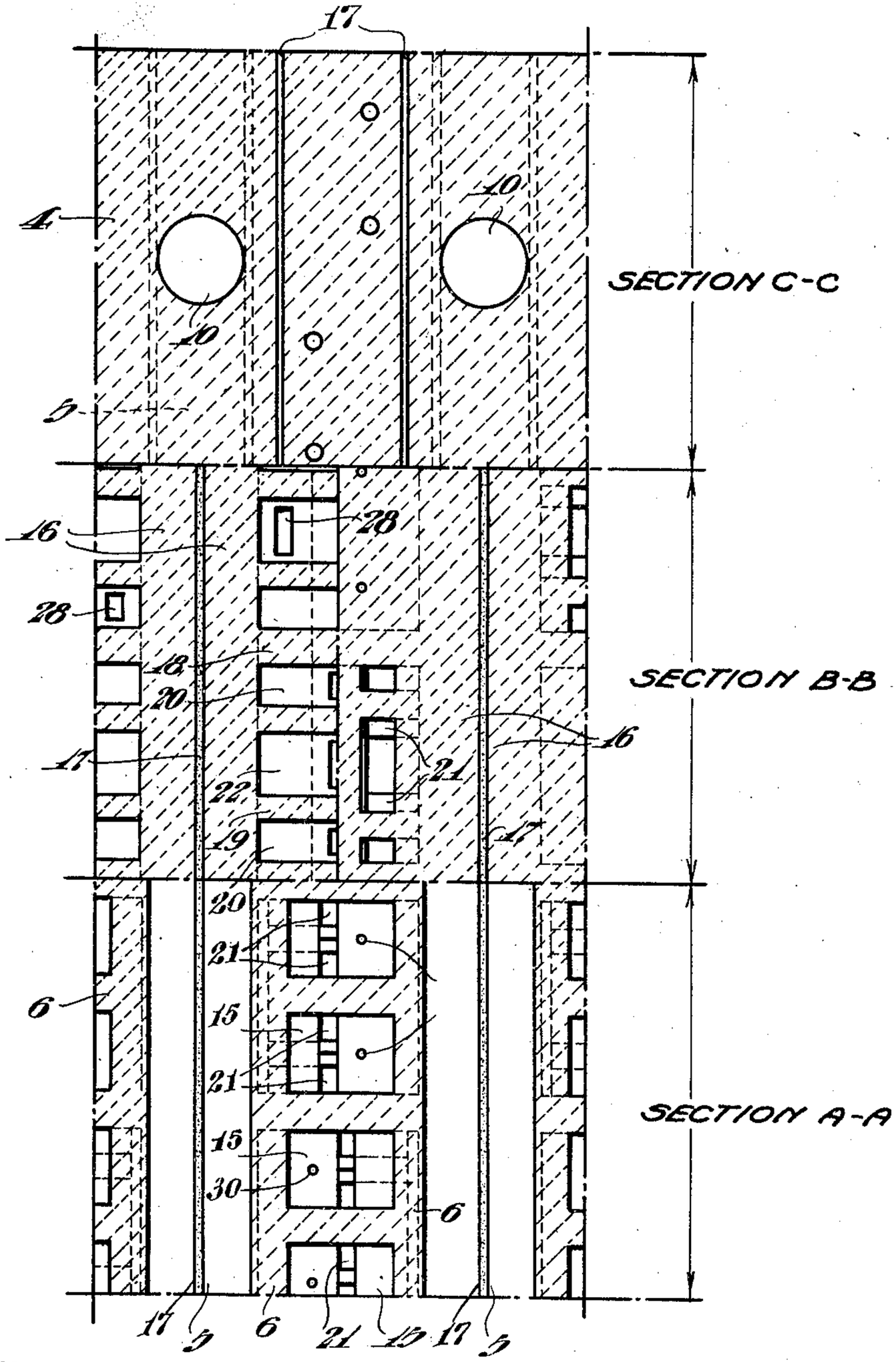

Fig: 3

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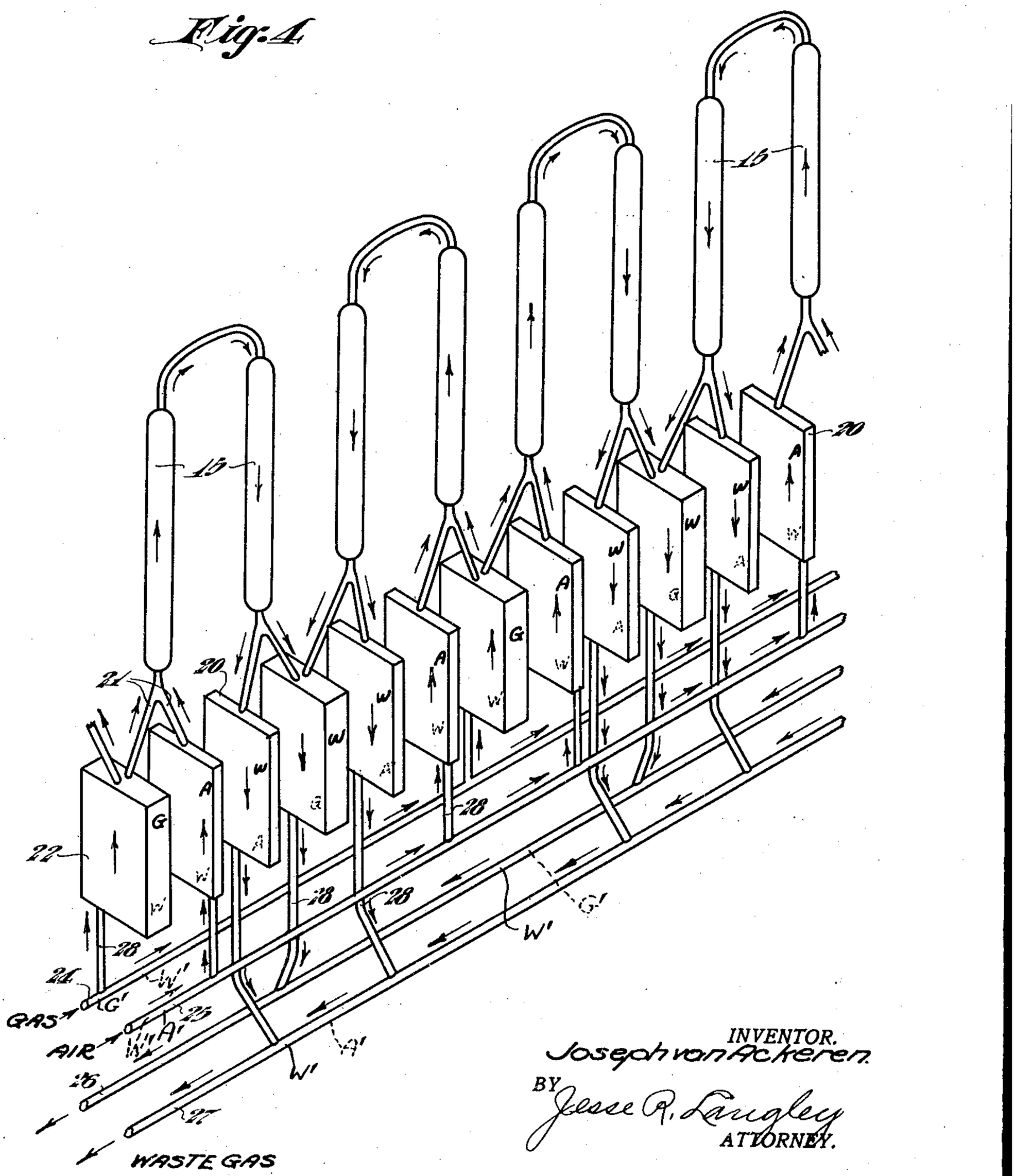
COKING RETORT OVEN

Filed Jan. 28, 1930 6 Sheets-Sheet 4

Fig. 4



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COKING RETORT OVEN

Filed Jan. 28, 1930 6 Sheets-Sheet 5

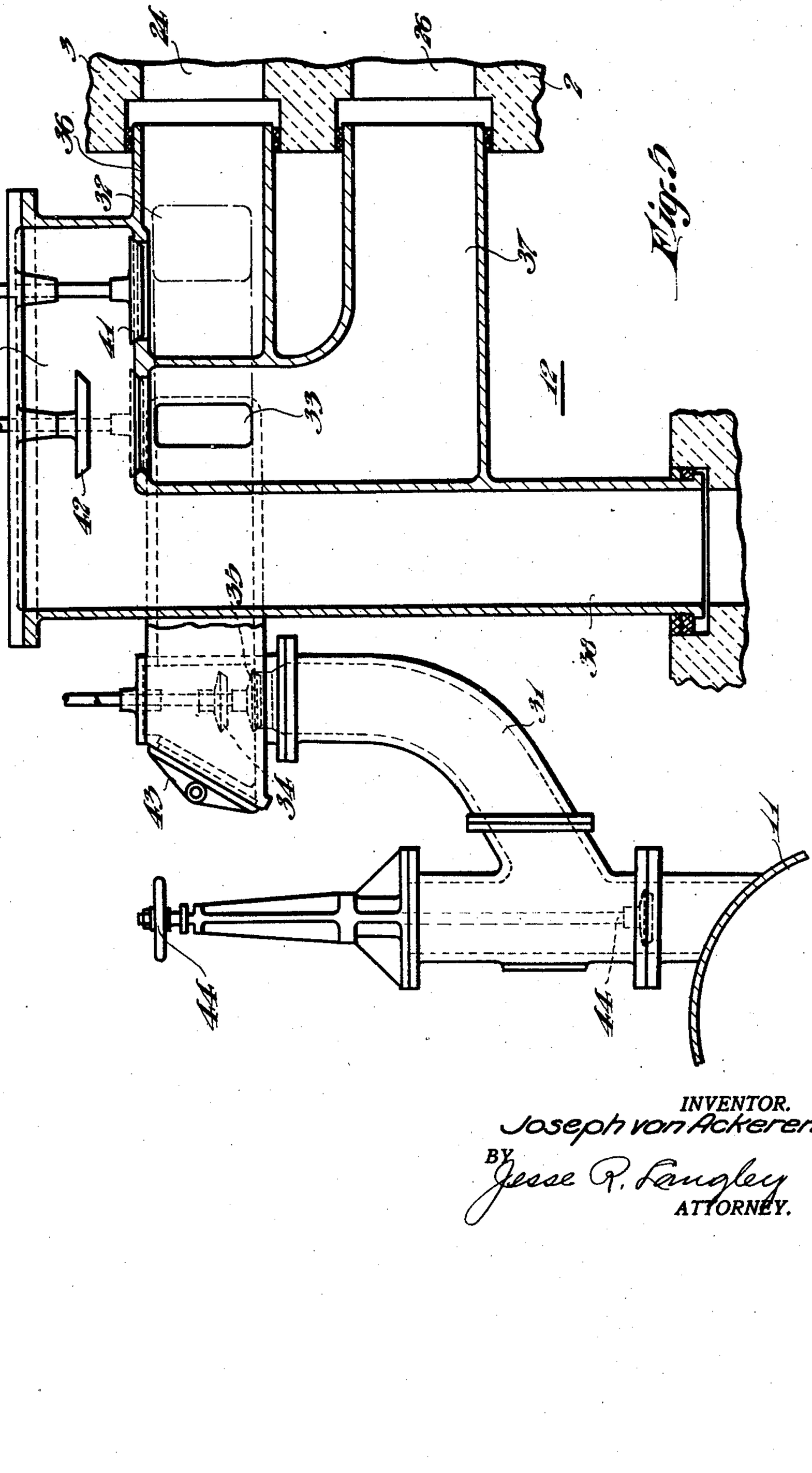

Fig. 6

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COKING RETORT OVEN

Filed Jan. 28, 1930 6 Sheets-Sheet 6

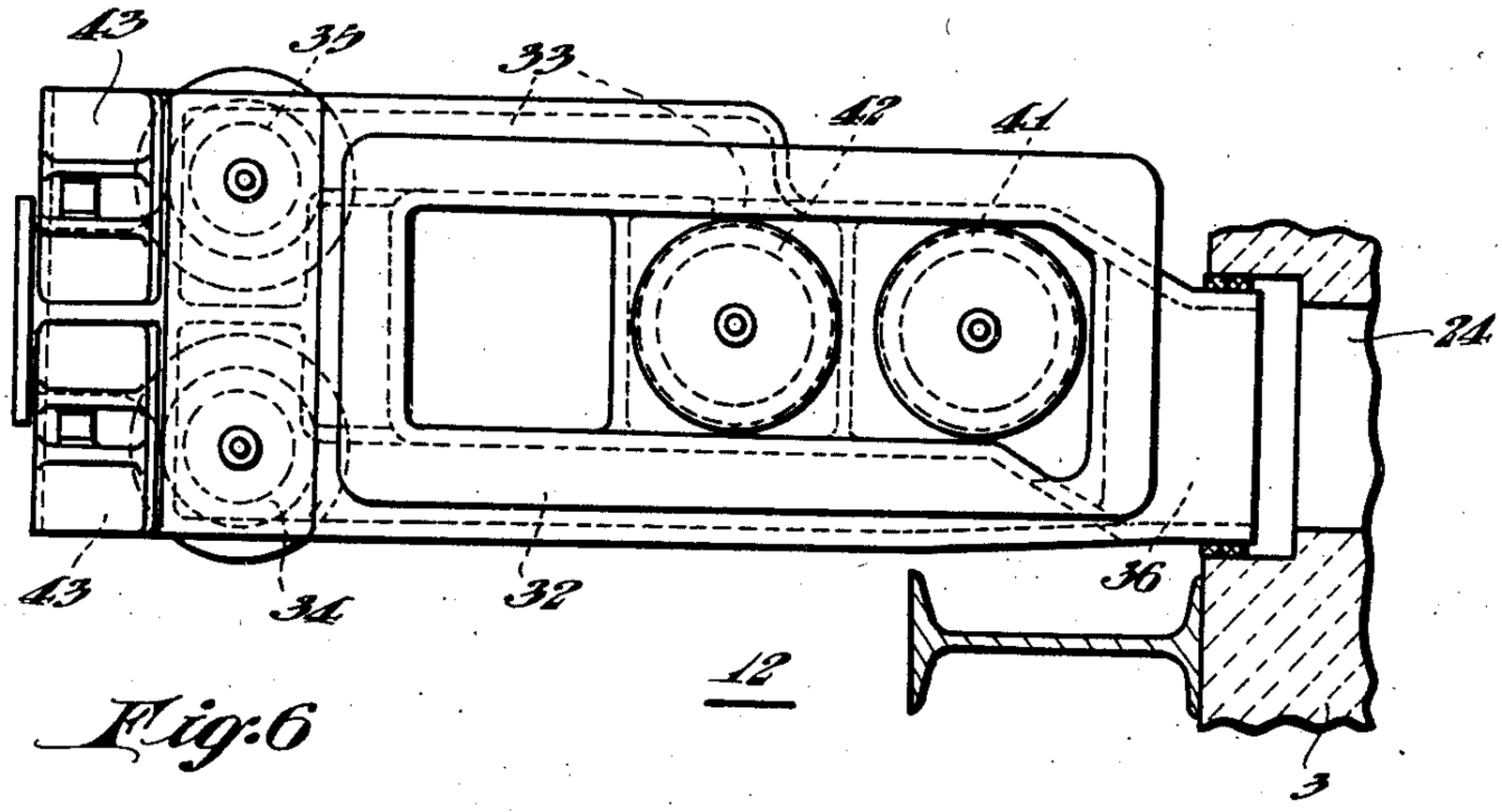

Fig:6

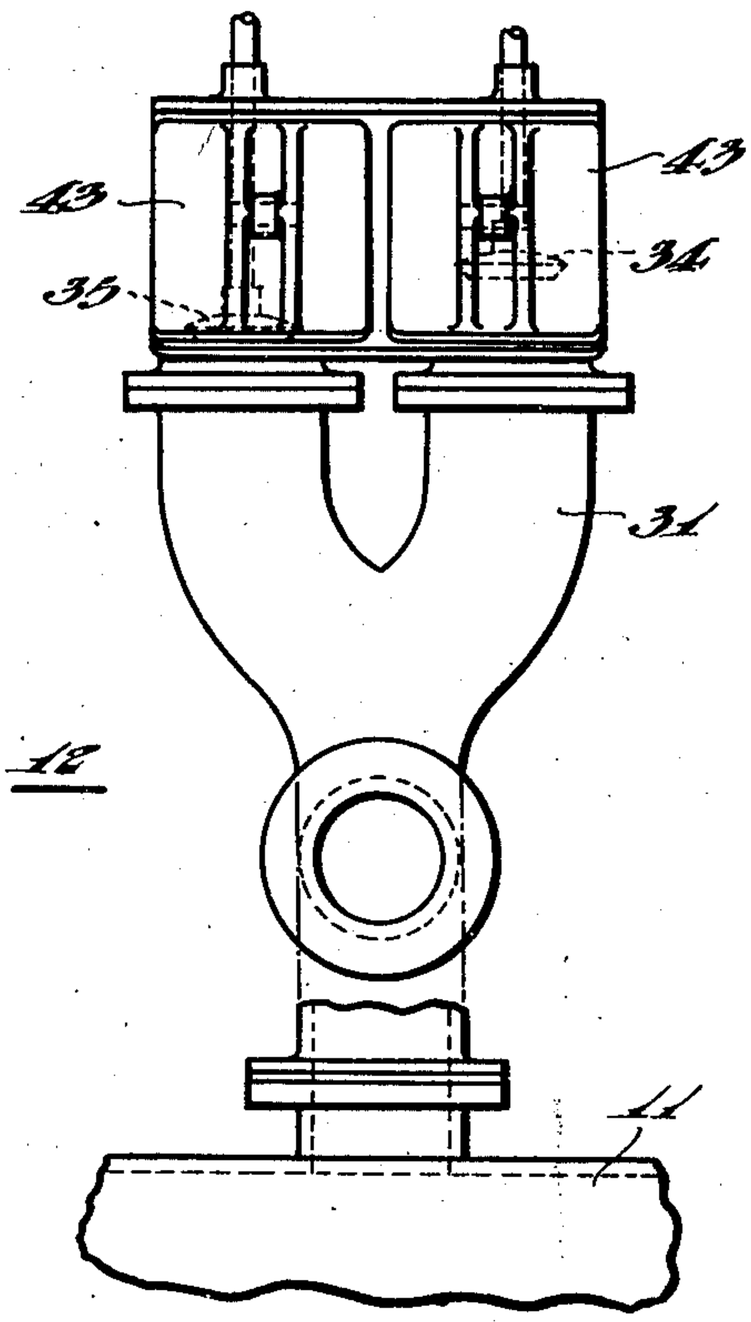

Fig:7

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Patented June 5, 1934 1,961,265

UNITED STATES PATENT OFFICE

1,961,265

COKING RETORT OVEN

Joseph van Ackeren, O'Hara Township, Allegheny County, Pa., assignor to The Koppers Company of Delaware, a corporation of Delaware

Application January 28, 1930, Serial No. 423,929

18 Claims. (Cl. 202—144)

My invention relates to coking retort ovens and particularly to coke ovens of the horizontal type in which the inflow of combustible media and the outflow of products of combustion occur in the same heating wall simultaneously.

It is an object of the present invention to provide a coke-oven battery that is so arranged that the upper structure comprising the coking chambers and heating walls is supported by a regenerator structure of such construction that its walls are suitably located with respect to the distribution of the loads to be supported and the regenerator walls may be of relatively great strength.

A further object of my invention is to provide a regenerator structure beneath the coking chambers and heating walls of a horizontal coke-oven battery in which expansion joints are so located that they are not traversed by any of the ducts for conveying gas and air to the flame flues of the heating walls or for conveying waste gases therefrom.

A further object of my invention is to provide a regenerator structure of such nature that the expansion joints therethrough may divide the regenerator structure into units that are self-contained with respect to the transmission of combustible media to, and the transmission of waste gases from, the flame flues of the heating wall with which such units co-operate.

A further object of my invention is to provide an arrangement comprising a series of regenerators for each heating wall for connection to certain of the flame flues thereof in such manner that an air regenerator is always interposed between a gas regenerator and a waste-gas regenerator of the series whereby counterflow between the latter regenerators may be avoided in either direction of flow of gases through the coke oven structure.

A still further object of my invention is to provide a unitary reversible mechanism for simultaneously conducting combustible media to a coke-oven structure and conveying waste gases therefrom.

The coke-oven battery of the present invention comprises a series of alternately-disposed coking chambers and heating walls. The flame flues of each heating wall are connected in pairs for operation in series whereby one flue operates as a return flue for products of combustion from the other flue of the pair. A series of regenerators is provided for each heating wall and the regenerators are divided into groups of one large and two small regenerators. Each group conducts combustible media to, or conveys waste gases from, one member of each of two pairs of flame flues in the heating wall.

The regenerator structure for each heating wall comprises two side walls that are located beneath the adjacent coking chambers and are substantially co-extensive horizontally with the coking chambers. The regenerator structure is divided by partition walls into a number of compartments or regenerators and these partition walls materially increase the stability of the side walls which support the upper structure of the battery.

Between each pair of closely adjacent side walls beneath a coking chamber is an expansion joint that extends from the bottom of the coking chamber vertically downward to the bottom of the supporting structure. The regenerators of the series beneath each heating wall are connected to a series of ducts located beneath the regenerators and between the side walls of the latter. Each of these ducts is connected to certain of the regenerators.

This arrangement of the regenerator structure and the expansion joints insures that the latter are not traversed by any of the ducts for connecting the exterior of the coke-oven battery to the regenerators or for connecting the regenerators to the corresponding flame flues. This arrangement tends to minimize leakage which is caused when expansion joints intersect ducts for carrying combustible media or waste gases, as is frequently necessary in the construction of coke ovens in accordance with the prior art.

My invention will be described in connection with the accompanying drawings, in which

Figure 1 is a view in transverse vertical section, taken on line I—I of Fig. 2, through the heating wall of a portion of a coke-oven battery constructed in accordance with my invention;

Fig. 2 is a view in longitudinal section of a portion of the battery taken on line II—II of Fig. 1;

Fig. 3 is a composite horizontal sectional view, taken respectively on lines A—A, B—B and C—C of Fig. 2;

Fig. 4 is a diagrammatic view in perspective of the heating system of one heating wall of the coke-oven battery;

Fig. 5 is a side elevational view of a reversing box for controlling the simultaneous admission of combustible media to and the withdrawal of combustible gases from a plurality of ducts, together with certain associated parts;

Fig. 6 is a top plan view of the reversing box of Fig. 5, the cover being removed; and

Fig. 7 is a front elevational view of a portion

of the reversing box of Fig. 5, parts being broken away.

Referring particularly to Figs. 1 and 2, a coke-oven battery 1 constructed in accordance with my invention comprises a foundation 2, a side wall 3 and a top 4. Coking chambers 5 and heating walls 6, which are alternately disposed, extend transversely of the battery and are separated by a horizontal brickwork 7 from a regenerator structure 8, which rests upon the foundation 2.

The coking chambers 5 are provided with the usual charging openings 10, extending through the top 4. A gas main 11 supplies producer gas through a series of reversing boxes 12, one of which appears in Fig. 1. A waste gas main 13 conducts gases of combustion from the battery to the usual stack.

As best shown in Fig. 1, each heating wall 6 is provided with a series of vertical flame flues 15 that are connected at their tops in pairs whereby one flue operates as a return flue for conveying products of combustion from the flue to which it is connected. The number of flame flues in each wall may be as desired, depending upon the length of the heating walls and the coking chambers of the battery.

The regenerator structure 8, which is located beneath the horizontal brickwork 7 and which supports the coking chambers 5 and the heating walls 6 comprises regenerator units equal in number to that of the heating walls, each unit being substantially co-extensive horizontally with the heating wall. Each regenerator unit comprises two side walls 16 that are respectively located substantially directly beneath the adjacent coking chambers, the side walls of adjacent regenerator units being separated by an expansion joint 17 that extends from substantially the center of the coking chamber vertically downward to the bottom of the supporting structure.

Each regenerator unit is divided into a number of compartments or regenerators by means of relatively thick walls 18 and relatively thin walls 19. The regenerators into which each unit is divided are of two sizes, the larger regenerators being substantially double the capacity of the smaller regenerators. Each small regenerator 20 is connected by an inclined duct 21 to one of the flame flues 15 while each large regenerator 22 is connected by similar inclined ducts 21 to two adjacent flame flues which, however, are members of different pairs of flame flues.

As shown in Fig. 1 and also in Fig. 4, the regenerators are in groups of one large regenerator and one small regenerator on opposite sides of the large regenerator for supplying combustible media to two flame flues of adjacent pairs or for conveying products of combustion from the same flame flues when the direction of flow is reversed.

Beneath each regenerator unit is a series of four ducts 24, 25, 26 and 27, that are arranged in two superposed pairs. As shown in Fig. 4, each duct 24 is connected by vertical ducts 28 to alternate large regenerators 22 and the duct 26 is similarly connected to the other large regenerators 22. The duct 25 is connected to alternate pairs of small regenerators 20 and the duct 27 is similarly connected to the other pairs of small regenerators 20.

Each of the heating walls is adapted to be supplied with rich gas, such as coke-oven gas, through gas guns 29, one pair of gas guns extending horizontally through the brickwork 7 beneath each heating wall 6. Each of the flame flues 15 is provided with a nozzle 30 for the entrance of rich gas, it being noted in Fig. 3 that the nozzles are disposed on opposite sides of adjacent pairs of flame flues 15.

Reference may now be had to Figs. 5, 6 and 7, in which a reversing box 12 and certain of the connected parts are shown in enlarged detail. The box 12 is connected to the gas main 11 by means of a bifurcated pipe 31, the branches of which are respectively connected to passageways 32 and 33 within the main casting of the reversing box 12 and that are respectively controlled by gas valves 34 and 35.

The passageway 32 is connected to a tubular extension 36 that is connected to one of the upper ducts, for example, the duct 24, that extends under the regenerators, as previously described. The passageway 33 is similarly connected to a downwardly curved tubular extension 37 that is connected to the duct 26.

The reversing box 12 is connected to the waste gas main 13 by means of a vertical extension 38 that is connected to a horizontal passageway 39 in the upper portion of the reversing box. The passageway 39 is connected through a valve 41 to the extension 36 and the duct 24. The passageway 39 is connected also through a valve 42 to the extension 37 and duct 26.

Each of the passageways 32 and 33 is provided at its outer end beyond the valves 33 and 34 with a pivoted damper 43, which is opened when the corresponding passageway is supplied with air and which is closed when the corresponding passageway is supplied with gas.

In the operation of the reversing box 12 shown in Figs. 5, 6 and 7, and which is typical of all of the reversing boxes for the battery, it may be assumed that producer gas is being used as a fuel and that the manually-operated valve 44 is open. It may be assumed that the valve 34 is open and the valve 35 is closed whereby gas will flow through the passageway 32 and extension 36 into duct 24. Under these conditions, the waste gas valve 41 is closed and the waste gas valve 42 is open to permit waste gases from the duct 26 to flow outwardly through the extension 37 and passageway 39 through extension 38 to the waste gas main 13.

When it is desired to reverse the flow of gases in the battery, the usual reversing mechanism operates and the open valves 42 and 34 are closed and the closed valves 41 and 35 are opened, whereupon gas is supplied through the passageway 33 and extension 37 to the duct 26 and waste gases flow from the duct 24 through extension 36 and passageway 39 to the waste gas main 13.

In case the reversing box 12 is used as an air box instead of a gas box, the valve 44 will be closed and the dampers 43 will be alternately opened to supply air to the one or the other of the passageways in accordance with the direction of flow of gases in the battery. The operation is otherwise as described for use as a gas box.

The operation of the battery may be described with particular reference to Fig. 4, in which the directions of flow through the various parts of the heating system for a portion of one heating wall are indicated by arrows. It has been assumed that gas is supplied to the gas duct 24, air is supplied to the air duct 25 and waste gases are being withdrawn through the ducts 26 and 27.

The duct 24 is connected to alternate large regenerators 22, which supply one flame flue of each of two adjacent pairs. The air regenerators

to which the duct 25 is connected are connected to one flame flue of each pair. The gases burn upwardly in one member of each pair of flame flues and the products of combustion pass downwardly through the other flame flue and through the small regenerator and the large regenerator that are connected thereto.

It will be noted that a group of regenerators consisting of two small regenerators and one large one supply combustible media to two pairs of flame flues while a similar pair of regenerators conduct waste gases from a similar number of pairs of flame flues.

It may be noted, also, as indicated by appropriate legends G, A and W in full lines, denoting regenerators adapted for operation for concurrent flow of gas, air and waste gases, respectively, in Fig. 4, that the gas regenerators G operable for inflow of gas are always separated from the other regenerators operable concurrently for outflow as waste gas regenerators W by an air regenerator A operable concurrently for inflow of air. This arrangement is made possible by providing that air is always transmitted through small regenerators A while the large regenerators G are caused to alternately supply gas or conduct waste gases.

The relative arrangement of the regenerators GAWWWAGAWWWAG is also maintained when the connections are reversed and duct 26 supplies gas, duct 27 supplies air and ducts 24 and 25 convey waste gases, the respective ducts being indicated by the legends G^1, A^1 and W^1. The products carried by the several regenerators and the manner in which they are adapted for operation of such reversal are indicated by corresponding legends in dotted lines. It will be understood that the direction of flow through the various parts of the system will be opposite that indicated by the arrows.

The arrangement of the regenerators in series beneath each heating wall and the location of their sides walls beneath the coking chambers is of particular advantage in that the side walls are in position to directly support the loads of the coking chambers when the latter are filled. The arrangement of the regenerators for each heating wall in a series beneath it permits the use of partition walls which impart stability to the side walls which might otherwise be relatively long and comparatively narrow, as in certain structures of the prior art.

The provision of regenerator units for each heating wall enables the provision of expansion joints between the units whereby the expansion joints are not traversed by any of the inclined ducts for conveying gas, air or waste gases. It will be appreciated that such leakage as may occur through the side walls of ducts is minimized by the present construction.

The foregoing and other advantages will be appreciated by those skilled in the art relating to the construction and operation of coking retort ovens. My invention is not limited to the preferred embodiment herein described except as indicated in the appended claims.

I claim as my invention:

1. A coke-oven battery comprising a series of alternately-disposed coking chambers and heating walls therefor having flame flues, a supporting structure for said coking chambers and heating walls comprising a series of regenerators beneath each heating wall and communicably connected to said flame flues and having side walls extending beneath said coking chambers and transversely of the battery, and expansion joints in said side walls and extending from the bottoms of said coking chambers to the bottom of the supporting structure.

2. A coke-oven battery comprising a series of alternately-disposed horizontally-extending coking chambers and heating walls therefor having flame flues, a supporting structure for said coking chambers and said heating walls comprising a series of regenerators beneath each heating wall and communicably connected to said flame flues and having side walls beneath said coking chambers and extending longitudinally thereof and an expansion joint connected to each coking chamber at the bottom thereof and extending in a side wall between two adjacent regenerators longitudinally of the coking chamber and throughout the height of said supporting structure.

3. A coke oven comprising a coking chamber, a heating wall therefor having a series of flame flues, a series of regenerators beneath said heating wall for supplying fuel gas and air to, and conveying gases of combustion from, said flame flues, and a plurality of ducts beneath said regenerators for respectively supplying gas and air to and conducting gases of combustion from said regenerators.

4. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, certain of said regenerators being connected to one member of each of two pairs of flame flues and certain other of said regenerators being connected to one member of one pair only of said flame flues.

5. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, said regenerators being respectively connected to at least one member of one pair of flame flues, and means for supplying air and gas to the regenerators arranged for inflow and for withdrawing waste gases from the regenerators arranged for outflow.

6. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, certain of said regenerators being arranged in groups of one relatively large and two relatively small regenerators, the large regenerator of each group being connected to one member of each of a plurality of pairs of flame flues and the small regenerators being connected to one member of one pair only of said flame flues.

7. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, certain of said regenerators being arranged in groups of one relatively large and two relatively small regenerators, the large regenerator of each group being connected to one member of each of two pairs of flame flues and each of the two small regenerators of the same group being respectively connected to the flame flues to which the large regenerator is connected.

8. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said

heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, certain of said regenerators being arranged in groups of one relatively large and two relatively small regenerators, and each flame flue being connected to a large regenerator and a small regenerator.

9. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, certain of said regenerators being arranged in groups of one relatively large and two relatively small regenerators, and each flame flue being connected jointly with an adjacent flame flue to a large regenerator.

10. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each of said pairs in series, said series of regenerators comprising groups each comprising one relatively large and two relatively small regenerators, each of said regenerators being communicably connected to at least one of said flame flues, four ducts beneath and communicably connected with said regenerators, two of said ducts being respectively connected to alternate large regenerators and the other two ducts being respectively connected to alternate pairs of small regenerators.

11. A coke oven comprising a pair of heating walls, a coking chamber between said heating walls, each of said heating walls having a series of flame flues, a series of regenerators beneath each heating wall and communicably connected to the flame flues therein, a series of ducts extending beneath each of said series of regenerators and connected thereto, a wall beneath said coking chamber for separating the two series of regenerators and separating the two series of ducts and an expansion joint in the separating wall.

12. A coke oven comprising two heating walls having vertical flame flues therein, a horizontally-extending coking chamber between said walls, a series of regenerators beneath each of said heating walls and communicably connected to the flame flues therein, brickwork separating said heating walls from the regenerators therebeneath, gas guns extending through said brickwork for rich gas to said flame flues, ducts for supplying lean gas and air to the lower portions of said regenerators and for withdrawing waste gases therefrom, each series of regenerators having a side wall extending beneath said coking chamber, and an expansion joint parallel to said heating walls and within each of said side walls and extending from top to bottom of each of the side walls and centrally thereof.

13. A coke-oven battery comprising two horizontally-extending coking chambers, a heating wall therebetween having flame flues, regenerators communicably connected to said flame flues and having side walls extending beneath said coking chambers throughout the length thereof, partition walls extending between said side walls and beneath said heating wall for dividing the space between said side walls into compartments and for increasing the stability of said side walls and an expansion joint extending from the bottom of each coking chamber downwardly through the side wall therebeneath substantially to the base of the battery.

14. A coke-oven battery comprising a series of alternately-disposed horizontally-extending coking chambers and heating walls having flame flues therein, regenerator structure beneath each heating wall and having a side wall under each coking chamber adjacent to said heating wall, said coking chambers and the side walls being substantially co-extensive transversely of the battery, partition walls for dividing the regenerator structure into regenerator compartments for connection to certain of said flame flues and for increasing the stability of said side walls, said regenerator compartments being communicably connected with said flame flues, and an expansion joint in each of said side walls beneath each of said coking chambers, and extending throughout substantially the whole length of the side wall, the expansion joints being coextensive in height with the adjacent regenerator chambers that they are between.

15. A coke oven having a heating wall with vertical flame flues therein and arranged in pairs to communicate at their top portions for operation of the flues of each pair in series, and means for supplying said flame flues with combustible media and for conducting waste gases therefrom, said means comprising a series of regenerators communicably connected with the flame flues and arranged one after the other longitudinally beneath the heating wall with a common partition wall between each two adjacent regenerators, and operatively disposed in side-by-side groups of air and gas regenerators with the side-by-side groups operable in alternation with each other for concurrent inflow and outflow with inflow regenerators for air of said groups positioned between the fuel gas inflow regenerators and the concurrently adjacent outflow groups of regenerators.

16. A coke oven comprising a coking chamber, a heating wall, a series of regenerators for said heating wall located therebeneath, said heating wall having a series of flame flues connected in pairs for operation of the flues of each pair in series, certain of said regenerators being arranged in groups of one relatively large regenerator and two relatively small regenerators that are disposed on opposite sides of the large regenerator, each small regenerator being arranged, when the group operates as inflow regenerators, to conduct air while the large regenerator conducts fuel gas to said flame flues and all regenerators in a group being arranged to conduct waste gases when the group operates as outflow regenerators.

17. A coke oven having a heating wall with vertical flame flues therein and arranged in pairs to communicate at their top portions for operation of the flues of each pair in series, and means for alternately supplying combustible media to said flame flues or conducting waste gases therefrom, said means comprising a series of regenerators, certain of which communicate with only a single flame flue, and all of which are arranged one after the other longitudinally beneath the heating wall with a common partition wall between each two adjacent regenerators, and operatively disposed in side-by-side groups of air and gas regenerators with the side-by-side groups operable in alternation with each other for concurrent inflow and outflow with inflow regenerators for air of said groups positioned between

the fuel gas inflow regenerators and the concurrently adjacent outflow groups of regenerators.

18. A coke oven having a heating wall with vertical flame flues therein and arranged in pairs to communicate at their top portions for operation of the flues of each pair in series, and means for alternately supplying combustible media to said flame flues or conducting waste gases therefrom, said means comprising a series of regenerators, certain of which communicate with only a single flame flue, and others of which communicate with a plurality of flame flues, and all of which are arranged one after the other longitudinally beneath the heating wall with a common partition wall between each two adjacent regenerators, and operatively disposed in side-by-side groups of air and gas regenerators with the side-by-side groups operable in alternation with each other for concurrent inflow and outflow with inflow regenerators for air of said groups positioned between the fuel gas inflow regenerators and the concurrently adjacent outflow groups of regenerators.

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