March 16, 1954 C. OTTO 2,672,437

REGENERATOR FLOW DISTRIBUTION CONTROL

Filed July 30, 1951

3 Sheets-Sheet 1

Fig. 1.

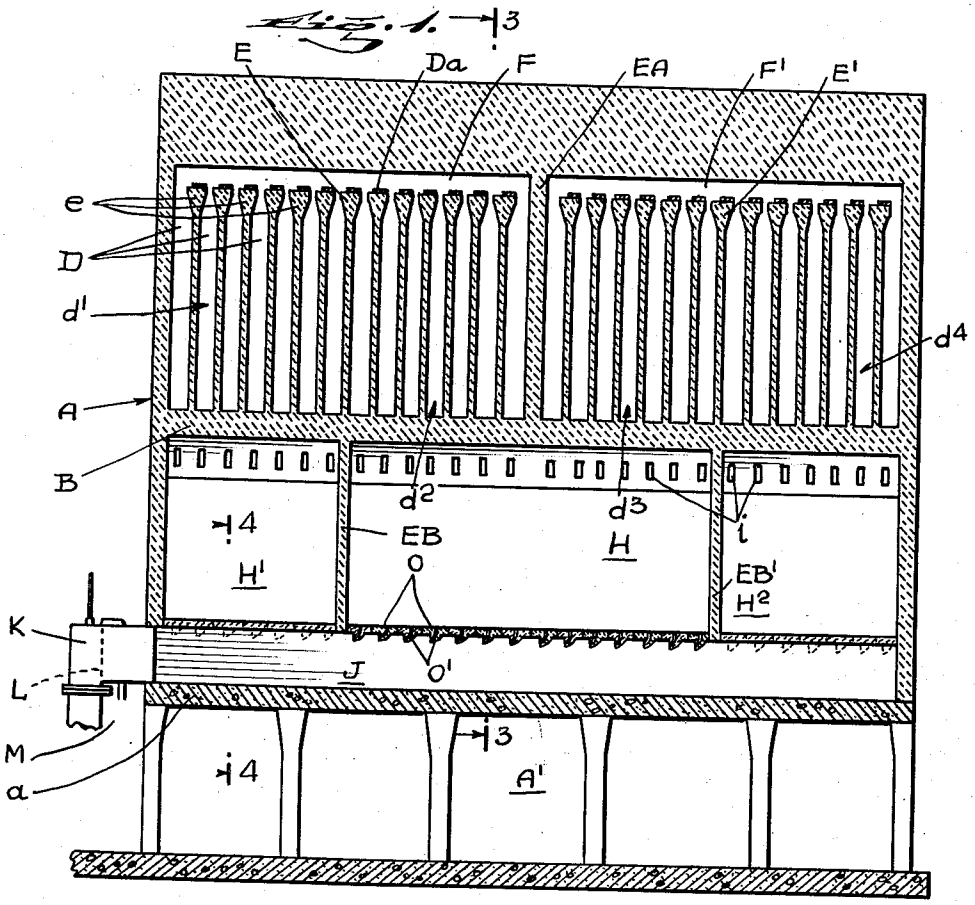
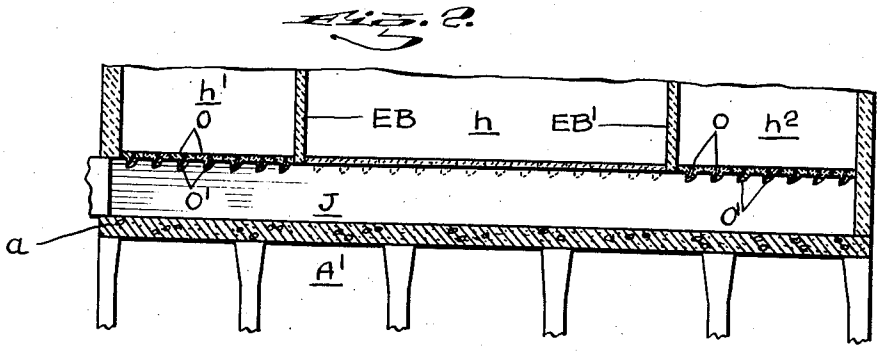


Fig. 2.



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Fig. 4.

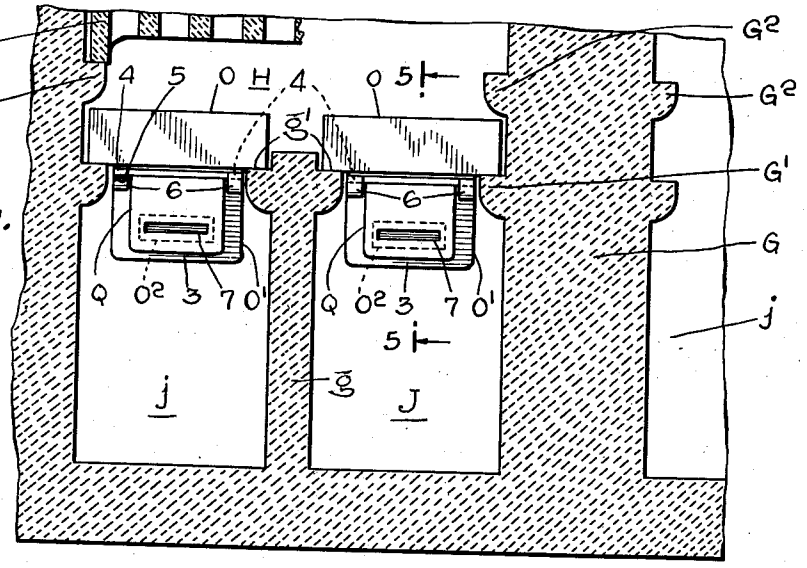


Fig. 3.

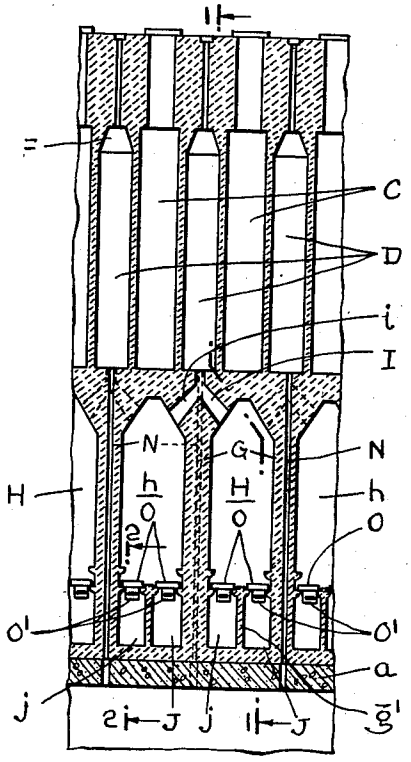


Fig. 5.

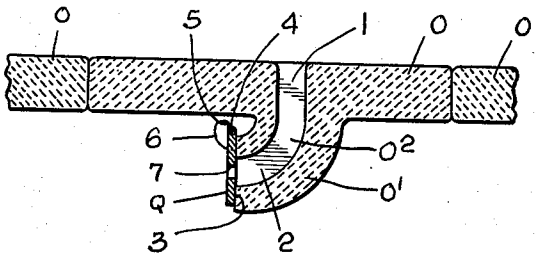
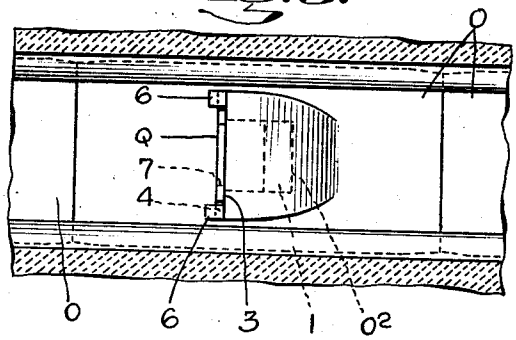


Fig. 6.



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REGENERATOR FLOW DISTRIBUTION CONTROL

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Fig. 7.

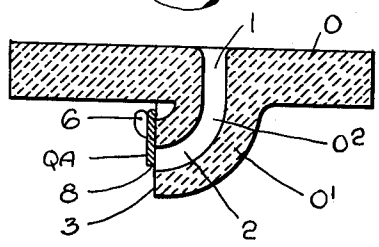
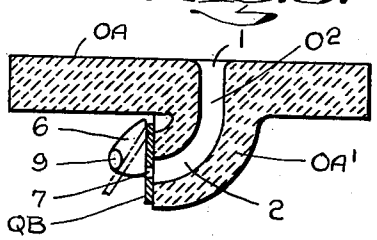


Fig. 8.



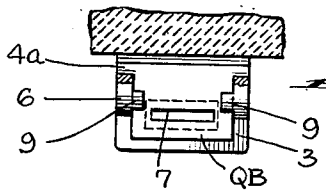


Fig. 8a.

Fig. 9.

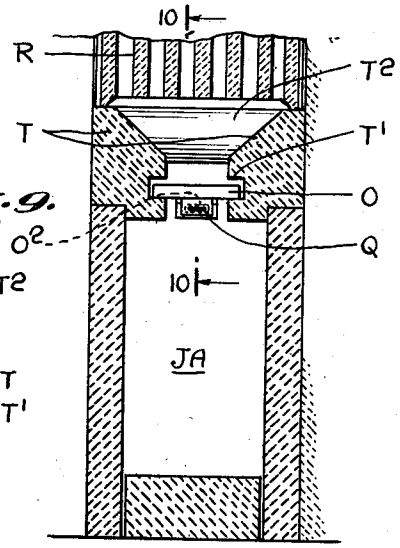


Fig. 10.

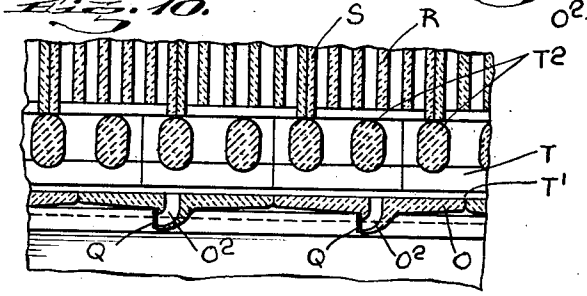
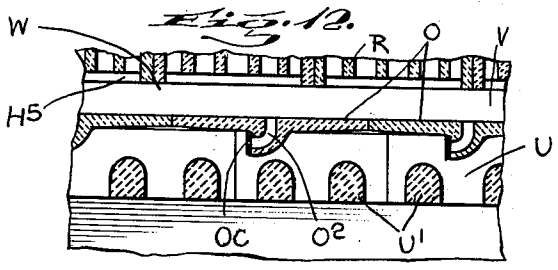


Fig. 12.



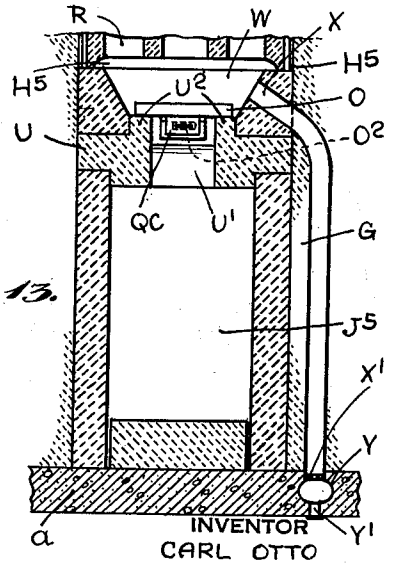


Fig. 11.

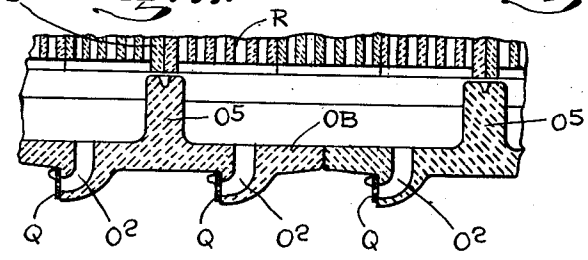


Fig. 13.

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Patented Mar. 16, 1954

2,672,437

UNITED STATES PATENT OFFICE

2,672,437

REGENERATOR FLOW DISTRIBUTION CONTROL

Carl Otto, Manhasset, N. Y.

Application July 30, 1951, Serial No. 239,253.

13 Claims. (Cl. 202—141)

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The present invention relates to the construction of a regenerative by-product coke oven battery of the type comprising horizontally elongated coking chambers extending transversely of the battery and alternating with heating walls each of which includes a horizontal row of vertical heating flues, and regenerator chambers below the coking chambers and heating walls and extending transversely of the battery, and characterized by the connection of the upper ends of a plurality of said flues in each heating wall to an upper horizontal channel in said wall, and the connection of the lower ends of a plurality of the heating flues in each heating wall to the upper edge of the same regenerator chamber, and to the connection of the lower edge of each regenerator chamber to a subjacent sole channel by a plurality of ports or passages distributed along the length of said channel. Coke oven batteries of the above mentioned type are used in the production of most of the metallurgical coke produced in this country now and for many years past.

The general object of the present invention is to provide improved means for controlling the distribution of combustion agents flowing through the coke oven regenerators and heating flues to thereby closely approximate the heating action referred to as "uniform heating." The intended purpose of "uniform heating" is the supply of heat to the different heating flues at the rates required for the efficient and suitably rapid attainment of substantially the same final coking effect all along the length, and from the top to the bottom of each coking mass, notwithstanding the fact that the thickness of each coking mass varies from one end to the other end of said mass, and may well be twenty percent greater at one end than at the other end of the oven. An approximation to "uniform heating" of a coking mass is a result which coke oven engineers and constructors have long recognized as desirable, and for which the workers in the art have been striving for a half century or longer.

A primary cause of the failure to obtain the desired uniform heating effect with regenerative coke ovens of the above mentioned type, is the practical necessity for passing combustion air and lean fuel gas, if used, into the battery, and for withdrawing partially cooled heating gases from the battery through the same elongated horizontal channels or bus flues, each of which has lateral branches distributed along its length. Said channels extend transversely of the battery, and in some cases are each of a length equal to

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the width of the battery, and in substantially all cases, each bus flue is long enough to insure an appreciable variation in the static air or gas pressure in the bus flue along the length of the latter, as a result of the variations in the linear velocity of flow in the passage at different points along its length.

The effect on the relative rates of flow through the different lateral branches of a bus flue of a reversal in the direction of flow through the flue and its branches has long been recognized, and numerous corrective expedients for minimizing that effect have been proposed in prior patents, including, for example, the Wilputte Patent 1,212,866 of January 16, 1917, Lucke Patent 1,332,909 of March 9, 1920, Becker Patent 1,374,546 of April 12, 1921, and Davis Patent 2,334,612 of November 16, 1943. However, none of the numerous prior expedients known to me gives results as good as are practically desirable.

I have discovered, and this is the gist of the present invention, that it is practically feasible to improve the heat distribution in coke ovens of the above mentioned type by providing means for utilizing the gaseous streams flowing in the regenerator sole channels to automatically vary the effective cross sectional areas of the ports connecting the lower edge of each transverse regenerator section with its associated sole channel when the direction of flow through that regenerator is reversed. In the practice of the present invention, I make use of flap valves or dampers each arranged to be moved between a first or second position, accordingly as the flow through the ports is into or out of the associated regenerator.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a transverse vertical section of a coke oven battery on the broken line 1—1 of Fig. 2;

Fig. 2 is a partial vertical section on the line 2—2 of Fig. 3;

Fig. 3 is a partial section on the line 3—3 of Fig. 1;

Fig. 4 is a reproduction on a larger scale and in more detail of a portion of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 4;

Fig. 6 is an inverted plan view of the orifice members shown in Figs. 4 and 5;

Fig. 7 is a section taken similar to Fig. 5 illustrating a modification;

Fig. 8 is a section similar to Fig. 5 illustrating a second modification, and Fig. 8*a* is a front elevation of the lower portion of the orifice member shown in Fig. 8;

Fig. 9 is a partial sectional elevation taken similarly to Fig. 4, of a coke oven battery of different type;

Fig. 10 is a partial section on the line 10—10 of Fig. 9;

Fig. 11 is a section taken similarly to Fig. 11 illustrating a modification; and

Figs. 12 and 13 are views taken similarly to Figs. 9 and 10, respectively, illustrating another modification.

In Figs. 1–6, I have illustrated a preferred form of the present invention incorporated in a horizontal under-fired regenerative coke oven battery A of the so-called "four divided" type, illustrated, for example, in the Davis Patent 2,334,612 of November 16, 1943. The battery illustrated in the drawings is a so-called "combination" oven battery, adapted to be heated either by the combustion of a lean fuel gas such as blast furnace gas, or by the combustion of a rich fuel gas such as coke oven gas. In the conventional form shown, the battery A comprises a concrete layer *a* forming a supporting deck for the oven brickwork, and forming the roof of the conventional basement space A′ of the battery A. The deck *a* may be supported in any usual or suitable manner which need not be illustrated or described herein. The coke oven brickwork comprises an upper story or section and a lower story or section which merge into an intermediate horizontal masonry layer B. Each of said stories, as shown, is of well known commercial form except in respect to the means, hereinafter described, which control communication between the lower edges of regenerator chambers and subjacent sole channels.

The upper story or section of the battery comprises horizontally elongated coking chambers C alternating with heating walls, each of said chambers and walls extending from one side of the battery to the other. Each heating wall is formed with a row of vertical heating flues D extending from one end of the heating wall to the other. In the "four-divided" oven battery A, the flues D in each heating wall are divided into four sections, d', d^2, d^3 and d^4. The flues D in each section are separated from one another by flue division walls *e*. Adjustable slide bricks or throttling dampers D*a* at the upper ends of the different flues, may be adjusted through oven roof channels in alignment with the flues, as is customary in ovens of the general type disclosed. The sections d' and d^2 are separated from one another by a vertical flue division wall E. Similarly, the sections d^3 and d^4 are separated from each other by a flue division wall E′. The sections d^2 and d^3 are separated from one another by a flue division wall EA which extends upward above the upper ends of the other flue division walls. The flue division walls E and E′ in each heating wall are structurally like the respectively adjacent flue division walls *e*. As hereinafter explained, however, the flues D in the different flue sections d', d^2, d^3 and d^4 are so connected to regenerator sections in the lower story of the battery that the flow is upward or downward in the flue sections d^2 and d^3 during reversal periods in which the flow is respectively downward or upward in the flue sections d' and d^4.

The flue sections d^2 and d^3 are separated from one another by a vertical flue division wall EA which extends to a level above the level of the tops of the other flues and separates the adjacent ends of two aligned upper horizontal channels F and F′ formed in the same heating wall. All of the flues D of the flue sections d' and d^2 have their upper ends beneath and in direct communication with the channel F′. As is hereinafter explained, the lower ends of the different flues D in each heating wall are so connected to regenerator chambers in the lower story of the battery A that the flows through the different flues of the sections d' and d^4 are always in the same direction, at any one time, being alternately up and down, when the flows through the flues of the sections d^2 and d^3 are respectively down and up.

The lower story of the battery A comprises a supporting or "pillar" wall G beneath and parallel to each heating wall and extending from one side of the battery to the other. At one side of each pillar wall are a central regenerator section or chamber H and left and right end regenerator sections or chambers H′ and H², respectively. At the second side of each pillar wall there are a central regenerator section or chamber *h* and left and right end regenerator sections or chambers *h′* and *h²*. Each set or row of regenerator sections or chambers H′, H and H² may be identical in construction with each set or row of regenerator sections or chambers *h′*, *h* and *h²*. As is hereinafter described, the regenerator chambers H′, H and H² are used only in preheating combustion air, while the regenerator chambers *h′*, *h* and *h²* may be used either in preheating combustion air or in preheating a lean fuel gas, such as blast furnace gas, accordingly as the battery is heated by the combustion of a rich fuel gas such as coke oven gas, or by the combustion of lean fuel gas preheated in the regenerator chambers *h′*, *h* and *h²*.

The regenerator chambers H′ and *h′* at opposite sides of each pillar wall G have their upper edges connected to the lower ends of the flues D in the flue section d' of the heating wall above said pillar wall by passages or channels I and *i*, respectively, formed in the intermediate masonry layer B. Each of said flues has its lower end connected to a passage I and to a passage *i*, each individual to that flue. Similarly, each of the flues D in the flue section d^4 of each heating wall has its lower end each connected by an individual channel I or *i* to the respective regenerator chambers H² and *h²* at opposite sides of the subjacent pillar wall. Each of the flues D in the flue sections d^2 and d^3 of each heating wall has its lower end connected by an individual channel I and an individual channel *i* to the central regenerator chambers H and *h* at opposite sides of the subjacent pillar wall.

Beneath the row of regenerator chambers H′, H and H² or *h′*, *h* and *h²* between each two adjacent pillar walls G, are two side-by-side sole channels J and *j* separated from one another by a division wall *g*. Each sole channel J is in communication with the central regenerator chamber H or *h* above it at points distributed along the length of the chamber. Similarly, each sole channel *j* is in communication with the two end regenerators H′ and H² or *h′* and *h²* above it at points distributed along the length of each of the two end regenerators. As is well known,

in a battery of the general type shown, the sole channels J and *j* may each have each end connected to a reversing valve at the corresponding side of the battery or the different sole channels may have their ends connected to reversing valves at one side of the battery only, as in the case in the battery A shown herein.

Thus in Fig. 1, the end of each sole channel J and *j* at the left side of the battery is connected to a corresponding reversing valve K. The reversing valves K are arranged to connect each sole channel J to a source of combustible agent to be preheated in the corresponding regenerator chamber H or *h* when that regenerator chamber is operating as an "on" regenerator, and to connect each sole channel J to a waste heat flue L during each period in which the associated regenerator chamber H or *h* is operating as an "off" regenerator. Similarly, each sole channel *j* is connected by a corresponding reversing valve K to a source of combustible agent to be preheated in the associated pair of regenerator chambers H′ and H^2 or *h′* and h^2 during each period in which those regenerators are operating as "on" regenerators. When the regenerators connected to a sole channel *j* are operating as "off" regenerators, the corresponding reversing valve connects said channels *j* to the waste heat flue L. As will be understood in the type of battery shown, the re-enerator chambers H and *h* operate as "on" and "off" regenerators during each reversal period in which the regenerator chambers H′ and H^2 and *h′* and h^2 are operating as "off" and "on" regenerators, respectively. The waste heat tunnel L passes the waste gases to a stack or exhaust fan, not shown, employed, as is customary, to draw waste gases out of the battery A, and provide the suction needed to draw atmospheric air into the reversing valves and thence through the heating flues and regenerator chambers into the waste heat flue L. In normal operation, the direction of flow in each sole channel J is opposite to the direction of flow in the sole channel *j* between the same pair of pillar walls G.

In the battery A, the regenerator chambers H, H′ and H^2 are used only to preheat combustion air. The combustible agent preheated in the regenerator chambers *h*, *h′* and h^2 is air when the fans are heated by the combustion of rich fuel gas, and is a lean fuel gas when the latter is to be preheated and burned to heat the latter. Air to be preheated is sucked into corresponding reversing valves through inlet ports through which those reversing valves are then in communication with the atmosphere. Those ports are closed when the corresponding sole channels are connected to the waste heat flue L. In accordance with conventional practice, lean fuel gas to be preheated in the regenerator chambers *h*, *h′* and h^2 may be supplied to the corresponding reversing valves from a gas supply main M alongside the waste heat tunnel L and to which lean gas may be supplied in any suitable manner. Since the described reversing valves K and the connections thereto include nothing claimed as novel herein, and may be of well known type, they need no further illustration or description herein.

When the battery is to be preheated by the combustion of coke oven gas or other rich fuel gas which need not be preheated, said gas is supplied to the lower end of each flue D during the alternate reversing periods in which combustion is initiated in that flue by an individual supply channel N extending upward through the

subjacent pillar wall from the underside of the battery, as is customary in so called "under-fired" or "under-jet" coke oven batteries. The channels N are shown as having their upper discharge ends opening into the flues D as is conventional in so called "high-low" burner coke oven batteries.

Insofar as above described, the coke oven battery shown in Figs. 1–3 includes nothing claimed as novel herein, but on the contrary, is of the commercial type disclosed in the above mentioned Davis patent. However, the battery structure A differs structurally and operatively from the battery disclosed in the Davis patent in the manner in which each of the different regenerators H, H′, H^2, *h*, *h′* and h^2 communicates with the sole channel beneath it. In the structure disclosed in the Davis patent, each of the different regenerator sections is in communication with the sole channel associated therewith through a plurality of ports formed in the top wall of the sole channel and each of fixed form. Each of the different ports connecting each regenerator section with the associated subjacent sole channel, differs in form and size from some of the other ports connecting said regenerator and sole channel. In accordance with the present invention and as shown, each of the ports through which a regenerator chamber and associated sole channel are connected is automatically adjusted to alternately increase and decrease its effective flow capacity as the direction of flow through the regenerator and sole channel is successively reversed.

In the desirable form of the invention illustrated in Figs. 1 to 6, the wall between each sole channel J or *j* and the superposed regenerator chamber or chambers which it serves, comprises a row of refractory orifice members O. The members O may be made of fire clay or analogous material. As shown, each member O comprises a horizontally elongated brick-like body with an integral portion O′ depending from the body portion intermediate the ends and sides of the latter. Each member O is formed with an L-shaped port O^2 comprising a vertical upper portion 1 open at its upper end to the associated regenerator chamber, and comprising a horizontal lower portion 2 with an open end surrounded by a valve seat 3 which advantageously is substantially vertical and faces the reversing valve to which the corresponding sole channel is connected.

Mounted on each orifice member O is a valve or damper Q. The latter advantageously comprises a thin plate of a metal such as stainless steel, not adversely affected by the constituents or temperature of the waste gases passing from the regenerator into the sole channel through the port O^2. As shown, the plate-like valve member Q is provided adjacent its upper end with laterally extending pivots 4 which may well be formed by the end portions of a stainless steel rod which may be a quarter of an inch or so in diameter. The body of the rod between its pivot forming end portions 4, may be welded to the upper edge of the valve plate Q. As shown in Figs. 4, 5 and 6, the pivots 4 are received in upwardly opening recesses or grooves 5 formed in portions 6 of the part O′ at opposite sides of its valve seat 3. Advantageously and as shown, the port O^2 is generally rectangular in transverse cross section but has its corners rounded and the damper Q is formed with a generally rectangular opening or port 7 in register with, but smaller in cross section than, the lower end of the port O^2. As shown

the side and end edges of the port 7 are spaced inwardly away from the corresponding edges of the port portion 2. The valve member Q formed and supported as described, is gravitationally biased toward its position shown in Figs. 4, 5 and 6, in which it is in contact with the vertical valve seat 3.

When gaseous fluid to be preheated is flowing into a superposed regenerator chamber through an orifice member port O^2 from an associated sole channel, the static pressure of the fluid will be higher in the portion of the sole channel adjacent the lower end of the port than in the latter. In consequence, the corresponding damper Q is then subjected to a fluid pressure differential which presses the damper against the valve seat 3, and the effective flow capacity of the corresponding port O^2 is then directly dependent on the cross sectional area of the corresponding damper port 7. When the direction of flow through the port O^2 is reversed, the waste heating gases flowing through that port into the subjacent sole channel will have a pressure higher than the static pressure in the adjacent portion of the corresponding sole channel. The fluid pressure differential force then acting on the valve member Q will move the latter away from the corresponding valve seat 3, and thus make the effective area of the bottom outlet from the port O^2 larger than the cross sectional area of the corresponding port 7. Thus the effective flow capacity of each port O^2 for a given difference in the pressures at the ends of the port, is greater when waste heating gas is flowing downward through the orifice member port O^2 than when air or lean gas is passing upward through that port. By suitably proportioning the cross sectional areas of the orifice member ports O^2 communicating with any one of the regenerator chambers H, H'—h^2 and suitably proportioning the ports 7 in the damper members Q associated with the ports O^2 the effective flow capacities of each of the flow paths formed by a port O^2 and associated damper Q may be separately regulated as desired for flow in each direction between the regenerator and the subjacent sole channel with which it is in communication.

For the separate regulation of the relative rates of flow through the different ports O^2 associated with a regenerator chamber, the fact that the volume of the down flowing gases exceeds the volume of the upflowing gases to be heated makes it practically essential that the regulation of the down flow through the ports O^2 should be effected by proportioning the cross sectional areas of those ports, and that the regulation of the up flow through the ports O^2 should be regulated by proportioning the associated dampers Q to thereby vary the effective capacities for up flow through the ports 7. Without regard to the matter of flow distribution through the different ports O^2, the aggregate area of the down flow paths through the orifice members O may advantageously be greater than the aggregate area of the up flow paths through those members because the waste heating gases are at a temperature substantially higher than that of the air or lean fuel gas passing upward through the orifice member. As a result of the temperature difference, the volume and linear velocity of the gas flow through the upper ends of the ports O^2 is greater than the volume and linear velocity of the up flow through the upper ends of the ports. In consquence, it is thus practically essential to make the minimum cross section area of the path of down flow through each orifice member O greater than the minimum cross sectional area of the up flow paths through said member.

The use of the present invention makes it practically feasible to obtain a closer approximation to "uniform heating" than has been heretofore attainable in a coke oven battery of the particular "four-divided" form illustrated in Figs. 1–3 herein, or in other forms of coke ovens in which gaseous fluids flow alternately in opposite directions through a regenerator chamber and a plurality of side-by-side vertical flues connected in series between a sole channel communicating with the regenerator chamber at distributed points along the length of the sole channel and an upper horizontal channel above and in communication with the upper ends of said flues.

As those skilled in the art will recognize, use may be made of dampers differing in form and disposition from the dampers Q shown in Figs. 4, 5 and 6. Thus as shown in Fig. 7, the damper Q may be replaced by a damper QA which omits the port 7 of the damper Q, but has its lower edge 8 intermediate the top and bottom walls of the lower outlet end portion 2 of the port O^2 when the damper is in engagement with the seat 3. With the proper distance between the bottom wall of the port O^2 adjacent the valve seat 3, and the lower edge 8 of the damper QA when the latter engages said seat, the port O^2 of Fig. 7 may have the same capacity for flow in either direction as the port O^2 of Fig. 4.

In some cases it may be desirable to limit the extent of angular movement permitted a damper such as the dampers Q and QA. One arrangement for accomplishing this is shown in Fig. 8, and 8*a*. That arrangement differs functionally from the arrangement of Figs. 4 to 6 only in that each portion 6 of the orifice member OA of Figs. 8 and 8*a* includes a lateral projection 9 extending into the path of movement of the damper QB. The projections 9 limit the angular movement of the damper away from its seat 3 to a predetermined angle smaller than would otherwise be given the damper by the waste gases flowing through the port O^2 at the normal rate. The damper QB differs structurally from the damper Q in that its lateral pivots 4*a* are integral extensions of the damper body plate which may thus be a one piece sheet metal part. By positively limiting the angular movement of the valve member away from the seat 3 as shown in Fig. 8, the extent to which the downflow capacity of a port O^2 is increased by the clockwise movement given the valve Q by the downflowing waste heating gases is regulated. Such regulation may be effected in other ways, as for example, by varying the cross sectional areas of the valve port 7 relative to the cross sectional area of the corresponding port O^2, or by increasing the gravitational bias torque tending to hold the valve Q in engagement with its seat 3.

To permit the replacement of the orifice members O and associated dampers Q for repair or cleaning purposes or to vary the relative flow capacities of different orifice member ports, each orifice member O may advantageously be supported by and longitudinally movable on side wall ledges G' and *g'*, as shown in Fig. 4. With the orifice members so arranged, they may be moved out of the battery and back into the latter when either end of the sole channel is opened for the purpose, as by means of a rod extending into the battery above the level of the tops of the orifice members and provided with a de-

pending hook portion which can be extended into the orifice O^2 of each orifice member.

Advantageously, and as shown in Fig. 4, the individual checker bricks R in each regenerator may ordinarily be of the familiar perforated block type as shown for example, in my prior Patents 2,018,223 of October 22, 1935, and 2,018,224 of October 22, 1935, with each brick of a length approximately equal to the width of the regenerator chamber in which it is used, so that the lower bricks at the bottom of the checker brick mass may be supported on ledge portions G^2 of the pillar walls G at opposite sides of the regenerator chamber.

Among other types of coke ovens in which the present invention may be used with advantage, I mention by way of example the so called "cross over" coke oven battery, an early form of which is shown by the Becker Patent No. 1,374,546. In that patent there is a single sole channel beneath each regenerator, as is the case in the construction shown in Figs. 9 and 10. In the arrangement shown in Figs. 9 and 10, the checker brick stack in each regenerator chamber may be arranged to form a row of vertical passages with a division wall S between the adjacent passages. The wall S may be formed by checker brick end walls in accordance with the disclosure of my prior Patent 2,049,272 of July 28, 1936. As shown in Figs. 9 and 10, the checker brick mass is supported on a row of brick blocks T extending transversely of the battery and shaped to provide a grooved guideway T' for orifice members O. The latter may be like the members O shown in Figs. 4, 5 and 6. The blocks T also include a plurality of vertically elongated spaced apart vanes T^2 extending longitudinally of the battery. The vanes T^2 tend to maintain the same general distribution of flow in the checker brick mass as is maintained at the bottom of the regenerator space by the action of the proportioned ports O^2 and the dampers Q associated therewith. As shown, the lower edges of the vanes T^2 are displaced upwardly from the subjacent orifice members O.

In Fig. 11, I have illustrated a modification of the arrangement shown in Figs. 9 and 10, in which the orifice members O are replaced by orifice members OB which differ from the members O in that they comprise uprising portions O^5. The latter extend into contact with, or close proximity to, regenerator division walls directly above the projections O^5. As shown in Fig. 11, the parts are so proportioned that there is a projection O^5 beneath every third division wall S, and each projection O^5 substantially closes the ends of the adjacent space between the bodies of each two adjacent orifice members OB and the three checker bricks R above that space. As shown, each orifice member OB is provided with two ports O^2, one at each side of the uprising projection O^5 of the corresponding plate.

Figs. 12 and 13 illustrate an arrangement in which a regenerator chamber H^5 and sole channel J^5 are arranged for use exclusively in preheating fuel gas in a coke oven battery which may be of various types including the cross-over type. As shown, superposed courses of refractory elements U and V are interposed between the sole channel J^5 and the portion of the regenerator chamber H^5 containing checker bricks R. The latter may be formed and arranged in the regenerator chamber as are the bricks R shown in Figs. 9 and 10. The elements U are formed with

side portions integrally connected by vanes U'. The latter are spaced apart to form ports through which the waste heating gases pass from the regenerator chamber H^5 down into the sole channel J^5. Uprising flange portions U^2 of the elements U extend longitudinally of the sole channel at opposite sides of the ports between the vanes U', and form seats or guideways on which orifice members O are supported and may slide. The members O may be identical in construction with the members O shown in Figs. 4, 5 and 6, but are associated with damper members QC which differ from the previously mentioned damper members Q and QB, in that each damper QC is adapted to close the port O^2 in the corresponding member OA and prevent upflow through that port under a condition in which an objectionable upflow through the port would otherwise occur.

The refractory elements V form supporting ledges for the superposed checker bricks R, and space those bricks above the upper sides of the members O to provide a suitable gas receiving and distributing space W above the members O. Lean gas to be preheated is passed into the space W through metal pipes X distributed along and imbedded in an adjacent pillar wall G. Each pipe X has its lower end connected to a horizontal lean gas supply pipe Y imbedded in the deck *a*, and extending transversely of the battery for connection at one side of the latter to a lean gas supply main. The amount of lean gas supplied through each pipe X may be regulated by a corresponding adjustable or replaceable flow restricting device X' in the inlet end of the pipe and accessible for adjustment or replacement from below the deck *a* through a normally closed lateral branch Y' of the pipe Y.

The ports O^2 of the apparatus shown in Figs. 12 and 13 are relatively proportioned to provide the proper downflow distribution of the waste heating gases passing from the regenerator chamber H^5 into the sole channel J^5. The inlet adjustment devices X' are adjusted to provide the proper distribution of the lean gas to be preheated among the sections of the space W into which the different pipes X discharge. The ports O^2 permit of lean gas flow from the space W into the sole channel J^5, but any significant gas flow from the sole channel back into the space W is prevented by the pivoted valves or flap dampers QC. Each of the latter is gravitationally biased for movement into the position in which it engages the valve seat 3 of the corresponding orifice member O. Any fluid pressure differential which can make the pressure in the portion of the sole channel adjacent any damper greater than the pressure in the corresponding port O^2 will press the valve QC against the corresponding valve seat 3.

The dampers QC thus operate to prevent any undesirable variation in the distribution of the fuel gas supplied to the regenerator H^5 which might otherwise result under some condition creating a pressure in the sole channel J^5 higher than the pressure in some of the associated ports O^2. But for the action of the dampers QC, a pressure in the channel J^5 higher than the pressure in some of the associated ports O^2 would increase the gas flow into one or more of the sections of the space W, and thereby upset the desired distribution.

While in accordance with the provisions of the statutes, I have illustrated and described the best forms of embodiment of my invention now known to me, it will be apparent to those skilled in the

art that changes may be made in the forms of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The combination with a regenerator having an elongated edge and a sole channel alongside said edge, of a wall interposed between said edge and sole channel and formed with ports distributed along the length of said wall, valve means selectively responsive to the direction of gaseous fluid flow through the regenerator and actuated by said flow through the regenerator in one direction to subject said ports to a throttling effect and actuated to eliminate said throttling effect when the flow through the regenerator is reversed.

2. The combination with a regenerator having an elongated edge and a sole channel alongside said edge of a wall interposed between said edge and sole channel and formed with ports distributed along the length of said wall and having their relative cross sectional areas proportioned to regulate the distribution of gaseous fluid flow through said ports in one direction and valve means actuated by said fluid flow when in the opposite direction to variably modify the relative cross sectional areas of the ports and thereby regulate the distribution of the flow in the opposite direction through said ports.

3. In a regenerative coke oven structure, the combination with a regenerative chamber, of a sole channel alongside said chamber and having one end arranged to receive gaseous fluid to be preheated in said chamber during periods alternating with periods in which said sole channel discharges waste heat gases at said end, a wall interposed between said regenerator and sole channel and formed with a plurality of ports distributed along the length of said wall and having their cross sections proportioned to regulate the distribution of flow of waste gases from said chamber into said sole channel, and valve means associated with said ports and actuated by the flow into the regenerator of the gaseous fluid to be preheated therein to variably throttle said ports.

4. A combination as specified in claim 1, in which said wall has projections transverse to the length of said channel and extending into the latter, and in which each projection has one side transverse to the length of said channel, and in which said ports have their ends in communication with said channel opening into the latter through said projection sides, and in which said valve means comprise valve members supported by said wall and each arranged for movement by fluid flow through said channel into said regenerator into a position in which it throttles flow through the port opening into the channel through a corresponding one of said sides.

5. A combination as specified in claim 4, in which said valve member is a metal plate hinge connected to said wall.

6. A combination as specified in claim 4, in which said valve member is a metal plate with aligned oppositely extending pivot portions, and in which said wall is formed with portions engaging and supporting said pivot portions.

7. A combination as specified in claim 4, in which said valve member is a one piece metal plate formed with integral, oppositely extending pivot portions, and in which said wall is formed with portions engaging and supporting said pivot portions.

8. A combination as specified in claim 4, in which said valve member is shaped and is arranged for movement into and out of a position in which it extends across and closes a portion of the port which it throttles.

9. A combination as specified in claim 4, in which said valve member is formed with an opening smaller than the port which it throttles and is arranged for movement into and out of a position in which said opening is in register with said port.

10. The combination with a regenerator having an elongated edge and a sole channel alongside said edge, of a wall interposed between said channel and regenerator and having projections distributed along its length and extending into said channel, and each having one side transverse to said channel, said sides all facing in the same direction, said wall being formed with ports each opening at one end into said regenerator and each opening at its other end into said channel through a corresponding one of said sides, and a separate valve member associated with each projection for movement toward and away from said transverse side of the corresponding projection accordingly as the flow through the ports is into or out of said regenerator, and adapted to throttle said ports on movement toward said projection.

11. The combination with a regenerator having an elongated edge and a sole channel alongside said edge, of a wall interposed between said channel and regenerator and having projections distributed along its length extending into said channel, and each having one side transverse to said channel, said sides all facing in the same direction, said wall being formed with ports each opening at one end into said regenerator and each opening at its other end into said channel through a corresponding one of said sides, and a separate valve member associated with each projection for movement toward and away from said transverse side of the corresponding projection, and responsive to the direction of flow through said ports and arranged to be moved toward said side by flow through said port into the regenerator.

12. Regenerator apparatus for preheating lean fuel gas comprising in combination, an elongated regenerator chamber, a sole channel alongside said chamber, a wall interposed between said chamber and sole channel, checker brickwork in said chamber including wall portions arranged to form a plurality of passages transverse to and distributed along the length of the regenerator, and each having one end adjacent said wall, a separate lean gas supply conduit in communication with the end of each of said passages adjacent said sole channel, said wall being formed with ports for the separate flow of waste heat gases into the sole channel from the different passages during reversal periods in which the passage of lean fuel gas into said regenerator chamber through said conduits is interrupted, and separate valve means associated with each port and actuated to close the latter by an excess in the sole channel pressure over the pressure in the adjacent passage.

13. In a regenerative coke oven of the type comprising a regenerator chamber, a sole channel in communication with one edge of said chamber at points distributed along its length, heat-

ing flues connected to the opposite edge of said chamber and an upper horizontal flue to which the upper ends of said flues are connected, the improvement comprising a wall interposed between said regenerator and sole channel and formed with a plurality of ports distributed along the length of said wall and proportioned to regulate the distribution of gaseous flow through the ports from the regenerator into the sole channel, and valve means associated with the different ports and actuated by gaseous flow through said ports into the regenerator to throttle said ports.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,400,506	Abram	Dec. 20, 1921
1,788,358	Goerg	Jan. 6, 1931
2,151,512	Hagen	Mar. 21, 1939
2,334,612	Davis	Nov. 16, 1943

FOREIGN PATENTS

Number	Country	Date
515,997	Great Britain	Dec. 20, 1939