Feb. 10, 1970 W. GRUMM 3,494,833

COKE OVEN BATTERY INCLUDING HIGH AND LOW RICH GAS BURNERS

Filed Jan. 24, 1966 3 Sheets-Sheet 1

FIG. 1.

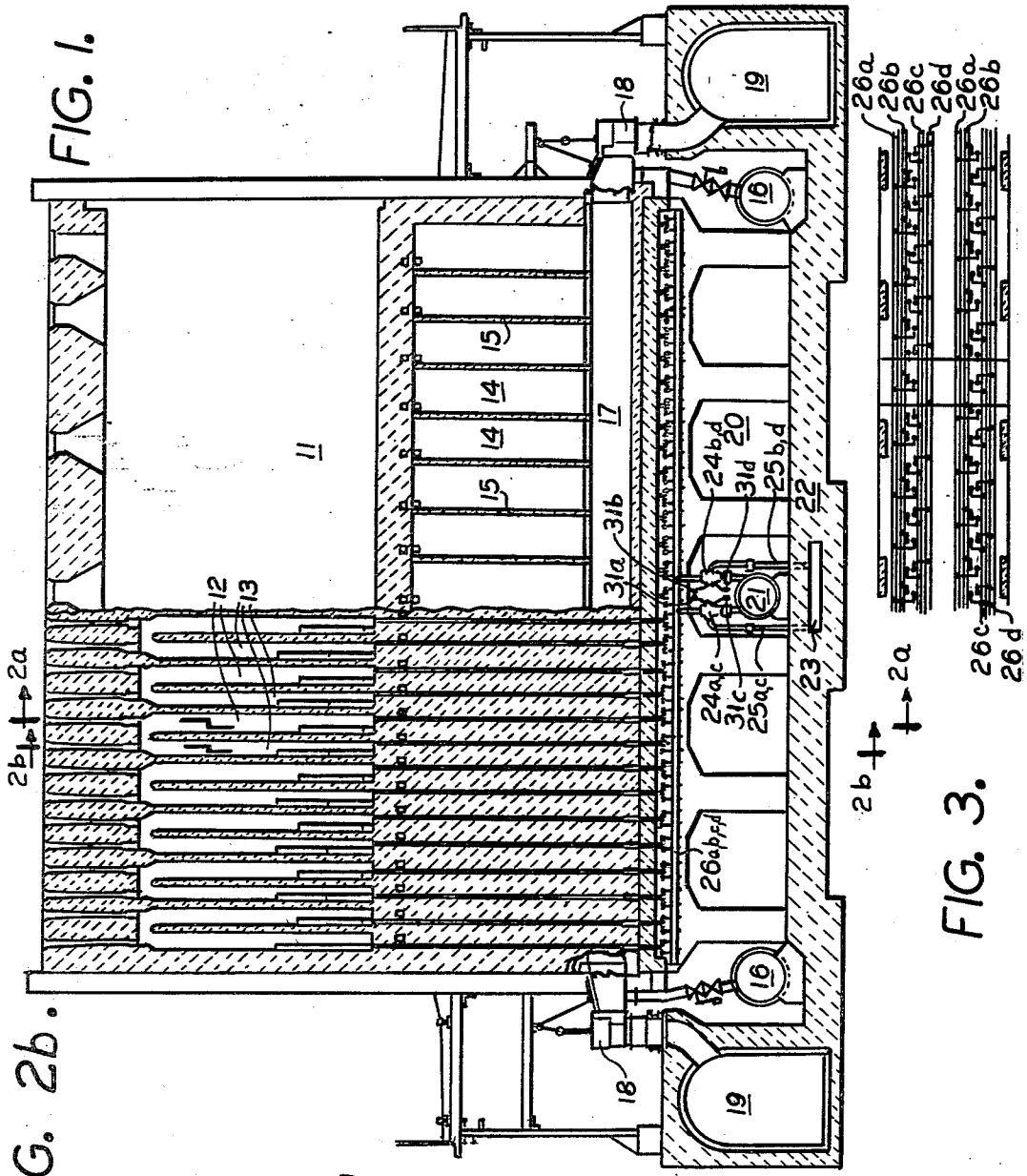


FIG. 3.

FIG. 2b.

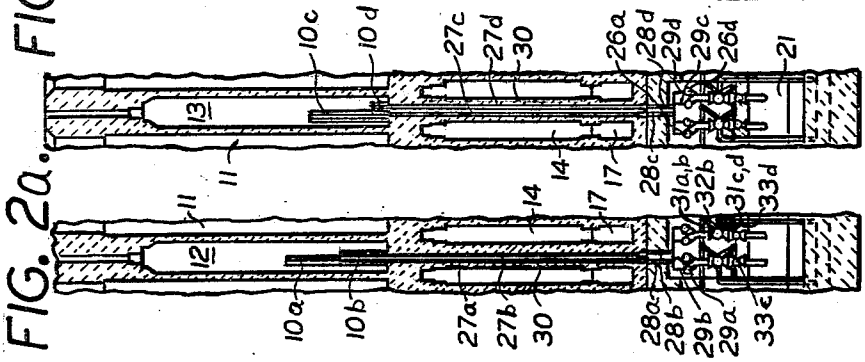


FIG. 2a.

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FIG. 5.

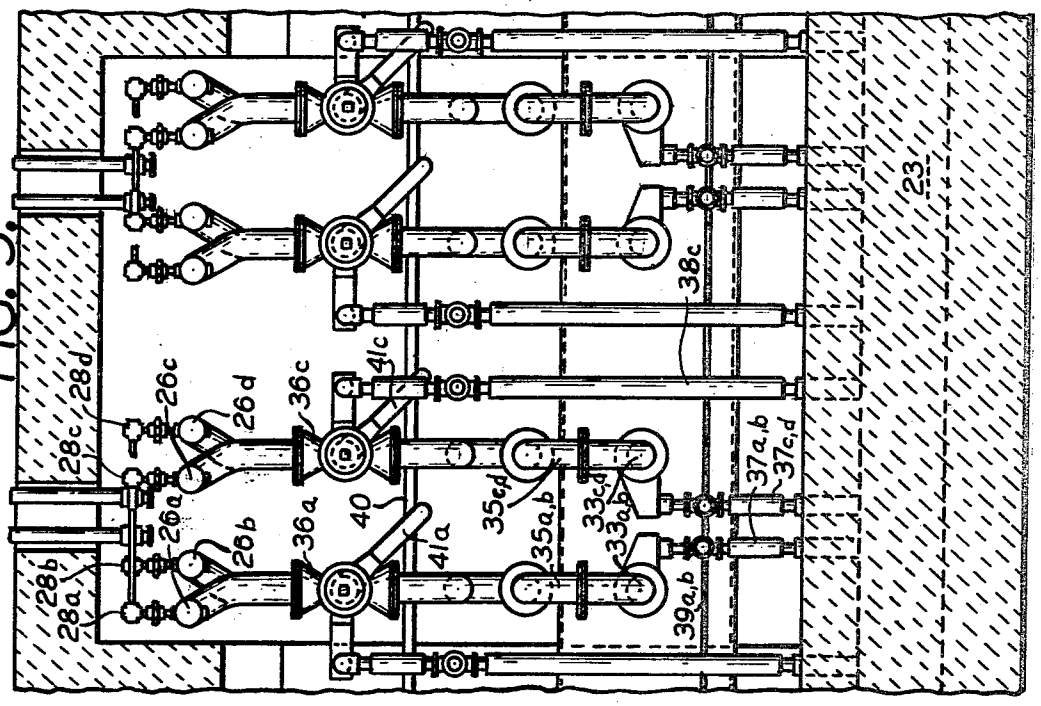
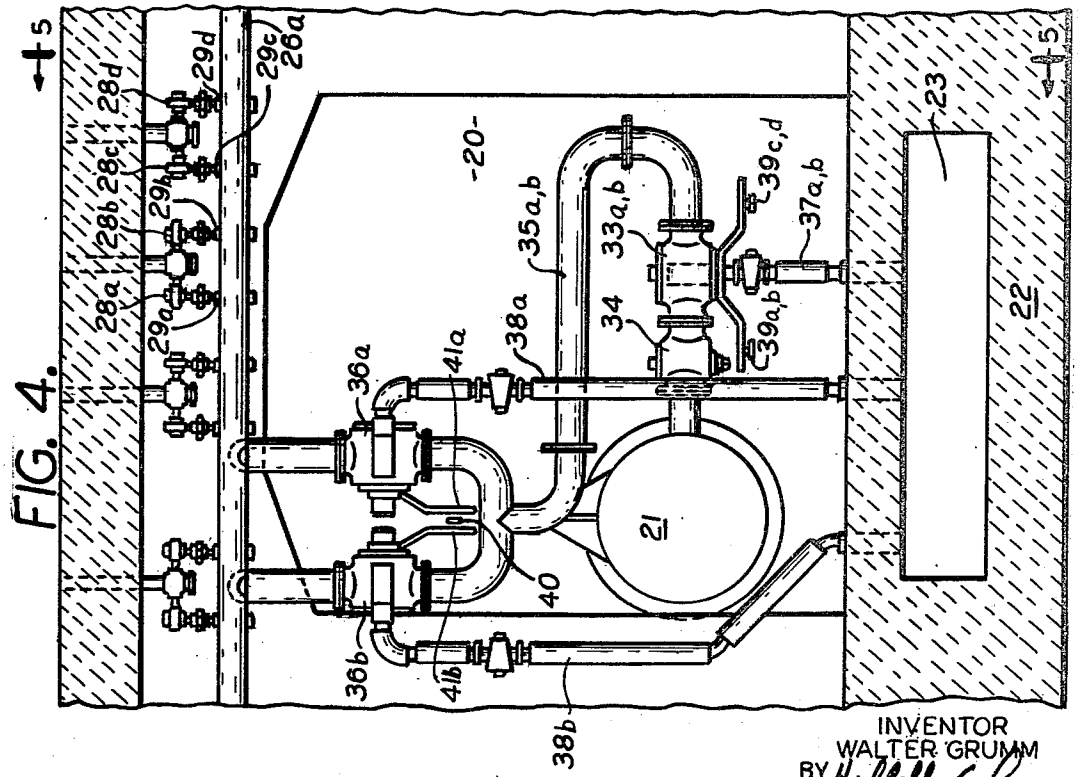


FIG. 4.



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FIG. 6a.

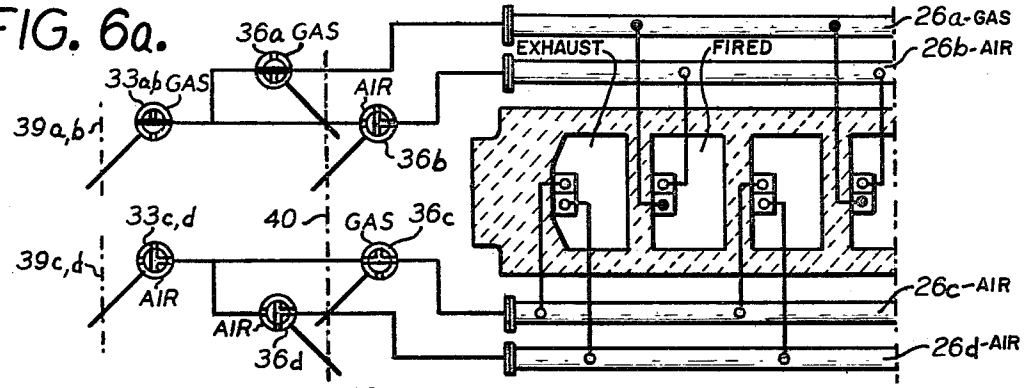


FIG. 6b.

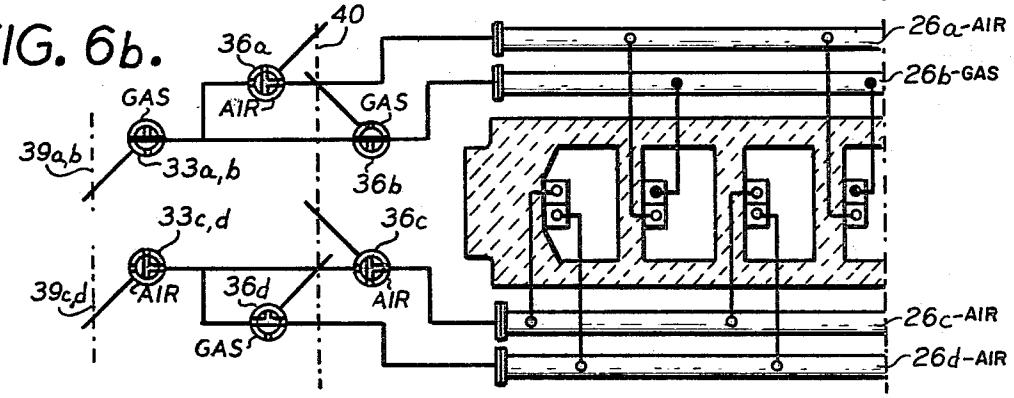


FIG. 6c.

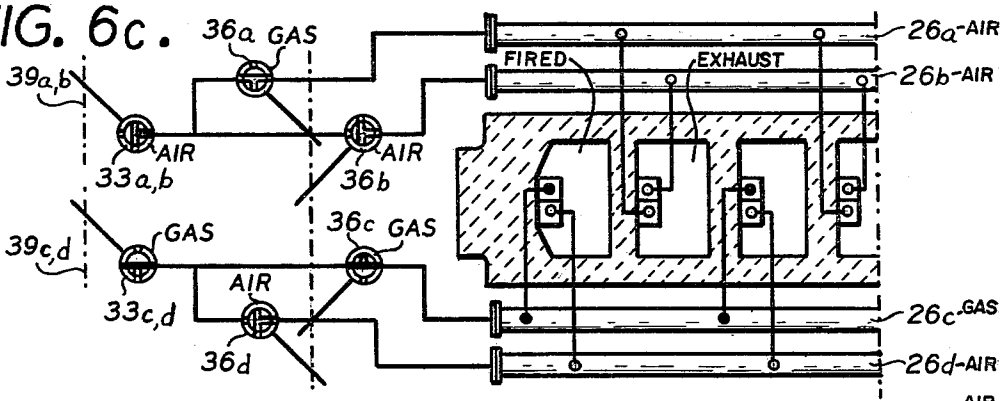
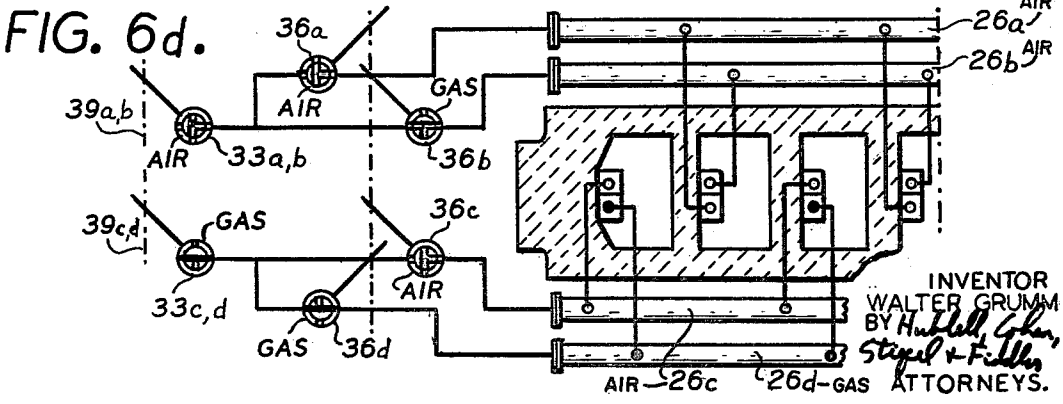


FIG. 6d.



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3,494,833

COKE OVEN BATTERY INCLUDING HIGH AND LOW RICH GAS BURNERS

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Int. Cl. C10b 21/22
U.S. Cl. 201—41 5 Claims

ABSTRACT OF THE DISCLOSURE

A valve arrangement for controlling the supply of air and gas to a high and low burner coke oven battery wherein for each heating wall there are two master valves and four subordinate valves associated therewith and means interconnecting the four subordinate valves to operate them every quarter cycle and means connected to the two master valves for operating them every half cycle to yield an operating cycle wherein gas is supplied sequentially to each burner for a quarter of an operating cycle and degraphitizing air is supplied for the remaining three-quarters of a cycle. The invention further resides in the method of operating the valves to yield this result.

This invention relates to a horizontal coke oven battery and especially to a regenerative horizontal coke oven battery having high and low burners for the introduction of rich gas into each flue. As coke oven heating flues and coking chambers get taller in order to accommodate more coke for a given land area, the problem of obtaining uniform heating along the vertical length of a heating flue becomes increasingly acute. This is especially true in the consumption of rich gas which, under normal circumstances, tends to have a relatively short flame. Such a short flame will result in higher heat near the bottom of the flue than at the top of the flue and thereby yield uneven coking rates which is undesirable.

To overcome this problem, it has previously been suggested to provide in each heating flue a high and low burner for introducing rich gas into the flue. This will in effect "divide the flame" to thereby elongate it. Such a solution has limited success due to the fact that the rich gas passing through the passage to the high burner (and sometime to the low burner) may have a large quantity of hydrocarbons which, under the severe temperatures encountered, will crack and cause a deposit of graphite to sharply reduce the amount of gas being introduced. The present invention is directed to a new means and method for degraphitizing such burners.

The main object of the present invention is the provision of a new and improved means and method for degraphitizing high and low burners in a coke oven battery during rich gas operation thereof.

This object and other characteristics and features of the present invention will be more fully understood from the following description taken in connection with the accompanying illustrative drawings.

In the drawings:

FIG. 1 is a vertical section through a battery or horizontal coke ovens, partially through the vertical central plane of a heating wall and partially through the vertical central plane of a coking chamber;

FIG. 2*a* is a vertical sectional view along the line 2*a*–2*a* of FIG. 1, through the flues with the higher burners;

FIG. 2*b* is a vertical sectional view along the line 2*b*–2*b* of FIG. 1, through the flues with the lower burners;

FIG. 3 is a schematic view of the rich gas distribution lines extending over a central portion of a heating wall;

FIG. 4 is a view similar to FIG. 1, but showing only the valving means and connections thereto for a modified embodiment of the present invention;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4; and

FIGS. 6*a* through 6*d* are schematic diagrams showing the inter-relationships of the control valves of the embodiment illustrated in FIGS. 4 and 5 during the four consecutive time intervals of a regenerative cycle.

The oven shown is a hairpin flue oven with so-called compound heating, i.e., with optional heating by a rich gas which should not be preheated and by a lean gas which is preheated in a regenerative flue exchange. It will be obvious of course that the present invention may be used in connection with rich gas ovens having no provision for lean gas operation. In addition, the invention is not limited to hairpin flue ovens but may be employed in other types of heating wall constructions such as two-divided ovens, four-divided ovens and crossover ovens.

The oven chambers **11** alternate with heating walls which include a series of pairs of heating flues **12** and **13** arranged in rows. Beneath the coke oven chambers and the heating walls, there are arranged regenerators which serve as heat-exchangers between the combustion media (air or air and lean gas) which have not yet been oxidized, on the one hand, and the gaseous products of such combustion, on the other hand. These regenerators are subdivided by partitions **15** into chambers **14**, each chamber being associated with a pair of heating flues **12** and **13**. Below the regenerator chambers, there extend horizontal regenerator sole channels **17**. To the latter there are alternately connected, during "on" time, the lean-gas distribution lines **16** and, during "off" or exhaust time, the regenerator sole channels discharge through change-over valves **18** to the stack channels (flues) **19**.

A special feature of the oven consists in the fact that both in the heating flues **12** and in the heating flues **13** which cooperate in flue exchange with the flues **12** there are arranged two burners each.

10*a* is the upper burner in the heating flues **12**, **10***b* the lower burner in the heating flues **12**, **10***c* the upper burner in the heating flues **13**, and **10***d* the lower burner in the heating flues **13**. In this regard, the burners **10***a* are higher than the burners **10***c* and the burners **10***b* are higher than the burners **10***d*.

One feature of the present invention resides now in the fact that in each regenerative half cycle, and only during a fraction, for instance, during half the time of such half cycle, the upper burner is supplied with rich gas and during the rest of the time of that half cycle the lower burner is so supplied. Therefore there burn, for instance, in succession first only the burners **10***a* and then only the burners **10***b*; and after the cycle reversal, the burners **10***c* burn first and then the burners **10***d*. To all the burners which are not fed, air is supplied for the removal of graphite, i.e., for the burning off of any deposits of carbon which may have formed.

To facilitate an understanding of the drawings, all parts which are related to the firing of the burner **10***a* are designated with the subscript *a*, and all parts which are related to the firing of the burners **10***b* are designated with the subscript *b*, while the others are correspondingly designated with the subscripts *c* and *d*, respectively.

For the feeding of the rich gas to the battery, there is used the rich gas main conduit **21** which is disposed in the basement **20**. The degraphitizing air is preferably fed under pressure through the conduit **23** which is here shown to extend in the bottom plate **22** of the battery.

There are discharged on the upper side of the main gas line **21** connecting pieces for the change-over valves **24***a* and **24***d* on the one side (towards the coke side of the

coking chamber) and 24*b* and 24*c* on the other side (towards the pusher side of the coking chamber). The valves 24 are three-way valves. Their air slot is connected via the pipes 25*a*, 25*b*, 25*c*, 25*d* with the compressed air line 23. The rich gas main line 21 is connected via the valve 24*a* with the horizontal rich gas distribution line 26*a* extending over the entire length of a heating wall. With said rich gas distribution line, the burners 10*a* are connected via vertical channels 27*a* which extend through the regenerator partition walls 30. The channels 27*a* are connected via metallic elbows 28*a* to the distribution line 26*a* at the point of deflection of which individually adjustable regulating devices 29*a* are arranged. Therefore, the quantity of gas fed to each individual burner 10*a* can be regulated individually from the basement.

For the firing of the burners 10*b*, there serve corresponding members 24*b*, 25*b*, 26*b*, 27*b*, 28*b*, 29*b*. For the firing of the burners 10*c*, there are used corresponding members 24*c*, 25*c*, 26*c*, 27*c*, 28*c*, 29*c* and for the firing of the burners 10*d*, there are used members 24*d*, 25*d*, 26*d*, 27*d*, 28*d*, 29*d*.

For the changing-over of the valves 24*a*, 24*b*, 24*c*, and 24*d*, respectively, there is used a series of rods or links which consist of the connection means 31*a*, 31*b*, 31*c* and 31*d*, respectively, to which means the corresponding change-over valves 24*a* to 24*d* are connected by means of the change-over levers 32*a* to 32*d*.

The change-over valves 24 actuated via the levers 32*a* to 32*d* from the connected means 31*a* to 31*d* therefore, in the one position, free the path of the gas from the main gas line 21 into the corresponding gas distribution line 26*a*, 26*b*, 26*c* or 26*d*, respectively. In the other position, they therefore conduct the degraphizing air coming from the channel 23 into the gas distribution lines, from where they are fed to the burners.

If we designate A the time of the regenerative period durin which combustion takes place in burner 10*a* and, correspondingly, B, C and D the combustion periods of the burners 10*b*, 10*c* and 10*d*, respectively, we have the following change-over sequence:

During the period of time A, all valves 24*a* are on gas, while the valves 24*b*, 24*c* and 24*d* are on air. At the end of the time A, the connection means 31*a* is reversed and the means 31*b* now displaced. Now, only the valves 24*b* are on gas, while the other valves are all on air. After the next change of flues, that is during the time C, only the valves 24*c* are on gas, while the valves 24*a*, 24*b* and 24*d* are on air. During the period D, only the valves 24*d* are on gas, while the valves 24*a*, 24*b* and 24*c* are on air.

It can therefore be seen that during three time intervals, all burners are on air, i.e., when, for instance, the regenerative half cycle amounts to half an hour, and the time A is equal to the time B, the time B is equal to the time C and the latter is equal to the time D, each burner is on gas only for a quarter of an hour, while it is fed with degraphitizing air for about three-quarters of an hour. In this way, the result is obtained that carbon deposits which might be produced upon the feeding of the gas into the burners are consumed by the air.

It may also be pointed out that the sequence in which the burner which is higher or lower at the time is fired in succession in the heating flues can be selected as desired; therefore, for instance, the times A and B and also the times C and D can be interchanged.

The change-over processes which are necessary in order to effect the operation of the furnace consist in the fact that at the start and at the end of the time A, the means 31*a* is to be reversed. Correspondingly, at the start and at the end of the times B, C and D the means 31*b*, 31*c* and 31*d* are to be shifted. Therefore, during a regenerative period, eight different change-overs are effected which are in time dependency on each other.

While, in the case of the arrangement shown in FIGS. 1 to 3 four change-over valves, namely, the change-over valves 24*a* to 24*d*, are necessary for the distribution of the rich gas from the rich gas main line 21 to the four distribution lines 26*a* to 26*d*, for each row of heating flues, in the case of the distribution system shown in FIGS. 4 to 6 six change-over valves per row of heating flues are used. As can be noted from FIG. 4, two lines branch laterally off from the rich gas main line 21 below each heating wall and lead to the two change-over valves 33*a*,*b* and 33*c*,*d*. In front of these valves there are arranged shut-off valves 34. The lines 35*a*,*b* and 35*c*,*d* connected, respectively, to the change-over valves 33*a*,*b* and 33*c*,*d* are divided up into two lines each which lead to the other change-over valves 36*a* to 36*d*. Via the change-over valve 36*a*, it passes into the gas distribution line 26*a*, and via the change-over valve 36*b* into the rich gas distribution line 26*b*, etc. These rich gas distribution lines 26*a* to 26*d* are developed substantially in the same manner as in the case of the arrangement of FIGS. 1 and 3. The other means for introducing the combustion media for the heating of the oven and for the removal of the spent gases are also the same, as in the case of the arrangement shown in FIGS. 1 to 3, and the same reference numbers will be used for same also insofar as these parts appear in FIGS. 4 to 6.

Both the change-over valves 33*a*,*b* and 33*c*,*d*, as well as the change-over valves 36*a*, 36*b*, 36*c* and 36*d*, are three-way valves which in the one position open the passage of the combustion gas, while in the other position they are connected via the air slot and corresponding connecting lines 37*a*,*b*, 37*c*,*d* and 38*a*, 38*b*, 38*c*, 38*d*, respectively, to the channel 23 which is connected in turn to a source of compressed air.

For the reversing of the valves 33*a*,*b* and 33*c*,*d*, there are used the rods 39*a*,*b* and 39*c*,*d*, respectively, which extend below the valves. For the reversing of the valves 36*a* to 36*d*, there is used a rod 40 to which the valves are connected by means of levers 41*a* to 41*d*. In this connection, the valves 36*a* and 36*b* are reversed by a parallel pair of levers and the valves 36*c* and 36*d* by another parallel pair of levers. The reversing of all valves 36*a* to 36*d* takes place always simultaneously. The two valves 36*a* and 36*b*, as well as the valves 36*c* and 36*d*, are arranged as mirror images of each other, so that the open position of the one valve of each pair always corresponds to the closed position of the other valve.

In order to understand the actuation of the reversal more easily, consider the schematic diagrams of FIGS. 6*a* to 6*d*. In these figures, the has been shown in each case for one heating wall the positions of the valves 33*a*,*b* and 33*c*,*d* and of the valves 36*a* to 36*d*, the showing in FIG. 6*a* corresponding to the valve position during the time A of the regenerative cycle (in the meaning explained above). The showing of FIG. 6*b* corresponds to the time B, the showing in FIG. 6*c* to the time C and the showing in FIG. 6*d* to the time D.

During the times A and B, the valve 33*a*,*b* is connected to gas, while the valve 33*c*,*d* is connected to air. After the completion of the time B, the reversal of these valves takes place. In the times C and D, the valves 33*a*,*b* is connected to air, and the valve 33*c*,*d* is connected to gas. The valves 36*a* to 36*d* are now reversed every quarter of an hour by means of the rod 40. For example, the valve 36*a* is on gas during the time A, and is on air during the time B, while during the time C, it is again in the "gas" position, and during the time D, in the "air" position. It should be noted in this connection that the "gas" position does not necessarily lead to the gas actually flowing through the valve; rather, the air can also flow through the valve, introduced through one of the valves 33*a*,*b* or 33*c*,*d*.

It can now be seen that in the position of the valves shown in FIG. 6*a*, gas is fed only to the gas line 26*a*, while all three other gas lines are fed with air. In the position of the valves shown in FIG. 6*b*, only the gas line 26*b* is

fed with gas, while all the three other gaslines, namely, **26***a*, **26***c* and **26***d*, are on air. In the position shown in FIG. 6*c*, only the gas line **26***c* is charged with gas, and in the position shown in FIG. 6*d*, only the line **26***d*. It can therefore be seen that all burners are charged with gas only during one of the times A to D, while the rest of the time degraphitizing air enters. In this manner, there is taken into consideration the essence of the invention in accordance with which the burners are charged for the longest possible period of time with degraphitizing air.

In the case of the arrangement of FIGS. 4 to 6, the change-over devices are relatively simple. Only one rod **39***a,b* is necessary for the reversing of the valves **33***a,b*, to which there corresponds another rod **39***c,d* for the reversing of the valves **33***c,d*. The reversing of the two valves is effected at the time of the regenerative reversal at the beginning and end of each regenerative half cycle. By means of the rod **40**, a reversal takes place not only at the end of each regenerative half cycle, but also at a time approximately at the center of the half cycle. With respect to the reversing means required, the arrangement of FIGS. 4 to 6 is therefore simpler. However, it requires a larger number of change-over cocks than the arrangement shown in FIGS. 1 to 3.

While I have herein shown and described the preferred form of the present invention and have suggested modifications therein, other changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of this invention.

What I claim is:

1. In a cyclically operating regenerative coke oven battery including a plurality of spaced apart heating walls with coking chambers therebetween, each heating wall having a plurality of vertically extending heating flues therein, passage means for defining said heating flues into first and second groups which operate concomitantly so that combustion occurs in all of the flues in one group at the same time whereas the flues in the other group serve as exhaust flues and vice versa, each group having combustion occur therein during substantially one-half of said cycle of operation and serving as exhaust flues for the other half cycle, a high burner and a low burner in each of said flues, a first line connected to one burner in each of said flues in said first group for alternately supplying combustion gas and air thereto, a second line connected to the other burner in each of said flues in said first group for alternately supplying combustion gas and air thereto, a third line connected to one burner in each of said flues of said second group for alternately supplying combustion gas and air thereto, and a fourth line connected to the other burner in each of said flues in said second group for alternately supplying combustion gas and air thereto;

means for alternately supplying air and combustion gas to said first, second, third and fourth lines associated with each heating wall comprising:

a gas main,

an air main,

first, second, third, fourth, fifth and sixth valves associated with each heating wall, each having first and second inlets and an outlet, each valve including operating means operable to and from a first position wherein said first inlet is connected to said outlet and from and to a second position in which said second inlet is connected to said outlet,

each valve having its first inlet connected to said air main,

means connecting said second inlet of said first and second valves to said gas main,

means connecting the outlet of said first valve to the second inlets of said third and fourth valves,

means connecting the outlet of said second valve to the second inlets of said fifth and sixth valves.

means connecting the outlets of said third, fourth, fifth and sixth valves to said first, second, third and fourth lines, respectively.

a first actuating member connected to the operating means of each of said first valves for operating them between said first and second positions,

a second actuating member connected to the operating means of each of said second valves for operating them between said first and second position, and

a third actuating member connected to the operating means of each of said third, fourth, fifth and sixth valves for operating them between said first and second position.

2. The coke oven battery of claim **1**, wherein the burners connected to said first line are low burners, the burners connected to said second line are high burners, the burners connected to said third line are low burners, and the burners connected to said fourth line are high burners.

3. The coke oven battery of claim **1**, wherein said actuating members are reciprocably operable members.

4.The coke oven battery of claim **1**, wherein said first and second valves are in opposite positions, said third and fourth valves are in opposite positions, and said fifth and sixth valves are in opposite positions.

5. The method of operating cyclically a coke oven battery of the type including a plurality of spaced apart heating walls with coking chambers therebetween, each heating wall having a plurality of vertically extending heating flues therein, passage means for defining said heating flues into first and second groups which operate concomitantly so that combustion occurs in all of the flues in one group at the same time whereas the flues in the other group serve as exhaust flues and vice versa, each group having combustion occur therein during substantially one-half of said cycle of operation and serving as exhaust flues for the other half cycle, a high burner and a low burner in each of said flues, a first line connected to low burners in each of said flues in said first group for alternately supplying combustion gas and air thereto, a second line connected to the high burners in each of said flues in said first group for alternately supplying combustion gas and air thereto, a third line connected to the low burners in each of said flues of said second group for alternately supplying combustion gas and air thereto, and a fourth line connected to the high burners in each of said flues in said second group for alternately supplying combustion gas and air thereto;

means for alternately supplying air and combustion gas to said first, second, third and fourth lines associated with each heating wall comprising:

a gas main,

an air main,

first, second, third, fourth, fifth and sixth valves associated with each heating wall, each having first and second inlets and an outlet, each valve including operating means operable to and from a first position wherein said first inlet is connected to said outlet and from and to a second position in which said second inlet is connected to said outlet,

each valve having its first inlet connected to said air main,

means connecting said second inlet of said first and second valve to said gas main,

means connecting the outlet of said first valve to the second inlets of said third and fourth valves,

means connecting the outlet of said second valve to the second inlets of said fifth and sixth valves,

means connecting the outlets of said third, fourth, fifth and sixth valves to said first, second, third and fourth lines, respectively, said first and second valves being in opposite positions, said third and fourth valves being in opposite positions, said fifth and sixth valves being in opposite positions,

a first actuating member connected to the operating

means of each of said first valves for operating them between said first and second positions,

a second actuating member connected to the operating means of each of said second valves for operating them between said first and second position, and

a third actuating member connected to the operating means of each of said third, fourth, fifth and sixth valves for operating them between said first and second position,

commencing with the valve positions as defined, said method comprising the steps of maintaining said defined condition for about one-quarter of a cycle period, then operating said third actuating member to reverse the condition of said third, fourth, fifth and sixth valves while maintaining the condition of said first and second valves, and then after the passage of about another quarter cycle period operating said first, second and third actuating members to reverse the immediately preceding conditions of all valves, and then after the passage of about

another quarter-cycle period operating said third actuating member to reverse the conditions of said third, fourth, fifth and sixth valves while maintaining the conditions of said first and second valves, and then after the passage of about another quarter-cycle period operating said first, second and third actuating members to restore said valves to their initially defined conditions.

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U.S. Cl. X.R.

202—143