April 16, 1957 H. SCHÜRHOFF ET AL 2,789,086

DECARBONIZING OF THE RICH GAS NOZZLES OF COKING OR OTHER CHAMBER OVENS

Filed Aug. 19, 1953 4 Sheets-Sheet 1

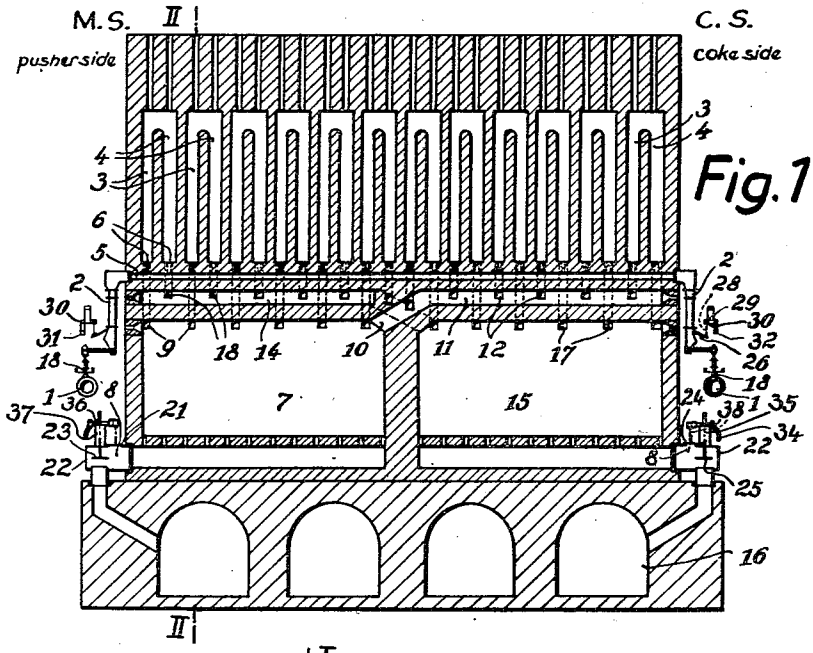


Fig. 1

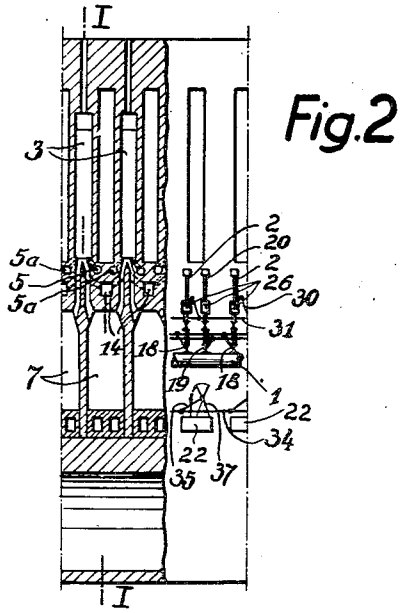


Fig. 2

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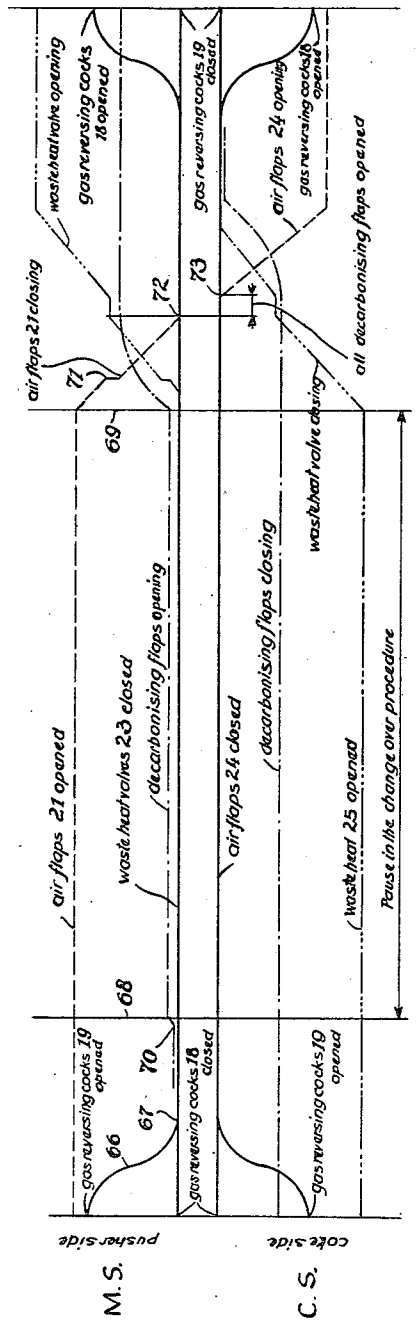
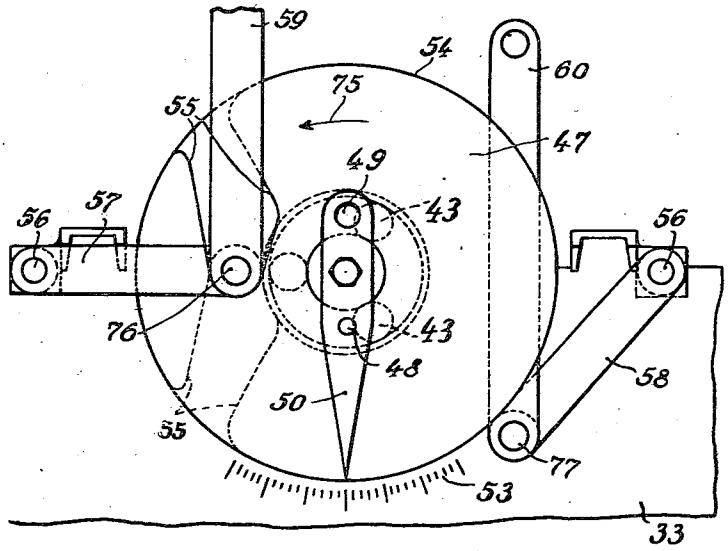


Fig. 3

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Fig. 4



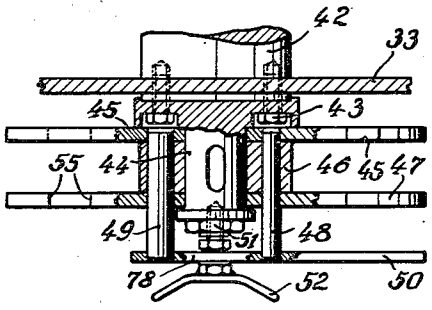


Fig. 5

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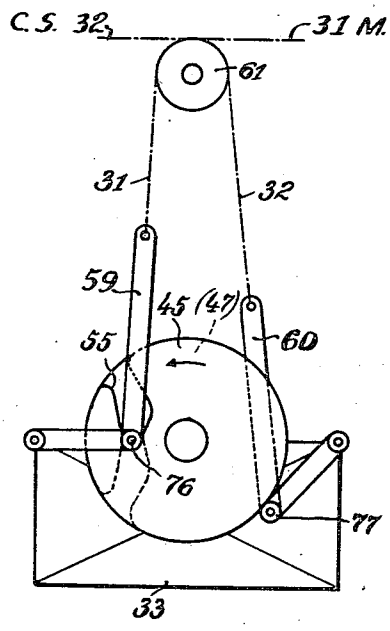


Fig. 6

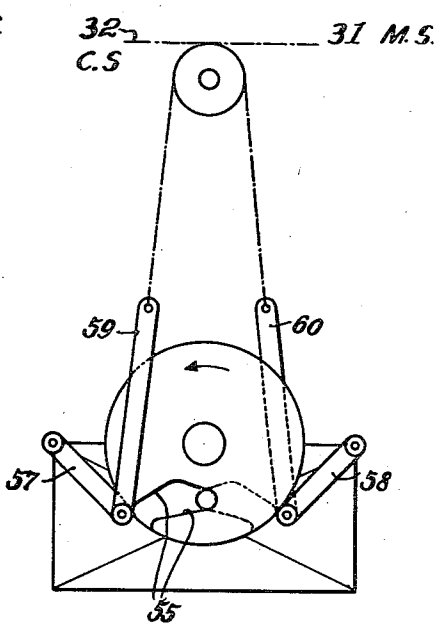


Fig. 8

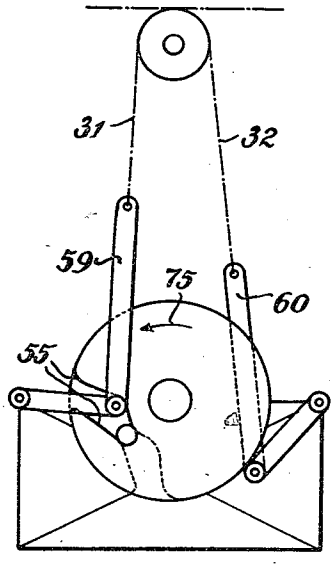


Fig. 7

United States Patent Office 2,789,086 Patented Apr. 16, 1957

2,789,086

DECARBONIZING OF THE RICH GAS NOZZLES OF COKING OR OTHER CHAMBER OVENS

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Application August 19, 1953, Serial No. 375,273

3 Claims. (Cl. 202—38)

The present invention relates to the decarbonizing of the rich gas nozzles of regeneratively-heated coking chamber ovens or similar ovens by the induction of air during the reversal of the direction of heat flow, using flap valves operated by the reversing gear (usually a winch).

In the heating of coking or other chamber ovens by means of rich gas, deposits of graphite are formed in the portions of the rich gas nozzles of the heating system which are located in zones of high temperature, owing to the decomposition of the hydro-carbons therein, these deposits producing variations in the free cross-section of the nozzle which impair the uniform heating effect which is aimed at, and consequently such deposits have to be removed from time to time. Hitherto this removal has been carried out by opening, at specific intervals at which the reversal mechanism has cut off the rich gas and only half of the regenerators are open to their waste gas channels, air inlet flaps which are furnished on the outer rich gas supply conduit, the air which is accordingly drawn in producing combustion of the graphite deposits while the rich gas is cut off.

Where normal coke oven gas is utilized as the rich gas, such an expedient suffices to remove the graphite deposits in the rich gas nozzles, but where ovens are heated by means of a rich gas with a high content of heavy hydrocarbons such as residual synthesis gas, the amount of deposited graphite is such that the usual manner of introduction of relatively small quantities of air is inadequate to deal with the problem and some of the deposits have to be removed eventually by a difficult manual operation.

The present invention aims at the provision of apparatus for the automatic removal of the graphite deposits in the rich gas nozzles of coking or other chamber ovens, in which the graphite deposits formed as a result of heating by a gas having a higher content of heavy hydro-carbons are completely banished by the drawing in of larger quantities of air for short periods by the natural draft of the oven with all of the regenerators open to their stack draft channels.

In accordance with the present invention this aim is achieved by connecting the decarbonizing air inlet flap valves, which are located outside the oven in the rich gas supply conduits, in such a way with the reversing gear for effecting the change over of the direction of heat flow that, at a specific period in the reversing procedure, air only is drawn through all the rich gas nozzles, under the action of the flue draught by the waste heat conduits of all regenerators.

In accordance with a further feature of the invention reversing members for the regenerator air valves and waste heat valves are operated by the reversing gear in such a way as to cause an acceleration in the closure of the regenerator air valves at one regenerator side, relatively to the opening of the air valves for the other regenerator side which is to be opened, thus providing a time interval in which the waste heat valves of all the regenerators of both sides are partially opened and all the air inlet flap

valves for the decarbonizing air are fully opened since these regenerator air valves conventionally are hooked up with the waste heat valves, so that when the air valve is opened the waste heat valve is closed, and vice versa, i. e., when the air valve closes the waste heat valve automatically opens. Since neither the combustion air for burning gas for the underfiring nor the combustible gas for underfiring can enter the heating system in this period, the whole of the suction effect of the flue draught, of about 25 mm. W. S. (water column), is made available for a sudden influx of a larger amount of decarbonizing air through all the rich gas nozzles to all the waste heat conduits, so that a short intermission of about 1 second or less, during the interval of reversing of the direction of heat flow, is sufficient for the complete combustion of the greater amounts of graphite deposits resulting from such a rich gas of higher hydrocarbon content than that of coke oven gas.

According to a further feature of the invention the decarbonizing air inlet flaps are controlled through a cam disc which is coupled to the reversing gear and has, running over the cam surface thereof, a roller cam follower connected to a draw member of the reversing gear. Preferably in accordance with yet another feature of the invention, special cam discs are used on the one hand for closing the air inlet flaps of the rich gas conduits which, at that particular instant, were just closed to gas flow and on the other hand for holding open the decarbonizing air inlet flaps of the rich gas conduits which were at that time closed to such rich gas flow but are next to be turned on. By this feature, the air flaps of the rich gas conduits previously open to gas flow are opened while the air flaps provided in the rich gas conduits closed against the inflow of gas are also open during the end of the purge period.

Yet another feature of the invention resides in the connecting of two cam discs for controlling the flap valves for the decarbonizing air, by means of two bolts, with the shaft of the reversing gear so that they can be brought stepwise into the position necessary for the closure of the decarbonizing flaps during the change over of the heating to lean gas.

A preferred embodiment of the invention is illustrated in the drawings in which:

Figure 1 is a vertical section through the heating flues and through the regenerators of a coke oven battery, taken on the line I—I of Figure 2 and indicating the heating mechanism;

Figure 2 is a vertical section on the line II—II of Figure 1 with a part shown in elevation;

Figure 3 is a diagram showing the movements of the control members effected during the reversal operation of the heating system;

Figure 4 is an elevational view of the mechanism for reversing the decarbonizing flaps, which mechanism is coupled to the reversing gear;

Figure 5 is a vertical section through the mechanism taken on line V—V of Figure 4; and

Figures 6 to 8 illustrate different positions of the reversal mechanism illustrated in Figure 4.

The coke oven battery illustrated in Figure 1 is of the twin flue oven type in which the rich gas for effecting the heating is supplied through distribution pipes **1** arranged along both the pusher machine and coke discharge sides of the oven battery. The rich gas passes in one phase of a regenerative cycle through vertical pipes **2** at both sides of the oven battery and through horizontal channels **5** and nozzles **6**, located below the heating flues **3** and **4**, to the foot of one set of flues **3** and in the next phase upon reversal of the heat flow, through pipes **20** at both sides of the battery and channels **5a** to the foot

of another set of flues 4. The regenerators are in two sets as indicated at 7 and 15, and associated with each regenerator is an elbow 22, the elbows on one side, the pusher machine side, of the battery each having an air inlet flap 21 and a waste heat valve 23, while those on the opposite coke discharge side of the battery each have an air flap 24 and waste heat valve 25.

When rich gas is used for heating, combustion air for burning the same is preheated in a regenerator 7 and for this is admitted to the regenerators through openings 8 in elbows 22, and is supplied by the regenerator 7 through regenerator ducts 9 to the heating flues 3 in the regenerative heating period or phase in which these flues 3 are fired upwards. At the inner end 10, the regenerators 7 are connected each with a horizontal conduit 11 which delivers preheated air therefrom to the heating flues 3 on the coke side half of the battery through regenerator ducts 12. Waste heat from flues 3 flows downwards through the other set of heating flues 4 and through regenerator ducts 13 in the left-hand pusher machine side half of the heating walls into counterpart horizontal conduits 14 then into the other set of regenerators 15 connected to these conduits 14. The waste gases from the flues 4 on the right hand coke side half of the heating wall also pass through conduits 17 directly into the other set of regenerators 15. From the latter regenerators 15, the waste gases are drawn off into the waste gas passage 16 through the opened waste heat valve 25 of their elbows 22.

The rich gas pipes 2 and 20, which are respectively connected to the gas distribution pipes 1 at both sides of the battery and with the respective rich gas channels 5 and 5*a* are equipped with individual shut-off cocks 18 and 19, Fig. 2, which are adapted to be opened or closed by reversing gear according to the direction of heat flow. The reversing cocks 18 for pipes 2 at both sides of the oven battery are thus opened when the upward firing of the heating flues 3 takes place, and during the same heating period the reversing cocks 19 for gas pipes 20 on both sides of the battery are closed. During this regenerative heating phase, moreover, the air flaps 21 of the elbows 22 on the pusher machine side of the battery indicated by M. S. in Figure 1, are opened for regenerators 7 and the waste heat valves 23 for said elbows 22 are closed, while the flaps 24 of the elbows 22 at the coke discharge side of the battery, marked C. S., are then closed for regenerators 15 and the waste heat valves 25 opened.

When the direction of heat flow has been changed over the flow program is correspondingly reversed for inflow through regenerators 15 and flues 4 and outflow through flues 3 and regenerators 7.

Openings for inflow of decarbonizing air, closable by flaps 26, are formed in the vertical rich gas pipes 2 and 20. The flaps 26 are connected to a lever arm 30 by means of a chain 28 and a shaft 29 (Fig. 1). At the pusher machine side M. S. of the battery the lever arm 30 is engaged by a draw member 31 and on the coke discharge side C. S. by a draw member 32, which are connected to the reversing mechanism of the reversing gear as illustrated in Figures 4 to 7. Only one decarbonizing air inlet opening, adapted to be closed by the flap 26, need be provided per duct 5 or 5*a*. The flaps 26, for example on the M. S. side, operated for the gas pipes 2, and on the C. S. side only the gas pipes 20, are provided with these flaps 26 so that decarbonizing air enters from one end only of the ducts 5 and 5*a*.

The combustion regenerator air flaps 21 and 24 and the regenerator waste heat valves 23 and 25, and also the rich gas cocks 18 and 19, are changed over, reversed, by means of the customary reversing equipment 33 as conventionally indicated in Figures 4 and 6 to 8. To this end the reversing equipment is connected to the regenerator valves through a draw member 34 of the

elbows 22 to a draw lever 35 which is fastened to a shaft 36 mounted on a plummer block 37.

The air flaps 21, 24, and waste heat valves 23, 25, of the elbows 22 are so interconnected by chains 38 that, on opening the air flaps 21 or 24, the waste heat valves 23 or 25 are closed and vice versa. If for example the air flaps 21 on the machine side M. S. are opened during a heating period, the waste heat valves 23 are closed against discharge of the heat, and the air flaps 24 are closed and the waste heat valves 25 opened at the coke side C. S. When the regenerator air flaps and waste heat valves are thus set, the reversing cocks 18 of the rich gas pipes 2 on the two sides of the battery are opened for ducts 5, while the reversing cocks 19 for the gas admission pipes 20 connected to the ducts 5*a*, which are arranged to operate in alternate succession with pipes 2 and ducts 5, are closed. This means that when air streams in through the opened regenerator flaps 21 into the regenerators 7 it also flows through the connecting regenerator ducts 9 directly, and indirectly through the horizontal conduits 11 and regenerator ducts 12 to the heating flues 3, the rich gas flows to the latter in through the nozzles 6 from the horizontal gas duct or channel 5. Waste gas resulting therefrom is then withdrawn through the heating flues 4 indirectly through regenerator ducts 13 of the left hand half of the oven battery and horizontal conduit 14, and through regenerator ducts 17, directly into the regenerators 15, whence it passes out into the waste heat passage 16.

In accordance with the invention, in Figure 5, a spindle 44 is rigidly connected to the shaft 42 of the reversing gear 33 by means of screws 43. Slidably disposed on spindle 44 is a cam disc 45 and also, through the agency of a spacing ring 46, a further cam disc 47. The spacing ring 46 is firmly keyed on the spindle 44. The cam discs are rigidly connected to the shaft 42 of the reversing gear 33 by means of two bolts 48 and 49 of different cross-sectional size which pass through the two cam discs 45 and 47 and the spacing ring 46, are held against axial displacement by means of a screw 51 rotatable by a butterfly 52 and threaded into the spindle 44. An indicator 50 welded to the bolts 48, 49 enables the position of the decarbonizing flaps 26 to be shown on a stationary scale 53 on the reversing gear.

The cam discs 45 and 47 have a circular peripheral part 54 and a recessed part 55. Mounted pivotally on the stationary frame of the gear 33 in pivots 56 are two cam follower arms, 57 being associated with cam disc 47 and the arm 58 with the cam disc 45, through rollers 76 and 77, respectively, which are also articulated to links 59 and 60 connected to the draw members 31 and 32 which run over a roller 61.

The link 59 is connected by draw members 31 via the roller 61, with the levers 30 of the decarbonizing air flaps 26 of the rich gas admission pipes 2 at the M. S. side of the battery. These decarbonizing flaps are closed during the heating period under consideration since the gas pipes 2 are then delivering rich gas to the heating flues 3. The link 60 through draw member 32, is connected via the corresponding roller 61 with the lever arms 30 of the decarbonizing flaps 26 for the pipes 20 on the C. S. side of the battery, the rich gas supply pipes 20 at this time being closed by valves 19 to the admission of gas, and the flaps 26 for pipes 20 are opened by member 32 since no air can flow from the counterpart regenerator 15 to flues 4 during this heating period.

The reversal of the direction of heat flow takes place in the manner indicated in the diagram of Figure 3. The gas cocks 18 for channels 5 are first closed at the machine side by operation of the reversing gear, this closure movement being identified by the curve 66 which terminates at the point 67. After the closure of the cocks the reversing gear continues to turn until the moment represented by the vertical line 68. At this moment a purge pause starts, this being represented by the vertical line 69.

When the gas cocks **18** have been thus closed as at **68**, a partial opening of the decarbonizing flaps **26** on the machine side to the gas supply pipes **2** for channels **5** starts at the point **70** in the diagram. As a result of the limited degree of opening of these flaps **26** a certain amount of air flows in at **26** and gradually drives ahead with it the residual gas in channel **5** to the heating flues **3**, the so produced mixture of air with the gas in channel **5** being however below the explosive limit.

The reversing of the regenerator waste heat and air valves begins at the end of the purge pause as at **69** in the change over procedure. In this phase of the reversal operation the opened air flaps **21** for regenerators **7** for flues **3** close more rapidly, by means of member **34**, than the closed air flaps **24** for regenerators **15** can commence to open, through member **34**, for flues **4**, thus opening up waste gas valves **23** for regenerators **7** while waste gas valves **25** for regenerators **15** are still open to tunnel **16**, so that there is a short intermission, for example of about one second, between the end of the closure movement of the regenerator air flaps **21** and the beginning of the opening of the regenerator air flaps **24**.

This relative faster closure operation, by draw member **34** of the air flaps **21**, as at the machine side on the left hand of Figure 1, is effected by an accompanied connecting of the flaps, as flap **21** with the shaft **36** through slackage in the chain **38**, at a point which imparts, at the moment indicated in the diagram at **71**, with certainty a certain acceleration to the closure movement of the air flaps of each regenerator set, which also, of course, affects the quicker opening of the waste heat valve **23** which is conjugated therewith before the opening operation of the air flaps of the other regenerator set. The closure of the air flaps **21** terminates at the point **72**, whereas the air flap **24** at the coke side does not begin to open until the point **73** is reached. In the period separating these two points **72** and **73**, a period of about one second, all the air flaps **21** and **24** at both sides of the oven battery are therefore closed. The waste heat valves **23** and **25** at both sides of the battery are however, as is apparent from the diagram, approximately half open, since the waste heat valves **25** have not yet been fully closed and the waste heat valves **23** not yet fully opened due to excess chain slackage take-up.

At the conclusion of the pause however, the decarbonizing flaps **26** of the vertical gas pipes **2**, which hitherto have only been slightly opened for channels **5**, begin at the same time to open further as a result of the continued rotation of the reversing gear shaft **42**. The opening is concluded when the air flaps reach the closure position at the vertical line **72**, as can also be seen from the diagram, so that in the cam-determined period between the closure of the regenerator air flaps **21** and opening of the regenerator air flaps **24**, which are designated by the points **72** and **73**, comparatively larger quantities of air are drawn through the ducts **5** and **5a** and every one of their rich gas nozzles **6** under the effect of the direct flue draught of their regenerators **7**, **15** with tunnels **16** through valves **23** and **25**, instead of all draft being through only one valve, **23** or **25**, as heretofore. This excess air provokes a combustion of the greater amounts of graphite deposits in the nozzles **6** and, after leaving the nozzles, passes directly to the immediately adjoining connecting conduits **9**, **12** and **13**, **17** leading to the regenerators **7** and **15** without passing through flues **3** and **4** and through waste heat valves **23** and **25** to the waste heat passage **16**.

The reversing procedure is now terminated by the uninterrupted continued rotation of the reversing gear shaft **42**, in that the air flaps **24** open, the waste heat valves **25** close and the waste heat valves **23** are fully opened. When this change over procedure is concluded the gas cocks **19** of the gas pipes **20** for channels **5a** and flues **4** are opened. The decarbonizing flaps of the gas admission pipes **2** for channels **5** and flues **3** remain open since these are still shut off from the gas supply, while the decarbonizing flaps of the gas pipes **20** are closed, as is also apparent from the diagram.

In Figure 4, arms **57** and **58** of the draw members **31** and **32** connected to the decarbonizing flaps are in a position in which the decarbonizing flaps of the gas pipes **2** are closed and those of the gas pipes **20** are open. Figure 7 illustrates the position in which during a rotation of the reversing gear in the direction of the arrow **75** (Figure 4), the recessed surface **55** of the cam disc **47** has actuated the roller **76** for member **31** to produce the limited opening of the decarbonizing flaps of the conduits **2** at the beginning of the purge pause which is represented in the diagram of Figure 3 by the vertical line **68**. The roller **77** of the lever **58** of the cam disc **45** for member **32** at that time runs over the circular periphery of the cam disc so that the opened condition of the decarbonizing flaps **26** of the rich gas pipes **20** is consequently not altered but kept open also.

In Figure 8 the roller **76** of the lever **57** for member **31** has reached the circular periphery of the cam disc **47**, so that the corresponding decarbonizing flaps **26** for gas pipes **2** are fully opened, as is disclosed in the diagram of Figure 3 by the vertical line **72**. The roller **76** runs over this circular peripheral part of the cam disc **47** until the conclusion of the reversing procedure, while from this time onwards the roller **77** of the lever **58** enters the corresponding recess in the edge of the cam disc **45** and thus closes the associated decarbonizing flaps of the gas pipes **20**.

In changing over from heating by rich gas to heating by lean gas it is necessary to close all the decarbonizing flaps. This is effected by turning the butterfly **52** of the screw **51**, causing the nut **78** to act on the indicator **50** and withdraw the bolts **48** and **49** connected to the latter out of the path of the cam disc **45**. When the decarbonizing flaps **26** associated with the cam disc **45** are opened it is necessary before carrying out this step to await the succeeding reversing procedure in which the flaps are closed. Since, during the next reversal the cam disc **47** has reached the position corresponding to the closure of the corresponding decarbonizing flaps, the bolts **48** and **49** can be fully withdrawn. Since the cam discs **45** and **47** are now loose on the spindle **44** they can no longer participate in the rotation of the reversing gear. The use of bolts **48** and **49** of different size guarantee that these always enter the same openings, and thus ensure the correct relative positioning of the cam discs.

The invention can be applied to any kind of regeneratively heated oven, such as those heated with rich gas, or optionally with rich gas and lean gas.

What we claim is:

1. A regeneratively-heated coking chamber oven with two sets of rich gas nozzles and two sets of regenerators, and an arrangement for decarbonizing the rich gas nozzles during the reversal of the direction of heat flow, using valves to the nozzles which are operable by the reversing gear to open and allow the drawing-in of air to the nozzles, and valves associated with the two sets of regenerators for inflow of air to, and outflow of waste gas from, the regenerative system of the oven, characterized by all said valves being coupled with the reversing gear in such a manner that, at a specific time in the reversing procedure, air only is drawn in the heating system only through all the rich gas nozzles of both sets and exhausted through both sets of regenerators into the waste heat passages for both sets by the action of the flue draught.

2. An arrangement according to claim 1, characterized in that air inlet valves and waste heat valves associated with the two sets of regenerators are operatively coupled with the reversing gear such that the air inlet valves of one set of the regenerators is closed in advance of the opening of the corresponding air valves of the other set of regenerators, thereby establishing an intermission in which the waste heat valves of both sets of regenerators

and the decarbonizing valves for both sets of nozzles are open.

3. An arrangement according to claim 2, characterized in that the reversing gear comprises cam discs for air valves for the nozzles connected to a shaft of the reversing gear by two bolts such that they can be brought stepwise into a position thereby closing all the decarbonizing valves for a change to heating by lean gas.

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