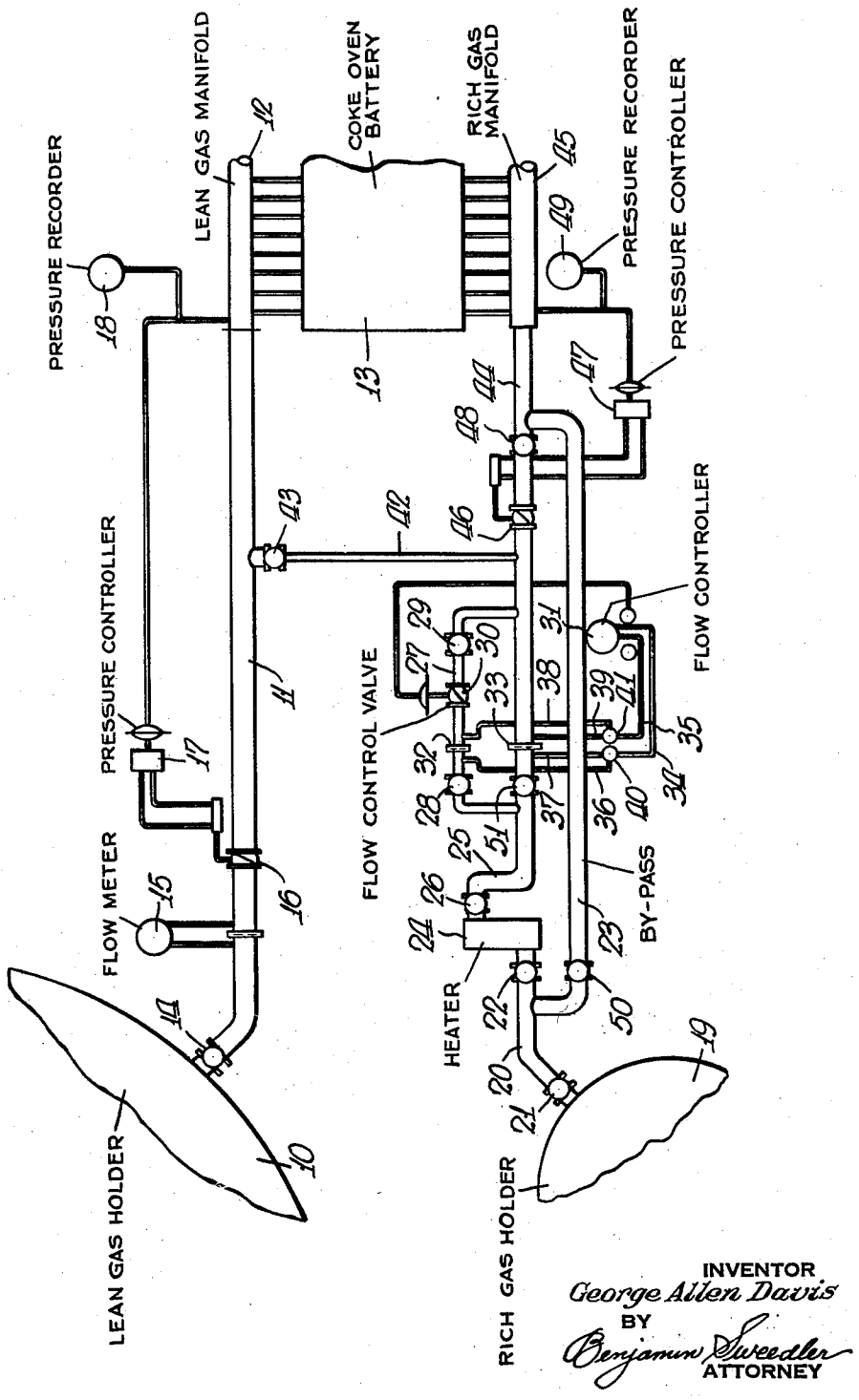
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SIMULTANEOUSLY FIRING A COKE OVEN BATTERY WITH RICH AND LEAN FUEL GASES

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SIMULTANEOUSLY FIRING A COKE-OVEN BATTERY WITH RICH AND LEAN FUEL GASES

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This invention relates to the simultaneous firing of a coke oven battery with lean gas, such as blast furnace gas or producer gas, and a rich gas, such as coke oven gas, the latter gas supplying not more than 25% of the heat required to coke the charge.

Coke oven batteries are commonly designed to be fired by burning rich gas, such as coke oven gas fed directly to the heating flues, or alternatively by burning lean gas, such as blast furnace gas, which is first preheated by flow through the gas regenerators and the preheated lean gas then burned in the flues. In such batteries, known as combination oven batteries, the distribution main for the coke oven gas is designed to handle the relatively large volume of coke oven gas which must be burned when the battery is fired with coke oven gas alone to supply the heat necessary to coke the charge. In the operation of such batteries it is sometimes desirable to fire the battery by supplying simultaneously blast furnace or other lean gas to the inflow gas regenerators and coke oven or other rich gas to the flues. For example, it may be desirable to burn a small amount of coke oven gas fed directly to the flues to insure satisfactory heating of the base of the charge in each coking chamber. When firing with blast furnace gas alone, the base of the charge in each coking chamber may be undercoked due to the fact that an appreciable time interval elapses after the gas enters the flues and begins to burn for the maximum temperatures to develop. In some cases there may be an over-abundance of coke oven gas, so that it is desirable to burn some of this coke oven gas to supply the heat necessary to coke the charge. In other cases the burning of the blast furnace gas of the type and in the volume available may be inadequate to supply the necessary heat to coke the charge at the desired rate. To provide the necessary heat for this purpose, coke oven gas may be fed directly to the flues and burned therein. When it is attempted to distribute a relatively small amount of coke oven gas through the coke oven gas distribution system, as distinguished from the normal flow employed when the charge is coked by burning coke oven gas alone, it is found that the pressure in the coke oven gas distribution system is so low that small variations in the pressure within the individual flues caused by variations in draft to which the flue system is subjected, materially affects the distribution of the coke oven gas to the individual flues with consequent poor distribution of the coke oven gas to these flues.

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It is an object of this invention to efficiently and economically fire a combination coke oven battery with lean gas supplied directly to the inflow gas regenerators and rich gas supplied directly to the flues.

Another object of this invention is to provide a process for firing a coke oven battery in which rich gas is supplied in amount adequate to provide only a small proportion of the heat required to coke the charge, i. e., not exceeding 25% of this heat, to the rich gas distribution system of a capacity to supply all the coke oven or other rich gas required for heating the charge and at the same time obtain efficient distribution of this rich gas throughout the heating flues.

Still another object is to provide an improved arrangement of rich and lean gas feed and distribution lines and control mechanism therefore designed to supply any desired amount of coke oven gas to the coke oven gas distribution system, and notwithstanding the supply to the system of an amount of coke oven gas far below that for which the system is designed when the battery is operated so that it is fired by coke oven gas alone, uniform distribution of this smaller amount of coke oven gas throughout the flues is effected.

Other objects and advantages of this invention will be apparent from the following detailed description thereof.

In accordance with this invention, rich gas is supplied at a desired rate of flow to the rich gas distribution system of a combination regenerative coke oven battery, the rate of flow being controlled to maintain it constant notwithstanding variations in the rich gas supply, for example, variations in the volume of rich gas within the rich gas holder, lean gas is supplied to the lean gas distribution system to maintain a substantially constant pressure of lean gas within this system, a small amount of lean gas is withdrawn from the main stream flowing to the lean gas distribution system, this small amount mixed with the stream of rich gas fed at a controlled rate, and the pressure of the resultant mixture is regulated responsive to variations in pressure in the rich gas distribution system to supply to this system a mixture of lean and rich gas at a substantially constant desired pressure, desirably in excess of 5 mm. of water gauge, preferably at least 10 mm. of water gauge, such that variations in draft within the flues do not appreciably affect the distribution of the mixed gas to the flues. Thus, the battery is fired by lean gas fed directly to the gas inflow regenerators where the lean

gas is preheated, at least 75% of the heat required to coke the charge being supplied by burning the preheated lean gas and by rich gas fed directly, i. e., without preheating, to the burners in the flues, the rich gas being supplied at a controlled rate of flow to the rich gas distribution system at a constant pressure sufficient to result in satisfactory distribution thereof throughout the heating flues and this notwithstanding variations in draft to which the flues are subjected. When firing the battery with lean gas, it is important to supply at least 75% of the heat required to coke the charge by burning such lean gas, because, if a smaller amount of lean gas is fed through the inflow gas regenerators, inefficient operation takes place from the standpoint of preheating the lean gas and recovering the heat content of the outgoing products of combustion.

In the accompanying drawing, forming a part of this specification, the single figure illustrates a preferred arrangement of gas lines and controls therefore connecting the blast furnace gas holder with the blast furnace gas manifold and the coke oven gas holder with the coke oven gas manifold. The description which follows will be confined to the present illustrated embodiment of the invention. It will be understood, however, the scope of this invention is not confined to the embodiment herein described, but that other lean gas may be supplied to the lean gas distribution system instead of blast furnace gas, for example, producer gas and other rich gas, such as water gas, natural gas, refinery gas, or other gas having a heating value greater than 150 B. t. u. per standard cubic foot, may be supplied to the rich gas distribution system.

In the drawing 10 indicates a blast furnace gas holder connected by a line 11 with the blast furnace gas manifold 12, which communicates with the gas inflow regenerators of a coke oven battery 13. This battery may be any well known type of combination regenerative battery. As conventional the gas in its flow through these regenerators is preheated and the preheated gas fed to the flues where it is burned; air for supporting combustion is supplied to the flues by the air inflow regenerators.

Gas line 11 is provided with a usual shut-off valve 14, flow meter 15 for indicating the rate of flow of the gas therethrough and controlling valve 16 operated by a pressure controller 17 of any well known type, which is responsive to the pressure in the blast furnace gas manifold 12 and functions to position valve 16 to control the flow of blast furnace gas into manifold 12 such that a substantially constant pressure of gas is maintained within this manifold. A pressure recorder 18 of any conventional type may be associated with the pressure controller 17 to provide a record of the pressure conditions within manifold 12.

A coke oven gas holder 19 has a line 20 leading therefrom. Valves 21 and 22 are disposed in line 20 and a by-pass line 23 leads from line 20 at a point intermediate valves 21 and 22, as shown in the drawing. Line 20 leads into a heater 24, which may be heated by steam circulated on the outside of the pipes through which the coke oven gas flows for heating the coke oven gas to a temperature such that no condensation will occur in the subsequent flow of the gas to the flues.

A line 25 provided with a valve 26, leads from heater 24 and is of a capacity to handle the flow of the entire amount of coke oven gas required to coke the charge.

An auxiliary line 27 of smaller capacity, say about ¼ of that of line 25 leads from line 25 and is provided with valves 28 and 29 and a flow control valve 30 operated by a flow controller 31 of any conventional type, preferably the well known meter type which meters the gas and also can be adjusted to effect operation of the controlling valve 30 to give any desired rate of flow of gas.

Associated with flow controller 31 is a pair of orifices 32, 33, disposed in the auxiliary line 27 and the main gas line 25 respectively. Flow controller 31 has leading therefrom a pair of lines 34, 35; line 34 is provided with two branch lines 36, 37 and line 35 with two branches 38 and 39. Branches 36, 38 communicate with auxiliary line 27 on opposite sides of the orifice plate 32. Branches 37, 39 on the other hand communicate with main line 25 on opposite sides of the orifice plate 33 therein. Three-way valve 40 is positioned to place either branch 36 or 37 into communication with the line 34 leading to the flow controller 31. In other words, in one position valve 40 shuts off the connection between branch 37 and line 34 and places the latter line in communication with branch 36 leading to one side of orifice plate 32 in line 27. In like manner three-way valve 41 may be positioned to place either branch 38 or 39 in communication with line 35 leading to the flow controller 31.

A side stream line 42 provided with a valve 43 connects the blast furnace gas line 11 with line 25. Line 42 communicates with line 25 at a point beyond the flow control valve 30 in the direction of flow of coke oven gas through line 25. A mixed gas line 44 leads from the point of jointure between line 42 and the gas line 25 to a coke oven gas manifold 45. Regulating valve 46 is disposed in mixed gas line 44 and is operated by a pressure controller 47 of any well known type responsive to the pressure within the coke oven gas manifold 45. Valve 48 is disposed in the mixed gas line 44 just before the point in this line where it communicates with the by-pass line 23. A pressure recorder 49 of any conventional type may be associated with the pressure controller 47 to provide a record of the pressure conditions within manifold 45. Valve 50 is positioned in the by-pass line 23 and valve 51 in line 25. The function of by-pass line 23 is to permit flow of coke oven gas through this line when it is desired, for any reason, to interrupt flow through the main line 25, for example, for the purpose of cleaning and repairing any of the equipment associated with the line 25. When this by-pass line is used, valves 22 and 48 are closed and valve 50 open. When by-pass line 23 is not in use, as customary, valve 50 is closed and valves 22 and 48 open. By-pass line 23 can, of course, be omitted, if desired.

In operation when the regenerative coke oven battery is fired with coke oven gas exclusively, valve 43 is closed, the blast furnace gas reversing valves (not shown) controlling flow of blast furnace gas to the gas inflow regenerators are all closed, being declutched from the reversing cables, and valves 28 and 29 in auxiliary line 27 are closed. Valve 14 is maintained open so that the entire blast furnace gas system is under holder pressure, thus eliminating explosion hazards due to infiltration of air into the system. Valves 40 and 41 are positioned to place the opposite sides of orifice plate 33 in communication with flow controller 31 which operates only as a meter to show the volume of coke oven gas fed. The coke oven gas flows from the coke oven gas holder 19 through line 20, coke oven gas heater 24, line 25,

valve 51 being open, line 44 into the coke oven gas manifold 45, valve 46 being operated by pressure control 47 to maintain a substantially constant pressure of coke oven gas within manifold 45. From this manifold the coke oven gas is distributed to the flues and burned; air for combustion is supplied from the air inflow regenerators.

When it is desired to fire the coke oven battery with both lean gas and coke oven gas, the lean gas flows through line 11 into blast furnace gas manifold 12; the pressure controller 17 maintains a substantially constant pressure of blast furnace gas in manifold 12. At least 75% of the heat required to coke the charge is supplied by the blast furnace gas fed from manifold 12 to the gas inflow regenerators from which the preheated blast furnace gas flows into the flues.

Coke oven gas is supplied simultaneously to line 20 from which it flows into line 25; the remainder of the heat required to coke the charge, i. e., not more than 25% is supplied by the coke oven gas. Valve 51 in line 25 is closed and valves 40 and 41 positioned so that the flow controller 31 is in communication with the opposite sides of the orifice 32 in auxiliary line 27. Flow controller 31 is adjusted to give the desired rate of flow of coke oven gas through lines 25 and 27, this rate of flow being maintained substantially constant by the flow controller 31. That is to say, if variations in the rate of supply of coke oven gas takes place due, for example, to variations in the volume of coke oven gas in holder 19, flow controller 31 operates to position valve 30 to compensate for such variations and maintain a substantially constant rate of flow through line 27 into line 44. The rate of flow of coke oven gas for which controller 31 is set by the operator will be chosen to supply the heat, in addition to that supplied by burning the blast furnace gas, to efficiently coke the charge. This will vary for each battery and will depend on many factors such as the amount of blast furnace gas available, whether the amount results in satisfactory coking, including proper coking of the base of the charge, the amount of coke oven gas available, etc. For any given battery the optimum amount is readily determinable; in all cases when firing with both blast furnace and lean gas, the amount of coke oven gas employed should not exceed the amount which when burned supplies 25% of the heat required to coke the charge.

A small amount of blast furnace gas flows from main line 11 through the by-pass line 42, valve 43 being open for this purpose, and mixes with the coke oven gas flowing through line 44. The pressure of the resultant gas mixture is controlled by pressure controller 47 which actuates valve 46 so that the mixed gas comprising predominantly coke oven gas is supplied to the coke oven gas manifold 45 at a substantially constant pressure such as to effect uniform distribution of the gas to the burners in the flues notwithstanding variations in draft to which the flues may be subjected. The amount of blast furnace gas thus supplied through by-pass line 42 will vary in accordance with variations in pressure in the manifold 45. The amount of blast furnace gas thus supplied results in the supply of a mixture of coke oven gas and blast furnace gas at a substantially constant pressure to the manifold 45 which pressure may be as low as 5 mm. of water gauge, preferably about 10 mm. of water gauge and is adequate to cause satisfactory distribution of the gas from manifold 45 to the flues notwithstanding variations in draft to which the flues

are subjected. The coke oven blast furnace gas mixture is burned in the flues along with the preheated blast furnace gas fed thereinto from the inflow gas regenerators. Air to support combustion is applied to the flues from the air inflow regenerators.

When the battery is fired with blast furnace gas exclusively, a small amount of blast furnace gas flows through valve 43 into the rich gas manifold 45, valve 43 being opened for this purpose. The pressure of this gas within manifold 45 is maintained substantially constant at from 5 to 10 mm. water gauge by the pressure controller 47. Thus manifold 45 is constantly maintained under gas pressure eliminating explosion hazards due to infiltration of air thereinto.

It will be noted this invention provides a combination coke oven battery which is efficiently and economically fired by blast furnace gas or other lean gas supplied directly to the gas inflow regenerators and coke oven or other rich gas supplied directly to the flues, in which efficient distribution of the coke oven gas to the flues is effected notwithstanding variations in draft to which the flues are subjected and the fact that a relatively small amount of coke oven or other rich gas is supplied to the rich gas distribution system.

Since certain changes in carrying out the above process and in the coke oven battery set forth, which embody the invention, may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. The process of firing a combination regenerative flued coke oven battery, which comprises flowing a stream of lean gas to the lean gas distribution system, thence through the regenerators where the lean gas is preheated and then into the flues; controlling the flow of a stream of rich gas to the rich gas distribution system communicating with the flues of said coke oven battery so as to supply said rich gas to said rich gas distribution system at a predetermined rate to provide not more than 25% of the heat required to coke the charge; withdrawing a portion of the lean gas stream flowing to the lean gas distribution system and mixing the portion thus withdrawn with the stream of rich gas; flowing the resultant mixture through a pressure regulating zone; flowing the mixture from said regulating zone to the rich gas distributing system; controlling the flow of the mixture flowing through said regulating zone in accordance with a predetermined pressure in said rich gas distribution system to supply said mixture at a substantially constant pressure substantially the same as said predetermined pressure in said rich gas distribution system and burning the lean gas and the mixture of rich and lean gases in the flues to supply the heat necessary to coke the charge.

2. The process of firing a combination regenerative flued coke oven battery, which comprises flowing a stream of blast furnace gas to the blast furnace gas distribution system, thence through the regenerators where the blast furnace gas is preheated and then into the flues; controlling the flow of a stream of coke oven gas to the coke oven gas distribution system communicating with the flues of said coke oven battery so as to supply said coke oven gas to said coke oven gas distri-

bution system at a predetermined rate to provide not more than 25% of the heat required to coke the charge; withdrawing a portion of the blast furnace gas stream flowing to the blast furnace gas distribution system and mixing the portion thus withdrawn with the stream of coke oven gas; flowing the resultant mixture through a pressure regulating zone; flowing the mixture from said regulating zone to the coke oven gas distribution system; controlling the flow of the mixture flowing through said regulating zone in accordance with a predetermined pressure in said coke oven gas distribution system to supply said mixture at a substantially constant pressure substantially the same as said predetermined pressure in said coke oven gas distribution system and burning the blast furnace gas and the mixture of coke oven and blast furnace gases in the flues to supply the heat necessary to coke the charge.

3. In a gas distribution system for firing a combination regenerative coke oven battery, in combination, a lean gas line, a lean gas manifold into which said lean gas line leads and communicating with the regenerators, a rich gas line, a flow controller, a valve in said rich gas line operated by said flow controller for controlling the rate of flow of the rich gas therethrough, a side stream line connecting said lean gas line with the rich gas line at a point in said rich gas line beyond said valve in the direction of flow of rich gas through said rich gas line, a mixed gas line through which flows the mixture of rich gas from said rich gas line and lean gas from said side stream line, a valve in said mixed gas line, a rich gas manifold into which said mixed gas line leads, and a pressure controller responsive to the pressure in said rich gas manifold for operating said valve in the mixed gas line to control the flow of the mixture of rich gas and lean gas into the rich gas manifold so that the mixed gas is supplied to the rich gas manifold at a substantially constant pressure.

4. In a gas distribution system for firing a combination coke oven battery, in combination, a blast furnace gas holder, a blast furnace gas manifold, a blast furnace gas line connecting said holder with said manifold, a valve in said blast furnace gas line, a pressure controller responsive to the pressure in said blast furnace gas manifold for operating said valve to regulate the flow of blast furnace gas from said holder to said blast furnace gas manifold to maintain a substantially constant pressure of gas in said manifold, a coke oven gas holder, a coke oven gas manifold, a coke oven gas line leading from said coke oven gas holder, a valve in said coke oven gas line, a flow controller for operating said valve to cause the coke oven gas to flow through said coke oven gas line at a predetermined substantially constant rate of flow, a side stream line connecting said blast furnace gas line with said coke oven gas line at a point in the flow through said coke oven gas line beyond the valve therein in the direction of flow therethrough, a mixed gas line leading from said point of jointure between said coke oven gas line and said side stream line to said coke oven gas manifold, a valve in said mixed gas line, and a pressure controller responsive to the pressure in the coke oven gas manifold for operating said valve in the said mixed gas line to control the flow of the mixture of coke oven gas and blast furnace gas into the coke oven gas manifold so that the mixed gas is supplied to the coke oven gas manifold at a substantially constant pressure.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,398,055	Van Ackeren	Nov. 22, 1921
1,597,365	Keigley	Aug. 24, 1926
1,907,202	Ryan	May 2, 1933
1,918,926	Otto	July 18, 1933
1,921,145	Albright	Aug. 8, 1933
1,968,367	Becker	July 31, 1934
2,342,214	Otto	Feb. 22, 1944
2,342,426	Ransome	Feb. 22, 1944

FOREIGN PATENTS

Number	Country	Date
24,809	Australia	of 1930

OTHER REFERENCES

"The Wilputte Coke Oven," published by the Wilputte Coke Oven Corp., 1944, pages 3 to 29. Copy in Div. 25.