United States Patent

[11] 3,607,660

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[33] **Germany**
[31] **P 17 71 688.0**

[54] **PROCESS FOR REGULATING THE TEMPERATURE OF A COKE OVEN CHAMBER**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **201/1,** 202/151, 236/15 B
[51] **Int. Cl.** **C10b 21/10**
[50] **Field of Search** ..... 201/1; 202/151; 236/15 B

[56] **References Cited**

UNITED STATES PATENTS

3,506,542	4/1970	Kulakov	202/151
3,319,887	5/1967	Gallagher	236/15
2,998,195	8/1961	Kahn	236/15
2,235,219	3/1941	Krogh	236/15

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ABSTRACT: The vertical temperature profile of the coke oven chamber is continually measured during the coking process. The measured temperature profile is compared with an optimum temperature profile for that period of the coking process and deviations of the actual temperature profile from the optimum temperature profile are corrected by regulating the heat supplied to the coke oven heating walls.

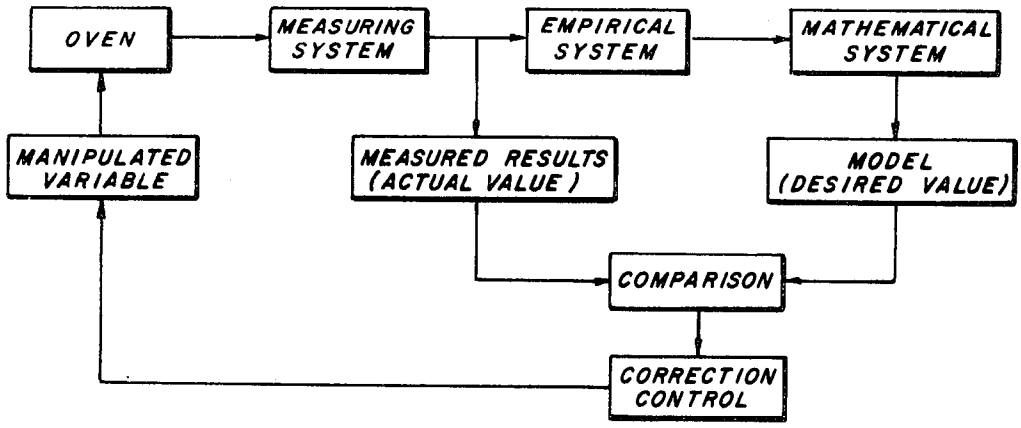


FIG. 1

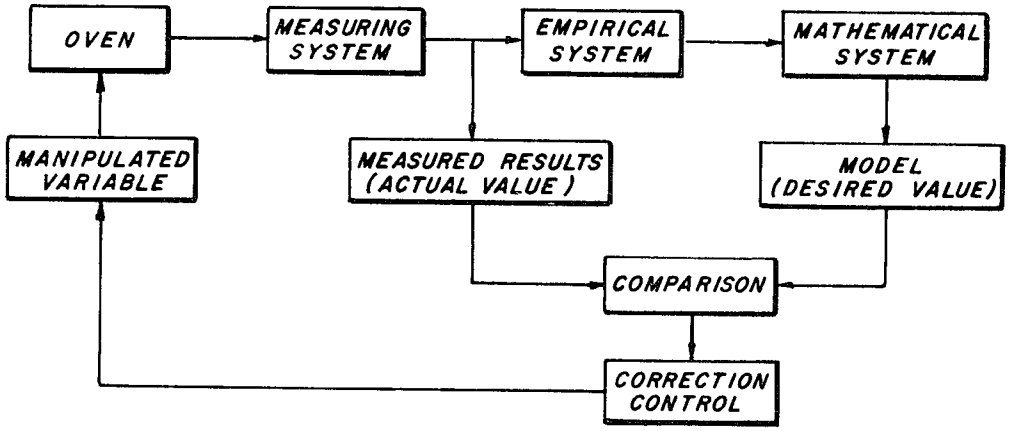


FIG. 2

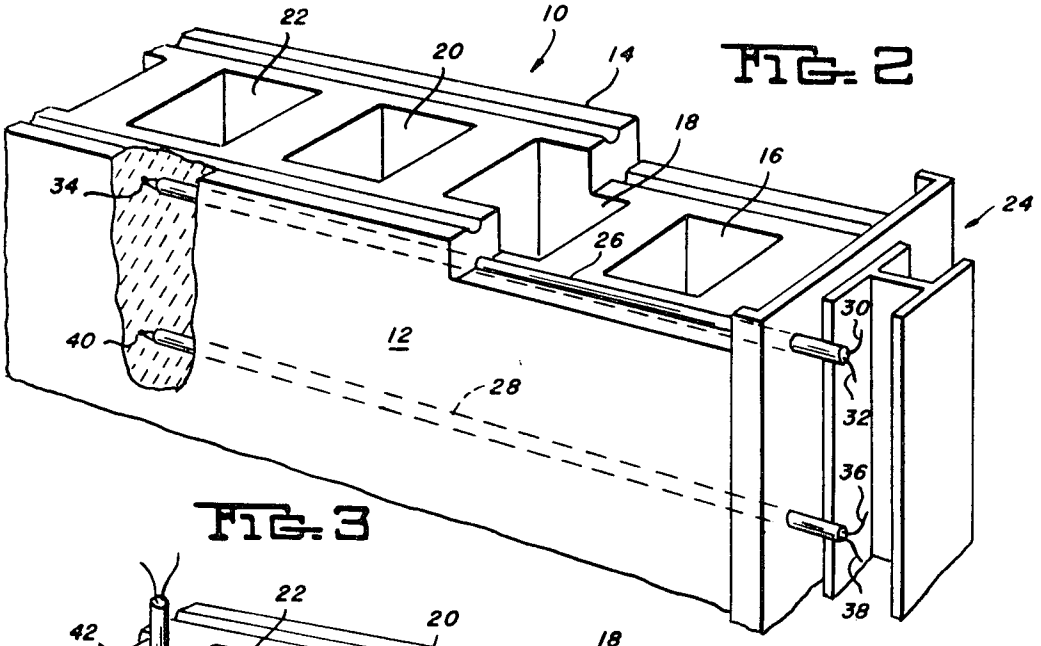
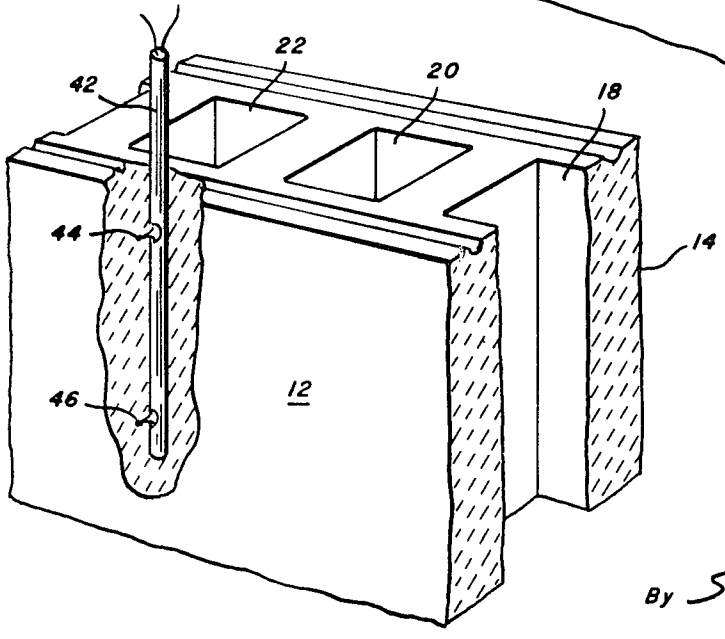


FIG. 3



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PROCESS FOR REGULATING THE TEMPERATURE OF A COKE OVEN CHAMBER

BACKGROUND OF THE INVENTION

This invention relates to a process for regulating the temperature of a coke oven chamber and more particularly to a process for comparing the vertical temperature profile of a coke oven chamber with an optimum vertical coke oven temperature profile and reducing the deviation therebetween.

Numerous attempts have been made in the past to increase the throughput capacity of coke ovens; to improve the quality of the coke and to regulate both the production and composition of the coke oven gas. Qualitative and quantitative improvements have been obtained by maintaining a uniform coking coal composition, particularly in regard to the moisture content of the coal charge. Improvements have also been obtained by maintaining the supply of heat to the coke oven relatively constant to thereby regulate the thermal efficiency of the coke oven. An increase of the throughput capacity of horizontal byproduct coke ovens has recently been attempted by raising the heating flue temperatures and thereby reducing the coking period.

There has been proposed a process for controlling the heating flue temperatures and thereby increasing the throughput of a horizontal byproduct coke oven. The temperature of the flue gas is continuously measured at the reversal place of the third or fourth heating flue on the coke side of the coke oven. A model temperature is obtained by measuring the heating flue temperature at the same location in the heating flues of five ovens which have been charged and pushed within the same time interval. The highest temperature is detected by a suitable temperature selector and is constantly maintained at an adjusted desired value. The temperature may be adjusted by changing the amount of heating gas or changing the composition of the heating gas.

Another process for increasing the throughput of a horizontal byproduct coke oven is disclosed in copending application entitled "Process and Apparatus for Coking Coal in a Horizontal Byproduct Coke Oven," Ser. No. 808,556, filed Mar. 19, 1969. It was discovered that the temperature in the upper third of the coke oven lags considerably during the coking period when a uniform supply of heat is provided along the height of the coke oven chamber and the desired or optimum temperature profile is reached only toward the end of the coking period. The reason for this lag in temperature gradient along the height of the coke oven chamber is the more rapid degasification or volatilization of the coal in the lower part of the coke oven chamber which results in the condensation of water vapor or condensation of the volatilized hydrocarbon products because of an insufficient supply of heat in the upper part of the coking chamber.

As disclosed in the above copending application, this deficiency in the coking process is eliminated by heating the oven chamber in such a way that the temperature in the lower zone of the oven is between about 50° and 150° C. below the temperature in the intermediate zone and the temperature in the upper zone of the coke oven chamber is about 100° C. above the temperature in the intermediate or middle zone of the coke oven chamber. This temperature profile is obtained by either decreasing the thickness of the heating walls of the coke oven chamber from the bottom to the top, or by providing brick material in the heating walls that has greater thermal conductivity in the upper region of the heating walls as compared with the lower region.

Although the two above-described processes improve the throughput capacity of the coke ovens and the quality of the coke, there remains a need for a process for continuously controlling the temperature profile of the horizontal byproduct coke ovens. In accordance with the hereinafter described invention, this optimum control is obtained by controlling the temperature of the individual coke ovens. The process comprises measuring the temperature profile along the height of the coke oven chamber by measuring the temperature of the

coke oven chamber at various heights between the floor of the coke oven chamber and the top of the coke oven chamber. This temperature profile is continually compared with an empirical or optimum model temperature profile. Where there are deviations of the measured real temperature profile from the model temperature profile, the real temperature profile is adjusted to correspond with the model temperature profile by increasing or decreasing the supply of heat to the heating flues adjacent the particular coke oven chamber.

Accordingly, the principal object of this invention is to increase the throughput of a horizontal coke oven by continuously maintaining an optimum temperature profile in the coke oven chamber during the coking process.

Another object of this invention is to provide a process for continuously measuring the temperature profile within the coke oven chamber and adjusting the temperature profile to correspond with an optimum temperature profile.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatic representation of the manner in which the herein described process is practiced.

FIGS. **2** and **3** are fragmentary diagrammatic illustrations of a portion of a coke oven battery on the coke side, illustrating the manner in which the temperature profile is measure along the height of the coke oven chamber.

Referring first to FIG. **2** the coke oven generally designated by the numeral **10** has a heating wall **12** and a heating wall **14** with vertical heating flues **16**, **18** **20** and **22** therebetween. The coke side of the coke oven **24** is the side from which the coke is discharged after the completion of the coking process. The heating walls **12** and **14** form the walls of the coking chambers on opposite sides of the vertical flues **16**, **18** **20** and **22**.

The heating walls **12** and **14** are formed of refractory bricks having tongue and groove portions. The horizontal groove portions in the refractory bricks at various elevations are enlarged and horizontal pipes, as for example pipes **26** and **28** are positioned in the enlarged grooves and extend to a location adjacent the fourth flue **22**. Wires **30** and **32** extend through the pipe **26** to a temperature-sensing element **34** that measures the temperature of the heating wall **12** at a predetermined elevation above the coke oven floor. This measured temperature is transmitted through the wires **30** and **32** to a suitable recording device. The pipe **28** similarly has a pair of wires **36** and **38** that are connected to a temperature-sensing element **40** positioned to measure the temperature at another predetermined elevation above the coke oven floor. Although only two of the temperature-sensing elements **34** and **40** with the respective wires connected thereto have been illustrated, it should be understood that a series of pipes may extend through the heating wall **12** as above described, to measure the temperature profile of the heating wall adjacent the fourth flue at any preselected number of elevations.

FIG. **3** is similar to FIG. **2** in that it illustrates a fragmentary portion of the flues **18**, **20** and **22** with the heating walls **12** and **14**. A vertical pipe **42** extends downwardly through the heating wall **12** and has a plurality of temperature-sensing elements **44** and **46** at different elevations to measure the temperature of the heating walls at these different elevations. Suitable wires extend through the pipe **42** to the temperature-sensing elements **44** and **46** to transmit the temperatures of the heating wall at various elevations to a suitable recording device. Again, for illustrative purposes only, two temperature-sensing elements **44** and **46** have been illustrated. It should be understood that a greater number of temperature-sensing elements may be utilized to measure the temperature of the heating walls at various elevations to provide a temperature profile of the heating wall. It is preferred to measure the temperature profile of the heating wall at a location adjacent the fourth heating flue on the coke side of the coke oven chamber.

The optimum model temperature profile may be obtained either empirically or mathematically. The most favorable model temperature profile is not obtained until almost the end of the coking period. Therefore, in practice, the heating of the coke oven chamber must be determined as a function of the lapsed time of the coking process. A large number of models or temperature profiles are required for different lapsed times of the coking period since the coking process is dependent on different heat requirements during the coking period. Other variables are the types of heat transfer surfaces present, the maximum permissible load on the regenerator, the maximum possible gas pressure at the gas burners, and the influence of the variable heating on the quality of coke. It is, therefore, desirable to take the above variables into consideration when the model temperature profiles are prepared and to measure the real temperature profile several times, either cyclically or continuously during the coking period and compare this real temperature profile for a particular time during the coking process with a model temperature profile that has been determined as optimum for the same particular time during the coking process and then adapting this real temperature profile to the particular model temperature profile for that particular lapsed time in the coking process.

The temperature of the heating walls may be varied in order to obtain a uniformity between the measured temperature profiles and the model temperature profiles during the coking period. The temperature of the heating walls may be varied by modifying or changing either the amount of supplied heating gas or the composition of the heating gas. The composition of the heating gas may be varied by adding inert gas, air, flue gas, or by admixing different combustion gases. It is preferred, however, that the oven floor temperature be maintained at a constant value.

There are several arrangements whereby the process may be carried out. The heating of one or more coke oven chambers having substantially the same coal charge may be continuously or cyclically changed during the coking period by means of a program transmitter so that the real temperature profile always agrees with a particular model temperature profile. The process may also be controlled by a computer in which a large number of model temperature profiles are stored and the real temperature profile for a particular time during the coking process is compared with a particular model temperature profile for the same period of the coking process and the temperature of the coke ovens may be varied in the event there are deviations between the real temperature profile and the model temperature profile.

Referring to FIG. 1 there is illustrated by means of a block diagram the manner in which the herein-described process is practiced with a computer. The actual temperature profile of the coke oven is measured by means of the previously described measuring apparatus to provide the actual value or measured results. The model is determined by an empirical or mathematical system to provide the desired optimum temperature profile for the particular period during the coking process. The actual or measured temperature profile is compared by the computer with a model or optimum temperature profile and deviations between these temperature profiles are transmitted to a correction control device. A signal is transmitted from the correction control device to apparatus for increasing or decreasing the temperature at various elevations along the heating wall. This control is designated in FIG. 1 as the manipulated variable. With the above arrangement it is now possible to maintain the real temperature profile of the coke oven chamber substantially the same as the optimum temperature profile throughout the coking process.

The operating efficiency of either the program transmitter or the computer can be checked by monitoring continuously or at optional intervals of time the nozzle brick temperature as the maximum temperature of the heating flue and also measuring the temperature at the reversal place.

According to the provisions of the patent statues, I have explained the principle, preferred construction and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment.

I claim:

1. A process for continuously regulating the temperature of a coke oven chamber during the coking process comprising,
   - continuously measuring the vertical temperature profile at preselected elevations along the height of the coke oven chamber at preselected times during the coking process,
   - obtaining a plurality of optimum vertical temperature profiles for the coke oven chamber corresponding to the preselected times at which the vertical temperature profiles are measured during the coking process,
   - comparing each of the measured vertical temperature profiles with said corresponding optimum vertical temperature profile, and
   - adjusting at preselected intervals the supply of heat to preselected elevations within said coke oven chamber to reduce the deviation between the measured vertical temperature profile and said corresponding optimum temperature profile.

2. A process for regulating the temperature of a coke oven chamber during the coking process as set forth in claim 1 which includes,
   - measuring the vertical temperature profile of a plurality of coke oven chambers at preselected times during the coking process,
   - comparing said measured vertical temperature profiles of said plurality of coking chambers with an optimum temperature profile, and
   - separately controlling the supply of heat to each coke oven chamber to reduce the deviation between the measured temperature profile of all of said ovens and the optimum temperature profile.

3. A process for regulating the temperature of a coke oven chamber during the coking process as set forth in claim 1 which includes,
   - measuring the temperature of the coke oven heating walls at various elevations to obtain a measured temperature profile of the adjacent coke oven chamber.

4. A process for regulating the temperature of a coke oven chamber during the coking process as set forth in claim 4 which includes,
   - measuring the temperature of the heating walls at various elevations adjacent the fourth flue on the coke side of the coke oven to obtain the temperature profile of the adjacent coke oven chamber.

5. A process for regulating the temperature of a coke oven chamber during the coking process as set forth in claim 1, which includes,
   - storing optimum temperature profiles in a computer,
   - feeding actual temperature profiles into said computer, comparing in said computer said actual temperature profiles with said optimum temperature profiles,
   - measuring the deviation between the optimum temperature profiles and the actual temperature profiles,
   - transmitting the deviations to a control device,
   - adjusting in response to transmitted deviations the supply of heat to the heating wall of the coke oven chamber.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,607,660 Dated September 21, 1971

Inventor(s) Ernst Kumper

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the claims, Column 4, line 48, "as set forth in claim 4" should read --as set forth in claim 3--.

Signed and sealed this 25th day of April 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents