W. MUELLER.

REGENERATIVE OVEN.

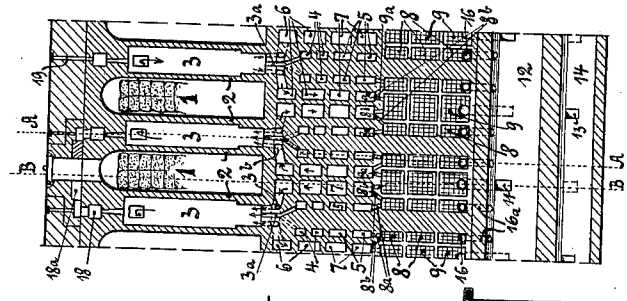
APPLICATION FILED MAR. 8, 1913.

1,089,663.

Patented Mar. 10, 1914.

3 SHEETS—SHEET 1.

Fig. 2.



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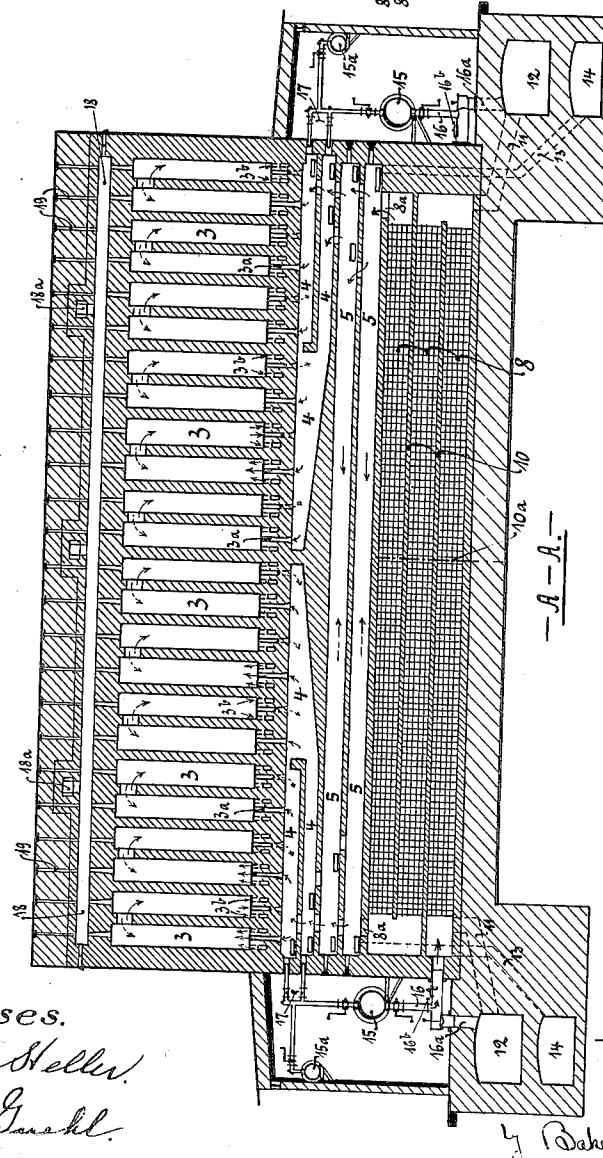

A—A.

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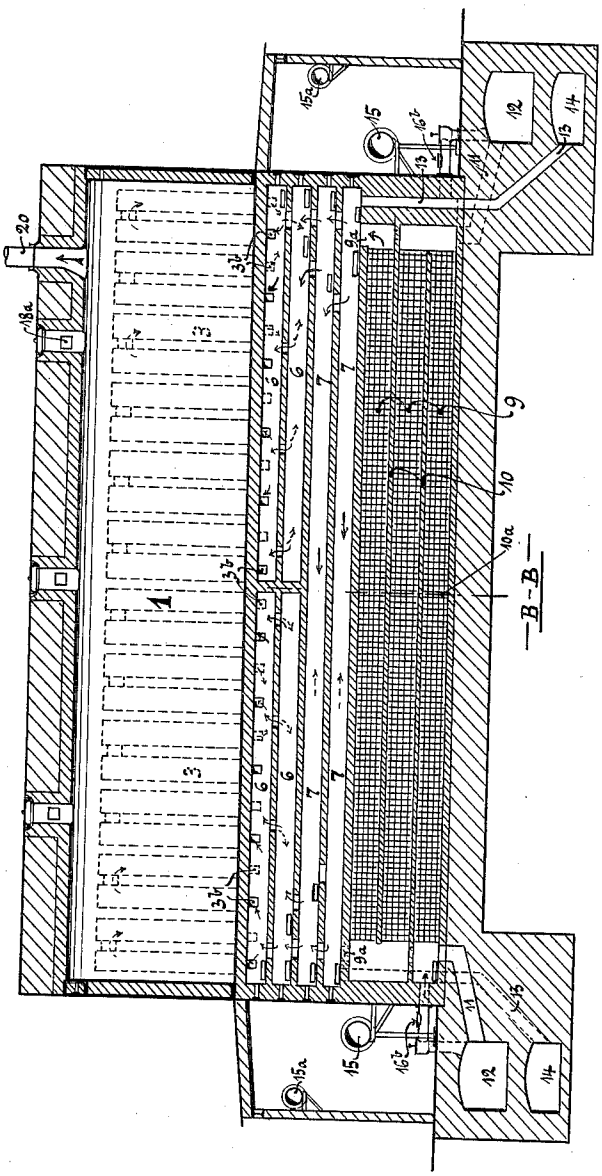
Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 5.

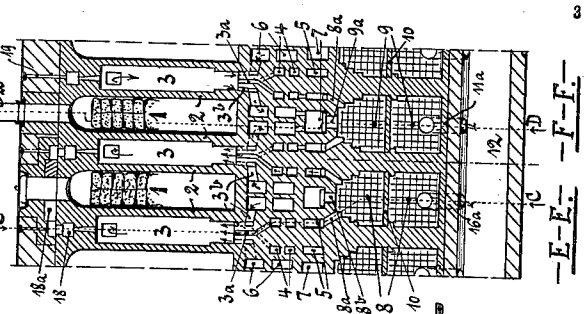
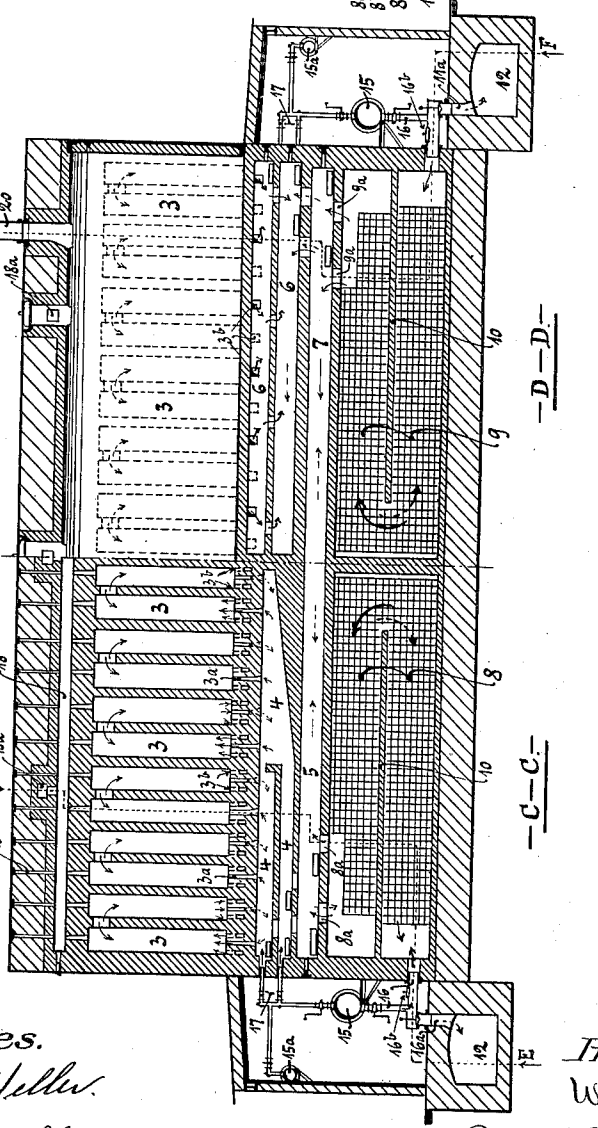


Fig. 4.



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UNITED STATES PATENT OFFICE.

WILHELM MUELLER, OF ESSEN-ON-THE-RUHR, GERMANY.

REGENERATIVE OVEN.

1,089,663. Specification of Letters Patent. **Patented Mar. 10, 1914.**

Application filed March 8, 1913. Serial No. 752,923.

To all whom it may concern:

Be it known that I, WILHELM MUELLER, a subject of the Emperor of Germany, residing at 17 Gutenbergstrasse, Essen-on-the-Ruhr, Germany, have invented new and useful Improvements in Regenerative Ovens, of which the following is a specification.

My present invention relates to improvements in the heating of coke ovens or gas-chamber ovens or retorts and is adapted to use a heating gas of inferior value, such as producer-gas or blast furnace-gas, and only to make use of coal-gas temporarily or as auxiliary to the first mentioned gases, whereby the whole amount or practically the whole amount of coal-gas is available for illuminating or other purposes as desired.

In order to attain an economical heating of the coking chamber when producer-gas or blast furnace-gas is used, it is essential that these gases which are of low heating power be preliminarily heated up to as high a temperature as possible, that is to say, to approximately the same degree as the hot combustion air, which usually reaches 1000 degrees centigrade in the regenerators. For accomplishing this preliminary heating, separate regenerators for air as well as gas are arranged underneath each oven chamber or chamber wall, which regenerators have suitable connecting passages to the air and gas distribution channels and to the combustion flues of the chamber walls.

The precise nature of the invention will be best understood by reference to the accompanying drawings, in which:

Figure 1 is a vertical longitudinal section of one form of my invention taken through the combustion chamber of the oven on the line A—A of Fig. 2; Fig. 2 is a vertical transverse section through several ovens of a battery; Fig. 3 is a vertical longitudinal section taken through the oven chamber on the line B—B of Fig. 2; Fig. 4 is a longitudinal section through a coke oven showing a modified arrangement of regenerators, the left-hand half being taken through the combustion chamber on the line C—C of Fig. 5, whereas the right-hand half is taken through the coking chamber or retort on the line D—D of Fig. 5; Fig. 5 is a vertical transverse section through several ovens on the lines E—E and F—F of Fig. 4.

Similar reference characters indicate corresponding parts in all figures.

Referring to the drawings, the coking chambers or retorts 1 are provided with doors, charging holes and a crude gas offtake 20 in the usual manner. At the side of each of the partitioning walls 2 between the coking chambers is arranged a series of vertical heating or combustion-flues 3 which are connected at their upper ends in pairs or groups. The lower end of each heating flue 3 is provided with gas and air nozzles or burners 3^a and 3^b which are respectively connected by suitable passages or ports to the gas and air distribution channels 4 and 6. The latter channels are divided in the center and are provided at their ends with regulating dampers. Underneath the distribution channels 4 and 6 one or two gas and air transfer and equalizing channels 5 and 7 are arranged. These equalizing channels run the entire length underneath the oven chamber or wall and communicate by regulatable passages with the distribution channels as well as by passages 8^a, 8^b and 9^a with the regenerators 8 and 9 below. The regenerators 8 and 9 are filled with checker brick work which is divided by partition walls 10 in order that the passage of the waste gases may be lengthened whereby a better recovery of the heat from the waste gases is attained. The remaining waste heat after leaving both regenerators 8 and 9 at about 150 degrees centigrade passes through the regulatable passages 11, 11^a or 16, 16^a and escapes into the smoke flues 12, which are connected at the end of the battery to the chimney and atmosphere.

Each of the heating flues 3 can be inspected from above through the passages 19. The channel 18 above the heating flues 3 is connected by ports 18^a to the charging holes in order to provide means for setting the ovens into operation by conveying the crude gas from the coking chamber 1 directly into the heating flues 3. The crude gas offtake 20 is connected in the usual manner to the hydraulic gas-main and the by-product recovery plant.

The fuel gas is supplied to the ovens along the battery by means of pipes 15 which have reversing valves in the branch pipes 16 and 17 connected with the gas regenerators 8 or the gas distribution channels 4 respectively. This arrangement renders it possible to supply from the pipe 15 producer gas or blast furnace gas through the lower branches 16 into the gas regenerators 8, or, after disconnection of pipes 16^a and regenerators 8, sup-

ply coal gas from the pipe 15 through the upper branches 17 immediately into the same gas distribution channels 4 to the burner-nozzles of the heating flues. In case a mixture of producer gas and coal gas shall be used for oven heating, the producer gas or blast furnace gas may be passed through the gas regenerators, while the coal gas is supplied from a pipe 15^a through the upper pipes 17 directly into the distribution channels 4 where it mixes with the preliminary heated producer gas and enters the vertical flues 3 where it meets with the hot air for combustion.

The present invention comprises also the improvement over known types of ovens by the fact that under each oven chamber separate gas and air regenerators are provided for preliminary heating of gas and of air, and that these regenerators can be divided by a vertical center partition wall 10^a as shown in Fig. 4 and indicated in Figs. 1 and 3, so that each half of the oven chamber has its own gas or air-regenerator each one of which being in connection by the transfer-channels, enables gas or air to be supplied as desired to each half as well as to the whole length of the heating walls.

The operation of my improved oven is as follows: If for example producer gas is used for heating, the gas is conducted through the pipes 15 and enters the regenerators 8 through the branch pipes 16. While passing through the regenerators, the gas is highly heated to, say about 1000 degrees centigrade and escapes through the regulatable passage 8^a into the equalizing or transfer channels 5, which lead the hot gas to the distributing channels 4 from whence it passes by means of the passages or nozzle-burners 3^a into the heating flues 3 of the chamber walls. The passage of the air is accomplished in a manner similar to that of the gas. Fresh air enters the regenerator 9 from the flue 12 and ducts 11 or through a side valve 16^b, and while passing the regenerator the air is also heated up to about 1000 centigrade. The hot air is then conducted through the equalizing or transfer channels 7 to the channels 6 from which it enters through the passages 3^b into the heating flues 3. Each of said regenerators 8 and 9 supplies the heating flues of two adjacent heating walls with gas and air. The gas and air, being both highly heated, ignite while mixing, burn as they flow upward and escape into the next flues in which they pass downward. From the heating flues 3 the waste gases escape through the passages 3^a and 3^b into the channels 4, 6 and 5, 7 of the neighboring chambers and pass then through the gas regenerators 8 as well as the air regenerators 9, leaving their heat to the checker brick work. The waste heat or off-gases finally escape through the elbows 16, 16^a and ports 11 or 11^a into the smoke flue 12, which leads to the chimney. The regenerators beneath alternative ovens either carry the waste heat or off-gases, or preheat gas and air. On reversal of the flow of combustion the regenerators which carried the off-gases are used for preheating and supplying gas and air to the heating flues, while the other regenerators now carry the off gases. As the fuel gas is preliminarily heated in regenerators as well as the air, a higher efficiency of combustion is attained, and as the whole amount of waste gases is not required for reheating the regenerators, a part of same may be taken off before it enters the regenerators, to be used for other purposes such as steam generating, etc. For this object, special passages 13 and collecting channels 14 are provided through which the surplus waste gases can be drawn off and disposed as desired. However this arrangement may be omitted, as is the case in Fig. 4, when desired.

In the modified construction of oven shown in Figs. 4 and 5 the two regenerators 8 and 9 beneath each oven are undivided structures serving as a whole for preheating gas or air. The mode of operation is as follows: Gas may be supplied through regenerators 8 of the left hand side only, from which it passes through the regulatable ports 8^a into the transfer channels 5 leading the gas to the distribution channels 4 of either half of the oven wall. Air is supplied to regenerators 9 of the right hand side only, from which it passes through ports 9^a into the transfer channel 7 from which the hot air enters the distribution channels 6 of either half of the oven wall. If desired, the left or right hand regenerator may be used for preheating gas or air, in which event only the respective ports to the transfer channels have to be changed. In case the oven chambers or retorts shall be heated temporarily with coal gas only, which latter is very liable to decompose and does not allow a preliminary heating, the gas is conducted from the pipe 15 or pipe 15^a through the upper pipes 17 immediately into the distribution channels 4. In this event the valve in pipe 16 is closed and the gas regenerators 8 are disconnected from the channels 5 and connected to the air regenerators 9 for the heating of the air supply. The air is heated in the same manner as before described and the combustion in the heating flues 3 remains also the same, except that the waste gases are only used for reheating the air regenerators. Changing of the gas and air supply and the current of combustion takes place as usual. If it is desired that coal gas may be used in connection with producer gas, the latter is supplied through pipes 15, 16 and the regenerators in the manner previously de-

scribed, and the coal gas is conducted separately through the pipes 15ª and 17 direct into the distribution channels 4, where it mixes with the hot producer gas and enters the heating flues 3.

My present invention renders it possible, that the same distribution channels underneath each oven wall can be used to supply coal-gas directly, or preliminary heated producer gas indirectly always to the whole length of the chamber walls so that a constant uniform distribution of the heat and shortest carbonization of the coal charge is attained.

The invention consists also in the improved arrangement that each half of the oven has its own gas and air regenerator, which being connected by the transfer channels, enable the gas or air to be supplied to either half as well as to the whole length of the heating wall in order to attain a compulsory heating without which the working of the oven is dependent mostly upon chance.

The new construction of oven constitutes the further improvement over known devices, that the oven can be heated in an economical way, either with producer gas, or if desired with coal gas, or a mixture of both gases, which can be performed without alteration of the construction by simply changing a few valves or connecting dampers.

I claim:

1. A regenerative coke oven or a gas retort furnace which is heated with producer gas or coal gas, comprising coking chambers, heating flues connected in groups between the coking chambers, an interconnectible gas regenerator and an air regenerator arranged beneath each coking chamber, gas and air transfer channels beneath the entire length of the oven, regulatable passages connecting said gas and air transfer channels with said regenerators and with said heating flues, means for supplying gas and air to said regenerators and said heating flues, means for drawing off the waste combustion gases from said heating flues through said transfer channels and said regenerators, means for changing the gas supply and admission of air alternately to alternate regenerators and heating flues, and means for changing the waste heat discharge passages in accordance with the reversal of the regenerators.

2. A regenerative coke oven or a gas retort furnace which is heated with producer gas or coal gas, comprising coking chambers, heating flues between said chambers, gas and air regenerators beneath each coking chamber, gas and air transfer channels connected with said regenerators and regulatable superimposed interconnected gas and air distribution channels for the entire length of each half of the oven connected to said transfer channels and connected by gas ducts and air ducts with the said heating flues of the oven wall.

3. A regenerative coke oven as set forth, comprising coking chambers, heating flues between said chambers, interconnectible gas and air regenerators for each coking chamber, means to supply producer gas and air through said regenerators and through the gas and air transfer channels into the distribution channels, means for supplying auxiliary cold coal gas directly into said gas distribution channels to be mixed with the hot producer gas and passing said mixture of gases through the gas ducts and the hot air through the air ducts into the heating flues for combustion, means for drawing off the waste combustion gases from the heating flues through the distribution channels, transfer channels and regenerators, means for closing and changing said producer gas and said coal gas supply to alternate regenerators and to alternate distribution flues and to said heating flues, and means for changing the air supply intakes and the waste heat discharge passages, all in accordance with the reversal of the combustion gases, substantially as described.

4. A regenerative coke oven having interconnectible and interchangeable regenerators for each oven, means for disconnecting the gas regenerator from the gas supply pipe and from the gas distribution channels and connecting said gas regenerator to the transfer and distribution channels of the adjacent regenerator to be adapted for air heating only, substantially as described.

5. A regenerative coke oven comprising coking chambers, heating flues between said chambers, two sets of superposed regulatable gas and air distribution channels each connected to an alternate set of said heating flues, transfer channels connecting said distribution channels to the regenerators and two interconnectible and interchangeable regenerators beneath each coking chamber, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILHELM MUELLER. [L. S.]

Witnesses:
HELEN NUFER,
ALBERT NUFER.