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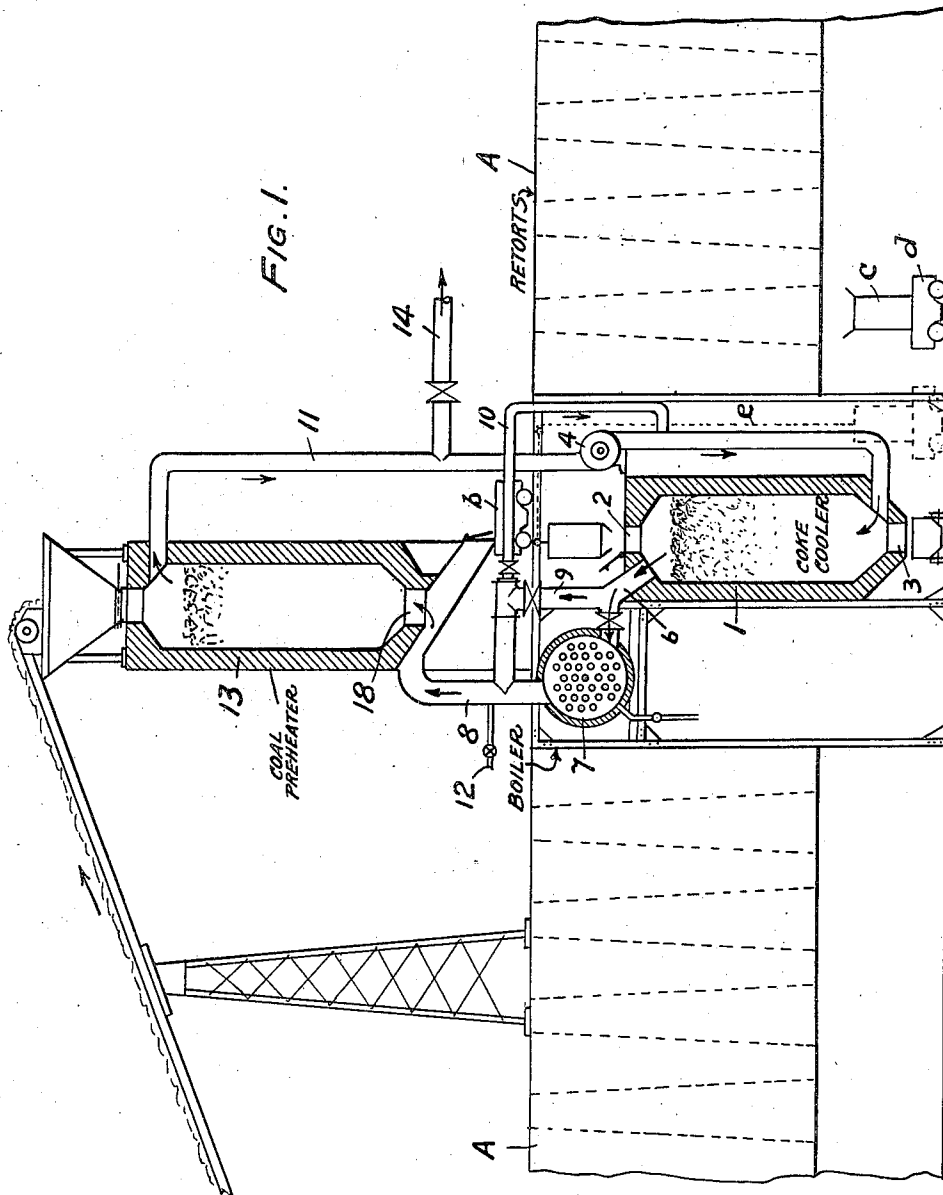
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1,854,407.

MEANS FOR PREHEATING COAL AND COOLING COKE

Filed Nov. 3, 1927

2 Sheets-Sheet 1



WITNESS:

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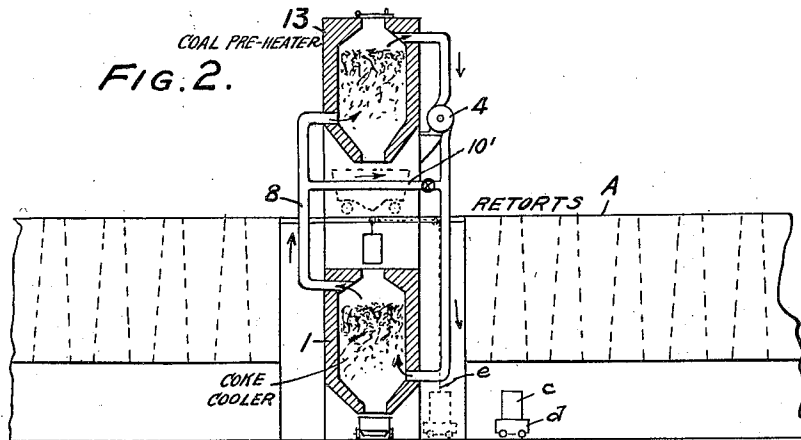
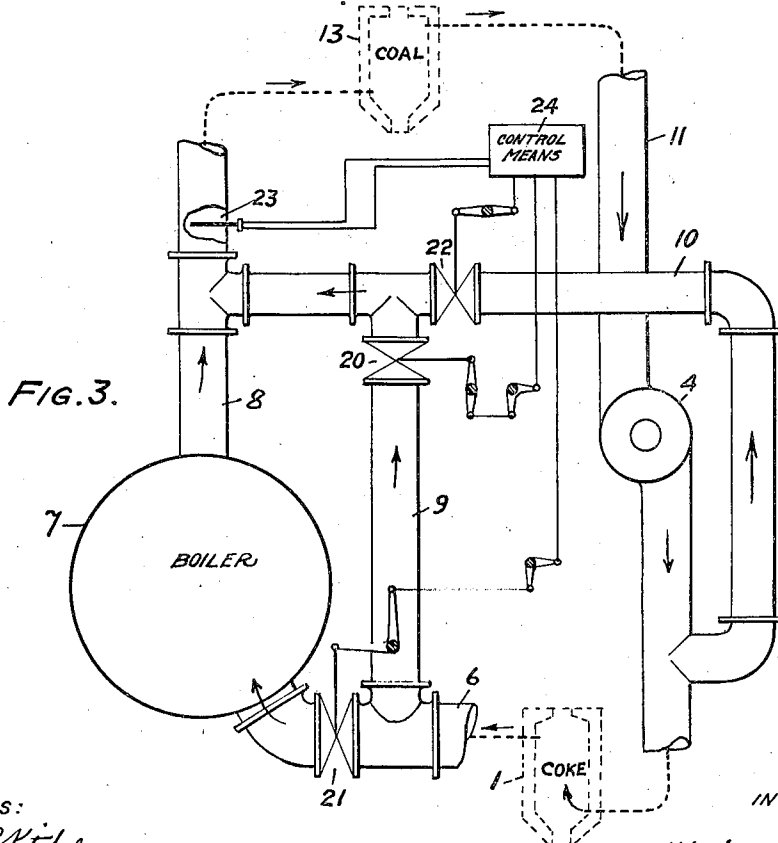
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2 Sheets-Sheet 2



WITNESS:

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UNITED STATES PATENT OFFICE

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MEANS FOR PREHEATING COAL AND COOLING COKE

Application filed November 3, 1927. Serial No. 230,731.

One object of the present invention is to provide an improved method and means of pre-heating coal prior to carbonization and of cooling the coke resulting from the carbonization.

In the operation of coke ovens and retorts the pre-heating of the coal is desirable, especially if this can be effected with waste heat. It decreases largely the time necessary for carbonization and thereby increases the capacity of the carbonizing plant. The carbonizing plant is of very expensive construction and should be relieved of work which cheaper apparatus may perform. Drying and pre-heating of the coal also prolongs the life of the retorts or ovens, as they are not exposed to such changes of temperature as when the coal is charged wet and cold.

It is also desirable to cool the coke resulting from the carbonizing process by dry quenching, recovering the heat in the coke, and also causing the formation of less breeze than in the wet quenching method.

The most efficient method of pre-heating coal is by direct contact with hot gases, and it has been previously proposed to pre-heat the coal prior to carbonization by passing through the coal the waste combustion gases from the carbonizing plant. However, these gases contain a variable amount of free oxygen and may contain a comparatively large quantity of it.

The passage of free oxygen through heated coal has a tendency to reduce the coking power of the coal, and although there may be some advantage in reducing the coking power of certain coals, the amount of oxygen passed through should be closely under control, and in the case of other coals the pre-heating should be carried on in the presence of as small a quantity of free oxygen as possible.

It is the procedure of the present invention to cool the coke resulting from the carbonization in a container by passing through it inert gases, such as products of combustion resulting from the initial air in the container, or, for instance, blue water gas, and then passing these hot gases through the coal to be preheated. A small boiler may be inter-

posed between the coke cooling apparatus and the coal pre-heater (in the flow of the gases), so as to reduce the temperature of the gases before entering the coal, or a part of the gases passing through the coal may be by-passed around the coke cooler, the remainder of the gases being returned from the coal pre-heating apparatus to the cooler to effect the same end. If desired, a boiler may be provided as well as the above by-pass, and there may be an additional by-pass around the boiler, so that, if necessary, the temperature of the gases entering the coal may be raised to any degree up to that at the exit of the gases from the coke cooler. If desirable, the temperature of the gases entering the coal may be kept at a pre-determined elevation by automatic operation of the valves or dampers in the by-pass conduits, actuation being secured from thermally responsive means in the conduit leading to the coal pre-heater.

The circulation of the hot gases from the coke cooler through the coal cools these gases, and they are recirculated again through the coke, and so forth.

The passage of the gases through the coke prior to entrance to the coal ensures that there will be only a very small amount of free oxygen in the gases passing through the coal. If desired, a regulated amount of air may be admitted just prior to entrance to the coal, in sufficient quantity to oxidize the coal to the desired extent, and reduce its coking power to the desired extent, but not a sufficient amount to cause undue combustion in the coke cooler after the passage of the gases through the coal.

The coal is preferably not raised to a temperature at which carbonization begins, and the temperature of the preheating gases, as well as the presence or absence of free oxygen, may be regulated so that the conditions are the most suitable to produce the best grade of coke from the particular coal being treated.

After its passage through the pre-heater, the coal is charged into the retorts or ovens and carbonized. As charged, it carries back to the carbonizing plant a large part of the

sensible heat abstracted from the plant in the hot coke.

The invention will be claimed at the end hereof but will be first described in connection with the accompanying drawings forming part hereof and in which

Figure 1 is an elevational view largely in section embodying features of the invention.

Fig. 2 is a similar view illustrating a modification, and

Fig. 3 is a diagrammatic or schematic view illustrative of the operation.

Referring to the drawings, more particularly to Fig. 1.

1 is the coke cooling container with the charging opening 2, and discharge opening 3. The fan 4 circulates the cooling gases upward through the hot coke and thence through connection 6 and through the boiler 7, cooling the gases somewhat. The gases leave the boiler through connection 8 leading to the coal pre-heater 13. In the form of pre-heater chosen for illustration the coal descends to the discharge 18. The particular forms of the coke container, coal pre-heater and boiler are not part of this invention.

The gases, after traveling through the coal in counter-current fashion, are cooled and are led back to the fan 4 by connection 11 to be forced again through the coke and so on in repetition or continuation.

If the temperature of the gases, after passing through the boiler, is too high, the valve in the by-pass 10 may be opened, mixing some of the gas prior to its passage through the coke with the gas coming from the boiler and reducing its temperature.

If, on the other hand, the temperature of the gases after passing through the boiler is too low, the valve in the by-pass 9 may be opened, somewhat, by passing some of the gas around the boiler and raising the temperature of the gas admitted to the pre-heater.

If desired a small quantity of oxygen may be admitted at 12. 14 is a valved offtake for excess gas, if any is generated.

A indicates vertical retorts into which the preheated fuel is charged, for example, by means of a car *b* and from which hot coke is received in the container *c* which by car *d* and elevator *e* are caused to discharge into the coke cooling container. The opening through which the coke is discharged into the cooling container 1 is normally closed.

The construction and mode of operation of the modification illustrated in Fig. 2 are as above described, except that the boiler is omitted and the regulation of the temperature is secured by the regulation of valved by-pass 10' only.

In Fig. 3 the connections between the coke cooling apparatus, the boiler and the coal pre-heater are indicated in larger scale, together with a conventional indication of automatic control apparatus actuated by thermally re-

sponsive means, located in the connection between the boiler and the coal pre-heater.

The valves 20, 21 and 22 control the flow through the conduits 9, 6 and 10, respectively.

23 is as shown, a thermo-couple located in the conduit 8 and operative through suitable control means 24 and through link and lever mechanism as shown to actuate the valves 20, 21 and 22 in accordance with the temperature conditions in the conduit 8.

If the temperature in the conduit 8 should drop below the pre-determined value desired, the control 24 will operate to open the valve 20, the valve 22 being closed and the valve 21 partially closed, so that some of the hot gases from the coke cooler are by-passed around the boiler 7 and enter the conduit 8 at a higher temperature than would be the case if they had passed through the boiler.

If the temperature in the conduit 8 rises to a greater value than the pre-determined temperature, the control operates to close the valve 20 and open the valve 21, causing all of the hot gas from the coke cooling apparatus to pass through the boiler and thereby reducing its temperature. Should the temperature in the conduit 8 still remain too high after the valve 20 has been completely closed and the valve 21 completely opened, the control operates to open the valve 22, thereby by-passing a portion of gas coming from the fan (the gas is cooled, having just passed through the coal pre-heater). This gas enters the conduit 8, mixing with that portion of the gas which has been passed through the coke cooler and reduces its temperature.

By the operation of the described mechanism and connections, the temperature of the gas entering the coal may be automatically maintained at the pre-determined temperature, so as to minimize the temperature of the coal, being somewhat carbonized in the pre-heating apparatus. Such carbonization would result in the loss of a portion of the volatile matter of coal, and might cause the coal to become plastic and sticky, hindering its free flow through the coal pre-heating apparatus.

It will be obvious to those skilled in the art to which the invention relates that modifications may be made in details of construction, arrangement, procedure and in matters of mere form without departing from the spirit of the invention which is not limited to such matters or otherwise than the prior art and the appended claims may require.

I claim:

1. In apparatus for carbonizing fuel, the combination of a coke cooler adapted to receive hot coke, a coal preheater adapted to supply preheated coal, and means for circulating in a closed path a gas substantially chemically inert to coal and coke through said cooler and then through said preheater.

2. In apparatus for carbonizing fuel, the combination of a coke cooler adapted to receive hot coke, a coal preheater adapted to supply preheated coal, a gas conduit connection between the cooler and the preheater, a boiler interposed in the connection between the cooler and the preheater, a valved connection including a fan constructed and arranged to circulate a gas substantially chemically inert to coal and coke from the cooler through the boiler and the preheater in series, and a by-pass around the boiler, said by-pass being in said gas conduit connection.

3. In apparatus for carbonizing fuel, the combination of a coke cooler adapted to receive hot coke, a coal preheater adapted to supply preheated coal, a gas conduit connection between the cooler and the preheater, a boiler interposed in the connection between the cooler and the preheater, a valved by-pass in said gas conduit connection said by-pass by-passing said boiler, a return connection between said preheater and said cooler, a fan in said return connection for circulating a gas substantially chemically inert to coal and coke from the cooler through the said boiler and said preheater in series or through the cooler and preheater in series and valved connection from said by-pass to said return connection.

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