INDIRECTLY HEAT EXCHANGING PLURAL GAS STREAMS FOR DRY QUENCHING HOT COKE AND DRYING COAL

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ABSTRACT
A coke plant and method for operating the same according to which the coke is cooled by dry-quenching and the coal is dried, prior to being charged in a coke oven, with heat extracted during dry-quenching of the coke. The coke plant and method, in addition to carrying out the latter operations, reduce pollution of the atmosphere by releasing only cleaned and desulfurized gas to the outer atmosphere.

4 Claims, 8 Drawing Figures
INDIRECTLY HEAT EXCHANGING PLURAL GAS STREAMS FOR DRY QUENCHING HOT COKE AND DRYING COAL

BACKGROUND OF THE INVENTION

The present invention relates to coke plants and methods for operating the same.

As is well known, large amounts of coke are required for purposes such as the manufacture of steel. In connection with blast furnace installations, for example, it is conventional to utilize batteries of coke ovens which are periodically charged with coal which is distilled into coke in the coke ovens. During the treatment of the coke in the coke ovens it is possible to derive a considerable amount of energy from the coke ovens, and the coke itself, immediately upon being discharged from the ovens, has a high temperature so that a considerable amount of energy is available from the coke itself immediately upon discharge thereof from the ovens. At the present time much of this energy is wasted. Also, in connection with the operation of conventional coke plants, it is customary to release to the atmosphere undesirable impurities many of which are noxious, with the result that a very substantial pollution problem is encountered. A further factor encountered in connection with conventional coke plants and methods for operating the same is a lack of efficiency resulting from such conditions as charging the batteries of coke ovens with coal which is not in the best condition for treatment in the coke ovens and obtaining from the coke plant coke which is not in the best condition for subsequent use.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a coke plant and method for operating the same according to which the above drawbacks are reduced and in some cases eliminated.

Thus, it is a primary object of the present invention to provide a coke plant and method for operating the same which makes the greatest possible use of the energy resulting from distillation of the coal into coke.

Also it is an object of the present invention to provide a coke plant and method for operating the same according to which the coal is in the best possible condition for treatment in the coke ovens and the coke derived from the plant and method of the invention is in the best possible condition for subsequent use.

The object of the present invention also include the provision of a coke plant and method of operating the same according to which release of pollutants to the outer atmosphere is reduced to such an extent that if there is any such release it is too small to create any problem.

According to the method of the invention there is a periodic charging of a coke oven with coal and a discharging of hot coke therefrom. The discharge hot coke is subjected to dry-quenching to reduce the temperature of the hot coke while extracting heat therefrom. At least part of the coal which is charged into the coke oven is dried prior to charging with heat extracted from the hot coke during the dry-quenching thereof.

The coke plant of the invention has an oven means for distilling coal into coke as well as a charging means operatively connected with the oven means for charging the latter with coal. A discharging means is operatively connected with the oven means for discharging hot coke therefrom, and a bunker means is provided for receiving the hot coke discharged from the oven means. A transporting means extends between the oven means and the bunker means to transport hot coke from the oven means to the bunker means. A gas-circulating means is provided for circulating a quenching gas along a path part of which is formed by the interior of the bunker means. A coal drying means is provided for gas-drying coal prior to charging of the coal by the charging means into the oven means. A gas-directing means communicates on the one hand with the coal-drying means and on the other hand with the path along which the quenching gas is circulated for heating gas used for coal drying with heat extracted from the coke.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a schematic representation of a coke plant according to the invention, FIG. 1 also illustrating the method of the invention;

FIG. 2 is a schematic partly sectional elevation of that part of the plant of FIG. 1 where the coke-cooling bunker is located, FIG. 2 illustrating components which cooperate with this bunker;

FIG. 3 is a schematic partly sectional elevation taken along line 3—3 of FIG. 2 in the direction of the arrows and illustrating further features of the plant and method of the invention;

FIG. 4 is a schematic partly sectional elevation of a further embodiment of a coke-plant and method of the invention;

FIG. 5 is a schematic elevation taken along line 5—5 of FIG. 4 in the direction of the arrows and illustrating a larry car installation of FIG. 4;

FIG. 6 is a fragmentary partly sectional schematic elevation showing the arrangement of successive coke-cooling bunkers used with the embodiment of FIGS. 4 and 5;

FIG. 7 is a schematic illustration of the circulation of the quenching gas and the manner in which this gas is used with the embodiment of FIGS. 4-6; and

FIG. 8 is a schematic illustration of a further embodiment of a coke plant and method according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to FIG. 1 there is illustrated therein, schematically, a coke plant 10 according to the invention for carrying out the method of the invention. The coke plant 10 includes an oven means 12. This oven means 12 in practice takes the form of a battery of many ovens located one next to the other. As is well known during distillation of coal in the oven means 12 gas is directed through the oven means 12 so as to carry out the distillation of the coal with the heated gas being directed to regenerators, for example, after which the gas may be used in blast furnaces.

Each oven of the oven means 12 is periodically charged with coal by way of a charging means 14. This charging means may take the form of a larry car which travels along the top of the battery of ovens from one
oven to the next, periodically charging each oven with a charge of coal to be distilled into coke. The charging means 14 receives its charge of coal from a storage bunker installation 16 where the coal is stored in preparation for being charged into the oven means 12.

During charging of the oven means 12 hot gases escape out of the oven and are cleaned and de-sulfurized by the gas cleaning means 18 before being released to the atmosphere. This gas cleaning means 18 may include suitable dust collectors, centrifuges, and the like, with a suitable fan operating for creating the desired flow of gas, and in addition the gas discharging from the oven means during charging thereof may be burned so as to prevent release of noxious fumes to the outer atmosphere while at the same time providing a source of useful heat which may be used for such purposes as generating steam in a boiler or the like.

In addition, through suitable stand pipes the gases discharging from the oven means 12 are received in a conduit 20 from where the gases flow to a by-product plant 22. In this case also the stand pipes may be cooled to extract heat from the gas discharging from the oven means, and this heat may be used for generating steam or other purposes.

A discharging means 24, shown at the lower right of FIG. 1, takes the form of well known pushing structure operatively connected with the oven means 12 for pushing the coke out of the latter in order to discharge the coke as schematically represented in FIG. 1.

A coke guide and exhaust assembly 26 is capable of travelling along rails supported by a framework 28 into alignment with whichever one of the ovens happens to be discharged at any given time, and the discharge coke is received in the coke guide and exhaust unit 26 which is completely enclosed so that there will be no escape of impurities into the outer atmosphere. An unillustrated exhaust unit is operatively connected with the coke guide and exhaust 26 for preventing release of smoke to the outer atmosphere, the gas which is discharged from the unit 26 being purified before being released to the outer atmosphere, and in this case also the heat in the gases taken from the unit 26 may be used for generating steam of the like.

In this way through the enclosed unit 26 the discharged coke is received in a hot coke car 30 supported for movement along rails which extend along the battery of ovens which form the oven means 12 so that the discharged coke will be received in the coke car 30. This car 30 together with the unit 26 form part of a transporting means 32 for transporting the hot coke from the oven means 12 to a bunker means 34 in which dry-quenching of the hot coke takes place. Thus, the transporting means 32 is situated between the oven means 12 and the bunker means 34 for delivering hot coke to the latter. This transporting means 32 in the embodiment of FIG. 1 takes the form of a skip hoist provided with buckets 36 capable of being raised and lowered by way of a cable and pulley assembly 38 operated in any suitable manner and situated over the bunker means 34. The car 30 as well as the buckets 36 form coke containers which are maintained closed off from the outer atmosphere during travel of the coke between the oven means 12 and the bunker means 34.

For the purpose of further preventing escape of undesirable pollutants into the outer atmosphere there is situated over the bunker means 34 an exhaust hood 40 (FIG. 2) as well as a coke chute 42. When a bucket 36, shown in FIG. 2 on its way to the exhaust hood 40 reaches the latter, the bucket 36 is tipped in the manner shown in FIG. 1, with the top cover removed from the bucket 36, so that the contents will flow out of the bucket 36 into the bunker 34 while the open end of the bucket 36 is enclosed by the hood 40. At this time the chute 42 is displaced from the position shown in FIG. 2 in any suitable way to the position shown in FIG. 1 so as to guide the coke from the hood 40 directly into the bunker 34, and in this way escape of undesirable contaminants to the outer atmosphere is avoided during charging of the bunker means 34 with the hot coke.

The exhaust hood 40 communicates with an exhaust pipe 44 through which gases are directed to a gas-cleaning system 46 such as a suitable cyclone separator, dust collector, or the like, so that the gases discharging from the hood 40 are suitably cleaned before reaching a fan 48 of this gas-cleaning system. The fan 48 serves to draw the gas from the hood 40 through the conduit 44 and the gas-cleaning system 46, and clean gas is then discharged from the fan 48 along the conduit 50 for a purpose referred to below. After the bunker means 34 is charged with hot coke, the chute 42 is retracted to the position shown schematically in FIG. 2 and the filling pipe of the bunker 34 is closed and sealed with a cover 52 shown in FIG. 2. This cover 52 is removed during charging of the bunker means 34 when the chute 42 extends between the exhaust hood 40 and the supply pipe at the top of the bunker means 34.

Situated in the interior of the bunker means 34 is a cooling gas distributor 52 through which the relatively cool gas is delivered to the interior of the bunker means 34 in order to carry out dry-quenching of the coke therein. When the charge of the coke in the bunker means 34 has been dry-quenched by the cooling gas to the desired extent, a discharge valve means 54 of known construction is opened so as to release the cooled coke to a coke-discharge hopper 56. From the hopper 56 the cooled coke is received by a conveyor means 58 which, as schematically shown in FIG. 1, delivers the coke to a screening station 60. Before screening the coke passes through a crusher unit 62 at the screening station. In this case also the screening station 60 is completely enclosed and the gases in the latter are drawn into a gas-cleaning system 64 which serves to clean the gas before it is released to the outer atmosphere, this gas-cleaning system including cyclones, dust collectors, or the like, which removed particulate matter from the gas and deliver this particulate matter to a sintering plant. Thus, the coke breeze resulting from these operations is received at the unillustrated coke-sintering plant. The coke from the screening station, assuming that it is of the proper size as determined by the screening operations, is delivered to a coke bin from where the coke is then delivered to a blast furnace installation.

The dry-quenching gas distributed by the unit 52 in the interior of the bunker means 34 may be an inert gas or air, or a combination thereof. This dry-quenching gas is circulated by a circulating means 66 along a closed path part of which is formed by the interior of the bunker means 34. Thus, the circulating means 66
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takes the form of a cooling gas fan which delivers the quenching gas along a conduit 60 to the distributor 52 from where the gas flows through the coke to extract heat therefrom. This quenching gas which is thus heated, while reducing the temperature of the coke, is received in a discharge pipe 68 which communicates with a boiler or steam generator 70 having a series of convective sections where heat is taken from the quenching gas and delivered to water which is converted into steam, a suitable steam drum 72 being provided at the top of the boiler 70. From the steam drum 72 the steam travels along a pipe system 74 and is delivered in part through a conduit 76 to the byproduct plant 22 while the remainder of the steam is transported through a conduit system 78 to any desired location where use is made of steam. A feedwater means 80 communicates through a conduit 82 with the steam generating means 70, 72 for delivering to the latter the water which is converted into steam while extracting heat from the quenching gas.

After travelling through the boiler 70 the quenching gas flows through a heat-exchanger means 84 where further heat is extracted from the quenching gas which has already been cooled by the cooling means 70 to a temperature substantially below the temperature which the quenching gas has when it leaves the bunker means 34.

The quenching gas which is thus further cooled in the heat exchanger means 84, for a purpose referred to below, is then drawn through the inlet 86 into the circulating means 66 which now again delivers the cooled quenching gas through the conduit 60 to the gas-distributor 52 in the interior of the bunker means 34. Thus, the circulating means 66 provides for the quenching gas a closed path through the bunker means 34, the cooling means 70, the heat-exchanger means 84, and back to the circulating means 66.

At the bottom of the boiler and heat-exchanger installation 70, 84 is a dust hopper 86 in which dust in the quenching gas is collected, and through a suitable valve 88 the collected dust is released from time to time to be delivered, as shown schematically in FIG. 1, to the sintering plant. The dust collected at the gas-quenching system 46 may be delivered in the same way to the sintering plant.

The coal which is delivered to the storage bunkers 16 to be received therefrom by the charging means 14 is first dried by a coal-drying means 90. In accordance with one of the important features of the present invention the coal which is charged into the oven means 12 is first dried with heat extracted from the coke delivered to the bunker means 34. For this purpose a gas-directing means 92 is provided in the form of a suitable fan. This gas directing means 92 communicates on the one hand with the path along which the quenching gas is circulated by the circulating means 66 and on the other hand with the coal-drying means 90. Thus, the discharge of the fan 92 communicates through a pipe 94 with the heat exchanger 84 so as to direct into the latter a gas which is preferably inert gas. This gas is heated in the heat exchanger with heat extracted from the quenching gas after the latter flows through the boiler 70. The inert gas, preferably nitrogen of which a large supply is readily available, is delivered to the gas-directing means 92 through an inlet conduit 96. However, some of the cleaned gas from the gas-cleaning system 46 may be combined with the inert gas through the conduit 50, as shown in FIG. 1. The heated coal-drying gas is delivered from the heat exchanger 84 through a conduit 98 to a pipe 100 which delivers the gas to the lower end of the coal-drying means 90. The conduits 94 and 98 may be provided with suitable valves for controlling the flow of gas therethrough, as shown in FIGS. 1 and 3.

The coal which is dried in the coal-drying means 90 rests on a suitable screen 102. This coal-drying means 90 is in the form of a suitable enclosure into which the coal to be dried is delivered through an inlet 104, as schematically shown in FIG. 1. The drying gas under pressure which is delivered through the conduit 100 into the lower end of the coal-drying means 90 flows up through the screen 102 so as to form the coal into a fluidized bed in the coal-drying means 90.

Dust in the coal drying means is collected in a hopper 106 and delivered from time to time through a valve 108 to the sintering plant.

Also, part of the gas within the coal-drying means is continuously circulated by a gas-cleaning system 110 from which part of the gas is delivered to the gas-cleaning system 112 from which gas has been cleaned and desulfurized is delivered to the outer atmosphere through a fan 114. In this case also any dust which is collected from the gas is delivered through a conduit 116 or the like to the sintering plant.

The dried coal is conveyed by a conveyor means 118 from the drying means 90 to the storage bins 16, as schematically shown in FIG. 1.

The wet coal is initially delivered by a conveyor means 120 to blending bins 122 from which the coal is delivered through feed weigher units 124 to coal crushers 126 from which the coal is delivered through the inlet 104 into the coal dryer 90. However, part of the coal may be conveyed without drying to a mixer unit 128 to be delivered to the bins 16 from the unit 128, so that if desired part of the coal in the bins 16 will not be dried, and thus it is possible to control very precisely the condition of the coal which is charged into the oven means 12.

FIGS. 4-7 illustrate another embodiment of the invention. According to this embodiment the bunker means 130 (FIG. 4) is situated at an elevation lower than the oven means 132, and the transporting means 134 serves to direct the discharged coke from the oven means 132 to the bunker means 130 gravitationally. The oven means 132 may be the same as the oven means 12, and a suitable discharge means, such as the means 24, connects with the oven means 132 for periodically discharging the hot coke therefrom. The coal is charged into the oven means 132 in the manner described above in connection with the oven means 12.

FIG. 4 illustrates a standpipe arrangement 136 through which gas discharges from the oven means 132 into a unit 138 which serves to purify the gas and utilize heat therein before the gas is discharged to the outer atmosphere. FIG. 4 also illustrates schematically the structure 140 which directs the gas through the coke oven for treating the coal therein and for then flowing to a regenerator, as referred to above.

The transporting means 134 includes a car movable along rails 142 into alignment with the particular oven
which is to be discharged. The transporting means 134 is in the form of an enclosure which is mounted on the car. This enclosure 144 has a lower inclined wall and a pair of side walls forming a guide through which the hot coke flows down into the bunker means 130. The left end of the enclosure 144 is open for receiving the coke when it is discharged from the oven. The right end of the enclosure 144, as viewed in FIG. 4, is provided with a suitable gate 146 capable of being raised and lowered through a suitable winch and cable drive driven by a suitable gate drive 148. The side walls of the enclosure 144 are interconnected by a roof which includes a smoke-exhaust hood 150 which in turn communicates with an exhaust pipe 152. This structure is also illustrated in FIG. 5. To the right of the gate 146, as viewed in FIG. 4, is a second smoke exhaust hood 154 which communicates with an exhaust pipe 156. A flexible curtain 158 extends down from the periphery of the hood 154.

Each bunker of the bunker means 130 is provided with a closing cover 160 capable of being swung to the open dot-dash line position shown in FIG. 4 by the drive 162. The hood 154 is aligned with the cover 160 of that bunker which is to receive the charge of hot coke, and then the cover 160 is raised. Upon discharge of the coke from the oven the gate 146 is raised, and thus the coke will flow down into the bunker 130 in order to charge the latter. The bunker is provided with an explosion damper 162. The pipes 152 and 156 deliver the smoke to a scrubber 164 through which the gas from the enclosure 144 is drawn by a fan 166 before being delivered by the latter to the stack 168. In this way only purified gas is released to the outer atmosphere from the transporting means 134. The same gas-cleaning arrangement may be provided for the guide 26 of FIG. 1.

After a bunker of the bunker means 130 has been charged, the cover 160 is returned to its closed position and the car together with the remainder of the transporting means 134 is moved to the next oven which is to be discharged.

The hot coke within the bunker means 130 is dry-quenched in the manner described above. Thus, cooling gas from a heat exchanger is delivered through a pipe 170 (FIG. 4) into each bunker to charge a gas distributor 172 so as to reach and flow through the hot coke in order to extract heat therefrom. The dry-quenching gas is then received in a pipe 174 which delivers the hot gas to the boiler where steam is generated, and then this gas which has thus been cooled is returned to the pipe 170 as described above. In this way the dry-quenching gas is circulated along a closed path in the manner described above, a suitable circulating fan being provided for this purpose. The gas delivered to the pipe 174, after being cooled as by flowing through a steam generator such as a boiler may then be used for drying coal in a coal-drying means 178, as schematically shown in FIG. 4.

The cooled coke is released from each bunker of the bunker means 130 by way of a suitable bunker-discharge unit 180 provided for each bunker and actuated by a suitable drive 182. The cooled coke is received on a conveyor 184 which delivers the coke to the screening station.

FIG. 6 shows part of the series of bunkers of the bunker means 130 arranged beside each other and all communicating with the pipe 174 which in turn delivers the dry-quenching gas to the steam generator. Also FIG. 6 shows the cooling gas supply pipe 170 as well as the bunker-discharge units 180 and the conveyor 184.

As is schematically shown in FIG. 7, the oven means 132 may take the form of a pair of coke oven batteries 132a and 132b arranged beside the rails 142 for the transporting means 134. Beside these rails 142 are located the series of bunkers of the bunker means 130. The conveyer means 184 for conveying the coke to the screening station is also shown schematically in FIG. 7. FIG. 7 shows schematically the communication between the top ends of the several bunkers of the bunker means 130 with the hot gas pipe 174 which delivers the hot gas to the boiler 186 from where the hot gas flows to the heat exchanger 188 before being returned to the circulating fan 190 after first passing through a cyclone gas cleaner 192. The fan 190 then delivers the cool gas to the supply pipe 170 shown in dotted lines in FIG. 7 communicating with the several bunkers of the bunker means. In this way the quenching gas is circulated by the circulating means 190 along a closed path. Feedwater is supplied to the steam generator 186 through the feedwater supply system 194, and after passing through the boiler 186 the steam is delivered to any suitable plant where use may be made of the steam, by way of the pipes 196. The inert gas for drying coal is directed through the heat exchanger 188 by a fan 198 which thus forms the gas-directing means for directing the coal-dry quenching gas through the heat exchanger 188 so that this gas can then be delivered through the conduit 200 to the coal dryer such as the coal-drying means of FIG. 1 or the coal-drying means 178 schematically shown in FIG. 4.

According to the embodiment of the invention which is illustrated in FIG. 8, there is a single path of gas flow through the bunker for dry-quenching the coke and through the coal-dryer for drying the coal. Thus, referring to FIG. 8, there is schematically shown therein, at the left, a bunker means 202 into which the hot coke is delivered from the coke oven means through a transporting means such as that of FIG. 1 or that of FIG. 4. The dry-quenching gas is delivered to the interior of the bunker means 202 by a gas-circulating means 204, and this gas may be distributed through the coke after passing through a suitable gas distributor such as the distributor 52 of FIG. 1 or the distributor 172 of FIG. 4. The quenching gas which has thus extracted heat from the coke discharges from the bunker means 202 through a conduit 206. The gas is delivered to the interior of the bunker means 202 through a conduit connected to the discharge end of the circulating fan 204. The cooled coke is discharged from the bottom end of the bunker means 202 in the manner described above.

The hot dry-quenching gas is delivered from the conduit 206 into a boiler 208 which forms a cooling means for cooling the dry-quenching gas. This boiler has the feedwater pipe system 210 through which feedwater is delivered to be heated and converted into steam to be used wherever desired as described above.

From the boiler 208 the cooled dry-quenching gas is delivered through a conduit 212 into a filter 214 which
can be combined with a simple cyclone dust collector so that the quenching gas after being cooled is also cleaned. A gas-directing means 216 in the form of a suitable fan draws the cleaned gas from the filter 214 through a conduit 218 into the gas-directing means 216 which now delivers the gas through a conduit 220 into the lower end of the coal-drying means 222 to which wet coal is delivered in a manner described above in connection with FIG. 1 and in which the coal, while it is dried, is maintained in the form of a fluidized bed.

From the coal-drying means 222 the drying gas is delivered through a conduit 224 into a cyclone 226 so as to be cleaned before being returned through a conduit 228 to the inlet of the gas-circulating means formed by the fan 204.

Thus, with the embodiment of FIG. 8 the gas-directing means 216 also communicates on the one hand with the path of flow of gas through the bunker means 202 in order to utilize the heat extracted from the coke, this gas-directing means 216 also communicating with the coal-drying means 222, but in the embodiment of FIG. 8 the path of flow of the drying gas is part of the path of flow of the quenching gas, and this latter path is a closed path along which an inert gas stream is continuously circulated by the circulating means 204.

Part of the water vapor in the gas used both for quenching and coal-drying is bled from the conduit 228, through a suitable conduit 230 to be delivered by the latter to a wet or dry dust collector 232 which communicates with a fan 234 from which air is delivered to the outer atmosphere so that in this way an undesirable increase in water vapor content in the quenching and drying gas is avoided.

It is apparent that with all of the above-described embodiments of a coke plant and method for operating the same according to the invention, a highly efficient use is made of the energy available in the system, pollution of the outer atmosphere is avoided, the coal is delivered to the coke oven in a highly favorable condition as the result of the preliminary drying of the coal, and the coke is itself in the best possible condition for further use because of the dry-quenching thereof. In particular, the use of the heat extracted from the coke during the dry quenching thereof for the purpose of drying the coal represents a considerable economy because of the use which is made of heat energy which otherwise would be wasted, and at the same time condition of the coal is improved prior to charging of the coal into the coke oven means while at the same time all of the advantages of dry-quenching of the coke are maintained.

What is claimed is:

1. In a method for operating a coke plant, the steps of periodically charging a coke oven with coal and discharging hot coke therefrom, dry-quenching the discharged hot coke to cool the latter while extracting heat therefrom, drying at least part of the coal charged to the oven with the heat extracted from the hot coke during dry-quenching, and utilizing for dry-quenching the hot coke and drying the coal a pair of completely distinct gas streams which are respectively directed along entirely separate paths so that the gas streams do not intermingle with each other, and transferring by indirect heat exchange heat from the dry-quenching gas to the coal-drying gas, the gas used for coal drying being subsequently discharged in part to the outer atmosphere, and cleaning and desulfurizing said part of said coal-drying gas before it is discharged to the outer atmosphere.

2. In a method for operating a coke plant, the steps of periodically charging a coke oven with coal and discharging hot coke therefrom, a dry-quenching the discharged hot coke to cool the latter while extracting heat therefrom, drying at least part of the coal charged to the oven with the heat extracted from the hot coke during dry-quenching, and utilizing for dry-quenching the hot coke and drying the coal a pair of completely distinct gas streams which are respectively directed along entirely separate paths so that the gas streams do not intermingle with each other, and transferring by indirect heat exchange heat from the dry-quenching gas to the coal-drying gas, and including the step of generating steam from the gas used for dry-quenching prior to transfer of heat from the latter gas to the coal-drying gas so that the gas used for dry-quenching has its temperature reduced after the steam is generated thereby, thus delivering to the coke for dry-quenching thereof a relatively cool gas which extracts from the coke a relatively large amount of heat in a relatively short time.

3. In a coke plant, oven means for distilling coal into coke, charging means operatively connected with said oven means for charging the latter with coal to be distilled into coke, discharging means operatively connected with said oven means for discharging hot coke therefrom, bunker means for receiving the hot coke discharged from said oven means, transporting means between said oven means and bunker means for transporting hot coke from said oven means to said bunker means, gas-circulating means for circulating a quenching gas along a closed path part of which is formed by the interior of said bunker means, coal-drying means for gas-drying coal prior to charging of the coal by said charging means into said oven means, and gas-directing means communicating with said coal-drying means for directing a coal-drying gas therethrough and along a path separate from but in part in close proximity with said path along which the quenching gas is circulated for heating gas used for coal drying with heat extracted from the coke, indirect heat-exchanger means situated along said paths where they are in close proximity for extracting heat from the quenching gas and delivering the extracted heat to the coal-drying gas, and means located along the closed path of said quenching gas upstream of said heat-exchanger means for generating steam from the gas used for dry-quenching prior to transfer of the heat from the latter gas to the coal-drying gas so that the gas used for dry-quenching has its temperature reduced after the steam is generated thereby, thus delivering to the coke for dry-quenching thereof a relatively cool gas which extracts from the coke a relatively large amount of heat in a relatively short time.

4. In a coke plant, oven means for distilling coal into coke, charging means operatively connected with said oven means for charging the latter with coal to be distilled into coke, discharging means operatively connected with said oven means for discharging hot coke therefrom, bunker means for receiving the hot coke discharged from said oven means, transporting means
between said oven means and bunker means for transporting hot coke from said oven means to said bunker means, gas-circulating means for circulating a quenching gas along a closed path part of which is formed by the interior of said bunker means, coal-drying means for gas-drying coal prior to charging of the coal by said charging means into said oven means, gas-directing means communicating with said coal-drying means for directing a coal-drying gas therethrough and along a path separate from but in part in close proximity with said path along which the quenching gas is circulated for heating gas used for coal drying with heat extracted from the coke, indirect heat-exchanger means situated along said paths where they are in close proximity for extracting heat from the quenching gas and delivering the extracted heat to the coal-drying gas, and means communicating with said coal-drying means for discharging part of the coal-drying gas to the outer atmosphere and for cleaning and desulfurizing said part of said coal-drying gas before it is discharged to the outer atmosphere.

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