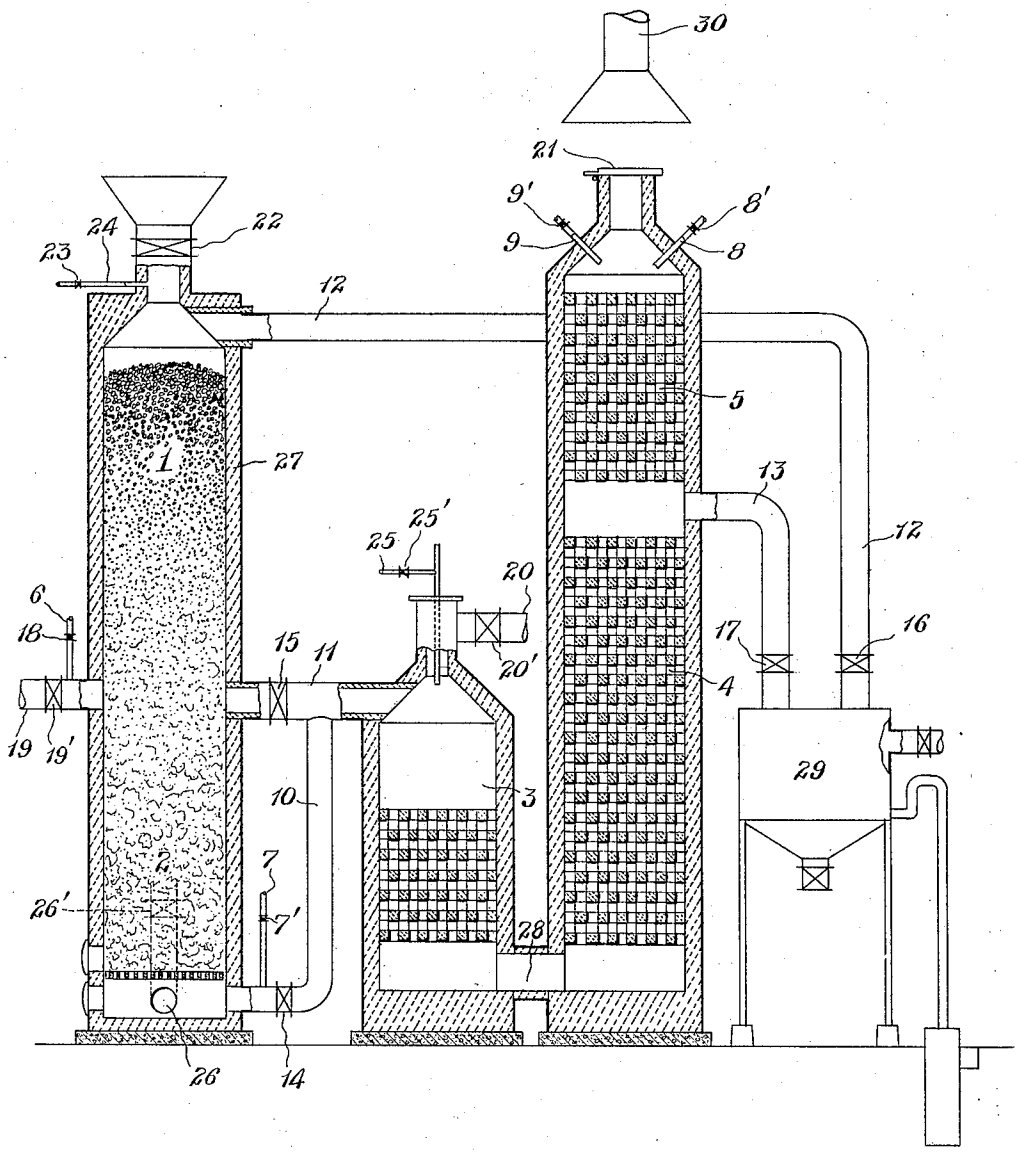
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PROCESS OF MAKING WATER GAS

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PROCESS OF MAKING WATER GAS

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My invention relates to water gas sets designed to carbonize and completely gasify bituminous coal and to manufacture water gas in one apparatus. My invention also comprehends improved methods of operating said sets.

The particular objects and advantages of the invention are as follows:

To eliminate smoke nuisance;

To recover more coal gas than any bituminous coal water gas apparatus with which I am acquainted, and thus to obtain a higher B. t. u. in the final gas with the use of less oil for carburation, this recovery of coal gas effecting practically complete gasification of the volatile elements in the coal as distinguished from the complete destruction of the coal gas in the usual water gas sets;

To make possible down-blasting through the lower part of the generator;

To permit back up-running by admitting steam or water at the top of a superheater extension;

To keep the carburetor and superheater checkerbrick at the usual operating temperatures by the use of water evaporated and superheated in said superheater extension or steam superheated therein, thus obviating excessive cooling of the checkerbrick regularly used in the carburetor and superheater;

To recover oil from the coal instead of tar and pitch;

To economize in fuel inasmuch as the hot coke is delivered to the generator by gravity and there is no cooling of the generator caused by the dropping in of fresh charges of cold fuel; and

To increase the flexibility of operation and control since both ends of the set are maintained comparatively cool.

Other objects and advantages will appear in detail in the description hereinafter given by reference to the accompanying drawing.

The annexed drawing and the following description set forth in detail certain means illustrating my improvements in water gas sets and the steps by which my improved method may be carried out, such means and steps constituting, however, but one of the forms and but one of the series of steps, respectively, in which the principles of my invention may be embodied or by which they may be carried out. The claims in this application are limited to the improved process.

The drawing represents diagrammatically and partly in vertical section a water gas set embodying that part of my invention which relates to the apparatus and also serving to illustrate means by which the improved process may be carried out.

Referring to the annexed drawing, a water-gas generator 27 is formed with an upper coal compartment 1 and a lower coke compartment 2, this generator being provided with a charging valve 22, a down-blast connection 19 having a valve 19′, an up-blast connection 26 having a valve 26′, an upper steam connection 24 having a valve 23, a steam connection 6 having a valve 18 and communicating with the generator 27 intermediate the top and bottom thereof and substantially centrally thereof, and a lower steam connection 7 provided with a valve 7′. The bed of solid fuel in the generator 27 comprises an upper coal carbonizing zone, corresponding substantially to compartment 1, and a lower gas generating zone, corresponding substantially to compartment 2. A carburetor 3 and a superheater 4 having an upward extension 5 are also provided, the carburetor and superheater with its extension having checkerbrick or other heat storing means. Connecting the generator 27 and the carburetor 3 is a pipe 11 serving as an upward-blast offtake, this pipe 11 being provided with a valve 15 and communicating with the top of the carburetor 3, and with the generator 27 about midway of its height. Communicating with the pipe connection 11 and the bottom of the coking chamber 2 is a pipe 10 provided with a valve 14, the valves 14 and 15 may be interconnected so that when one is closed the other is open. Communicating with the top of the carburetor 3 is an air blast connection 20 provided with a valve 20′ and an oil inlet 25 provided with a valve 25′. Connected to the lower portion of the carburetor 3 and the lower portion of the superheater proper 4 is a pipe 28. Communicating with the superheater between the

lower portion 4 and the upper extension 5 is a gas off take 13 provided with the valve 17 and communicating with the seal 29. Also connected with the seal is a pipe 12 provided with a valve 16 and communicating at its other end with the top of the coal chamber 1 of the generator 27. A stack valve 21 at the top of the superheater extension 5 communicates with the usual stack 30, and communicating with the superheater extension 5 below said stack valve 21 is a water pipe 9 provided with a valve 9′ and a steam pipe 8 provided with a valve 8′.

The improved combination of elements hereinbefore described and shown in the accompanying drawing serve as means for illustrating one way of carrying out my improved method which is as follows.

Two kinds of cycles of operation are utilized and I term one a special cycle, utilized immediately after coaling the generator 27, and the others, regular cycles, of which a number are carried out subsequent to the special cycle. After the compartment 1 of the generator 27 has been coaled, assuming that the coke compartment 2 is filled, the valves 19′, 14, 20′ and 21 are opened and all of the other valves closed, so that air blasting can be effected down through the generator 27 commencing at about the central portion thereof, up through the connection 10, down through the carburetor 3, up through the superheater proper 4 and the superheater extension 5, and out into the stack 30. Air is admitted through valve 20′ to burn, in carburetor 3, the air blast gas from coke compartment 2. Then the valves 19′, 20′ and 21 are closed, and the valves 17 and 18 are opened, and a down-run through the highly heated lower gas generating zone of the fuel bed is effected with steam admitted through steam connection 6 at about the center of the generator 27, the blue water gas offtake being through the connection 13 into the seal 29. The valves 7′ and 16 are then opened and all of the other valves closed, the valve 14 remaining open, and an up-run effected with steam admitted through steam connection 7 at the bottom of the coke compartment 2, the gas offtake being from the top of the coal compartment 1 to the seal 29 through the connection 12. The valve 7′ is then closed and the valve 8′ opened and a back up-run effected with steam admitted at the top of the superheater extension 5, the gas offtake being from the top of the coal compartment 1 to the seal through the pipe connection 12. If desired, or jointly with the steam admission through the inlet 8, water may be admitted through the inlet 9, in which case the valve 9′ is opened, during the up-run water gas step just described, the water being evaporated and steam superheated in the superheater extension 5.

The above operations complete what I term the special cycle, after which several regular cycles of operations are effected as follows.

The valve 26′ in the up-blast connection 26 is opened together with the valves 15, 20′ and 21, all other valves being closed, which effects an up air blast through the water gas generating coke bed in compartment 2 of the generator 27, through the connection 11, down through the carburetor 3, up through the superheater 4 and superheater extension 5 and into the stack 30. A down-run to make carbureted water gas is then effected by opening the valves 18, 14, 25′ and 17, all other valves being closed, thus admitting steam to the central part of the generator 27, the blue water gas being conducted to the carburetor 3 through the pipe connection 10, there it is enriched with oil admitted through oil inlet 25 into the top of carburetor 3 the gas office being through the connection 13 and to the seal 29. A run which is optional is then effected by opening valves 7′ and 16, all other valves being closed, valve 14 remaining open, this optional run being an up-run effected with steam admitted at the bottom of the coke compartment 2, or at the top of the superheater extension 5, the gas offtake being from the top of the coal compartment 1 through the connection 12 to the seal 29. A back up-run is then effected by opening valve 8′, leaving valves 14 and 16 open and closing all other valves, whereby steam is admitted at the top of the superheater extension 5, or water through the connection 9 by opening the valve 9′, or both, if desired, the superheated steam issuing from the top of the carburetor 3 into the connection 10 and thence upwardly through the coke compartment 2 and the coal compartment 1, the gas offtake being through the connection 12 into the seal 29.

The set of operations last described completes one of the regular cycles, and after several of these regular cycles have been made, the charging valve 22 is opened to again coal the generator compartment 1.

If the heat of the checkerbrick in the carburetor 3 and the superheater 4 permits or requires occasional blow-runs can be effected by air blasting for a short period through the entire fuel bed in the generator 27 and conducting the gas through the connection 12 to the seal 29.

The steam connection 24 and its controlling valve 23 serve to furnish purge steam, and also to provide a steam curtain in the coal compartment 1 before charging the latter. During forward water gas runs, when the gas offtake is from the top of the superheater lower portion 4 through the connection 13 into the seal 29, some steam may be admitted through the connection 8 to form a seal in the superheater extension 5 and also to obviate any untoward effects by reason of

any leakage around the stack valve 21. The superheater 4 and the superheater extension 5, although enclosed in a continuous steel outer shell, are not a single chamber in effect, but the superheater portion 4 filled with checkerbrick is a normal superheater as found in any usual water gas set and the offtake from this superheater portion 4 is at about the normal height of the offtake of any superheater, the extension 5 serving to superheat steam admitted through the connection 8 or evaporate and superheat water admitted through the connection 9, thus keeping the checkerbrick of the normal superheater member 4 and the carburetor 3 at the usual operating temperatures, and not cooling them excessively by reason of superheating steam therein or evaporating and superheating water therein. The gases obtained by the upward air blasting do not pass through the coal in the compartment 1 but the heat in said gases is effectively used, except during the occasional blow-runs mentioned, to heat the checker-brick in the carburetor 3, superheater portion 4 and superheater extension 5, by providing an offtake for these blast gases at about the mid-height of the generator 27. Carbonization of the coal in the compartment 1 is effected by the up-run blue water gas and by the heat conducted from the coke compartment 2 of the generator 27, and at times by blow-running through the up-air blast conduit 26. No carburation of the blue water gas is effected during the special cycle but this operation is limited to the down-runs of the regular cycles of operations. The steam back runs are limited to up-runs through the generator and no use is made of back down-runs.

The arrangement of apparatus and the cycles utilized make possible the use of less oil than ordinarily used because of the comparatively great amount of coal gas that is recovered from the bituminous coal, which coal gas has a high B. t. u. value. This high recovery of coal gas is due to the back up-running and the avoiding of passing the coal gas through the fire and hot checkerbrick.

The apparatus as a whole and the use of the method of operation described, result in a coke producing process and also in water gas manufacture by the use of bituminous coal whose volatile elements are completely gasified.

Due to the fact that the coal in the upper part of the compartment 1 is mostly cold, and due to the steam curtain which can be provided by use of the steam connection 24, and the provision of the central blast gas offtake from the generator 27, instead of normal air blasting through the whole generator, smoke nuisance is largely eliminated.

When water is admitted to the top of the superheater it is preferably admitted hot and is evaporated and the resulting steam is superheated in the superheater extension 5. Thus considerable saving is effected in expense of boiler fuel for making steam. This admission of water is made practicable by the use of the superheater extension 5. When checkerbrick are cooled excessively, emulsion troubles are caused in the tar and liquor obtained by plant operation, but I obviate this by reason of the use of the superheater extension 5 and still leave sufficient checkerbrick in the normal superheater portion 4 to fix the gas properly by reason of increasing the height of the superheater and taking the forward-run water gas off from the top of the superheater portion 4, at about the height of a normal superheater.

In the following claims, the term "aqueous fluid" is intended to mean water or steam, or both water and steam, the term "steam" comprising either wet steam or dry steam, or both. That is, "aqueous fluid" comprises water in any or all its liquid, vapor and gas states.

What I claim is:

1. A process of making carbureted water gas in a set comprising a single generator having a solid fuel bed including an upper coal carbonizing zone and a lower gas generating zone, a single carburetor having checkerbrick therein, and a single superheater having checkerbrick therein; which process comprises a special cycle of steps and a regular cycle of steps following said special cycle; said special cycle comprising air-blasting the lower zone only of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then passing steam through the highly heated lower zone only of the fuel bed and generating water gas, passing the water gas through the carburetor and the lower portion of the superheater, withdrawing the water gas from an intermediate portion of the superheater, then passing steam through the upper zone of the fuel bed and withdrawing the resulting gas directly from said upper zone and from the generator, then admitting aqueous fluid to the heated checkerbrick in the upper portion of the superheater above the intermediate gas offtake, passing steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator; and said regular cycle comprising air-blasting the lower zone only of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then passing steam through the highly heated lower zone only of the fuel bed and generating water gas, passing the water gas through the carburetor and enriching the water gas by adding oil thereto, passing the enriched water gas to the lower portion of the superheater and fixing the oil vapors mixed with the water gas, with-

drawing the carbureted water gas from an intermediate portion of the superheater, then admitting aqueous fluid to the heated checkerbrick in the upper portion of the superheater above the intermediate gas offtake, passing steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator.

2. A process of making carbureted water gas in a set comprising a single generator having a solid fuel bed including an upper coal carbonizing zone and a lower gas generating zone, a single carburetor having checkerbrick therein, and a single superheater having checkerbrick therein; which process comprises a special cycle of steps and a plurality of regular cycles of steps following said special cycle; said special cycle comprising air-blasting the lower zone only of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then passing steam through the highly heated lower zone only of the fuel bed and generating water gas, passing the water gas through the carburetor and the lower portion of the superheater, withdrawing the water gas from an intermediate portion of the superheater, then passing steam through the fuel bed and withdrawing the resulting gas directly from the top of the generator, then admitting aqueous fluid to the heated checkerbrick in the upper portion of the superheater above the intermediate gas offtake, passing steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator; and each of said regular cycles comprising air-blasting the lower zone only of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then passing steam through the highly heated lower zone only of the fuel bed and generating water gas, passing the water gas through the carburetor and enriching the water gas by adding oil thereto, passing the enriched water gas to the lower portion of the superheater and fixing the oil vapors mixed with the water gas, withdrawing the carbureted water gas from an intermediate portion of the superheater, then admitting aqueous fluid to the heated checkerbrick in the upper portion of the superheater above the intermediate gas offtake, passing steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator.

3. A process of making carbureted water gas in a set comprising a single generator having a solid fuel bed including an upper coal carbonizing zone and a lower gas generating zone, a single carburetor having checkerbrick therein, and a single superheater having checkerbrick therein; which process comprises a special cycle of steps and a plurality of regular cycles of steps following said special cycle; said special cycle comprising air-blasting downwardly through the lower zone of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then admitting steam to the lower zone of the fuel bed and passing the steam downwardly therethrough and generating water gas, passing the water gas through the carburetor and the lower portion of the superheater, withdrawing the water gas from an intermediate portion of the superheater, then passing steam through the upper zone of the fuel bed and withdrawing the resulting gas directly from said upper zone and from the generator, then admitting aqueous fluid into the upper portion of the superheater and heating it to superheated steam, passing the steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator; and each of said regular cycles comprising air-blasting upwardly through the lower zone of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then admitting steam to the lower zone of the fuel bed and passing the steam downwardly therethrough and generating water gas, passing the water gas through the carburetor and enriching the water gas by adding oil thereto, passing the enriched water gas to the lower portion of the superheater and fixing the oil vapors mixed with the water gas, withdrawing the carbureted water gas from an intermediate portion of the superheater, then admitting aqueous fluid into the upper portion of the superheater and heating it to superheated steam, passing the steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator.

4. A process of making carbureted water gas in a set comprising a single generator having a solid fuel bed including an upper coal carbonizing zone and a lower gas generating zone, a single carburetor having checkerbrick therein, and a single superheater having checkerbrick therein; which process comprises a special cycle of steps and a plurality of regular cycles of steps following said special cycle; said special cycle comprising air-blasting downwardly through the lower zone of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then admitting steam to the lower zone of the fuel bed and passing the steam downwardly therethrough and generating water gas, passing the water gas through the carburetor and the lower portion of the superheater, withdrawing the water gas from an intermediate portion of the superheater, then passing steam through the upper zone of the fuel bed and withdrawing the resulting gas directly from said upper zone and from the generator, then admitting aqueous fluid into the upper portion of the superheater and heating it to superheated steam, passing the steam downwardly through the superheater, through the carburetor and through the fuel bed in the generator, and withdrawing the resulting gas directly from the generator; and each of said regular cycles comprising air-blasting upwardly through the lower zone of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then admitting steam to the lower zone of the fuel bed and passing the steam downwardly therethrough and generating water gas, passing the water gas through

the carburetor and the lower portion of the superheater, withdrawing the water gas from an intermediate portion of the superheater, then passing steam upwardly through the entire fuel bed and withdrawing the resulting gas directly from the top of the generator, then admitting aqueous fluid to the heated checkerbrick in the upper portion of the superheater above the intermediate gas offtake and heating said fluid to superheated steam, passing the steam downwardly through the lower portion of the superheater, through the carburetor and upwardly through the fuel bed in the generator, and withdrawing the resulting gas from the top of the generator; and each of said regular cycles comprising air-blasting upwardly through the lower zone only of the fuel bed, burning the blast gases and heating the checkerbrick in the carburetor and superheater, then passing steam downwardly through the highly heated lower zone only of the fuel bed and generating water gas, passing the water gas through the carburetor and enriching the water gas by adding oil thereto, passing the enriched water gas to the lower portion of the superheater and fixing the oil vapors mixed with the water gas, withdrawing the carbureted water gas from an intermediate portion of the superheater, then admitting aqueous fluid to the heated checkerbrick in the upper portion of the superheater and heating said fluid to superheated steam, passing the steam downwardly through the superheater, through the carburetor and upwardly through the fuel bed in the generator, and withdrawing the resulting gas from the top of the generator.

5. The process set forth in claim 1, with an additional step in the regular cycle after withdrawing the carbureted water gas from the superheater, said additional step comprising passing steam through the upper zone of the fuel bed and withdrawing the resulting gas directly from said upper zone and from the generator.

6. The process set forth in claim 2, with an additional step in each regular cycle after withdrawing the carbureted water gas from the superheater, said additional step comprising passing steam through the fuel bed and withdrawing the resulting gas directly from the top of the generator.

7. The process set forth in claim 3, with an additional step in each regular cycle after withdrawing the carbureted water gas from the superheater, said additional step comprising passing steam through the upper zone of the fuel bed and withdrawing the resulting gas directly from said upper zone and from the generator.

8. The process set forth in claim 4 with an additional step in each regular cycle after withdrawing the carbureted water gas from the superheater, said additional step comprising passing steam upwardly through the entire fuel bed and withdrawing the resulting gas directly from the top of the generator.

9. The process set forth in claim 2, characterized by charging coal into the generator before the special cycle and admitting steam into the top portion of the generator concurrently with the charging.

10. The process set forth in claim 2, characterized in that the aqueous fluid admitted at the top of the superheater comprises water and characterized by generating steam from said water in the upper portion of the superheater above the intermediate gas offtake.

11. The process set forth in claim 2, with an additional step occasionally during the regular cycles, said additional step comprising air-blasting upwardly through the fuel bed and withdrawing the blast gases directly from the top of the generator.

Signed by me this 27th day of August, 1928.

WALTER M. RUSSELL.