

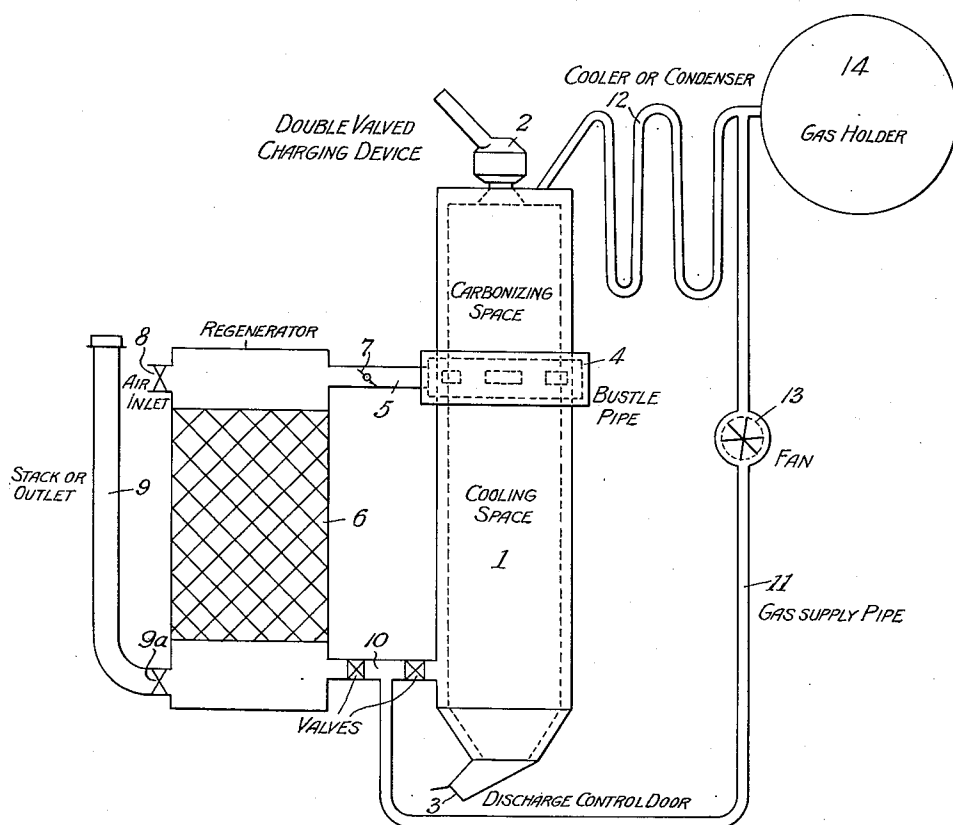
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CARBONIZATION OF FUEL

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CARBONIZATION OF FUEL

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7 Claims. (Cl. 202—16)

This invention relates to improvements in the carbonization of fuel and constitutes a division of the invention described and claimed in our co-pending prior application Serial No. 112,820 filed November 25th, 1936.

Specifically, it pertains to the method described in the aforesaid application and aims to provide an improvement in the art of carbonizing fuel by circulating hot gases therethrough.

According to the present method, fuel is carbonized and the carbonized residue is cooled, within a single vessel through which the fuel is gravitated, by means of gas distilled from the fuel and which, after cooling to recover by-products, is circulated during one part of the operative cycle through a heat exchanger or exchangers, i. e. a heat generator, in turn heated by combustion of a portion of the gas, and during another part of the cycle is circulated through the residue of fuel to cool it, unburnt gas thus heated being passed through the uncarbonized fuel during both parts of the cycle.

Briefly then, the improved method or process, consists in gravitating the fuel through a single preferably elongated chamber which is charged with the fuel at its top and discharged of the fuel again, or the residue thereof after treatment, at its bottom, and circulating upwardly through the fuel in said chamber a gas distilled from the fuel, the said gas, before passing through the fuel to be carbonized being heated during a part of the operative cycle by passage through connected heat exchanging or generating means and during another part of the cycle by passage through the carbonized residue of the fuel which is thereby cooled. A part of the gas which is heated by passage through the carbonized residue is advantageously burned to reheat the heat exchanging or regenerating means.

A suitable arrangement of apparatus for the practice of this method may comprise a vertical chamber or shaft of sufficient length to provide an upper carbonizing space and below this a space in which the carbonized fuel or residue can be cooled before discharge through a door or other discharge control device. The chamber or shaft should be provided with a double valved or other suitable charging device for admitting fuel without loss of gas and, at the zone at which maximum temperature will occur, the chamber or shaft will have connection by a valve passage with a heat exchanger of the regenerative or recuperative type that is provided with a valved air inlet and a valved stack or outlet and is also connected with the bottom of the chamber or

shaft by a passage having two valves intermediate of which the passage is connected with a gas supply pipe. The gas supply pipe will be desirably connected through a circulating fan or equivalent means to the outlet from a cooler or condenser, the inlet of which is connected with the top of the chamber or shaft. Also, there should be connected with the cooler or condenser outlet, and if necessary to the outlet of the circulating fan, a gas holder which receives excess gas so that some of it can be used in starting up the process.

The accompanying drawing diagrammatically illustrates an apparatus of this kind, adapted to carry the method into effect.

In said drawing, 1 is a chamber or shaft within which the fuel is carbonized and its carbonized residue is cooled, the upper so-designated part serving as the carbonizing space and the lower so-designated part as the cooling space. This chamber or shaft has a double valved charging device 2 at the top and a discharge control door 3 at the bottom. Around said chamber or shaft 1, at a level separating or demarking the carbonizing from the cooling space, is a bustle pipe or passage 4 communicating with the interior of the same as by a series of ports indicated in dotted lines, and the zone at which maximum temperature occurs is located at or in the region of said level. This bustle pipe 4 is connected by a passage 5 with the top of a heat generator and recuperator or "regenerator" 6, the said passage 5 being controlled by a suitable valve 7 as indicated. The said regenerator has a valved air inlet 8 as represented and a stack or outlet 9 controlled by a valve represented by 9^a. Its (the regenerator) bottom is connected with the bottom of the chamber or shaft 1 by a valved passage 10 which is connected with a gas supply pipe 11, the valves—or it may be a single valve—thereof enabling the pipe 11 to be connected open either to the bottom of the regenerator 6 or to the bottom of the chamber or shaft 1, depending upon the setting of the same. A cooler or condenser 12 is connected at one side or end to the top of the chamber or shaft 1 and at the other side or end to the gas supply pipe 11 through a fan 13. Said cooler is also connected to a gas holder or reservoir 14.

Assuming the chamber or shaft 1 to be charged and the regenerator 6 to have been heated by burning a gas or part of the gas therein with air and allowing the products to escape through the stack 9, the valve 9^a of said stack and the air inlet 8 are both closed and gas is circulated

from the holder or condenser through said regenerator, so as to be heated to the required temperature, thence into the chamber or shaft 1 through the valved passage 5 and the bustle pipe 4 and from there up through the upper carbonizing space where it heats and begins to carbonize the fuel, the gases therefrom passing through or back to the cooler or condenser 12. The fan 13 put into operation for the purpose continues to circulate gas thus through the regenerator and the upper part of the chamber or shaft until the regenerator has been so cooled that the gas cannot longer be heated thereby sufficiently. The valve or valves in the gas passage 10 is or are then set to close it to the heat regenerator and to open it instead, or alternatively, to the bottom of the chamber or shaft 1, so that the gas supply or flow through the passage 11 will be directed and the gas will be caused to circulate thence upwardly through the cooling space directly toward the top of the chamber or shaft to the cooler or condenser 12. At the same time, the valve 7 in the passage 5 is readjusted and both the air supply valve 8 and the stack valve 9^a are opened up again so that part of this gas passing directly from the bottom of the chamber through the residue fuel in the carbonizing space will be drawn or bled off through said passage into the regenerator where it is burned to reheat the latter. When the regenerator has become sufficiently reheated, the gas circulation is returned again therethrough as first described, and these two different flows or circulations are maintained alternately, one following the other, until the fuel has become sufficiently carbonized.

When the fuel in the carbonizing space of the chamber or shaft 1 has been sufficiently carbonized, a part of the charge is discharged through the door 3 and further fresh fuel is admitted and the process repeated with periodical partial discharge and recharging. After a few cycles of operation the cooling space of the chamber or shaft 1 will contain only carbonized fuel.

The carbonized fuel or residue having passed the zone of maximum temperature is cooled by the circulated gas and the finished product can be discharged at a temperature well below its ignition point, thus avoiding loss by combustion, and the need for expensive quenching; heat thus recuperated will be carried back to the uncarbonized or partially carbonized fuel above though some part of the heat will be carried to the regenerator in the gas bled off for burning in it.

The term "regenerator" as hereinafter used in the claims is intended to define a heat exchanger in which heat is maintained, or recuperated when lost, by regeneration.

What we claim is:—

1. A process of carbonizing solid carbonizable fuel and cooling the carbonized residue in a single vessel, through which the fuel is gravitated, by circulation through the fuel of gas distilled from it, characterized by the fact that the gas before passing through the fuel to be carbonized is heated alternately first by passage through a heat regenerator and then alternatively by passage through the carbonized residue which is thereby cooled, the gas being introduced to the vessel at the one time above the carbonized residue and at the other time below the residue.

2. A process according to claim 1 wherein part of the gas heated by passage through the car-

bonized residue is burned to reheat the heat regenerator.

3. A process of carbonizing solid carbonizable fuel and cooling the carbonized residue thereof, which consists in gravitating the fuel through a single chamber vessel charged therewith at the top and discharged thereof at the bottom, and circulating upwardly through the fuel in said vessel a gas distilled from the fuel, the said gas in one part of the operative cycle and before passing through the fuel to be carbonized being heated by passage through a connected heat regenerating means and then alternatively and in another part of the operative cycle being heated by passage through the carbonized residue of the fuel which is thereby cooled by giving off its heat thereto, and a part of the gas which is heated by passage through the carbonized residue being drawn off and burned to reheat the heat regenerating means.

4. A process of carbonizing solid carbonizable fuel and cooling the carbonized residue in a single vessel, through which the fuel is gravitated, by the circulation through the fuel of gas distilled from the same, characterized by the fact that the gas before passing through the fuel to be carbonized is first heated by passage through a heat regenerator in one part of the operative cycle and then, alternately, when no longer heated sufficiently by the heat regenerator is passed through the carbonized residue of the fuel so as to take up the heat from and thereby cool the latter in another part of the operative cycle, a part of the gas in said alternate passage in said another part of the cycle being drawn off and burned to reheat the heat regenerator.

5. The process of carbonizing solid carbonizable fuel and cooling the carbonized residue thereof within a single vessel, which consists in passing the fuel in successive charges through the vessel by gravitation and passing upwardly through said fuel a gas distilled therefrom, the said gas drawn from a source of by-product treatment and collection being first heated by passage through a connected heating means heated by burning a portion of the same therein and the thus heated gas being introduced into the vessel intermediate its ends beneath the most recent charge or charges of fuel so as to pass upwardly there-through and the heated gas introduction being continued by circulation from the top of the vessel back to the heating means until said heating means has become so cooled that it can no longer heat the gas sufficiently and then alternately introducing the gas at the bottom of the vessel beneath the residue of the precedent charge or charges so as to pass upwardly there-through and cool said residue by absorption of the heat therefrom and the said cooling gas introduction being continued by circulation from the top of the vessel back to the said point of introduction and a portion of the cooling gas being bled off and burned in the heating means so as to reheat the same until said means has become sufficiently reheated, whereupon the gas is again introduced at the original point and the cycle of flow is repeated.

6. A process of carbonizing solid carbonizable fuel and cooling the carbonized residue in a single vessel, characterized by circulating through the fuel passed by gravity through the vessel a gas distilled from said fuel, which consists in first burning a portion of the gas to heat a heat regenerator, passing the gas through the heated heat regenerator and thence into the vessel up-

wardly through the fuel to be carbonized, and continuing thus to pass the gas through the heat regenerator and through the fuel to be carbonized until the heat regenerator has become so cooled that it can no longer heat the gas sufficiently, in one part of the operative cycle, and then, alternately, passing the gas upwardly from a lower point in the vessel upwardly through the carbonized residue of the fuel and thence again through the fuel to be carbonized so as to take up heat from and to thereby cool the former before it reaches the latter, extracting a portion of the gas through its previous introduction point and burning the same to reheat the heat regenerator, and continuing to pass the gas thus upwardly through the carbonized residue and through the fuel to be carbonized above until the heat regenerator has been sufficiently reheated, in the second part of the operative cycle.

7. A process of carbonizing solid carbonizable fuel and cooling the carbonized residue in a single vessel, characterized by circulating through the fuel passed by gravity through the vessel a gas distilled from said fuel, which consists in first burning a portion of the gas to heat a heat regenerator, passing the gas through the heated

heat regenerator and thence into the vessel upwardly through the fuel to be carbonized, and continuing thus to pass the gas through the heat regenerator and through the fuel to be carbonized until the heat regenerator has become so cooled that it can no longer heat the gas sufficiently, in one part of the operative cycle, and then, alternately, passing the gas into the vessel from a lower point upwardly through the carbonized residue of the fuel and thence again through the fuel to be carbonized so as to take up heat from and to thereby cool the former before it reaches the latter, extracting a portion of the gas through its previous introduction point and burning the same to reheat the heat regenerator, and continuing to pass the gas thus upwardly through the carbonized residue and through the fuel to be carbonized above until the heat regenerator has been sufficiently reheated, in the second part of the operative cycle; meanwhile drawing the passed gas off from the top of the vessel for by-product extraction and collection for return to circulative usage, resulting in a partial cooling of the same.

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