Sept. 11, 1934. W. W. ODELL 1,972,897

ADJUSTABLE GRATE GENERATOR

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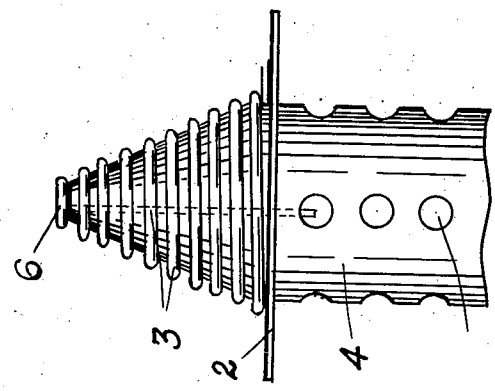


Fig-2

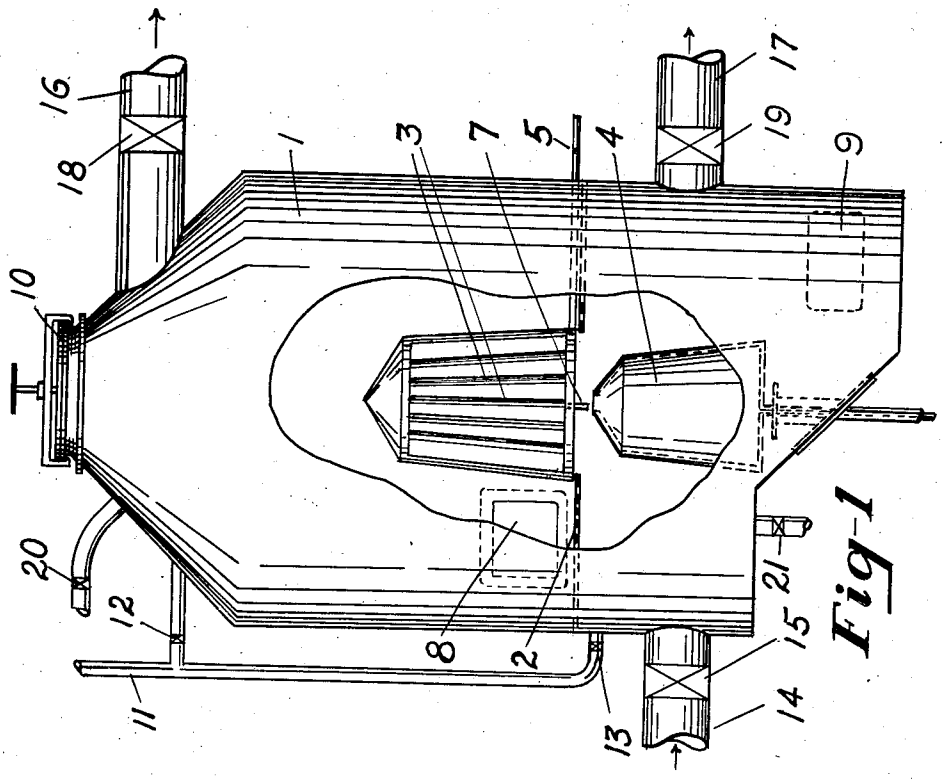


Fig-1

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INVENTOR

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ADJUSTABLE GRATE GENERATOR

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8 Claims. (Cl. 48—78)

My process relates to the generation of gas in a generator by introducing fluids (usually aeriform fluids) into a bed of ignited fuel; it may be substantially or distinctly intermittent and the fluids may vary in cycles, being or containing air or any oxygen containing gas during one portion of the cycle. The invention has to do with the combination of a substantially upright grate coacting with a movable plunger or ram. Normally the grate is stationary and the plunger is adapted to fit into the open chamber formed by the grate, and adapted to be inserted into and withdrawn from said chamber under control during operation.

The objects of this invention are numerous and include the following:

1. Decrease the fuel consumption in the production of combustible gas.

2. Increase the gas making capacity of a given size generator.

3. Increase the grate area of a generator or furnace without increasing the diameter of the shell.

4. In effect, decrease the thickness of the fuel bed of a water gas generator during the air blasting period and maintaining the normal thickness during the steam run.

5. Reduce the tendency for blow-holes or flues to form in the fuel bed.

6. Eliminate the blowing of fine size fuel out of the generator, and thereby permit the use of a greater volume of air blast per unit of time.

7. Elimination of a "dead" middle zone (cool inactive zone) in the fuel bed. Other objects will become evident by the disclosures herein made.

8. Permit the use of deeper fuel beds in making water gas. It has been recognized for years by gas engineers that it would be desirable to have a thin fuel-bed during the air blasting step in the generation of water gas and a thick or deep fuel bed during the "make" or steam-run period. It has not heretofore been possible to economically accomplish this result so far as I am aware; it is common practice to alternately air blast and steam a stationary bed of ignited fuel confined in a generator and supported on a flat or a substantially flat grate. I find that I am enabled to obtain improved results in operating gas generators by providing an upright grate substantially in the middle portion of the fuel bed. The grate may be conical, cylindrical, hexagonal, octagonal, the frustrum of a cone or other shape. My grate eliminates the tendency for all, or nearly all of the air blast to travel through the portion of the fuel bed adjacent the shell by making an easy path for the entry of air into the middle portion of the fuel bed. However, I have found that although this grate is highly beneficial in certain furnaces and gas producers, it is not of particular advantage during the steam run when making water gas because it shortens the path of travel of the gases and tends to lessen the time of contact of steam with the incandescent fuel. This I have overcome by providing a ram or plunger which fits into the configuration or chamber formed by the upright grate and substantially eliminates the passage of appreciable amounts of steam therethrough during the run. This ram is removed from within the confines of the upright grate during the air-blast periods.

Figure 1 is a diagrammatic elevation of a generator, having a portion of the wall cut out to show the grate within.

Figure 2 shows in elevation another form of grate also adapted for use with a ram. In this modification the grate is a coil (stationary coil) and, as shown, the ram is in its elevated position fitting into the chamber space formed by the coil, and, in effect, closing the grate.

In Figure 1, the generator shell is shown at 1, and ordinary flat grate at 2, and 3 is the specially provided upright grate located in the middle zone of the fuel bed. In this particular example it is a tubular grate, in which the tubes are substantially upright, extending about half way to the top of the fuel bed, but it need not have this form, it may extend much higher, through the fuel bed or it may extend a lesser distance into the fuel bed. The movable plunger or ram, 4 is adapted to substantially fit into and substantially fill the chamber space formed by the grate 3, when in an elevated position, however, when it, (the plunger) is lowered, the chamber space is not so filled but is available for the ready passage therethrough of gas, air steam or other fluid. Grate 3 is preferably made of metal and preferably is water cooled or cooled by the circulation of another suitable fluid. The means of circulating the cooling fluid is not pertinent to the invention, however suitable connections are diagrammatically shown and a control valve is shown at 5 for regulating the flow of the cooling fluid. The details of the operation of a ram or plunger in general, are not new, a ram has been used to break clinker and for other purposes and therefore the mechanical details are not shown nor specifically claimed as my own. One means for removing the circulating cooling fluid from 3 is shown at 7. A clinking door is shown at 8, a clean-out door (ash-pit door) at 9 and a fuel charging door at 10. A

steam line to the generator is shown at 11, with inlet control valves 12 and 13. The air supply line 14 has a control valve 15. Gas offtakes are shown at 16 and 17 with control valves respectively at 18 and 19. The flat grate used in conjunction with grate 3 is shown at 2. Ram 4 is shown in a lowered position.

A modified form of the grate 3 and a portion of the ram 4 are shown separate from the generator in Figure 2. The same system of numbering is employed in each figure. A cap 6, is shown in Figure 2 at the peak of the coil, that is the coil ends in the cap.

The usefulness of my combination grate and plunger is evidenced by the description of one method of operating the gas generator, shown in Figure 1, making water gas, as follows: Coke or other suitable solid fuel is charged into the generator through the fuel charging door 10 and kindled.

A bed of fuel is formed of about 4 to 10 feet deep, varying according to conditions as desired. The ignited fuel is now air blasted, by opening valve 15, until it is heated to a suitable gas-making temperature; the gases formed being expelled through outlet 16. During the air-blasting period (or a portion thereof) the plunger 4 is held in a lowered position, as shown in Figure 1, and thus some of the blast air passes into the fuel bed through the grate 3. This air does not react with the solid fuel only, a portion of it reacts with the gas evolved or produced in the fuel bed. For example oxygen combined with carbon forming CO in the lower portion of the fuel bed and, on passing upwardly is in part oxidized to CO_2 by the oxygen introduced through the grate 3. The air-blasting is now discontinued, plunger 4 is raised to substantially fill the chamber formed by grate 3 of Figure 1, that is, grate 3 is now substantially closed to the ready passage therethrough of a fluid. Valve 15 is closed and steam is now introduced beneath the flat grate 2 by opening steam valve 13, the gas formed is removed through outlet 16. In this manner the course of the gas-making fluids through the fuel bed is longer during the steam run than during the blast, because at least a large portion of the steam enters the fuel bed during up runs through the flat grate 2, whereas much of the air used during air-blasting passes through grate 3. After the fuel has cooled to a temperature below that deemed satisfactory for gas making the steaming is discontinued by closing valve 13. The cycle is then repeated. Down steam runs are also made as required to maintain a proper distribution of heat throughout the fuel bed. Down runs are made by opening valves 12 and 19 and closing valves 18, 15 and 13. Split runs can also be made when desired.

By operating a water-gas generator in the above described manner, I find that it is possible to maintain a higher temperature in the upper portion of the fuel bed than occurs in ordinary operation of the commonly used water-gas generators: This is a condition highly satisfactory for the use of bituminous coal as generator fuel. Because a portion of the blast gas passes through grate 3 there is less tendency for holes to form in the fuel bed and less blown-over fuel using the process outlined above than when making gas by the commonly employed method.

With a very hot and deep fuel bed it is frequently desirable to make the steam runs—with the plunger partly lowered.

The plunger, which is made preferably of metal, may be water cooled although this is not a necessary feature. A convenient manner of discharging the cooling fluid from the water cooled grate is through the plunger, although this is a detail to which I do not confine myself. Other means of removing the cooling fluid are also satisfactory. I believe that it is new to use a plunger in the manner coacting with a grate within the fuel bed, and I believe that the results attained thereby are different from, and better than those heretofore obtained and I therefore claim broadly the combination of parts and the process as my own.

Because of the difference between the courses of the fluids through the fuel bed during the air-blast and steam-run periods, the operation by my process in effect, comprises blasting with an oxygen containing gas through a moderately thin bed of ignited fuel and subsequently making a steam run through a relatively thicker fuel bed in a single generator.

The plunger may be operated on the hydraulic-ram principle which is not new. In this manner by the mere turning of a valve the plunger may be caused to move into or out of the space (chamber) formed within the confines of the upright grate. When it is desired to completely snugly fill this chamber by causing the plunger to rise, it is advantageous to have the plunger ribbed in such a manner that the ribs coact with the grate elements closing the grate spacing.

The term "upright grate" as used in this application does not necessarily mean a vertical grate. As already stated the grate may be a vertical cylinder, cone or of other shape. It is, however, essentially upright as distinguished from the usual horizontal grate or step grate. My grate is preferably stationary and preferably it is symmetrical about a central axis although it is obvious that it would function if shaped like a pentagonal prism or pyramid or other non-symmetrical form.

It is understood that my invention is applicable in making water gas, reformed gas resulting from introducing hydrocarbons into the fuel bed with or without other fluids, and other gases. Rich producer gas can be made using the grate advantageously by making some up blasts without steam and subsequently using both air and steam.

The upright grate is usually used in conjunction with another grate, such as, or including the common flat grate. This is shown in Figure 1.

I believe that my apparatus and process are particularly adapted for use in upright generators typified by the commonly used cylindrical water-gas generators and gas producers.

The term "fluid" or "gas-making fluid" as used in the claims does not necessarily refer to a single substance or gas, but includes a mixture which may comprise gases or gases mixed with vapors or vapors. Thus, steam, oxygen or both or mixtures of either or both with aeriform hydrocarbon compounds. Means for introducing other fluids than air and steam are shown at 20 and 21.

It is realized that grates are in use in gas producers that are somewhat conical and it is known that patents have already been allowed for various types of piers which have ports for introducing air to the fuel bed. However, the results I obtain can not be obtained with the grate alone. It is by the use of the combination, grate and plunger, in coaction that the benefits are derived. It is believed that the chief patent novelty lies in the use of this combination.

It can readily be seen that if the ram is hollow

and has slots or perforations in its shell it can remain always within the chamber formed by grate 3, and function by merely being turned on its vertical axis, making the slots coincide with the openings in the grate during one phase of operation only. The inner portion of the plunger is then open to the flow therethrough of the fluids. The element 4 designated as a plunger can not in a true sense of the word be called a plunger in this instance. The same result is obtained in a given generator by the same combination, in some cases, regardless of whether the plunger is merely turned periodically or periodically inserted into and withdrawn from the grate chamber. This form is not shown by a separate figure, because it is not believed to be patentably different from the apparatus shown in Figure 1, in view of the disclosure and claims.

I claim:

1. In a gas-generating apparatus, a gas generator adapted to confine a fuel bed, means for introducing air and steam to maintain combustion and produce combustible gas, an upright grate located substantially axially in the middle portion of said generator having a closed top and extending upwardly about midway to the top of said generator forming therein substantially a grate chamber open at the bottom, and a separate coacting plunger projectable upwardly into said chamber and retractable therefrom, said plunger being adapted to substantially close said upright grate to the passage of gas-making fluids when in its uppermost position and to open it to the free passage of said fluids when in the retracted position.

2. In a gas-generating apparatus, a gas generator adapted to confine a fuel bed supported by a bottom-grate, means for introducing air and steam to maintain combustion and produce combustible gas, an upwardly tapering grate located axially in substantially the lower middle portion of said generator having a closed top the whole forming therein substantially a grate chamber open at the bottom, and a plunger coacting with but separate from said upright grate controlling the flow of gas-making fluids therethrough, said plunger being projectable upwardly into said chamber and retractable therefrom being adapted to substantially close and completely open said upright grate to the passage of said fluids respectively when in its uppermost and retracted positions.

3. In a gas-generating apparatus, a gas generator adapted to confine a fuel bed supported by a bottom-grate, means for introducing air and steam to maintain combustion and produce combustible gas, an upwardly tapering grate located substantially axially in the lower middle portion of said generator having a closed substantially conical top, the whole forming therein substantially a grate chamber open at the bottom, and a plunger coacting with but separate from said upright grate controlling the flow of gas-making fluids therethrough, said plunger being projectable upwardly into said chamber and retractable therefrom being adapted to substantially close and completely open said upright grate to the passage of said fluids respectively when in its uppermost and retracted positions.

4. In a gas-generating apparatus, a gas generator adapted to confine a fuel bed supported by a bottom-grate, means for introducing air and steam to maintain combustion and produce combustible gas, an upwardly tapering grate located substantially axially in the lower middle portion of said generator having a closed substantially conical top, the whole forming therein substantially a grate chamber open at the bottom, and a plunger coacting with but separate from said upright grate controlling the flow of gas-making fluids therethrough, said plunger being projectable upwardly into said chamber substantially filling it and retractable therefrom being adapted to substantially close and completely open said upright grate to the passage of said fluids respectively when in its uppermost and retracted positions.

5. In a combustible gas generating apparatus adapted to confine a stationary bed of ignited solid fuel, comprising a generator having means for introducing gas-making fluids and for removing gas therefrom, means for controlling the path of travel of gas-making fluids into said bed in the gas-making process, comprising in combination, an upright stationary closed-top grate extending up into the lower middle portion of said generator forming a chamber open at the bottom, and a separate, movable hollow plunger coacting with said grate being adapted while in one position to contact substantially the entire inner wall of said chamber substantially closing it to the passage of said fluids and adapted by a downward movement to another position to allow the restricted passage therethrough of a gas-making fluid, said grate having a vertical axis substantially common with said generator.

6. In a combustible gas generating apparatus adapted to confine a stationary bed of ignited solid fuel, comprising a generator having means for introducing gas-making fluids therein and for removing gas therefrom, means of controlling the path of travel of gas-making fluids into said bed in the gas-making process, comprising in combination, an upright stationary closed-top grate extending up into the lower middle portion of said generator forming a chamber open at the bottom, and a separate coacting plunger projectable upwardly into said chamber and retractable therefrom, said plunger being adapted to substantially close said upright grate to the passage of gas-making fluids when in its uppermost position, to open it to the free passage of said fluids when in the retracted position and to open it to a restricted flow of said fluids when in an intermediate position, said grate having a vertical axis substantially common with said generator.

7. In a combustible gas generating apparatus adapted to confine a stationary bed of ignited fuel, comprising a generator having means for introducing gas-making fluids therein and means for removing gas therefrom, means of controlling the path of travel of gas-making fluids through said generator, comprising, an upright, upwardly tapering, stationary, water-cooled grate having a closed top extending up substantially axially into the lower middle portion of said generator forming a chamber open at the bottom, and a separate coacting plunger projectable upwardly into said chamber and retractable therefrom, said plunger being adapted to substantially close said upright grate to the passage of gas-making fluids when in its uppermost position and to open it to the passage of said fluids when in a retracted position.

8. In the apparatus defined in claim 7, a hollow plunger adapted to receive the cooling-water from said water-cooled grate.

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