

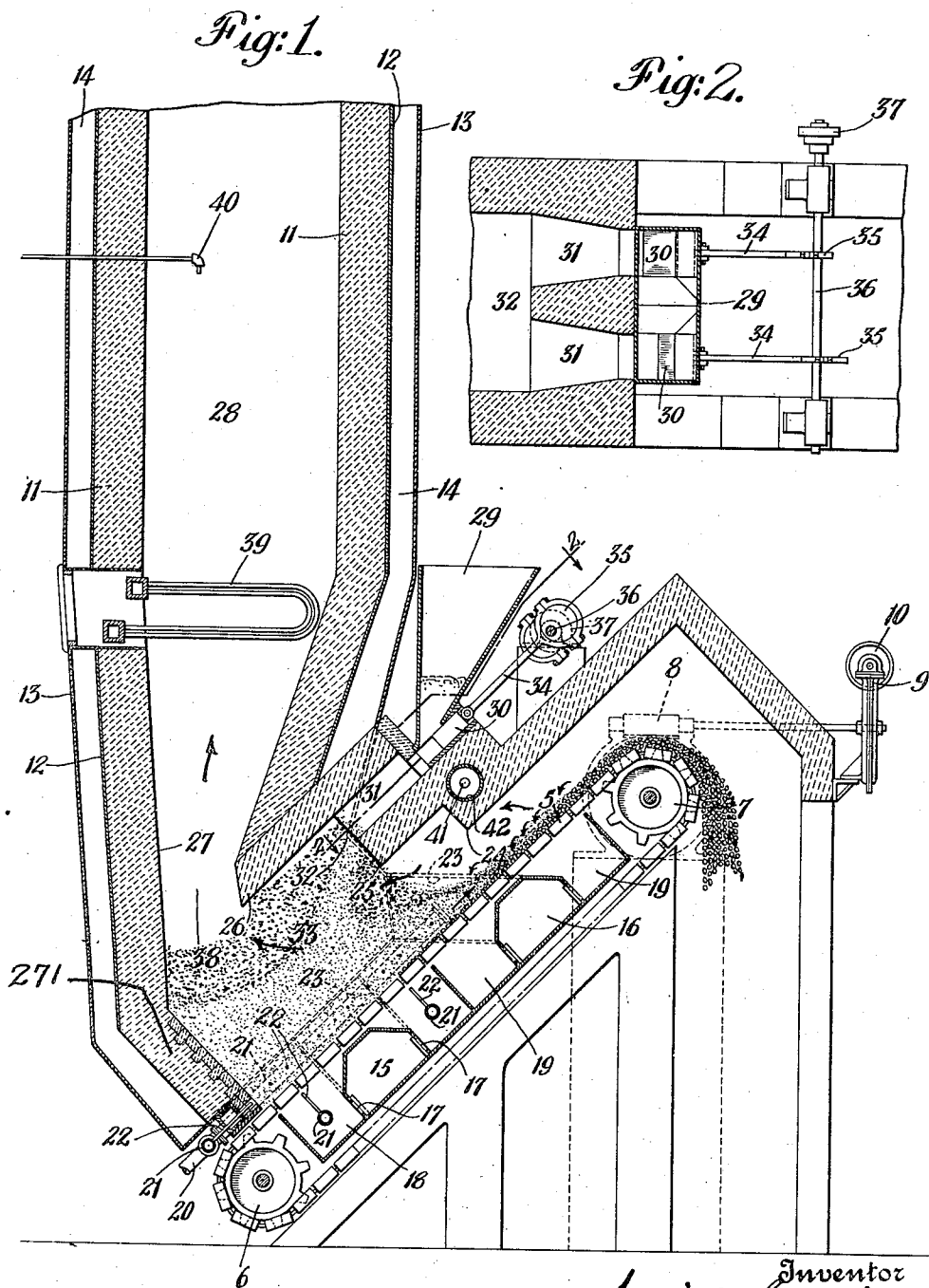
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GAS PRODUCER

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GAS PRODUCER

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This invention relates generally to an improved gas producer construction.

It is well known that the commonly accepted and universally used method for operating gas producers is to alternately force through a deep bed of incandescent coal a blast of air and then of steam, the blast of air being used to bring the fuel bed up to the proper temperature and, in addition, the oxygen of the air combining with the carbon of the fuel to produce carbon monoxide. When steam is turned on and blown through the fuel, the reaction with carbon produces carbon monoxide and free hydrogen, which is the well known water gas reaction. It will be clear that the continued blowing of steam through the fuel without the alternate use of air would soon lower the temperature of the fuel to a point where the reactions would no longer occur. The employment of air is useful chiefly in that it brings the temperature of the fuel bed up to a point where it will react in the desired manner with steam, the production of gas through the use of the air stream being secondary in comparison with the gas produced by the action of steam. In addition, the production of carbon monoxide by the use of the air stream is accompanied by the production of a considerable portion of carbon dioxide which, of course, is undesirable.

The foregoing methods of production of producer gas referred to were carried out in gas producers designed for the use of anthracite coal in relatively large sizes. This is objectionable because of the greater cost of coal in large sizes than that in the finely divided sizes, such as are used in making steam.

A general object of the present invention is to provide means and a method for the production of semi-water gas or producer gas which will be free from the objectionable features of the heretofore known methods and which will operate with the proper proportions of intermixed steam and air to carry on the process continuously and with fuel such as anthracite coal, coke and similar materials consisting largely of free carbon in finely divided form.

The invention comprises a gas producer

structure in which a traveling endless grate is provided which furnishes a fuel supporting surface at a relatively considerable inclination with respect to the horizontal, the travel of the grate being upwardly along the inclination. With this arrangement, a bed of finely divided fuel placed on the inclined traveling grate surface is so affected by the movement of the grate as to be turned over and over with the result that the fuel is constantly stirred or agitated and the fusing and agglomerating together of particles of fuel prevented.

The stirring of the fuel in the manner stated is supplemented by the provision of means for blowing a portion of the air delivered to the generating chamber upwardly through the grate at the forward edge of the fuel in order to blow back onto the bed of fuel particles of fuel which are carried upwardly on the pile by the movement of the grate. This continual returning of fuel particles to the fuel bed results in a complete consumption of the fuel charged to the gas producer. As the fuel is consumed and clinkers are formed, the heavier masses produced by the clinkers are carried by the grate and discharged from the upper end thereof to an ash pit below.

A feature of the invention resides in the continuous feeding of finely divided solid fuel into the gas producer at a point elevated somewhat above the grate structure so that the particles of fuel are ignited before they reach the fuel bed in which complete combustion occurs. This method of charging fuel into the gas producer results in the forming of a curtain of partially ignited solid fuel through which carbon dioxide gases, generated at the elevated or forward portion of the grate, pass and in so doing absorb carbon from the burning fuel with which they make contact. The fuel, thus introduced from an elevation, is arranged to fall downwardly along the surface of the grate in opposition to the direction of travel of the grate surface so that a still further source of agitation or stirring of the fuel takes place. The result is that the particles of coal, making up the fuel bed, are constantly being shifted in posi-

tion and the films of gases, generated on the surfaces of the particles, are constantly being brushed off.

A feature of the invention resides in the simultaneous and continuous introduction into the gas producer of steam and air which, because of the relatively shallow depth of the fuel bed and the constant agitation of the mass of fuel which occurs, easily permeate the incandescent fuel to carry on the desired reactions with the carbon therein, thereby forming producer gas.

With this structure and method of operation, a uniformly high temperature is maintained with the result that a combustible gas having a minimum content of carbon dioxide is produced. I therefore succeed in producing a high grade producer gas at a desirable low cost because of the continuous process of operation and the use of finely divided and, therefore, cheaper grades of anthracite.

Other features of the invention will be hereinafter described and claimed.

In the drawings, in which a preferred embodiment of the invention has been selected for illustration:

Figure 1 is a view in vertical section of a gas producer embodying the invention;

Figure 2 is a view in horizontal section taken on the line 2—2 of Figure 1.

Referring to the drawings for a more detailed description of the invention, a gas producer structure is shown which includes a traveling grate 5 of the endless type which is supported at an inclination to the horizontal which may be at an angle of 45° as shown or which may have an even greater inclination more nearly approaching the vertical. Under certain conditions the angle of inclination may be even smaller than 45° down to, say, 25° . This angle will depend upon the nature of the fuel being used and the manner in which the steam and air are passed through the bed of fuel. The angle should be sufficiently steep to cause the fuel at the surface of the bed to roll back upon itself under the assistance of the streams of air and steam passing through the bed. The grate is supported at its ends on the sprockets 6 and 7, the sprockets being driven through a worm and spiral gear connection 8 which is operated and turned by a worm and spiral drive 9, power being supplied through the pulley 10 from any suitable source. The travel of the grate is upwardly along its upper surface so that there is a constant tendency to move the lowermost layer of the bed of material upwardly with the traveling grate surface.

A gas producer shaft 11 leads upwardly from the zone of burning fuel on the traveling grate and is constructed of suitable refractory material reinforced by a steel shell 12. A jacket 13 surrounds the producer shaft in spaced apart relation thereto to provide a channel 14 through which air, entering the

combustion zone of the gas producer, can be preheated to effect a desired economy in the use of fuel.

Air entering through the channels or conduits 14 passes into manifold chambers 15 and 16 mounted between the opposite sides of the traveling grate 5. The air finds its way from the preheating chamber 14 through passageways 23 into the manifold chambers 15 and 16. From the manifold chambers 15 and 16 gate controlled ports 17 are provided through which air is delivered from the manifold chambers into compartments 18 and 19 of a wind box structure. From the wind box structure, air is blown from the upper and open face thereof through the grate sections into and around the bed of burning fuel.

I also provide for the simultaneous and continuous delivery of steam into and through the burning fuel as already indicated. The structure for accomplishing this takes the form of a supply pipe 20 which delivers steam to a manifold pipe 21 provided with nozzle openings 22 through which steam is blown into the sides of and upwardly through the fuel bed. It will be seen that a continuous discharge of air and steam is provided, both fluids coacting with the incandescent fuel to produce the desired combustible gas having a maximum content of carbon monoxide.

A feature of the invention resides in the relatively steep angle which is occupied by the traveling grate, so that in the upward movement of the fuel supporting grate surface, the fuel bed is caused to continually flow back on itself under the moving action of the grate. The action which takes place at the surface of the upwardly travelling bed of fuel may appropriately be described as an avalanching effect inasmuch as the material at the surface is constantly rolled back toward the lower end of the inclined bed. The result of this avalanching effect, in conjunction with the continuous, upward movement of the grate, is to continuously return the fine fuel particles into a more active zone while the heavier clinkers carried by the grate are brought to the top and discharged from the upper end. The result of this is that the bed of fuel is being constantly stirred or agitated, thereby preventing the fusing and agglomerating together of particles of fuel. By thus keeping the fuel bed in an agitated and porous condition, the fuel particles are wholly consumed so far as the combustible or carbonaceous content thereof is concerned. The resulting clinker, which represents the residue remaining after combustion has been completed, forms in relatively large masses which are carried upwardly with the travel of the grate and eventually fall over the end of the grate onto a pile or into a conveyor

which operates to remove them to a waste receiving receptacle.

Not only is the fuel stirred and agitated by the steep inclination of the grate on which it rests, but a further stirring and agitating effect is produced on the fuel bed by reason of the application of a blast of air entering through the upper end of the grate structure and blowing downwardly toward the fuel bed. The action of the air blast applied in this manner is to blow small particles of fuel advancing under the movement of the grate from the edge of the pile back onto the pile, thereby assisting the action of gravity to prevent fine material from being carried upwardly with the grate and discharged with the clinker from the combustion chamber. The total result of the steep inclination and the blast of air provided at the upper end of the edge of the fuel bed is to maintain the fuel bed in a constantly stirred and agitated condition which facilitates the complete combustion of the carbonaceous material and the efficient conversion thereof into combustible gas.

The directing of the blast of air which enters through the upper region of the grate at the advancing edge of the fuel bed is facilitated in a considerable degree by the roof construction of the combustion chamber which includes downwardly directed angular portions 24, 25 and 26 which aid in the deflection of air and gases and solid fuel particles into the lower or rearward portion of the combustion chamber.

The roof member 26 is so spaced with relation to the adjacent portion 27 of the wall structure 11 as to form a throat through which the hot gases pass into the vertical passage 28 through which they are conducted to purifying devices and collecting chambers or to the place of use, not shown. The lower end 271 of the wall 27 forms a V-shaped combustion or gas generating chamber with the grate 5.

A feature of the invention resides in the feeding of fuel such as finely divided anthracite coal, coke, or similar materials consisting largely of free carbon into the combustion chamber from a point elevated above the fuel bed, so that the particles of fuel become ignited in their descent and form what is, in effect, a curtain of blazing particles through which carbon dioxide gas, formed at the upper edge of the fuel bed by the reaction therewith of the entering blast of air, passes and is reduced by the carbon content of the fuel to produce combustible carbon monoxide which is added to the combustible gases formed directly above the bed of incandescent fuel. The means provided for thus feeding fuel into the combustion chamber at a point above the fuel bed comprises a hopper 29 with the base of which pushing or piston members 30 coact to force fuel from the hopper 29 into feeding pas-

sages 31 and thence through ports 32 into the combustion or gas generating chamber 33. The pushing or piston members 30 are coupled through pitman rods 34 to a pair of eccentrics 35 carried by a shaft 36 which is driven through a speed-change pulley connection 37 with any suitable source of power.

With this arrangement of structure it will be seen that fuel is continuously fed into the gas generating chamber from the hopper 29 while at the same time the endless grate 5 continuously operates to carry out ash and clinker from the fuel bed with the result that the operation is continuously maintained.

The surplus heat contained in the gases passing through the throat 38 into the chamber or uptake passage 28 may be recovered in part at least by the provision of a steam superheater coil 39 which may be connected to a waste heat boiler or equivalent device.

I provide also for the enriching of the combustible gases, passing through the chamber 28, by means of an oil pipe 40 through which oil is sprayed into the midst of the hot gases.

I preferably provide means for automatically controlling or regulating the rate of feeding of fuel into the combustion chamber and also the speed of travel of the grate structure. This is effected by the provision of a pyrometric device 41 in an opening 42 provided for the purpose in the roof of the combustion chamber, the pyrometric device being connected in any suitable way, not shown, to regulate the speed of a motor arranged to operate the eccentric driving shaft 36.

The desirable constant displacement and agitation of solid fuel particles which is accomplished in the structure described is considerably facilitated by the application of relatively powerful steam blasts applied along the lower layer of the bed of fuel at the edges thereof. The action of the steam supplements the action of the air blast at the forward end of the fuel bed and is assisted to some extent by the relatively less powerful blast forced through the fuel bed from the lower tuyère compartment 18. It will be seen that air from the compartment 18, together with the steam, reacts with the incandescent fuel to generate carbon monoxide, the chief constituent of the combustible fuel produced. The constant movement or agitation of particles of fuel in the fuel bed results in the continuous presentation of heated fuel particle surfaces for engagement by the steam to bring about the desired reaction. In addition, the constant agitation facilitates the passage of the steam into the fuel bed, thereby assisting in the reactions by bringing the steam into contact with all the incandescent surfaces. The constant movement of the carbon particles serves to utilize the particles as conveyors of heat with the result that a con-

stant and uniform temperature is maintained in the reducing zone and a continuous reaction between the carbon and the steam is produced.

5 The introduction of cold fuel at the point 32 into the combustion chamber has the beneficial result of reducing at that point the temperature of the combustion zone which would otherwise be so high as to produce carbon
10 dioxide and dilute the otherwise combustible gases produced.

What I claim is:—

1. In a gas producer designed for the gasification of relatively finely divided solid fuel,
15 a chamber forming a partial combustion zone, a traveling grate having its fuel supporting surface arranged to travel upwardly at an angle greater than twenty-five degrees from the horizontal through said chamber, means
20 for feeding fuel into the combustion chamber at a point spaced above the grate, and means for blowing steam and air into the bed of fuel on the grate to make producer gas.

2. In a gas producer designed for the gasification of relatively finely divided solid fuel,
25 a partial combustion chamber, a traveling grate having its fuel supporting surface arranged to travel upwardly at an angle greater than twenty-five degrees from the horizontal through said chamber, means for continuously
30 feeding fuel into the combustion chamber at a point spaced above the grate, and means for blowing steam and air into the bed of fuel on the grate to make producer gas, a portion of the air blast being directed through
35 the grate against the upper extremity of the bed of fuel whereby to blow particles of fuel back on the bed of fuel.

3. The process for making producer gas
40 from finely divided solid fuel, which consists in producing an avalanching effect upon the surface of a mass of incandescent fuel by supporting the fuel on an upwardly moving steeply inclined grate, and in blowing air
45 and steam through the mass of fuel and thereby generating producer gas.

4. The process for making producer gas from finely divided solid fuel, which consists in constantly stirring a mass of incandescent
50 fuel by supporting the fuel in a bed on an upwardly moving steeply inclined grate, in blowing a blast of air through the grate at the upper edge of the fuel bed to thereby return small particles of fuel to the bed, and
55 in blowing air and steam through the bed of fuel and thereby generating producer gas.

5. A gas producer for producing combustible gas from finely divided fuel by a continuous process comprising an inclined wall,
60 an inclined upwardly movable grate angularly related to said inclined wall to form therewith a V-shaped gas generating chamber, means for continuously introducing steam into a body of fuel in said gas generating
65 chamber to form combustible gas, and

means for introducing a gaseous current through said grate toward the upper side of said gas generating chamber to blow the lighter fuel particles from said grate back toward the centre of said gas generating
70 chamber, substantially as described.

6. A gas producer as defined in claim 5 wherein the grate lies at an incline approximating an angle of 45° with the horizontal.

7. A gas producer as defined in claim 5
75 wherein the inclination of the grate is such as to carry clinkers away from the region of gasification.

8. A gas producer having a V-shaped gas generating chamber formed between an inclined wall and an oppositely inclined upwardly movable grate, means for introducing steam into contact with incandescent coal in the deeper part of the gas generating
80 chamber, and means for introducing an air blast through the grate toward the edge of said gas generating chamber to blow unconsumed and partially consumed coal from the grate back toward the centre of the gas generating chamber, substantially as described.
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9. In a gas producer designed for the gasification of relatively finely divided solid carbonaceous fuel, a chamber forming a partial combustion zone, a traveling grate having its fuel supporting surface arranged to travel
95 upwardly through said chamber at a sufficient angle to cause the fuel to roll back on itself to thereby maintain a constantly stirring bed of fuel.

10. In a gas producer designed for the gasification of relatively finely divided solid carbonaceous fuel, a chamber forming a partial combustion zone, a traveling grate having its fuel supporting surface arranged to travel
100 upwardly at an angle greater than twenty-five degrees from the horizontal through said chamber.

11. In a gas producer designed for the gasification of relatively finely divided solid carbonaceous fuel, a chamber forming a partial combustion zone, a traveling grate having its fuel supporting surface arranged to travel upwardly at an angle approximating
110 forty-five degrees through said chamber.

12. In a gas producer designed for the gasification of relatively finely divided solid fuel, a chamber forming a partial combustion zone, a traveling grate having its fuel supporting surface arranged to travel upwardly at a relatively steep inclination
115 through said chamber, and means for blowing air through the grate at the upper edge of the fuel bed, said angle of inclination and said air blowing means producing an avalanching effect upon the fuel particles and
120 maintaining the surface of the fuel in agitation.

13. The process of generating producer gas, which comprises moving a continuous bed of carbonaceous fuel at an angle of more
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than 25 degrees to the horizontal, and simultaneously blowing streams of air and steam through said bed and thereby generating producer gas, said fuel due to the action of said streams and the angle of inclination of the bed undergoing an avalanching effect at the surface, whereby a constant agitation is produced and a uniform resistance to the passage of steam and air is maintained.

10 14. The process of generating producer gas, which comprises moving a continuous bed of carbonaceous fuel at a steep angle within a partial combustion zone, igniting said fuel, and blowing steam and air through
15 said bed to maintain partial combustion and generate producer gas, said fuel being caused to avalanche at its surface due to the inclination of the moving bed and the action of the air and steam.

20 15. A gas producer for generating producer gas from finely divided carbonaceous fuel by a continuous process, which comprises an inclined wall, an inclined upwardly movable grate forming with said wall a V-shaped
25 gas generating chamber, means for blowing steam through the bed of fuel carried by said grate, means for blowing air through said bed, means for directing gases produced by the action of said steam and air on the fuel
30 over the surface of the bed to create an avalanching effect at the surface of the fuel, and means for continuously introducing finely divided fuel onto the bed.

35 16. A continuous method of generating producer gas from finely divided carbonaceous fuel which comprises, maintaining a bed of fuel at a steep angle in a partial combustion zone, passing air and steam through said bed and thereby generating producer
40 gas, and continuously advancing said bed upwardly at said angle during partial combustion, the surface of said bed being maintained in constant agitation due to the angle of inclination assisted by the buoyant effect
45 of the air and steam.

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