March 31, 1931. J. U. McDONALD 1,798,617

GAS PRODUCING APPARATUS

Filed June 13, 1925 3 Sheets-Sheet 1

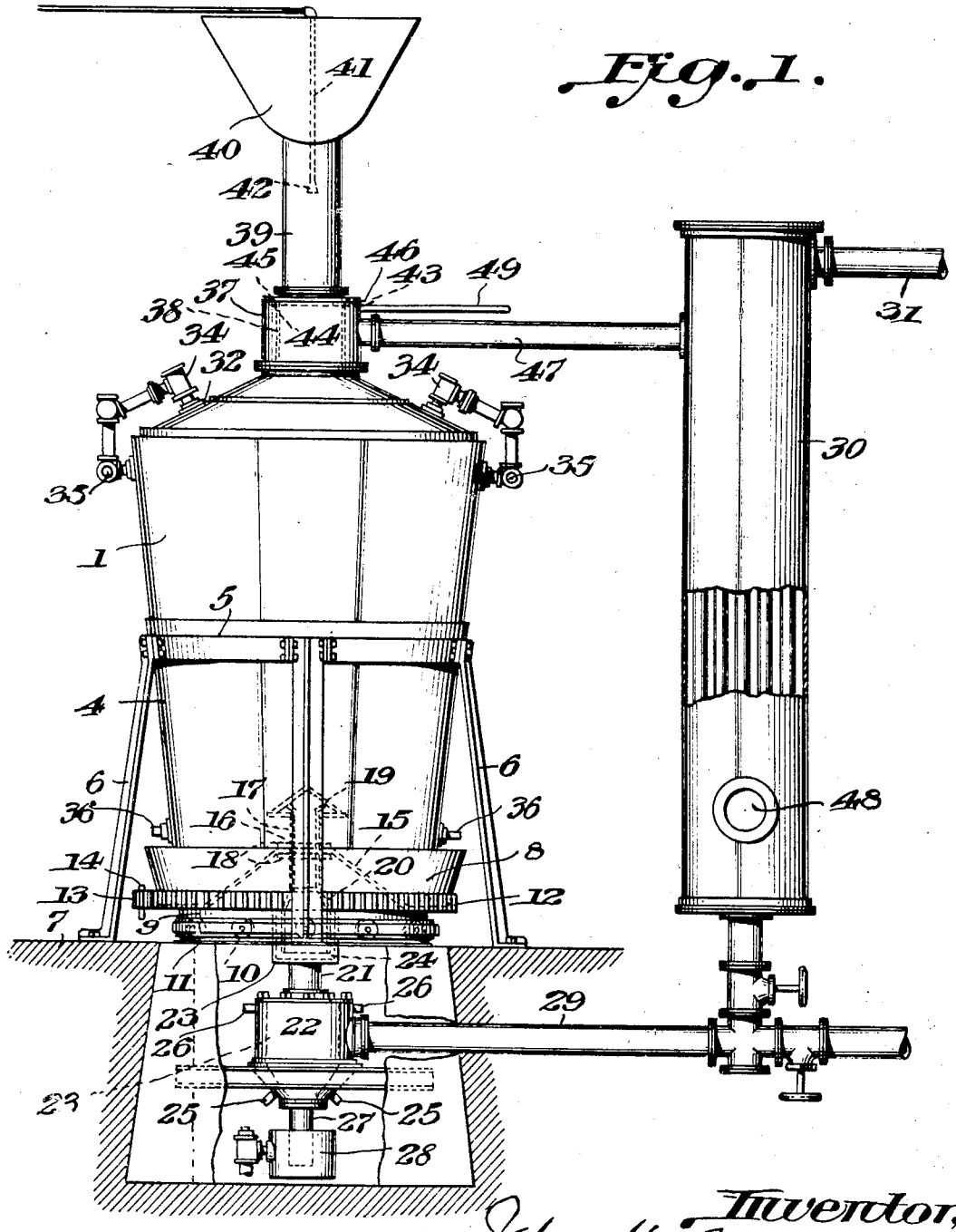


Fig. 1.

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Vernon E. Hodges
By his Atty.

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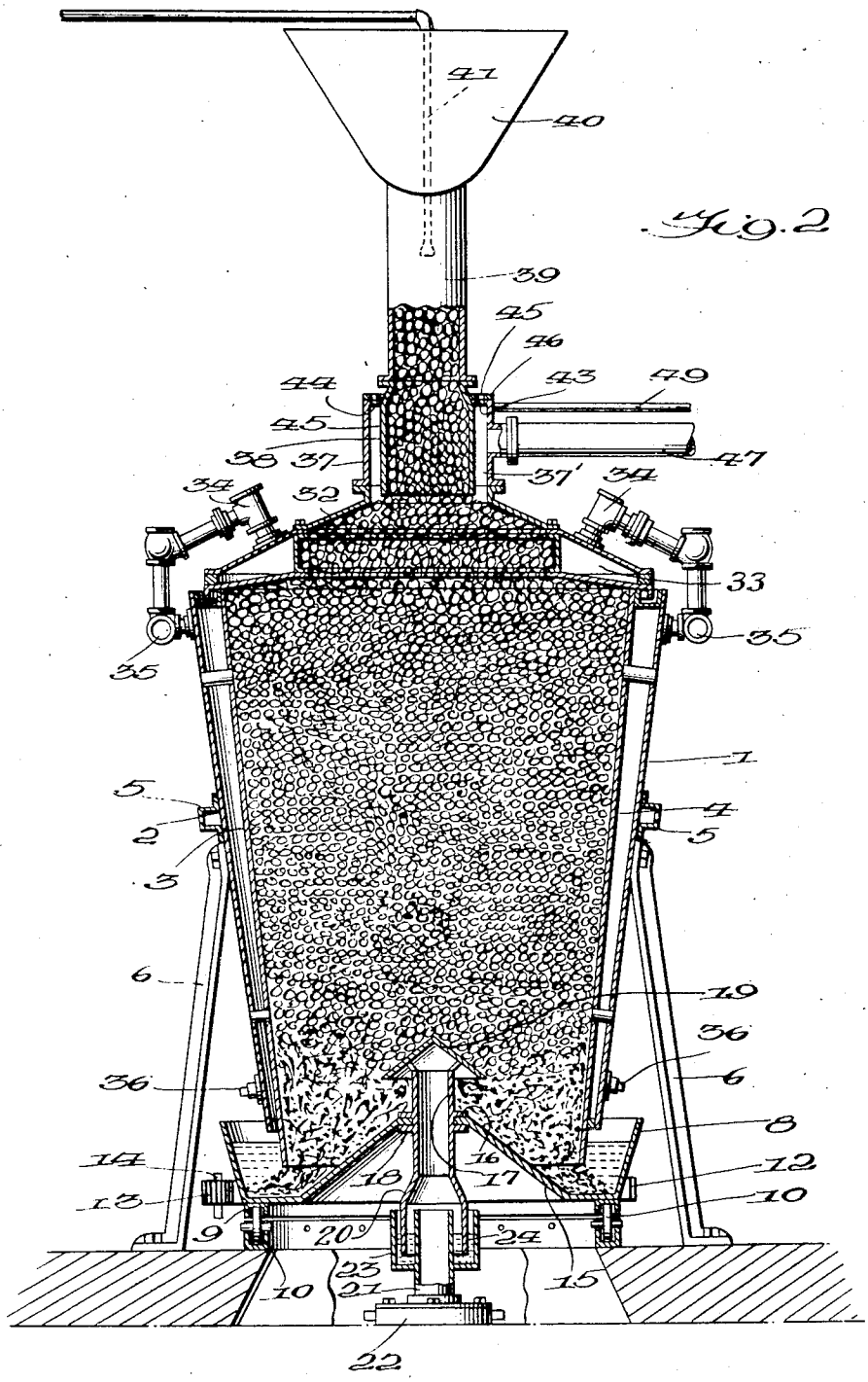


Fig. 2

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Fig. 5.

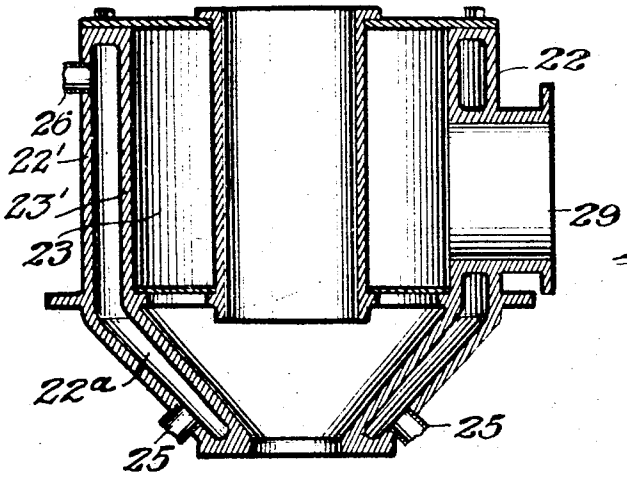


Fig. 4.

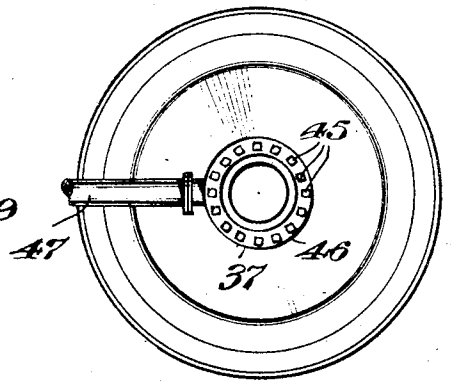
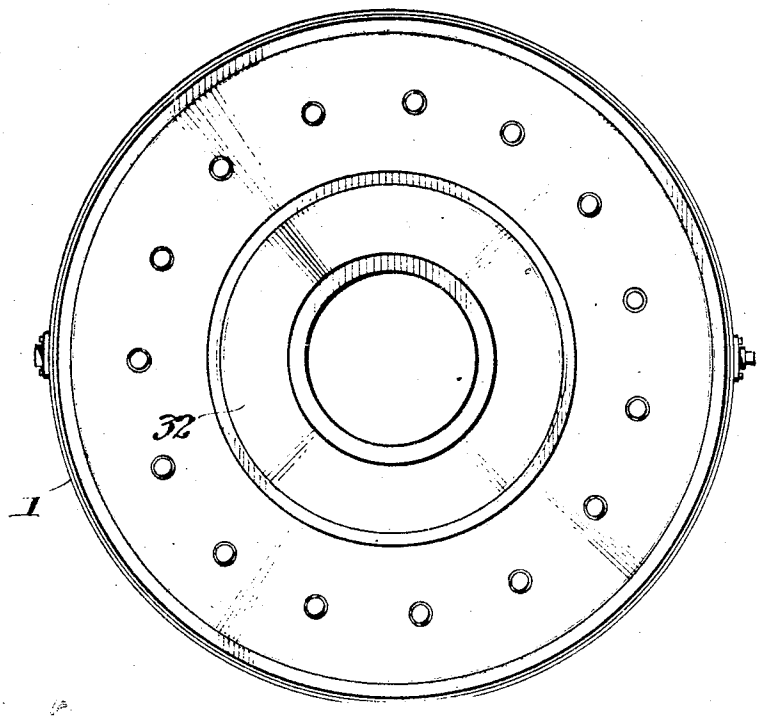


Fig. 3.



Inventor;
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Patented Mar. 31, 1931 1,798,617

UNITED STATES PATENT OFFICE

JOHN URBAN McDONALD, OF COLUMBUS, OHIO

GAS-PRODUCING APPARATUS

Application filed June 13, 1925. Serial No. 36,904.

This invention is a continuation in part of my prior application Serial No. 612,750, filed January 15, 1923, now Patent 1,771,133.

This invention relates to an improvement in producer gas making apparatus for manufacturing gas for power and heating purposes.

The object of my invention is to arrange the producer so that there is no intermittency of fuel admission thereinto. The fuel is fed into the producer in an unbroken column from some source of supply. This permits of using a continuous gravity feed, thus eliminating any mechanical means for feeding the fuel into the producer.

A further object of my invention is to permit the use of any carbonaceous gas making fuel, such for instance as any grade of fuel from vegetable or animal matter, to anthracite coal, and this fuel may be successfully gasified with this invention. Oil may be mixed with the other fuel for the purpose of enrichment, and thereby making a richer and more satisfactory gas than is ordinarily being done in the present producer gas practice.

A still further object of my invention is to cause a total gasification of all combustible constituents of the carbonaceous gas making fuel acted upon in one continuous operation without disturbing the reaction taking place in the producer by intermittently feeding the fuel.

The invention further provides for the generation of sufficient steam combined with a generation of gas to more than operate the entire gas producing plant.

The apparatus, by which these objects are obtained, consists in a double-shell gas producer into which the fuel is fed in an unbroken column, the space between the walls of the producer being provided for the admission of water to be generated into steam for use in operating the plant, and this steam may be piped to any desirable point. A revolving ash and water receptacle is provided for removing the ashes around the lower end of the producer, and said receptacle carries the outlet pipe for the gases, which pipe projects up into the producer and revolves with the water and ash receptacle so as to stir up or agitate the fuel in the producer. Suitable seal-pots are provided and connected with the outlet pipe for preventing the escape of the gas.

In the accompanying drawings:

Fig. 1 is a side elevation of the gas producing apparatus;

Fig. 2 is a vertical section through the producer;

Fig. 3 is a top plan view of the steam dome;

Fig. 4 is a top plan view of the air supply chamber; and

Fig. 5 is a vertical section through the water-cooled seal-pot.

The numeral 1 indicates the double shell gas producer having outer and inner shells 2 and 3 spaced apart to provide a space 4 therebetween. The producer is supported by means of a ring 5 surrounding the outer shell 2 and it is connected with and rests upon suitable supports 6, having their lower ends bolted to and supported upon the concrete foundation 7. The space 4 between the shells 2 and 3 is closed at the top and bottom, as shown in Fig. 2, to provide a closed circumferential water receptacle within this space.

The lower end of the producer is open, as shown in Fig. 2, and arranged beneath this lower end is a water and ash receptacle 8, provided on the lower side thereof with a circumferential groove 9, adapted to receive the rollers 10 supported and carried by the circular U-shaped member 11, which is suitably supported on the concrete foundation 7. This water and ash receptacle 8 is provided with a circumferential drive gear 12 adapted to mesh with and be driven by a driving pinion 13, mounted on the shaft 14, and driven by any suitable means, not shown, for rotating the receptacle 8. The lower end of the producer 1 is received within this water and ash receptacle 8 and the latter is filled with water to a sufficient height above the lower end of the shell 3 to effect a water-tight seal for the producer, thus preventing the escape of any gas through this outlet while yet permitting the ashes to be removed as they drop into the water and ash

receptacle 8. For this purpose, the upper side of the receptacle 8 is open. The water and ash receptacle 8 is provided with a cone-shaped center portion 15 sloping away from the center so as to direct the ashes away from the center and toward the outer edge of the receptacle 8, in order that they may be easily removed. This cone-shaped portion 15 extends upwardly to approximately the same height as the upper edge of the outer wall of the receptacle, in order to provide a circumferential trough for effecting the water-seal.

The cone-shaped center portion 15 is provided with a central opening 16 for receiving a gas outlet pipe 17. This outlet pipe 17 is provided with suitable flanges 18 for securing the outlet pipe to and supporting it upon the ash and water receptacle 8, so that it will be rotated with this receptacle. The upper end of the outlet pipe 17 is provided with a cone-shaped head or cover 19 to prevent dirt or ashes from dropping into the open end of the gas outlet pipe, while yet permitting the gas to pass into this pipe. The lower end of the outlet pipe 17 is provided with an enlarged portion 20. A pipe 21 is supported upon a water-cooled seal-pot 22 and extends upwardly therefrom having its upper end received in the enlarged portion 20 of the outlet pipe 17. A circumferential flange 23 extends outwardly and upwardly from from the pipe 21 surrounding the lower end of the enlarged portion 20. This flange 23 is spaced apart from the upper end of the pipe 21 providing an annular channel 24 between these members for receiving the lower end of the enlarged portion 20, of the pipe 17, and this channel 24 is partly filled with water to the proper height above the lower end of the enlarged portion 20, so as to provide a water-tight and flexible joint between the parts of the gas outlet pipe while yet permitting the pipe 17 to be rotated freely with the water and ash receptacle 8.

The water cooled seal-pot 22 receives the lower end of the outlet pipe 21 and this pipe opens into the chamber 23 in the seal-pot for discharging the producer gas thereinto. The seal-pot 22 is provided with double walls 22′ and 23′ having a space 22*a* therebetween for receiving the water from the lower water inlets 25, and water outlets 26 are provided at the upper end of this space in order to provide complete circulation of the water through the seal-pot, so as to properly cool the gas. A pipe 27 extends downwardly into an open seal-pot 28 partly filled with water to the height above the lower end of this pipe 27. A gas outlet pipe 29 extends from and communicates with the interior chamber of the seal-pot 22 and this pipe 29 leads to a tubular heat exchanger 30, as shown in Fig. 1, the upper end of which heat exchanger is provided with a suitable gas outlet pipe 31.

The producer 1 terminates at its upper end in a double walled steam-dome 32 provided with the space 33 between the walls of this dome for receiving water and generating the steam. Suitable outlet pipes 34 are provided for conveying the steam from this steam-dome 32 and these steam outlet pipes 34 communicate with the steam outlet pipes 35 extending from and communicating with the space 4 between the shells 2 and 3 for conveying the steam from this space as it is generated therein. Feed water inlet pipes 36 are provided at the lower end of the producer for feeding water into the circumferential steam generator provided by the space 4 between the shells 2 and 3.

The steam-dome 32 supports on its upper end a flanged bonnet 37 which communicates with the interior of the producer 1 through the open center of the steam-dome 32. Received in the upper end of the bonnet 37, is the enlarged lower end 38 of the feed pipe 39. The upper end of the fuel feed pipe 39 extends to and communicates with the fuel supply hopper or receptacle 40 from which the fuel is fed through the feed pipe 39 into the producer 1, thus providing a continuous uninterrupted feed. Arranged centrally of the hopper 40 is an oil supply pipe 41 provided with the oil spray 42 at its lower end for spraying oil into the fuel as it is fed downward through the feed pipe 39, so as to enrich the gas, if this is desirable.

The bonnet 37 is provided with an annular inturned flange 43 at its upper end for closing the annular space or air chamber 37′ between the enlarged end 38 of the feed pipe and the wall of the bonnet 37. The flange 43 is provided with a plurality of openings 44 which are adapted to register with openings 45 in the rotatable damper ring 46, seated upon the upper end of the bonnet 37 for controlling the inlet of cold air into the producer to temperate the warm air drawn into the bonnet 37.

Extending laterally from the bonnet 37 is a hot air inlet pipe 47 leading to the heat exchanger 30 by which means additional air may be injected into the producer, the said heat exchanger 30 being provided with an air inlet 48 at its lower end. Extending laterally from the bonnet 37 is a steam inlet pipe 49.

In operation, the producer is kept constantly full of fuel and a column thereof extends upwardly to any desired height in the feed pipe 39 and hopper 40, this hopper preferably being kept full so as to provide an absolutely constant uninterrupted passage of fuel into the producer, in order that the gasification taking place within the producer is never disturbed by any intermittent feed-

ing of the fuel. It is understood that the partial combustion of the fuel takes place directly within the producer itself and as the fuel is fed down into the producer, it is burned and the ashes fall into the ash receptacle 8 from which they may be removed. The air required to support partial combustion within the producer is drawn in at the top through the hot-air inlet pipe 47 and the cold-air ports 44 and 45, the partial combustion of fuel taking place at this point. Since the walls of the producer are provided with a water receptacle therein, the fuel will not stick to these side walls because the temperature of the iron shell 3 on the inside of the producer and next to the hot fuel cannot rise much higher than the temperature within the water receptacle and steam generator 4, when under a definite pressure. This being true, the fuel in the producer works downwardly in a steady and constant manner because of its not being obstructed, which is a necessary requirement in the production of uniform gas. A sufficient amount of steam may be taken from the steam generator 4 and the steam-dome 32 through the pipes 34 and 35, to more than operate the entire plant and this steam may be used for any purpose desired.

The gases are drawn downwardly from the bed of hot fuel and also through the ashes at the bottom, constituting a breaking up and purifying of all the combustible constituents acted upon. These gases are drawn off through the gas outlet pipe 17 from the center of the producer from where they pass into the seal-pot 22 and through the outlet pipe 29 into the tubular heat exchanger 30, passing through the pipe 31 to a suitable storage tank. The water seals maintained between the pipes 17 and 21 and between the lower end of the producer 1 and the receptacle 8 prevent the escape of any gases at these points. Since the outlet pipe 17 with its conical head 19 rotates with a continuous rotation of the water and ash receptacle 8, this outlet pipe 17 serves as an agitator for the fuel in the producer preventing it from stopping up, which is a very necessary requirement in operation and this agitating of the fuel increases the value of the producer gas as it is drawn off from the producer.

It will thus be seen that this invention provides for the destructive distillation of all of the combustible constituents of carbonaceous matter, leaving no resultant by-products or residue other than the ash content of the fuel. All the troublesome tarry content of the fuel gasified is converted into a fixed and permanent producer gas by being drawn downwardly through an incandescent bed of carbon which makes it possible to use any kind of carbonaceous material. Oil may be added to the other fuel if desirable and it produces a richer gas than other ordinary fuel. The fuel, being fed into the producer in a continuous unbroken column from a superimposed source of supply to the ash receptacle at the lower end of the producer, moves downwardly in proportion to the rate at which it is converted into gas and this gas is removed from the producer through a centrally located off-take pipe provided with a revolving cone-head, which serves to prevent the dirt from entering the pipe and agitates the fuel sufficiently to keep it moving downward.

Producer gas is thus produced by taking air into the producer by sufficient quantities to maintain the required temperature and to convert the fuel into a combustible gas. The resultant gas is of a lean quality because of the fact that it carries with it a high percentage of nitrogen which is separated from the oxygen upon entering the hot fuel bed and introduced by the admitted air. Consequently, the use of producer gas is limited to industrial purposes, such as heating furnaces and running gas engines.

I claim:

1. A gas producing apparatus including a gas producing chamber, a bonnet supported on said producer, a fuel feed pipe extending into said bonnet, and spaced apart from the walls thereof, said bonnet having an inturned flange between the walls of the bonnet and the feed pipe, and a damper ring seated upon said flange about the feed pipe, said flange and damper ring having openings therein in position to register with each other.

2. A gas apparatus comprising a vertical producer having its lower end open, a fuel feeding chamber above said producer having an annular air chamber arranged around the lower end thereof, a charging chamber arranged above said feeding chamber, an ash receptacle beneath said producer and adapted to receive the lower open end thereof, a gas off-take pipe arranged centrally of the lower end of said retort, a tubular heat exchanger in communication with said gas off-take pipe, and a hot air conduit leading from said heat-exchanger to said annular air-chamber.

3. A gas apparatus comprising a vertical producer having its lower end open, a fuel feeding chamber above said producer, having an annular air chamber arranged around the lower end thereof, a charging chamber arranged above said feeding chamber, a rotatable ash-receptacle arranged beneath the lower open end of said producer, the central portion thereof being conical and adapted to project inwardly into said retort, a gas off-take arranged centrally of said gas receptacle and adapted to project inwardly into said producer, and a deflector mounted on the upper end of said gas off-take.

4. A gas apparatus comprising a vertical producer having its lower end open, a fuel

feeding chamber above said producer, a charging chamber arranged above said feeding chamber having an annular air chamber arranged around the lower end thereof, a rotatable ash-receptacle arranged beneath the lower open end of said producer, the central portion thereof being conical and adapted to project inwardly into said retort, a gas off-take arranged centrally of said gas receptacle and adapted to project inwardly into said producer, a deflector mounted on the upper end of said gas off-take, a heat exchanger in communication with said gas off-take pipe, a hot air inlet leading from said heat-exchanger to said air chamber above said producer, and means for controlling the admission of atmospheric air to said chamber.

5. A gas apparatus comprising a vertical producer having its lower end open, a fuel feeding chamber above said producer, a charging chamber arranged above said feeding chamber, having an annular chamber arranged around the lower end thereof, an ash receptacle beneath said producer and adaped to receive the lower open end thereof, a gas off-take pipe arranged centrally of the lower end of said producer, a tubular heat exchanger in communication with said gas-off-take pipe, and a hot air conduit leading from said heat exchanger to said annular air-chamber, said annular air-chamber having a plurality of controlled inlets at the upper end thereof for controlling the admission of atmospheric air to said chamber.

6. A gas producer including a gas producing chamber, means for feeding fuel in a continuous gravity-controlled, uninterrupted column into and through the chamber, said means maintaining said column uninterrupted and continuous for a substantial distance from the chamber so that any disturbance by the addition of fuel thereto will not be communicated to the chamber, hood means extending upwardly into the lower portion of the fuel bed for agitating the fuel bed within the chamber to cause a continuous downward feeding thereof upon combustion, means for admitting air to the top of said producer, and means for withdrawing the liberated gases from the lower portion of said producer.

7. A gas producing apparatus including a stationary gas producing chamber having the lower end thereof open, means for feeding fuel to said gas producing chamber, an ash and water receptacle arranged beneath the gas producing chamber for receiving the lower end thereof and for receiving the ashes therefrom, said receptacle being adapted to contain a liquid to a height above the lower end of the gas producing chamber for preventing the escape of gas through said receptacle, means for rotating said ash and water receptacle relative to the gas producing chamber, a gas outlet pipe supported by and rotated with the ash and water receptacle for agitating the fuel within the gas producing chamber, and a flexible water-sealed joint arranged within portions of the gas outlet pipe.

8. A gas producing apparatus including a stationary gas producing chamber having the lower end thereof open, means for feeding fuel to said gas producing chamber, an ash and water receptacle arranged beneath the gas producing chamber for receiving the lower end thereof and for receiving the ashes therefrom, said receptacle being adapted to contain a liquid to a height above the lower end of the gas producing chamber for preventing the escape of gas through said receptacle, means for rotating said ash and water receptacle relative to the gas producing chamber, a gas outlet pipe supported by and rotated with the ash and water receptacle for agitating the fuel within the gas producing chamber, and a water-cooled seal-pot for the gas outlet pipe.

In testimony whereof I affix my signature.

JOHN URBAN McDONALD.