H. F. WALLMANN.

GAS GENERATING APPARATUS.

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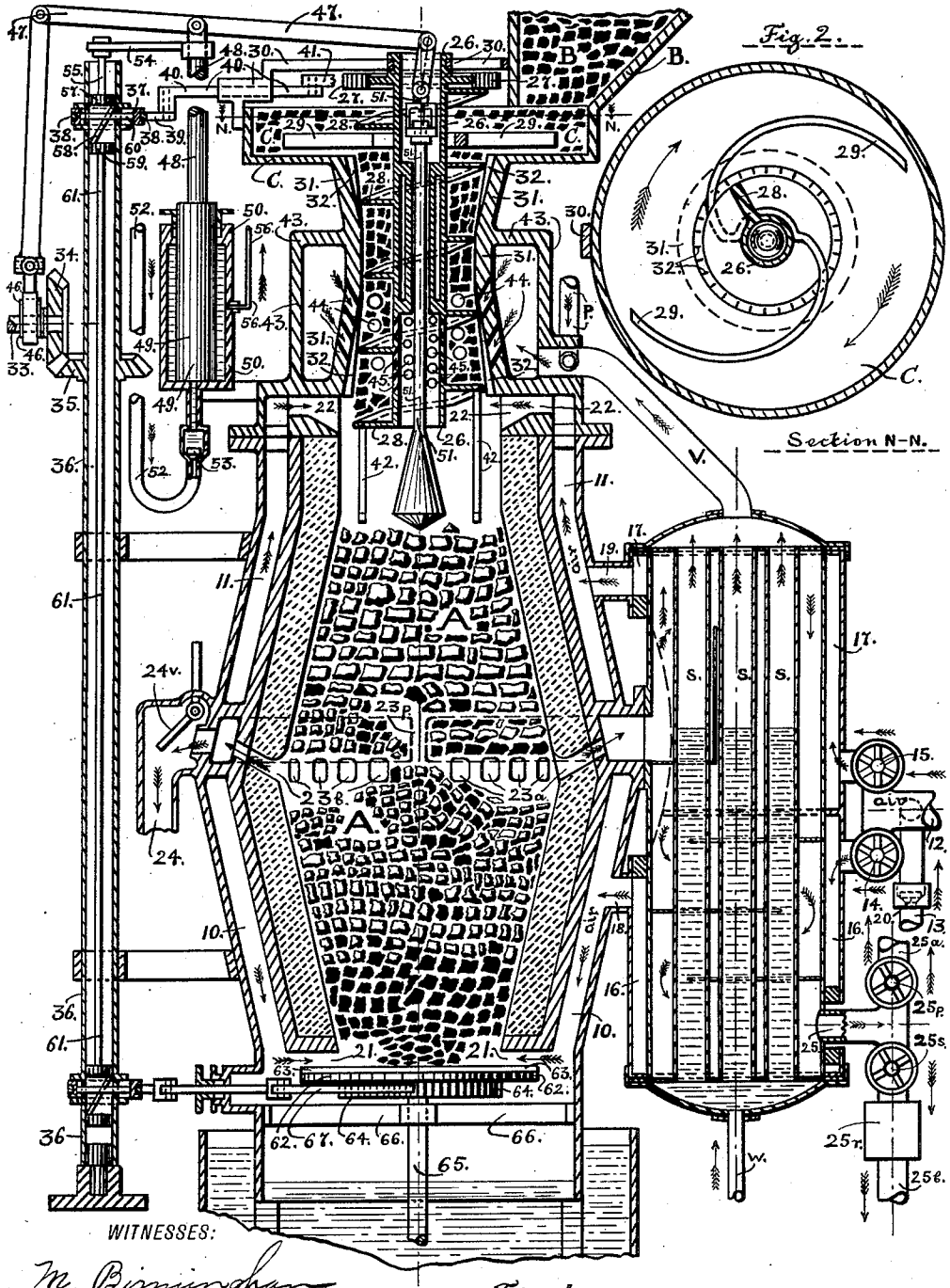

Fig. 1.

Fig. 2.

Section N-N.

WITNESSES:

M. Birmingham

F. Sumner

INVENTOR:

Henning Friedrich Wallmann.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HENNING FRIEDRICH WALLMANN, OF CHICAGO, ILLINOIS.

GAS-GENERATING APPARATUS.

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To all whom it may concern:

Be it known that I, HENNING FRIEDRICH WALLMANN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Generating Apparatus, of which the following is a description, reference being had to the accompanying drawing, forming a part of this specification, in which corresponding letters and numerals of reference in the different figures indicate like parts.

My invention relates to gas-generators in which two air-currents, an up-current and a down-current are employed for generating by a continuous process out of coal or out of other carbonaceous fuel a fixed, permanent and substantially uniform gas; the down-current being employed for carrying the evaporated volatile parts of the fuel into the incandescent body of the residue thereof, the incandescent carbon or coke, for destroying the evaporated tar, ammonia and other condensable vapors; the up-current being employed for consuming the said incandescent residue, the left carbon or coke, by converting the same into carbon-monoxid; and the objects of my improvements are, first, to store the bulk of the solid fuel to be gasified at such a distance from the location of the hot process of making gas as prevents a considerable heating and the results thereof as baking and clogging of the said bulk of solid fuel, until the latter is gradually delivered from the location of its storage to the location of its gasifying; second, to provide mechanical means for gradually delivering the said solid fuel, preferably through a conduit, from its place of storage to its place of gasifying, at the same rate at which the solid fuel is consumed by the process of gasifying; third, to heat the solid fuel during a part of the time of its transportation through the said conduit, preferably by means of superheated steam, in order to evaporate a part of its volatile substance; fourth, to interpose a closed air-space at the end of the said conduit for burning the said evaporated part of the volatile substance of the fuel by means of entering air in order to furthermore heat the solid fuel and to evaporate the rest of the volatile substance contained therein; fifth, to adapt the gas-generator to a difference between the air-pressures within and without the vessel employed for gasifying the solid fuel, preferably in such a way that the air-pressure within the said vessel may at times be lower and at other times be higher than the pressure of the atmosphere, or in other words, to construct a gas-generator which can be operated at times by suction and at other times by pressure; sixth, to provide the gas-generator with separate gas-outlets for gas to be used under lower and for gas to be used under higher pressure and preferably also for gas to be used at a lower and for gas to be used at a higher temperature, and to adapt the gas-generator to a simultaneous delivery of gas under a higher and of gas under a lower pressure and preferably also of gas at a higher and of gas at a lower temperature through separate gas-outlets; seventh, to provide the gas-generator with a mechanical contrivance adapted to deliver portions of solid fuel to different places of the surface of a fuel-bed in succession and repeatedly, and with such time-intervals between the repetitions that the volatile substance contained in a certain portion of fuel delivered to the fuel bed is perfectly evaporated by the heat of the surroundings before a new portion of fuel is delivered to the same place; eighth, to provide the gas-generator with a mechanical contrivance for automatically controlling the fuel-supply and preferably also for automatically controlling the discharge of the ashes and cinders; and ninth, to provide the gas-generator with a screw-conveyer adapted to gradually deliver solid fuel into a vessel for gasifying the same, with spiral or involute catch-arms adapted to gradually promote solid fuel from its storage-place to the said screw-conveyer and to gradually cram the said fuel into the latter, and with a rotary plate having spiral or involute-shaped ribs on top and being adapted to gradually remove the ashes and cinders from the vessel used for gasifying solid fuel.

The principle of the fuel-supply will be understood from the following: Assuming that a 100 horsepower-gas-engine requires per hour the amount of gas that can be generated out of 120 pounds of bituminous coal or out of one and a half cubic feet, and that on account of the temperature prevailing at the surface of the fuel-bed 15 minutes are

required for perfectly evaporating the volatile substance contained in a layer of bituminous coal which is placed one and a half inches thick on the surface of the fuel-bed. Then the screw-conveyer has to make four revolutions per hour, and the diameter of the upper surface of the fuel-bed has to be about two feet for generating in the fuel-bed the amount of gas consumed per hour by a gas-engine of about 100 horsepower. As the process of evaporating is already started, when the fuel is yet within the screw-conveyer, the total time of the process of evaporating the volatile substance contained in a certain portion of the fuel is more than twice 15 minutes in the above instance, which makes it evident that the fuel is effectively prevented from impeding the flow of the down-current of air and gases through the fuel-bed by baking and clogging.

If each layer of fuel is thinner than 1½ inches as assumed in the above instance, then the period of evaporating becomes shorter, the screw-conveyer can make more revolutions per hour, and the whole apparatus can be made smaller, but the pieces of coal have to be crushed to a smaller size.

Like numerous other gas-producers this gas-generator cannot well be operated without means for producing an air-current. The suction-power of a gas-engine or of a fan or gas-compressor may be used for drawing the gas past a cooling-apparatus out of the gas-generator, thus causing a partial vacuum therein and drawing thereby the air from the atmosphere through the fuel. But in the case that a part or all of the gas is to be used in a hot state and if a suction-apparatus cannot conveniently be applied to the gas or to the products of combustion thereof, then I prefer to promote the process of gasifying by means of compressed air delivered into the gas-generator. This will be fully explained further below.

In the drawing Figure 1. is a vertical section through the main parts of the gas-generator, and Fig. 2. is a horizontal section at the line N—N.

A is a vessel for gasifying solid fuel, lined with fire-proof material in the shape of a hollow double-cone inclosed by air-jackets 10 and 11, each adapted for the passage of an air-current, one for an up-current in the fuel-bed, the other for a down-current therein, and both communicating with the air-supply-pipes 12 and 13 through the valves 14 and 15, the air-jackets 16 and 17 and the conduits 18 and 19 respectively. Whenever the gas-generator is operated by suction, the air enters through the pipe 13 which is provided with a check-valve 20 preventing an escape of air through the pipe 13 in the case and as soon as the gas-generator is operated by air under pressure entering through the air-supply-pipe 12. From the air-jackets 10 and 11 the air flows through openings 21 and 22 respectively into the bottom and into the top of the vessel A and after passing through the incandescent solid fuel therein enters into openings 23^a or 23^b or 23^a and 23^b communicating with the gas-discharge-pipes 25 and 24 respectively. The discharge-pipe 24 is provided with a check-valve 24^v which may be operated at will by means of a handle or automatically by means of air-pressure. The discharge-pipe 25 has two branches 25^a and 25^b provided with valves 25^p and 25^s respectively, and the discharge-pipe 25^b besides provided with the pressure-reducing-valve 25^r. The discharge-pipe 24 is used for the delivery of hot gas, for directly heating a boiler for instance, and the discharge of the gas may be effected by pressure of the air entering through the pipe 12 or by suction of the products of combustion in the flue of the boiler. The gas discharged by the pipes 25^a and 25^b imparts, on its way from the holes 23^a, its heat to the water and steam contained in the boiler-tubes S, S, S, and to the air contained in the air-jackets 17 and 16. Whenever the gas-generator is operated by suction-power, for instance by the suction-power of a gas-engine, the gas is discharged through the pipe 25^b. The pressure-reducing valve 25^r is so adjusted as not to impede the flow of the gas in this case. But whenever the gas-generator is operated by compressed air entering through the pipe 12, the pressure-reducing-valve 25^r impedes the flow of the gas to such extent that it is delivered through the pipe 25^b with the same pressure as if the gas-generator would be operated by suction. Cold gas under pressure is discharged by the discharge-pipe 25^a.

In the case that the gas-generator is operated by suction, and the check-valve 24^v is left open by neglect or is not tight for other reasons, a partition 23^p prevents any air that enters the pipe 24 from flowing to the exhaust-pipe 25 without passing through the incandescent fuel in the vessel A and without that its oxygen is combined with the carbon of the fuel. W is the water-feed-pipe for the boiler-tubes S, S, S, and V is the delivery pipe for the superheated steam therefrom.

B is the magazine for solid fuel, and is placed above the circular vessel C which is provided in its center with a rotary pipe 26 carrying on its outside the ratchet-wheel 27, the screw 28, the spiral or involute catch-arms 29 and being journaled in the bracket 30. The pipe 26 and the screw 28 are surrounded farther below by the circular vessel 31, the upper and lower ends of which are preferably tapered and provided with vertical ribs 32 as indicated in the drawing. These ribs 32 may be provided in order to prevent a rotation of the fuel in connection

with the rotating screw 28. A shaft 33, being in operative connection with any suitable prime-mover, rotates the bevel-gear-wheels 34 and 35, the pipe 36 and the eccentric 37, thereby reciprocating the eccentric-strap 38, the connecting-rod 39, the stem 40 and the pawl 41, and rotating thereby the ratchet-wheel 27, the pipe 26, the screw 28 and the catch-arm 29, thereby cramming the solid fuel from the magazine B into the vessel and conduit 31 and gradually conveying the same to the top of the vessel A from where it drops through an air-space on the surface of the fuel-bed in the vessel A. The fuel, in being crammed into the conduit 31, prevents at the same time any considerable amount of air to pass through the conduit 31, although there may exist a considerable difference between the pressure of the atmosphere and the air-pressure within the vessel A. Rods 42 may be fastened to and rotate with the lower end of the screw-conveyer 28, and may extend through the air-space below, in order to stir the surface of the fuel-bed. The lower part of the conduit 31 is surrounded by a steam-jacket 43 communicating through the pipe V with the boiler-tubes S, S, S. Holes 44 may lead the superheated steam from the steam-jacket 43 into the interior of the conduit 31, and holes 45 may lead the steam and the generated vapors out of the fuel into the interior of the pipe 26, from where these fluids enter into the air-space below the screw-conveyer, burn with the warm air issuing from the holes 22, and evaporate by the heat generated the rest of the volatile substance contained in the fuel that is delivered on top of the fuel-bed in the vessel A. In order to improve the gas, liquid fuel, like crude-oil, may be introduced by the pipe P into the superheated steam within the pipe V or within the boiler-tubes S, S, S.

The plunger 49, movable in the cataract-cylinder 50, supports pivotally by means of its stem 48 a lever 47 at a suitable point between its two ends, one of which is in suitable operative connection with the eccentric 46 fastened on the shaft 33, and the other one of which is in suitable operative connection with the rod 51 extending through the pipe 26 down to the surface of the fuel-bed in the vessel A. The lower end of the rod 51 is preferably reinforced or provided with a disk or head affording a bearing when in touch with the surface of the fuel-bed. On account of the motion of the eccentric 46 the rod 51 moves up and down, leaving the plunger 49 at rest as long as the movement of the rod 51 is not impeded by the fuel below. As soon however as the screw-conveyer delivers more fuel than is consumed by the air-drafts in the fuel-bed and as soon as in consequence thereof the level of the surface of the fuel-bed rises above the lower limit of the movement of the rod 51, or, in other words, as soon as the rod 51 is prevented by the fuel to perform its normal down-stroke, the eccentric 46 lifts the plunger 49 instead of pushing down the rod 51, thereby drawing a suitable liquid through the pipe 52 and the check-valve 53 into the cylinder 50, raising the arm 54 with the rod 55 and in reducing the eccentricity of the eccentric 37 decreasing the length of the stroke of the pawl 41, and simultaneously, in decreasing the rotary speed of the catch-arms 29 and of the screw-conveyer 28, reducing the amount of fuel delivered during each unit of time, until a greater amount of fuel is consumed. Then, when the rod 51 can reoccupy its normal position, the plunger 49 drives the surplus-liquid slowly out of the narrow pipe 56 and also reoccupies with the arm 54, the rod 55 and the eccentric 37 a normal position. The latter eccentric 37 has the shape of a ring of which two opposite sides are connected by a horizontal rod 60 passing through the center of the ring and of the pipe 36 and having an inclined hole fitting to the inclined rod 58 which passes through the said inclined hole and which by being rigidly connected to the small pistons or better called guides 57 and 59 and thereby to the rods 55 and 61 is adapted to cause by its own vertical motion a horizontal movement of the rod 60 and of the eccentric 37 and to change the eccentricity and thereby the length of the stroke of the pawl 41.

A rotary, horizontal, circular plate 62 is placed below the lower end of the vessel A. The plate is provided at its upper side with ribs 63 of a shape similar to the spiral or involute catch-arms 29 shown in Fig. 2 with the exception that the curves are turned in opposite direction, if the plate 62 revolves in the same sense as the catch-arms 29, as indicated in Fig. 2. The plate 62 is provided at its bottom-side with the ratchet-wheel 64 and is supported by the shaft 65 being journaled in the bracket 66. The ratchet-wheel 64 is operated by the pawl 67 which in turn is in operative connection with the rotary pipe 36 in a similar way as is shown and described above with reference to the pawl 41. The contrivance for automatically regulating the fuel-supply, also automatically regulates the discharge of the ashes from the lower part of the vessel A into the water below which closes the lower end of the whole apparatus. It will be understood that there is a certain ratio of the amount of fuel to be supplied into, to the amount of ashes to be discharged from the vessel A, and the mechanical arrangement has to be constructed accordingly. But a universal rule for accomplishing this does not exist, because the ratio of the amount of ashes to the amount of fuel

depends on the nature of the fuel used in each case.

In cases in which a water-seal is not convenient, a horizontal screw-conveyer may be used for removing the ashes out of the vessel A.

The boiler construction is preferably of the water tube type. The water tubes S, S are surrounded by a cylindrical shell through which flow the hot gaseous products of the gas producer, and by two air jackets 16 and 17 for preparatorily heating the air used for the partial combustion of the fuel in the lower and the upper combustion zones or in these combustion chambers respectively of the gas producer. The upper part of the water tubes is filled with steam, and the hot gaseous products of the producer proper are conducted by suitable guide or baffle plates into contact with the steam containing part of the tubes S, S, before they touch the lower part of the tubes containing water. In this way the steam is superheated to a temperature sufficiently high for effectively distilling the fuel in the conduit 31, as it will be remembered that an effective distillation of bituminous coal begins at the temperature of boiling water under the pressure of the atmosphere, 100° C.

The apparatus operates as follows: A fire is kindled on top of the rotary plate 62, the gaseous products of combustion escaping through the opening 23^b, the pipe 24, and preferably through a chimney into the atmosphere; and in the beginning of the operation a quantity of coke or anthracite coal is put into the magazine B. As soon as the fire on the plate 62 is sufficiently developed, the shaft 33 is connected to a source of power for rotating the miter gears 34 and 35, the hollow shaft 36, the eccentric 37, and for thereby reciprocating the pawl 41, which rotates in turn the ratchet gear 27, the tube 26, and catch-arms 29 and the screw 28. Coke or anthracite coal is now delivered into the gas producer A until the fuel bed has attained its normal height and until the pusher 51 touches the top of the fuel bed and automatically regulates the fuel supply by its action on the variable eccentricity of the eccentric 37. In the beginning the air inlet valve 15 may be closed and the air draft may be reinforced by means of an exhauster or ventilator. As soon as the lower part of the fuel bed is incandescent, the valve 15 may be opened, and as soon as in consequence the upper part of the fuel bed has become incandescent, the apparatus delivers combustible gas, and the magazine B may be supplied with bituminous coal or other hydro-carbonaceous matter, which will be distilled by the generated superheated steam, and the condensable distillates be destroyed in passing through incandescent anthracite coal or incandescent residue of distillation. The resulting gas, especially if to be used in internal combustion engines, is cleaned and possibly stored by well known methods.

Claims—

1. In a gas-producer, a producer-shaft, a retort, a chamber for a hot fluid partly inclosing the said retort, a canal with a perforated wall inside of and communicating with the said retort, and an extension of the said canal to the outside of the said retort for the discharge of distillates thereform.

2. In a gas-producer, a producer-shaft, a retort, a chamber for a hot fluid partly inclosing the said retort, an outlet for residue of distillation from the said retort toward the said producer-shaft, a canal with perforated wall inside of and communicating with the said retort, and an extension of the said canal through the said outlet to the outside of the said retort for the discharge of distillates.

3. In a gas-producer, a combustion-chamber, a retort, a chamber for a hot fluid partly inclosing the said retort, a source of steam, a canal with perforated wall inside of the said retort and communicating therewith and with the said source of steam, and an extension of the said canal outside of the said retort for the discharge of steam and distillates.

4. In a gas-producer, a combustion-chamber, a magazine for fuel above the said combustion-chamber, a distillation-conduit connecting the said magazine to the said combustion-chamber, a chamber for a hot fluid partly inclosing the said conduit, and a fuel-feeder adapted to be continuously in operation for retarding the fall of the fuel from the said magazine through the said conduit toward the said combustion-chamber and for maintaining a cavity free of solid fuel for the discharge of distillates in the path of the fuel and in a location intermediate between the fuel-bed within the said magazine and the fuel-bed within the said combustion-chamber.

5. In a gas generating apparatus a combustion chamber for gasifying solid fuel, a source of motion, a reciprocating pusher in the upper part of the said combustion chamber, a hydraulic cataract, and a lever pivotally connected to the piston of the said hydraulic cataract and in operative connection with the said source of motion and with the said reciprocating pusher for periodically exerting a limited pressure on the fuel in the said combustion chamber.

6. In a gas generating apparatus, a magazine for storing solid fuel, a producer shaft for gasifying solid fuel, a conduit for fuel, a mechanical contrivance adapted to convey fuel from the said magazine through the said conduit toward the said producer shaft, a mechanism for regulating the speed of the said mechanical contrivance, and a

movable pusher in connection with the said mechanism and adapted to periodically exert a pressure on the fuel bed in the said producer shaft.

7. In a gas generating apparatus, a magazine for storing solid fuel, a combustion chamber for gasifying solid fuel, a screw conveyer for transporting solid fuel from the said magazine toward the said combustion chamber, a mechanism for regulating the speed of the said screw conveyer, and a reciprocating pusher in connection with the said mechanism and adapted to periodically exert a pressure on the fuel bed in the said combustion chamber.

8. In a gas-producer, a combustion-chamber, a magazine for fuel above the said combustion-chamber, a substantially vertical distillation-conduit connecting the said magazine to the said combustion-chamber, a chamber for a hot fluid partly inclosing the said conduit, and a screw-conveyer adapted to continuously retard the fall of fuel within the said conduit and to maintain a cavity free of solid fuel for the discharge of distillates in the path of the fuel from the said magazine toward the fuel-bed within the said combustion-chamber.

9. In a gas producer, a conduit for conveying and heating solid fuel, a down-draft gas-generating chamber communicating with the said conduit, a heating chamber partly inclosing the said conduit, a passageway for gaseous fluid within the said conduit and leading toward the said gas-generating chamber, and a wall constructed to impede an entrance of solid fuel from the said conduit into the said passageway.

10. In a gas producer, a metal-walled conduit for conveying and heating solid fuel, a down-draft gas-generating chamber with wall of refractory material and communicating with the said conduit, a heating chamber partly inclosing the said conduit, a passageway for fluid within the said conduit and leading toward said gas generating chamber, and a wall constructed to prevent an entrance of solid fuel from the said conduit into the said passageway.

11. In a gas producer, a conduit for conveying and heating solid fuel, a heating chamber partly inclosing said conduit, a gas generating chamber below and communicating with the said conduit, a passageway for fluid above the said gas generating chamber, a movable wall of the said passageway constructed to agitate solid fuel within the said conduit and provided with a lower aperture near the upper part of the said gas generating chamber for the passage of fluid, and means for moving said wall.

12. In a gas producer, a distillation conduit for conveying and distilling fuel, a heating chamber partly inclosing the said conduit, a down-draft gas generating chamber below and communicating with the said conduit, a discharge canal for distillates within and communicating with the said conduit and leading toward the said gas-generating chamber, and an inlet for fluid in communication with the said canal and constructed to mix said fluid with distillates from the said conduit.

13. In a gas producer, a retort, a screw conveyer within the said retort, and a hollow spindle of the said screw conveyer provided with apertures for a passage of gaseous fluid.

14. In a gas producer, a combustion chamber, a magazine for solid fuel, a retort connecting the said magazine to the said combustion chamber, a chamber for a hot fluid partly inclosing the said retort, a screw conveyer within the said retort, a hollow spindle with perforated wall of the said screw conveyer for a passage of gaseous fluid, and an arm in rigid connection with the said spindle and constructed to break the residue of distillation near the discharge end of the said retort.

15. In a gas generating apparatus a distillation chamber for distilling fuel, a producer shaft for gasifying residue of distillation, a chamber for gaseous fluid between the said distillation chamber and the said producer shaft, a catch arm rotary on a vertical pivot, and a vertical screw conveyer in conjunction with the said catch arm for transporting fuel through the said distillation chamber and through the said chamber for gaseous fluid into the said producer shaft.

16. In a gas-generating apparatus, a magazine for fuel, a distillation-conduit for distilling fuel, a combustion-chamber for consuming residue of distillation, a chamber for gaseous fluid at the oulet of the said distillation-conduit and above the said combustion-chamber, a perforated tube in the said distillation-conduit for discharging distillates therefrom, and a screw-conveyer surrounding the said perforated tube for transportating fuel from the said magazine through the said distillation-conduit into the said chamber of gaseous fluid.

17. In a gas-generating apparatus, a magazine for fuel, a distillation-conduit for distilling fuel, a combustion-chamber for consuming residue of distillation, a perforated tube in the said distillation-conduit for discharging distillates therefrom, a screw-conveyer surrounding the said perforated tube for transporting fuel from the said magazine through the said distillation-conduit, and a mechanism for automatically maintaining a substantially constant height of the fuel-bed in the said combustion-chamber.

18. In a gas-generating apparatus, a

magazine for fuel, a vertical distillation-conduit for distilling fuel, a combustion-chamber for consuming residue of distillation, means for transporting fuel in horizontal direction, a vertical perforated tube in the said distillation-conduit for delivering distillates therefrom, and a screw-conveyer surrounding the said vertical tube for transportating fuel through the said distillation-conduit.

19. In a gas-generating apparatus, a magazine for fuel, a producer-shaft below the said magazine for gasifying fuel, a mechanical fuel-feeder for feeding fuel from the said magazine into the said producer-shaft, a regulator for automatically maintaining a substantially constant height of the fuel-bed in the said producer-shaft, a rotary poker-rod for stirring fuel in the said producer-shaft, and a reciprocating mechanical feeder in operative connection with the said regulator.

20. In a gas-producer, a combustion-chamber, a magazine for fuel, a distillation-conduit connecting the said magazine to the said combustion-chamber, a screw-conveyer within the said conduit, and a steam-jacket partly inclosing the discharge end of the said conduit.

21. In a gas-producer, a combustion-chamber, a magazine for fuel, a distillation-conduit connecting the said magazine to the said combustion-chamber, a screw-conveyer within the said conduit, a steam-jacket partly inclosing the discharge-end of the said conduit, and a communication through a perforated wall between the said conduit and the said steam-jacket.

22. In a gas-producer, a combustion-chamber, a retort, a source of steam, an outlet for residue of distillation from the said retort toward the said combustion-chamber, a discharge-canal with perforated wall located in the interior of the said retort and in communication therewith and with the said source of steam, and an extension of the said canal through the said outlet to the outside of the said retort for the discharge of steam and distillates.

23. In a gas-producer, a producer-shaft, a retort, a chamber for a hot fluid partly inclosing the said retort, a source of fluid under a pressure higher than that of the atmosphere, a canal with perforated wall inside of the said retort and in communication therewith and with the said source of fluid, and an extension of the said canal to the outside of the said retort.

24. In a gas-producer, a combustion-chamber, a retort, a chamber for a hot fluid partly inclosing the said retort, an outlet for residue of distillation from the said retort toward the said combustion-chamber, a source of fluid under a pressure higher than that of the atmosphere, a canal with perforated wall inside of the said retort and in communication therewith and with the said source of fluid, and an extension of the said canal through the said outlet to the outside of the said retort.

25. In a gas-producer, a combustion-chamber, a magazine for fuel above the said combustion-chamber, a conduit for fuel connecting the said magazine to the said combustion-chamber, a jacket partly inclosing the said conduit and containing a fluid of a temperature lower than that of the gases issuing from the said combustion-chamber, a wall separating the contents of the said combustion-chamber from the contents of the said jacket, and an outlet and inlet out of and into the said jacket respectively.

26. In a gas-producer, a magazine for fuel, a producer-shaft, a conduit for fuel connecting the said magazine to the said producer-shaft, a source of fluid of limited temperature, a jacket partly inclosing the said conduit, a wall separating the contents of the said producer-shaft from the contents of the said jacket, an inlet canal connecting the said source of fluid to the said jacket, and an outlet in the inclosure of the said jacket.

27. In a gas producer, a combustion chamber, a vertical retort above the said combustion chamber, a chamber for a hot fluid partly inclosing the said retort, a screw conveyer within the said retort and surrounding with the wall of the latter a canal, the area of a cross-section of which at a lower location is greater than the area of such cross-section at a higher location, and a hollow spindle of the said screw conveyer provided with apertures for a passage of gaseous fluid.

28. In a gas producer, a combustion chamber, a vertical retort, a screw conveyer within the said retort and surrounding with the wall of latter a canal of gradually reduced areas of its successive cross-sections through its fuel inlet part for compressing freshly supplied fuel, and a hollow spindle of the said screw conveyer provided with apertures for a passage of gaseous fluid.

29. In a gas-producer, a producer-shaft, a magazine for fuel, a fuel-feeder for delivering fuel from the said magazine toward the said producer-shaft, a source of motion, a power-transmission device connecting the said source of motion to the said fuel-feeder, a chamber for gaseous fluid within the said producer-shaft, and provided with an aperture in its inclosure, a mechanical feeder within the said chamber, and a rod passing through the said aperture and movably fitting therein for operatively connecting the said mechanical feeder to the said source of motion and to the said power-transmission device.

30. In a gas-producer, a distillation-con-

duit, a screw-conveyer within the distillation-conduit, and a hollow spindle with perforated walls in the center part of the said screw-conveyer.

31. In a gas-producer, a distillation-conduit, a screw-conveyer within the said distillation-conduit, a hollow spindle of the said screw-conveyer, and a member within the said hollow spindle independent from the motion thereof.

32. In a gas-producer, a magazine for fuel, a producer-shaft, a mechanical feeder for delivering fuel from the said magazine toward the said producer-shaft, an automatic regulator in operative connection with the said feeder for automatically maintaining a substantially constant height of the fuel-bed in the producer-shaft, and a mechanically movable feeder being a part of the said regulator and partly located within operative proximity to the fuel-bed in the producer-shaft.

33. In a gas-producer, a magazine for fuel, a retort, a producer-shaft, a screw-conveyer for conveying fuel from the said magazine through the said retort toward the said producer-shaft, a canal for transferring heat from the said producer-shaft toward the said retort, an opening for the discharge of residue of distillation from the said retort toward the said producer-shaft, and a separate opening for the discharge of distillates from the said retort through a wall partly inclosing the space between the thread of the said screw-conveyer.

34. In a gas-producer, a magazine for fuel, a retort, a producer-shaft, a vertical screw-conveyer for conveying fuel from the said magazine through the said retort toward the said producer-shaft, a canal for transferring heat from the said producer-shaft toward the said retort, an opening for the discharge of residue of distillation from the said retort toward the said producer-shaft, and separate means for discharging distillates from a plurality of turns of the helical space between the thread of the said screw-conveyer through a wall partly inclosing said helical space.

35. In a gas producer, a distillation conduit for conveying and distilling fuel, a source of hot gaseous distilling fluid, a heating chamber partly inclosing said conduit and communicating therewith and with the said source, a perforated wall connecting the said chamber to the said conduit, a gas generating chamber below and in communication with the said conduit, a discharge-canal for distillates and for said fluid from the said conduit, a perforated wall connecting said canal to said conduit, a mechanical member constructed to agitate fuel within said conduit, and means for moving said member.

36. In a gas producer, a distillation conduit for conveying and distilling solid fuel, a source of hot gaseous distilling fluid, a heating chamber partly inclosing said conduit and in communication therewith and with said source, a perforated wall connecting the said chamber to the said conduit, a gas generating chamber below and in communication with the said conduit, a discharge canal for distillates and for said fluid from said conduit, a movable perforated wall connecting said canal to said conduit and constructed to agitate solid fuel in the latter, and means for moving said movable wall.

37. In a gas producer, a retort for primary distillation of solid fuel, a chamber for secondary distillation of residue of primary distillation, a chamber for a hot fluid partly inclosing the said retort, and a hollow spindle of the said screw conveyer provided with apertures for a passage of gaseous fluid and for a communication with the said chamber for secondary distillation.

38. In a gas producer, a combustion chamber, a magazine for solid fuel above the said combustion chamber, a retort connecting the said magazine to the said combustion chamber, a screw conveyer within the said retort, a hollow spindle of the said screw conveyer provided with apertures for a passage of gaseous fluid, and a catch arm in rigid connection with the said hollow spindle for conveying fuel into a canal formed by the thread and spindle of the said screw conveyer.

39. In a gas producer, a retort for distilling solid fuel, a chamber for a hot fluid partly inclosing the said retort, a rotary fuel feeder within the said retort and constructed to maintain a passage-way for distillates free of solid fuel, and projections on the inside surface of the said retort for obstructing a rotation of fuel with the said rotary fuel feeder.

40. In a gas producer, a retort for distilling solid fuel, a chamber for a hot fluid partly inclosing the said retort, a screw conveyer within the said retort and constructed to maintain a passage-way for distillates free of solid fuel within the said retort, and substantially parallel ribs on the inside surface of the said retort for obstructing a rotation of fuel with the said screw conveyer.

41. In a gas producer, a distillation conduit for primarily distilling solid fuel, a heating chamber partly inclosing said conduit, a chamber for secondarily distilling residue of primary distillation below and in communication with said conduit, a separate inlet for the passage of a heating fluid into each of the said two chambers, a discharge-canal for distillates from the said conduit, a movable wall of said canal and constructed to agitate solid fuel in said conduit, an outlet for distillates through said wall, and mechanical

means constructed to be continuously in operation for moving said wall.

42. In a gas producer, a retort for primary distillation of solid fuel, a chamber for a hot fluid partly inclosing the said retort, a chamber for secondarily distilling residue of primary distillation, a partition between the two said chambers, a separate inlet into each of the two said chambers for the passage of a heating agent, an outlet from each of the two said chambers, and a conduit for distillates free of solid fuel within the said retort.

43. In a gas producer, a retort for primary distillation of solid fuel, a chamber for a hot fluid partly inclosing the said retort, a chamber for secondarily distilling residue of primary distillation, a partition between the said two chambers, a producer shaft for consuming residue of secondary distillation, a separate inlet into each of the two said chambers for an agent transferring heat thereinto generated within the said producer shaft, and a conduit for distillates free of solid fuel within the said retort.

44. In a gas producer, a retort for primary distillation of solid fuel, a chamber for a hot fluid partly inclosing the said retort, a chamber for secondary distillation of residue of primary distillation, a partition between the two said chambers, a separate inlet into each of the two said chambers for the passage of a heating agent, a conduit for distillates free of solid fuel within the said retort, and a conveyer within the said retort and adapted to convey residue of primary distillation into the said chamber for secondary distillation.

45. In a gas producer, a distillation conduit for conveying and distilling fuel, a heating chamber partly inclosing said conduit, a gas generating chamber below and in communication with said conduit, a gas outlet provided for said gas generating chamber, an apparatus constructed to produce a gaseous heating fluid and operatively connected to said gas outlet, and a tube-connection connecting said apparatus to said heating chamber for leading said heating fluid thereinto.

46. In a gas producer, a distillation conduit for distilling fuel, a heating chamber partly inclosing said conduit, a gas generating chamber below and in communication with said conduit, a gas outlet provided for said gas generating chamber, an apparatus constructed to produce a gaseous heating fluid and operatively connected to said gas outlet, a tube-connection connecting said apparatus to said heating chamber, and a passageway connecting the said heating chamber to the said conduit for leading said fluid into the latter.

HENNING FRIEDRICH WALLMANN.

Witnesses:
F. PUNES,
M. BIRMINGHAM.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."