A. M. LEVIN.

GAS PRODUCER.

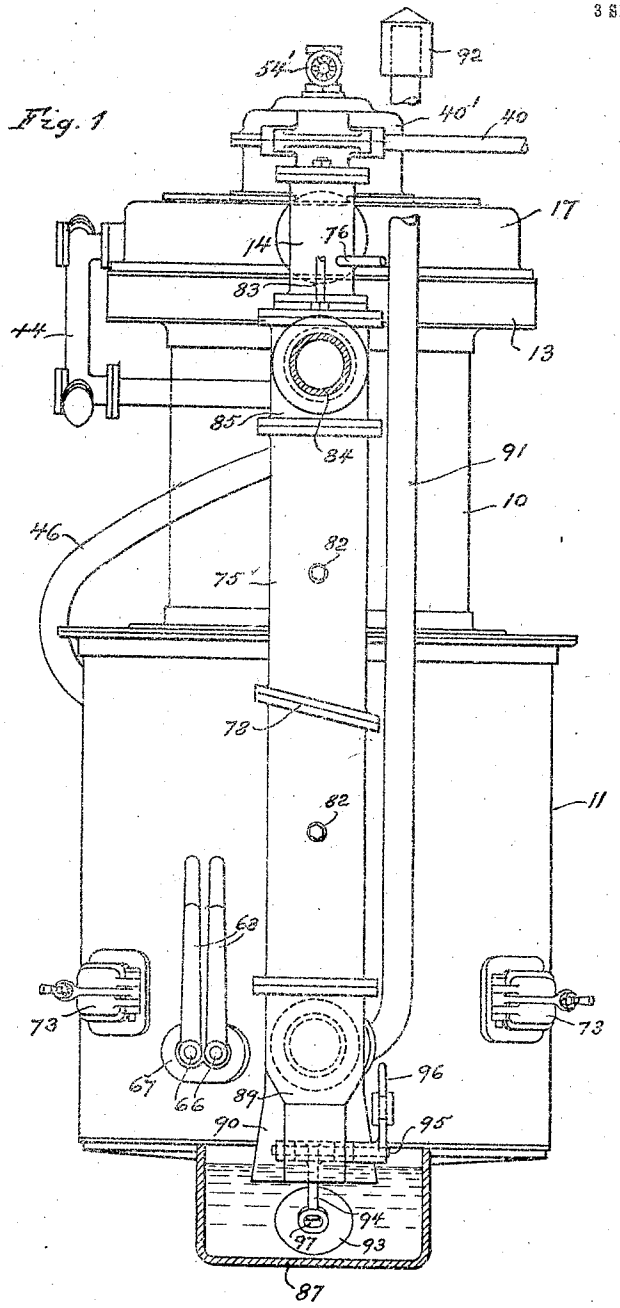
APPLICATION FILED JUNE 30, 1910.

1,008,833.

Patented Nov. 14, 1911.

3 SHEETS—SHEET 1.

Fig. 1



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3 SHEETS—SHEET 2.

Fig. 2.

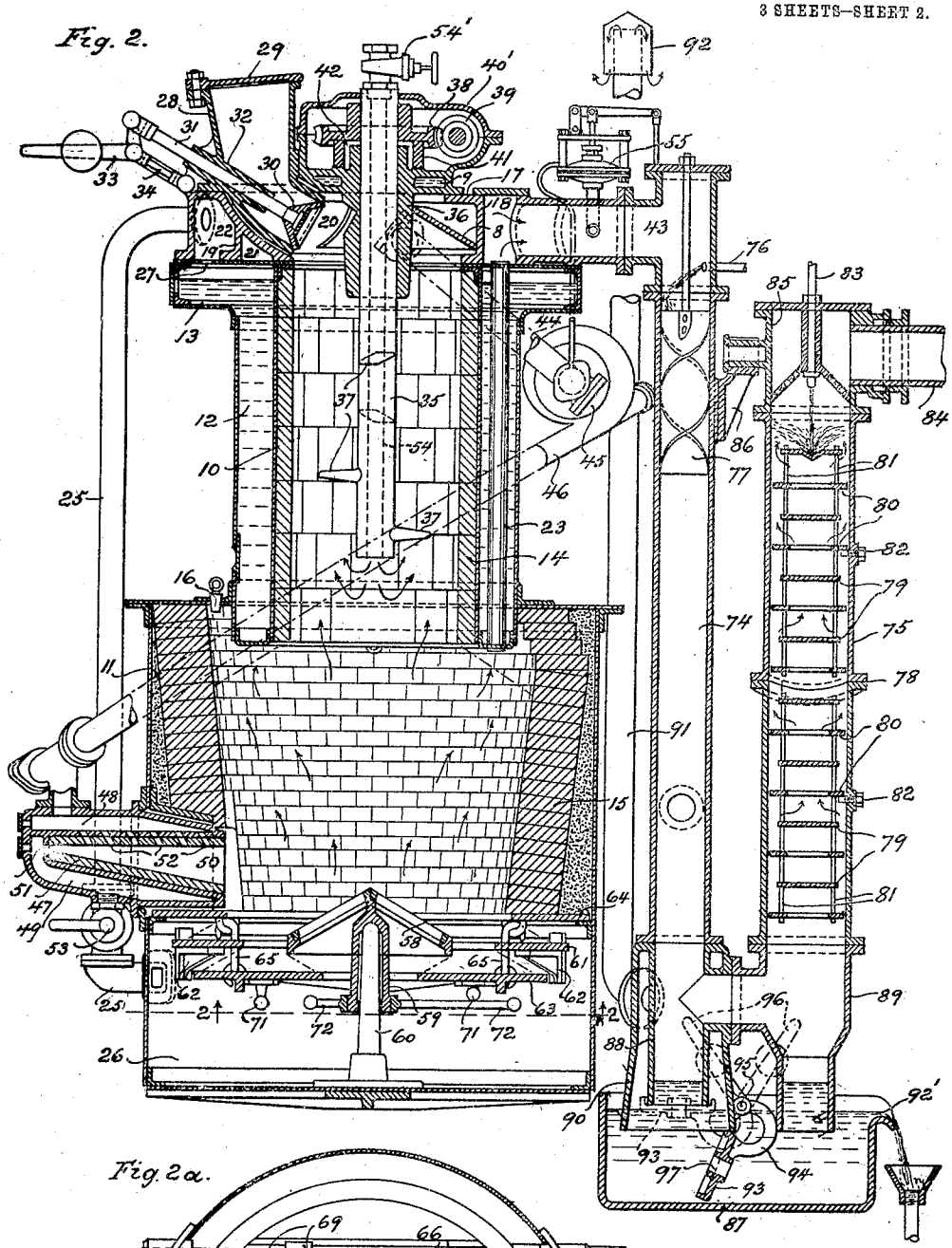
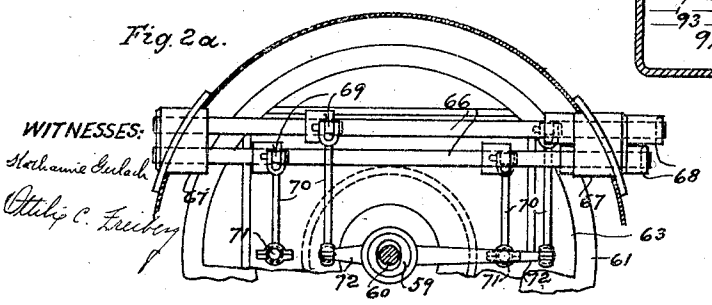


Fig. 2a.



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3 SHEETS—SHEET 3.

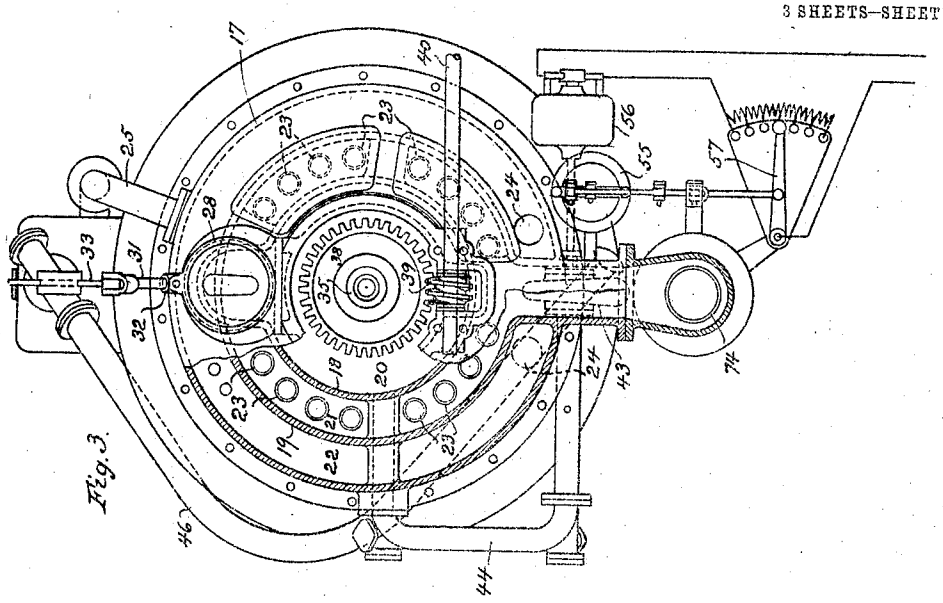

Fig. 3.

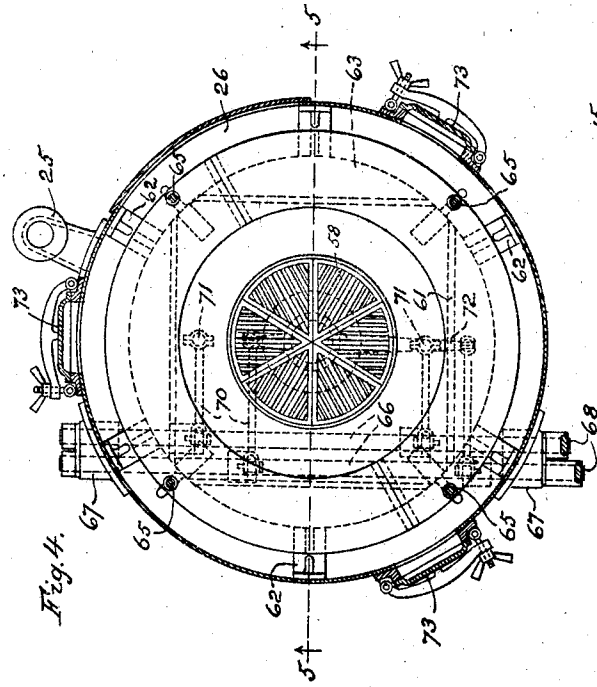

Fig. 4.

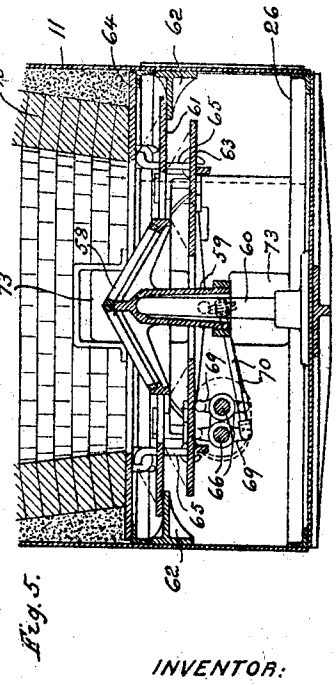

Fig. 5.

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UNITED STATES PATENT OFFICE.

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GAS-PRODUCER.

1,008,833. Specification of Letters Patent. Patented Nov. 14, 1911.

Application filed June 30, 1910. Serial No. 569,647.

To all whom it may concern:

Be it known that I, ARVID M. LEVIN, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Gas-Producers, of which the following is a specification.

The invention relates to gas producers and more particularly to producers designed for the generation from bituminous coal or lignite of gas suitable for use in explosive engines.

The invention seeks to provide a simple and effective gas producer furnace, the operation of which can be readily controlled in accordance with the varying qualities of fuel employed and the different load conditions and which will produce a fixed and clean gas of uniform quality from bituminous coal.

The invention consists in the features of improvement hereinafter set forth, illustrated in its preferred form in the accompanying drawings and more particularly pointed out in the appended claims.

In the drawings, Figure 1 is a view in elevation of the improved producer. Fig. 2 is a vertical section thereof. Fig. 2ª is a detail section on line 2—2 of Fig. 2. Fig. 3 is a plan view of a portion of the drum at the upper end of the furnace shown in section. Fig. 4 is a horizontal section through the ash pit of the furnace. Fig. 5 is a detail section on the line 5—5 of Fig. 4.

The improved furnace is preferably of the cupola type and comprises upper and lower sections 10 and 11 formed in suitable fashion of steel plate and arranged one above the other, as shown. The upper distilling section is slightly smaller in diameter than the lower decomposing section of the furnace and is preferably formed of double walls forming a water-containing and steam-generating space 12 having an enlarged upper portion 13. The upper section is preferably provided with a comparatively thin lining 14 of fire brick, and the lower section, above its grate, is provided with a heavier fire brick lining 15 which is preferably conical in form, so that the space within the lower or decomposition section of the generator is somewhat smaller than its upper end. The upper end of the lining 15 surrounds the lower end of the upper furnace section 10 which depends to a slight extent within the upper end of the lower section. The top plate of the lower section is provided, adjacent the circular wall of the upper section, with a series of poke holes closed by plugs 16, so that the surface of the lining 15 can be kept free from clinkers and cinders.

A cast metal drum 17 is mounted upon the upper enlarged end 13 of the top section, and this drum is divided by annular partitions 18 and 19 into a central space or chamber 20 which communicates with the upper end of the space in the distillation section and into two annular spaces or chambers 21 and 22. The intermediate annular space 21 communicates with the upper ends of a series of tubes 23 that extend through the water space 12 of the top furnace section and communicate at their lower ends with the upper portion of the lower furnace section. The pasage of hot gases from the lower furnace section through the tubes 23 serves to generate steam within the upper end of the water space 12 and at the same time the gases passing through the tubes are cooled.

The outer annular space 22 in the top drum 17 forms an air heater. At one point it is provided with two air inlets 24, (see Fig. 3) and at a diametrically opposite point it communicates with a pipe 25 which opens at its lower end into the ash pit 26 of the furnace. The air heating space 22 also communicates with the steam space of the chamber 12 through an opening 27, so that the steam generated within this space passes with the heated air through the pipe 25 into the ash pit and thence upward through the charge of coal.

The fresh coal is charged into the upper part of the distilling section 10 of the producer by means of a suitable hopper 28 which is mounted upon the upper portion and near the periphery of the drum 17. The upper end of the hopper is closed by a swinging cover 29 and, its lower end, by a shiftable cone 30. The cone is fixed to the end of a shifted rod 31 arranged to slide through a suitable bearing 32. At its outer end the rod 31 is connected to a weighted bell crank 33, carried upon a pivoted supporting link 34.

As stated, the producer is especially designed for generating gas from bituminous coal. As the coal passes down through the upper distilling section, it is prevented from caking by means of a suitable stirrer or agitator which preferably comprises a vertical shaft 35 journaled at the upper end in a

suitable bearing 36 secured to the top drum 17, and extending downwardly and centrally within the upper distilling section 10 of the furnace. The shaft is provided with a series of projecting agitator arms or lugs 37 and is slowly rotated by means of a worm wheel 38 fixed to its upper end and which engages a worm 39 upon a shaft 40. The shaft 40 is journaled in suitable bearings in an oil containing casing 40′ which surrounds the gears and the shaft is driven from any suitable source of power. The worm wheel 38 is provided with a depending flange 41 which forms a thrust bearing for the stirrer shaft or spindle 35. A space 42 within the flange 41 receives oil to lubricate the bearing 36 and prevent the escape of gas therethrough. A baffle plate 8, arranged within the space 20 at the upper portion of the distilling chamber, protects the drive gearing for the shaft 35 from the heat within the furnace. As an additional protection, the oil casing 40′ is provided with a water containing space or jacket 9 at its lower portion.

The fuel within the lower or decomposing section 10 of the furnace is maintained in a state of high incandescence, and the air and steam admitted to the ash pit pass through the incandescent fuel, the steam being decomposed and the oxygen of the air and steam uniting with the fuel to form carbon monoxid. These gases pass out through the vertical discharge tubes 23 within the water space 12 up into the annular chamber 21 in the top drum 17 and thence out through the exit pipe 43. The draft through the upper distilling section 10 is also in upward direction, and the volatile hydrocarbons, driven off from the fresh coal, are withdrawn from the upper portion of the furnace through a pipe 44 by a fan 45 or equivalent means for maintaining a forced circulation. The distilled gases are delivered by the fan through a pipe 46 into the lower portion of the decomposition section 11 of the furnace, or into the highly incandescent zone thereof, and the volatile hydrocarbons are decomposed or "fixed" and pass off with the other stable gases through the tubes 23, to the exit pipe 43.

Whenever the fuel used contains a high percentage of volatile hydrocarbons, the gases withdrawn from the upper part of the furnace are preferably projected into the hot zone at the lower portion of the furnace section through a nozzle-like construction 47. This nozzle comprises a gas chamber 48 into which the pipe 46 opens, an air heating chamber 49 and a mixing chamber 50 communicating with the air chamber through an opening 51, and with the gas chamber through a series of openings 52. Air is admitted into the chamber 49 through a branch leading from the lower end of the pipe 25, and having a controlling valve 53 therein. The volatile hydrocarbon gases distilled from the coal, thus pass from the upper end of the furnace and are forced through the nozzle 47 into the lower end or incandescent zone of the decomposing portion of the furnace. In the nozzle 47 the volatile hydrocarbon gases are mixed with a small amount of preheated air and are partially burned and heated. Thereby the volatile gases, when of considerable volume, are more readily decomposed into stable gases within the base section of the furnace.

A certain portion of the gases from the base section, of course, passes upwardly through the upper distilling section 10. To more readily control the heat in this upper distilling section and the volume of gases passing therethrough and thereby effectively drive off all the volatile hydrocarbons in the coal, a regulated supply of air is admitted to the lower portion of the upper distilling section 10, but at a point well above the inlet ends of the tubes 23, so that there is no danger that any appreciable quantity of unreduced carbon dioxid will pass off through these tubes. The stirrer shaft 35 forms a convenient means for admitting the air to the lower portion of the distilling section, and for this purpose it is hollow to form a suitable air passage 54, and is provided at its upper end with a valve 54′ whereby the amount of air admitted to the distilling section is controlled. By admitting the proper amount of air, sufficient heat is maintained in the distilling section to drive off all the volatile hydrocarbons.

To insure the proper circulation of the gases distilled from the fresh coal in the upward direction and through the pipes 44 and 46 back into the lower portion of the decomposing section of the furnace, it is necessary that the pressure within the upper portion of the distilling section 10 be slightly less than that within the exit pipes 43, otherwise the distilled gases would pass downwardly and thence out through the pipes 23 without being effectively decomposed or "fixed". For this purpose a pressure regulator 55 is provided. Any suitable form may be employed. That shown comprises a diaphragm regulator exposed on its opposite side to the pressures within the pipes 43 and 44, respectively. This regulator is arranged in any suitable manner to control the operation of the fan 45. In the form shown, (see Fig. 3) the fan is driven by an electric motor 56, and the switch 57 for controlling the speed of the motor and of the fan, is arranged to be shifted by suitable links or rods actuated by the diaphragm regulator 55.

By the present improved arrangement of updraft distilling and decomposing sections,

the proper flow of air and gases through both sections is insured, and the distilled gases are maintained in forced circulation from the upper end of the distilling section and through the hot zone of the decomposing section, so that they are properly converted to fixed gases before passing out through the exit pipe 43.

The lower base section may be provided with a water sealed ash pit or with any suitable form of grate. The novel form of grate shown is preferred and it constitutes one of the features of the present invention. This grate comprises a central conical portion 58 having a central, depending, hollow support or hub 59 mounted upon the upper end of a pedestal 60 that rises from the base of the ash pit. A fixed annular plate 61 is mounted upon a series of brackets 62, fixed to the wall of the furnace at the upper portion of the ash pit. This plate extends around the lower, outer edge portion of the central conical grate 58 and is spaced apart therefrom, as shown. The ashes and cinders passing downwardly between the conical grate 58 and the plate 61, lodge upon an annular plate 63 which is arranged below and is somewhat wider than the space between the grate 58 and the stationary plate 61. The plate 63 is hung from a stationary plate 64, which supports the brick lining 15, by a series of swinging hangers or links 65, so that the plate can be shifted to shake the ashes therefrom down into the ash pit 26. The grate 58 and the plate 63 are shaken by means of a pair of shafts 66 extending through the ash pit on one side thereof and journaled at their ends in bearings 67. At one end these shafts are provided with handle bars 68 by which they may be rocked. Each of these shafts is provided with a pair of oppositely projecting crank arms 69 which are arranged to be connected by links 70 to the grate 58 and plate 63. The links 70, extending from one of the shafts, are connected by ball and socket joints to a pair of depending lugs 71 on the plate 63 at diametrically opposite points and at equal distances from the center of the plate. The links extending from the other shaft 66 are connected by ball and socket joints to the ends of a pair of arms 72, which project laterally and in opposite directions from the lower end of the hub 59 of the grate 58. One of these arms is longer than the other and the opening in the hub 59 is elliptical (see Fig. 2[a]) so that the grate 58, when its shaft 66 is rocked, is not only oscillated about a vertical axis, but is also, at the same time, rocked to a slight extent upon a horizontal axis. If desired, the rocking of the grate can be effected automatically from any suitable source of power. This improved grate construction effectively prevents the formation of air holes or chimneys adjacent the walls of the furnace and through which carbon dioxid and air might pass to the outlet tubes 23. The ashes are removed from the pit 26 through suitable doors 73, which are normally held closed in gas tight fashion. Similar doors are provided in line with the grate for convenience in attending to the fire when necessary.

The gas passing from the producer through the pipe 43, passes downwardly through the cooler pipe 74 and upwardly through a washer and scrubber 75. It receives a preliminary cooling and cleaning in the pipe 74. For this purpose, water is admitted in the upper end of the pipe 74 through a small inlet pipe 76 and strikes upon a spiral diaphragm or partition 77 that is supported within the upper end of the pipe 74. This diaphragm imparts a swirling motion to the water and gas, so that the latter are intimately mixed and cooled while any ashes or like heavy impurities are thrown against the walls of the pipe and washed down into the water seal at its lower end. From the lower end of the pipe 74, the gases pass upwardly through the scrubber 75. This apparatus preferably comprises two cast metal sections which are connected by an inclined joint 78 (see Fig. 1) so that the sections can be readily parted for cleaning. Within each section is arranged a series of alternately disposed disks and annular rings 79 and 80 fixed to supporting rods 81 and held in position within the sections of the pipe 75 by bolts 82. Water is admitted through an inlet pipe 83 to the upper end and passes downwardly through the scrubber while the gas passes upwardly around the disks and annular plates. The gas is thereby effectively cooled and cleaned and finally passes through a pipe 84 and through a suitable gas holder to the engine.

The upper end portion or head 85 of the scrubber is preferably swiveled to a supporting bracket 86 on the pipe 74 at a point in line with the axis of the pipe 84, whereby the parts may be more readily cleaned.

The improved gas producer may operate either under pressure or the gases can be drawn therefrom by the suction of a suitable pump, or the like, or by the suction of the gas engine. The operation of the apparatus as a suction gas producer is preferred, but a suitable vent should be provided for diverting the flow of gases from the producer whenever the suction ceases.

In the present improved construction, the lower ends of the cooler pipe 74 and of the scrubber 75 are provided with a water seal and vent valve of novel form comprising a tank 87 and T-shaped heads 88 and 89, fixed to the lower ends of the pipes 74 and 75 and connected together, as shown. The T-shaped part 88 is provided with an addi-

tional outer wall 90 which depends below the main body thereof and which forms a space which communicates with the lower end of a vent pipe 91. This pipe leads to some suitable point outside of the building within which the producer is arranged, and the outlet of the pipe is preferably provided with a suitable cap or deflector 92.

The water within the tank 87 is maintained at a predetermined level by a suitable overflow 92' and the pipes 89 and 90 extend downwardly below this level, while the pipe 88 terminates slightly above the same. When the apparatus is under suction, water will be maintained within the lower ends of the pipes 88, 89 and 90, to effectively seal the same. If the suction in the system ceases, the water within these pipes will fall to the level maintained in the tank 87 and the gas passing from the producer can thus escape around the lower edge of the pipe 88 and up through the pipe 90, to the escape pipe 91 and out to the atmosphere. When the suction in the system is again started, the column of water in the lower end of the pipe 88 is reëstablished by means of a flanged plate or valve 93 which is mounted upon an arm 94 and is adapted to be swung into position over the lower end of the pipe 88. The arm 94 is hung from a shaft 95, and the outer end of this shaft carries a weighted arm 96 which is arranged to hold the plate 93 either in the position shown in the full lines in Fig. 1, or in the position shown in dotted lines, over the lower end of the pipe 88. The plate 93 is provided with a short flanged opening or pipe section 97 which, when in the position shown in dotted lines in Fig. 2, extends up into the lower end of the pipe 88 and down below the level of the water, within the tank 87, so that suction created in the apparatus will draw the water up into the pipe 88 and seal it so long as the suction is maintained. When the water seal in the pipe 88 is once established, the plate 93 is swung back to the position shown in full lines. Then, when the suction in the system again ceases, the water seal at the lower end of the pipe 88 is broken, as described, and the gas, instead of backing up through the ash pit and air supply pipes, passes through the vent pipe 91. When the producer is not in operation or when it is blown up at the beginning of its operation, it is vented through the pipe 91.

It is obvious that numerous changes may be made in the details set forth, without departure from the essentials of the invention, as defined in the claims.

I claim as my invention:—

1. A gas producing furnace comprising a vertical shaft having a lower, main decomposing section and an upper distilling section arranged to deliver coke directly into the upper end of said main section, said lower decomposing section having a main air inlet at its lower end to maintain a main combustion zone and having an outlet for the fixed gases at its upper end, means for admitting a controlled, supplemental supply of air into the lower end of said upper distilling section for maintaining a second supplemental combustion zone at such point and thereby regulating the distillation of the volatile gases, and means for maintaining an upward circulation of the gases throughout the shaft of said furnace and throughout both sections thereof and from the upper end of said distillation section to the incandescent zone of said lower main section, substantially as described.

2. A gas producer comprising a lower decomposing section and an upper distilling section arranged directly above said lower section and delivering devolatilized fuel directly into the upper end thereof, said lower section having a main air inlet at its lower end and said upper distilling section having a supplemental air supply at its lower end to thereby maintain separate combustion zones at the lower ends of said sections, means for maintaining an upward circulation of the gases throughout both of said sections and for maintaining a circulation of a suitable volume of the gases from the upper end of said distilling section to the lower portion or incandescent zone of said decomposing section, said lower decomposing section having an outlet for the fixed gases at its upper end, substantially as described.

3. A gas producing furnace comprising a vertical shaft having a lower, up-draft, main section and an up-draft distilling section arranged directly above said main section and delivering the devolatilized fuel into the upper end thereof, said lower main section having a main air inlet at its lower end to maintain a main combustion zone and having an outlet for fixed gases at its upper end, means for admitting a controlled, supplemental supply of air into the lower end of said upper distilling section for maintaining a second supplemental combustion zone at such point and regulating the distillation of the volatile gases, means for withdrawing the gases from the upper end of said distilling section and for forcing them into the lower portion or incandescent zone of said lower main section, and means for maintaining the pressure at the outlet end of said distilling section below that at the outlet end of said decomposing section to thereby maintain an upward circulation of gases throughout both of said sections and prevent the back-flow or short circuiting of the distilled gases to the outlet for the fixed gases, substantially as described.

4. A gas producer comprising an up-draft

decomposing section and an up-draft distilling section arranged to deliver the devolatilized fuel into said decomposing section, a fan for withdrawing a suitable volume of gases from the upper part of the distilling section and for forcing the same into the incandescent zone of said decomposing section, and a regulator controlled by the pressure at the outlets of said sections for varying the operation of said fan.

5. A gas producer comprising a lower up-draft, decomposing section and an up-draft, distilling section arranged directly above said decomposing section to deliver the devolatilized fuel into the upper end thereof, said lower decomposing section having a main air inlet at its lower end to maintain a main combustion zone and having an outlet for the fixed gases at its upper end and said distilling section having a supplemental air inlet at its lower end to maintain a second supplemental combustion zone at such point, a burner leading into the lower portion of said decomposing section and means for maintaining an upward circulation of the gases throughout both of said sections and for withdrawing the distilled gases from the upper portion of said distilling section and for forcing the same through said burner into the incandescent zone of said decomposing section, said burner comprising air and gas heating chambers and a combustion chamber wherein the distilled gases are partially burned and thereby heated prior to being forced into the incandescent zone of the decomposing section, substantially as described.

6. A gas producer comprising an up-draft decomposing section and an up-draft distilling section arranged to deliver the devolatilized fuel into said decomposing section, means for conducting the distilled gases from the upper end of the distilling section to the hot zone of the decomposing section and means for regulating the volume of the circulated distilled gases to prevent the back flow thereof to the outlet for the fixed gases.

7. A gas producing, cupola furnace comprising a vertical shaft having a lower decomposing section and an upper distilling section of smaller diameter arranged directly above said lower section and delivering the devolatilized fuel directly into the upper end thereof, said decomposing section having a main air inlet at its lower end and an outlet for the fixed gases at its upper end, said upper distilling section having an air inlet opening into the lower central portion thereof to maintain a supplemental combustion zone, a stirrer in said upper distilling section, means for maintaining an upward circulation of the gases throughout the shaft of said furnace and for circulating a suitable volume of the gases from the upper end of said distilling section to the lower portion or incandescent zone of the decomposing section, substantially as described.

8. A gas producing, cupola furnace comprising a lower decomposing section and an upper distilling section arranged directly above said lower section and delivering the devolatilized fuel into the upper end thereof, means for maintaining a circulation of a suitable volume of the gases from the upper end of said distilling section to the lower portion or incandescent zone of said decomposing section, an annular water and steam generating chamber surrounding said distilling chamber, an outlet for the fixed gases and a series of vertical condenser pipes leading from the upper end of said decomposing section, extending upwardly through said water and steam generating chamber and communicating with the outlet for the fixed gases, substantially as described.

9. A gas producing furnace comprising a vertical shaft having a lower decomposing section and an upper distilling section, said upper distilling section being arranged above said decomposing section and delivering the devolatilized fuel directly into the upper end thereof, said sections having outlets for the fixed and distilled gases respectively at their upper ends, means for admitting the main air supply and steam into the lower portion of said decomposing section and means for admitting a controlled supplemental supply of air into the lower portion of said distilling section to thereby maintain separate combustion zones at the lower ends of said sections, means for maintaining an upward circulation of the gases throughout the shaft of said furnace and throughout both sections thereof and means for withdrawing a suitable volume of the gases from the upper portion of said distilling section for forcing the same into the lower portion or incandescent zone of said decomposing section, substantially as described.

10. A gas producer comprising an up-draft, decomposing section having an outlet for the fixed gases at its upper end, an up-draft distilling section having an outlet for the volatile gases at its outer end and arranged to deliver the devolatilized coal directly to said decomposing section, means for maintaining a circulation of the gases from the upper end of said distilling section to the incandescent zone of the decomposing section, a stirring device arranged within the distilling section and having a hollow bore through which air is admitted to the lower portion of the distilling section.

11. In a suction gas producer, the combination with an outlet pipe for the producer gases and with a vent pipe, of a water seal normally preventing the flow of gases to said vent pipe and arranged to be broken

by the cessation of suction within said outlet pipe.

12. In a suction gas producer, the combination with an outlet pipe for the producer gases and with a vent pipe, of a water seal normally preventing the flow of gases to said vent pipe and arranged to be broken by the cessation of suction within said outlet pipe and means for reëstablishing said water seal.

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