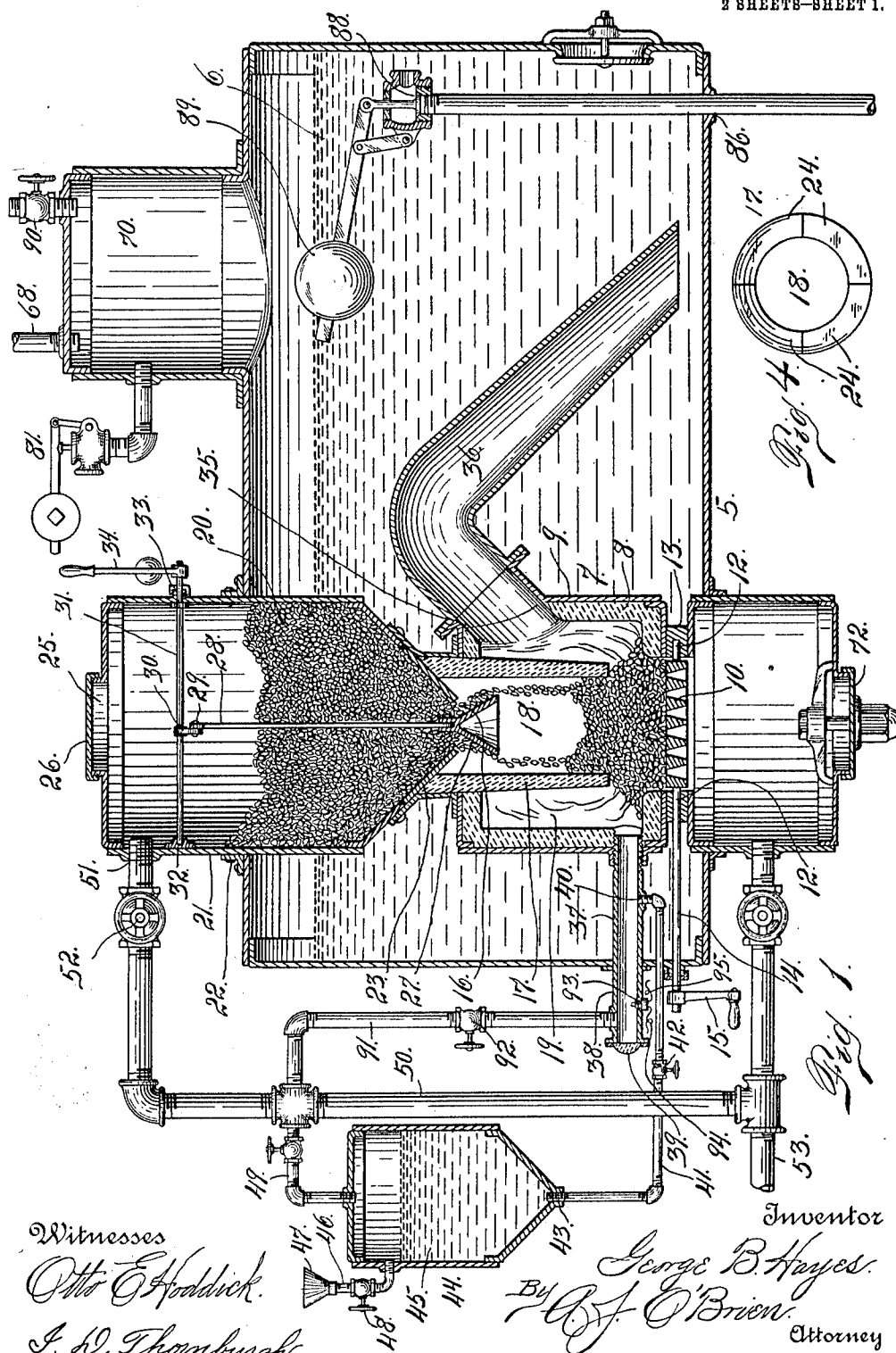


G. B. HAYES.
MOTIVE FLUID GENERATOR.
APPLICATION FILED AUG. 27, 1910.

1,001,592.

Patented Aug. 22, 1911.

2 SHEETS—SHEET 1.



Witnesses
Otto E. Haddock.
J. W. Thornburgh.

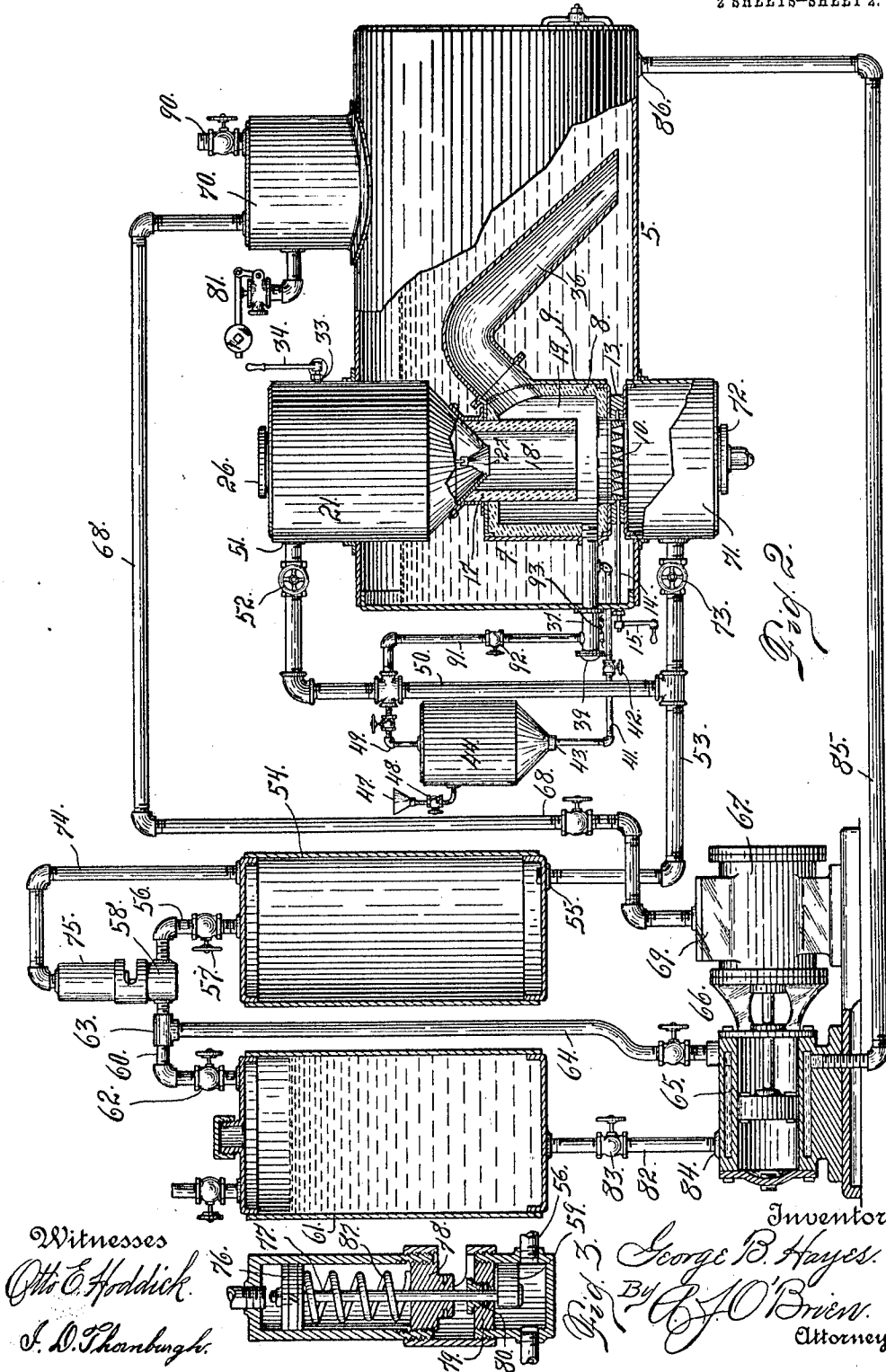
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UNITED STATES PATENT OFFICE.

GEORGE B. HAYES, OF DENVER, COLORADO.

MOTIVE-FLUID GENERATOR.

1,001,592.

Specification of Letters Patent.

Patented Aug. 22, 1911.

Application filed August 27, 1910. Serial No. 579,348.

To all whom it may concern:

Be it known that I, GEORGE B. HAYES, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Motive-Fluid Generators; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to that class of internal combustion generators in which solid fuel and air are burned continuously and under constant pressure, while the highly heated products of combustion are delivered to a liquid contained in the generator and diluted with steam generated by the excessive heat of the products of combustion and automatically reduced to a suitable working temperature so that it can be used in the working cylinder of a motor without detriment thereto. Both the products of combustion and the vapor of the liquid are utilized preferably in combined form.

The objects of the invention are:

First. To generate directly from solid fuel a motive fluid which will contain all of the heat incidental to combustion and that will be free from solid particles such as ashes, which are detrimental to the cylinders of the engines with which the fluid is employed, which fluid shall also have a constant and suitable temperature that can be used in the cylinder of a motor without detriment thereto.

Second. To construct a generator having a regenerative combustion chamber that will give complete combustion of the fuel with as little excess air as possible. This is accomplished by the exceedingly high degree of heat retained in the combustion chamber and utilized for regenerating the gases, while the double construction of the combustion chamber and the manner in which the products are separated therefrom also contribute to this end.

Third. To automatically regulate or control the flow of fuel and air to the combustion chamber and liquid to the generator as may be required by the latter, the fuel supply being regulated by the double construction of the combustion chamber, which pre-

vents the said chamber from ever becoming overcharged with fuel. The air receiver pressure is governed and this in turn governs the generator pressure and regulates the air supply. By maintaining a predetermined and constant pressure in the receiver any fluctuation of the generator pressure from the said receiver pressure will cause an increase or decrease in the flow of air as the case may be.

Fourth. To provide a simple and convenient means for igniting the solid fuel through the agency of fluid fuel and an igniting device.

Fifth. To provide a flow of air sufficient for automatically keeping the fire ignited when the generator is not in use, by adjusting the relief valve on the generator to open at a somewhat lower pressure than the pressure maintained by the governing valve in the air receiver.

Sixth. To provide an apparatus of simple construction and arrangement of parts and having few parts which can become deranged, while the whole is protected from the destructive action of the heat.

The water supply is regulated by a float valve which simultaneously regulates the supply as required by the generator and the flow through the air compressor jacket as required by the air compressor.

Since an apparatus of this character works more or less intermittently, it is frequently necessary that the solid fuel be ignited while under boiler pressure, and I have provided means for accomplishing this end through the agency of fluid fuel and an igniting device. In this construction the fuel receptacle is mounted upon and above the combustion chamber, and the fuel fed to the combustion chamber by gravity, the lower part being submerged in the liquid of the generator while the upper part protrudes through the generator and is rendered accessible for recharging. The lower part of the receptacle contains a cone-shaped valve, which is operated from a position outside of the generator. The combustion chamber is composed of two compartments, a primary and a secondary combustion chamber. The high temperature of the secondary combustion chamber is reverberated into the primary combustion chamber and utilized for regenerative purposes. Below the combustion chamber and protruding through the generator is an ash receptacle

having an opening in its lower part and a cover bolted over the same. Between the combustion chamber and ash receptacle is a shakable perforated grate mounted to be readily dumped for the purpose of clearing the same. This grate is preferably composed of some refractory material and is adapted to be operated from a position outside of the generator. The inner fire clay chamber is composed of several segments which set in a tapered collar in the upper part of the main combustion chamber and are thus securely wedged in place. Air is supplied to the combustion chamber through the fuel receptacle and above and through the ash receptacle from below, the supply being regulated by the respective valves. A small liquid receptacle contains gasoline or other highly inflammable fuel which may be easily ignited with a spark. This fuel is used for igniting the solid fuel. The liquid fuel is conducted to and injected into the twyer at an angle and caused to enter the combustion chamber in an atomized condition by the air supply to the twyer from outside the generator.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing in which is illustrated an embodiment thereof.

In this drawing: Figure 1 is a vertical longitudinal section taken through a generator equipped with my improvements. Fig. 2 is a view partly in elevation and partly in section showing the generator connection with the air compressor receiver and water supply tank, employed in connection with the generator in the use of my improved construction, the parts being shown on a smaller scale. Fig. 3 is a sectional view of the governor interposed between the air receiver and the water tank for the purpose of regulating the pressure in the former, the parts being shown on a larger scale than in Fig. 2. Fig. 4 is a section taken on the line 2—2 of Fig. 1, looking in the direction of the arrow.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate a generator containing liquid which is designated by the numeral 6. Mounted within this generator is a combustion chamber 7 composed of an inner wall 8 of fire clay, and an outer relatively thin wall 9 of metal. In the bottom of this chamber is located a grate 10 which may be of any suitable construction. As illustrated in the drawing this grate is trunnioned as shown at 12 in a base 13, one of the trunnions being extended as shown at 14 and passing through the end wall of the generator from which it protrudes for manipulating purposes. To the exposed extremity of this extension is applied a hand crank 15. The top of the generator is open

as shown at 16 to receive a cone-shaped circular partition 17 which separates the combustion chamber into two compartments 18 and 19. The partition 17 protrudes downwardly well toward the bottom of the combustion chamber, and into it is fed the fuel 20 from the fuel receptacle 21, which is mounted in the upper part of the generator directly above the combustion chamber, being secured to the top of the generator by an angle ring 22. The lower part of the fuel receptacle is cone-shaped and a section 23 thereof is removable. This removable section fits into the top of the circular partition 17 and is of such diameter that when it is removed, an opening in the bottom of the fuel receptacle is formed sufficiently large to permit the removal of the fire clay partition 17, which is composed of a number of segments 24, which are sufficiently small to be passed through the top opening 25 of the fuel receptacle. This opening is normally closed by a cap 26.

The passage of fuel from the receptacle 21 directly into the compartment 18 of the combustion chamber is regulated by a cone-shaped valve 27 with which is connected an upwardly projecting stem 28, whose upper end is pivotally connected as shown at 29 with a crank arm 30 fast on a shaft 31 journaled in the upper part of the fuel receptacle as shown at 32. This shaft passes through the wall of the receptacle on one side and is surrounded by a stuffing box 33, whereby a fluid-tight joint is formed. The protruding extremity of the shaft is equipped with an exposed operating handle 34 by means of which the position of the valve may be regulated for the purpose of controlling the quantity of fuel supplied to the combustion chamber.

The combustion chamber is provided with an opening 35 which communicates with a gooseneck shaped conduit 36 whose free extremity terminates near the bottom of the generator and is open to allow the products of combustion to pass directly into the liquid of the generator. On the opposite side of the combustion chamber and communicating with the bottom of the compartment 19, is a twyer 38 which as shown in the drawing has a threaded inner extremity screwed into the wall of the combustion chamber. This twyer protrudes through one end of the generator and its exposed extremity 38 is provided with a transparent lens 39 to permit the operator to inspect the interior of the combustion chamber while the same is tightly closed. Communicating with this twyer as shown at 40 is a pipe 41 provided with a controlling valve 42. The extremity of this pipe remote from the twyer communicates as shown at 43 with the bottom of a relatively small receptacle 44 containing some readily combustible igniting fuel 45, 130

as gasoline. This receptacle is provided with an inlet pipe 46 terminating at the top in a funnel 47 and controlled by a valve 48. The upper extremity of the receptacle 44 communicates by means of a pipe 49 with a branch pipe 50, one extremity of which communicates with the top of the fuel receptacle as shown at 51, and is equipped with a controlling valve 52 located between the pipe 49 and the fuel receptacle. The opposite extremity of the branch pipe 50 communicates with a pipe 53, one extremity of which is in communication as shown at 55 with the bottom of an air receiver 54. Connected with the upper extremity of this receiver is a pipe 56 in which is located a valve 57. The upper end of the pipe 56 is in communication with a chamber 58 in which is located a valve 59. Also leading from this chamber opposite the pipe 56 is a pipe 60 which leads to the top of a water tank 61 and is provided with a valve 62. Connected with the pipe 60 as shown at 63 is a pipe 64 which communicates with the cylinder 65 of an air compressor 66, the engine cylinder 67 being supplied with motive fluid through a pipe 68 connected at one extremity with the steam chest 69 of the said cylinder, and at its opposite extremity with the steam dome 70 of the generator 5. The pipe 53 communicates at its extremity remote from the air receiver 54 with the ash pit 71 located below the grate of the combustion chamber and protruding below the generator, its bottom being provided with a removable closure 72. Between the pipe 50 and the ash pit the pipe 53 is provided with a valve 73.

Leading from the top of the air receiver 54 is a pipe 74 whose upper extremity communicates with a governor chamber 75 in which is located a piston 76 attached to the upper extremity of the stem 77. Into the bottom of this chamber is screwed a plug 78 through which passes the piston rod 77, the lower extremity of the rod passing through a closure 79 screwed into the top of the valve chamber 58, the said closure being provided with a stuffing box 80, whereby a fluid-tight joint is formed. The lower extremity of the piston rod 77 is equipped with a valve piece 59, which is normally located in the upper part of the chamber above the adjacent extremity of the air pressure pipe 56. Normally the air receiver 54 is in communication with the top of the water tank 61 whereby the water is under the necessary pressure to force it into the generator. This water, however, passes through a pipe 82 controlled by a valve 83, into the water jacket 84 of the air compressor cylinder 65, the said water jacket being in communication with a pipe 85 whose opposite extremity communicates with the boiler as shown at 86.

A coil spring 87 is interposed between the

piston 76 and the closure 78 of the governor chamber 75. The closure 78 being threaded into the wall of the chamber 76, acts as a tension nut to regulate the tension of the spring 87, whereby the governor may be so set that the pressure on the piston 76 from the air receiver 54 will actuate the piston and consequently the valve 59, to cut off communication between the air receiver and the water tank, after the pressure within the receiver has reached a predetermined degree. It will be understood that the pressure within the water tank should be somewhat greater than that within the generator, since the generator is supplied with water from the said tank.

The pipe 85 as illustrated in the drawing rises within the generator and to its upper extremity is attached a valve 88 controlled by a float 89, the construction and arrangement being such that when the water reaches a predetermined level in the generator, the float will rise sufficiently to automatically close the valve 88 and prevent the further entrance of water until its level within the boiler has been reduced sufficiently to lower the float and open the valve.

The steam dome 70 of the generator is equipped with safety valve mechanism 81 and is also provided with a valve-controlled outlet 90 through which the motive fluid generated may be taken for the performance of any work desired.

The necessary air is supplied to the twyer 37 by a pipe 91 leading from the branch pipe 50. The passage of air through the pipe 91 is regulated by a valve 92. The twyer is further equipped with a spark plug 93 to which wires 94 and 95 of an electric circuit, the source of which is not illustrated in the drawing, lead.

From the foregoing description the use and operation of my improved construction will be readily understood.

The combustion chamber is supplied with solid fuel, as coal, from the fuel receptacle 21 by opening the valve 27. This fuel is originally ignited by taking some gasoline, for instance, from the small receptacle 44, which may be done by opening the valve 42 which will allow the gasoline to enter the twyer through the pipe 41. The necessary air to form a readily inflammable mixture is supplied to the twyer through the pipe 91. A spark from the plug 93 will ignite this combustible mixture and the gasoline may be allowed to flow into the twyer from the small receptacle 44 until the solid fuel within the generator has become sufficiently ignited to sustain combustion, after which the valve 42 may be closed. As the fuel is consumed within the combustion chamber, the products of combustion pass through the gooseneck shaped conduit 36 into the water and heat the same, whereby steam is

generated which combines with the products of combustion to form an exceedingly powerful motive fluid, the liquid serving to reduce the temperature of the products of combustion sufficiently to make it practicable to use this fluid in the cylinders of engines, or wherever it may be desired to employ the motive fluid to perform work. A portion of this motive fluid is delivered to the steam chest 69 of the engine cylinder 67 through the pipe 68, whereby the air compressor is operated and air compressed in the receiver 54, this air under pressure being supplied to the water tank 61 through the pipes 56 and 60, and to the combustion chamber through the pipe 53 and the ash pit 71. Water from the tank 61 after passing through the water jacket 84 of the air compressor, is forced into the generator through the pipe 85 as heretofore explained.

The tension of the spring 87 of the governor is regulated to determine the maximum pressure which should be delivered to the air receiver 54, and when this degree is reached the excessive pressure within the receiver will act on the piston 76 through the pipe 74 to actuate the valve 59 and close the inlet extremity of the pipe 56 where it communicates with the valve chamber 58. The pressure in this manner may be either partially or wholly cut off from the air receiver until the pressure within the receiver is reduced sufficiently to allow the piston 76 to move outwardly in response to the tension of the spring 77.

From this description it will be understood that practically the entire mechanism is entirely automatic in its operation.

The pressure of the air in the space above the water in the water tank 61 is governed by the compressor and contains a pressure exceeding that of the air receiver, as regulated by the governor valve 75.

Attention is called to the fact that combustion supporting media other than air may be employed in connection with my improved apparatus.

In further explanation of the operation of the double construction of the combustion chamber it may be stated that the fuel and air are pre-heated while passing through the primary chamber 18.

The feed water on its way to the boiler from the tank 61 passes through the jacket 8 of the air compressor for the purpose of cooling the cylinder of the same.

In further explanation of the function of the open-ended conduit 36, it may be stated that the products of combustion are delivered thereby directly to the liquid of the generator without the use of valves. This is an important feature, since in an apparatus of this class in which solid fuel is used, the open-ended conduit is much preferable to any valved mechanism, since the solid par-

ticles, such as contain acid, carried into the generator would render any valved mechanism unreliable.

Having thus described my invention, what I claim is:

1. The combination with a generator, of a combustion chamber therein communicating with the generator, a fuel receptacle protruding into the combustion chamber, means for regulating the supply of fuel to the combustion chamber, means for supplying the combustion chamber with fluid fuel and air under pressure, and means for igniting the fluid fuel while under pressure, substantially as described.

2. The combination with a generator, of a combustion chamber therein and communicating therewith, a solid fuel receptacle mounted in the generator and protruding into the combustion chamber, means for supplying the combustion chamber with fluid fuel and air under pressure, and means for igniting the solid fuel through the agency of the fluid fuel, substantially as described.

3. The combination with a generator, of a combustion chamber located therein and communicating therewith, a partition supported within the combustion chamber and dividing the latter into two compartments, and a fuel receptacle mounted on the generator above the combustion chamber and communicating therewith, substantially as described.

4. The combination with a liquid-containing generator, a combustion chamber therein and in communication therewith, the top of the combustion chamber being open, a fuel receptacle mounted on the generator and having its lower extremity cone-shaped and protruding into the combustion chamber, and a valve at the lower extremity of the fuel receptacle regulating the passage of fuel to the combustion chamber, the upper portion of the fuel receptacle extending beyond the generator, substantially as described.

5. The combination with a liquid-containing generator, of a combustion chamber located therein and in communication with the liquid of the generator, the upper extremity of the combustion chamber being open, a circular partition supported in the upper part of the combustion chamber and dividing the latter into two compartments, and means for feeding solid fuel into the combustion chamber by way of the centrally located circular partition.

6. The combination with a liquid-containing generator, of a combustion chamber located therein and open at the top, an annular partition inserted in the top of the combustion chamber and cone-shaped to fit thereinto, a fuel receptacle mounted on the generator and protruding thereinto, its lower extremity being cone-shaped

and fitted into the top of the circular partition, the said partition terminating above the bottom of the combustion chamber, and means for regulating the passage of fuel
5 from the fuel receptacle into the inner compartment of the combustion chamber, substantially as described.

7. The combination with a liquid-containing generator, of a combustion chamber located therein and communicating with the
10 liquid of the generator, a circular fire clay partition inserted in the opening in the top of the combustion chamber and projecting above the same, the said partition terminating
15 above the bottom of the combustion chamber and dividing the latter into inner and outer compartments, a fuel receptacle mounted on the generator and protruding
20 thereinto, its lower extremity being shaped to fit into the upper extremity of the circular fire clay partition, and means for subjecting the fuel within the receptacle to the action of air under pressure, substantially as described.

8. The combination with a liquid-containing generator, of a combustion chamber therein and communicating therewith, a circular partition supported within the combustion chamber and dividing the latter into
25 two compartments, a fuel receptacle mounted within the generator and having its lower extremity cone-shaped and protruding into the combustion chamber, and means for introducing air under pressure into the combustion chamber below the grate, substantially
30 as described.

9. The combination with a liquid-containing generator, of a combustion chamber located therein, means for introducing fuel
40 by gravity to the combustion chamber comprising a solid fuel receptacle mounted on the generator and having its lower extremity open to deliver fuel to the combustion chamber, a receiver containing air under pressure,
45 a connection between the said receiver and the fuel receptacle, and a similar connection between the air receiver and the combustion chamber, substantially as described.

10. The combination with a generator, of
50 a combustion chamber located therein and in communication therewith, means for feeding fuel into the top of the combustion chamber, a twyer connected with the combustion chamber and protruding through the wall
55 of the generator, means for introducing a highly inflammable mixture to the twyer, and means connected with the twyer for igniting the said mixture within the twyer, substantially as described.

60 11. The combination with a generator, of

a combustion chamber located therein, means for introducing solid fuel to the combustion chamber, means for subjecting the said fuel to air under pressure, a twyer communicating with the combustion chamber at one
65 extremity, its other extremity protruding beyond the generator, means for introducing highly inflammable fluid to the twyer under pressure, means for igniting the fuel within the twyer and means for introducing air
70 under pressure to the twyer, substantially as described.

12. The combination with a generator, of a combustion chamber located therein and in communication therewith, a fuel receptacle arranged to feed fuel by gravity into
75 the top of the combustion chamber, means for introducing air under pressure to the fuel receptacle, means for introducing air under pressure to the combustion chamber below the grate, a twyer connected with the combustion chamber, means for introducing
80 air under pressure to the twyer, and means for introducing a highly inflammable fluid under pressure to the twyer for igniting the solid fuel of the combustion chamber, and means for igniting the fuel within the twyer, substantially as described.

13. The combination with a generator, of a combustion chamber located therein and in
90 communication therewith, a fuel receptacle mounted above the combustion chamber, protruding into the generator and arranged to deliver fuel into the top of the combustion chamber, a liquid-containing tank for
95 supplying the generator, a receiver containing air under pressure, and suitable connections between the receiver and the fuel receptacle, between the receiver and the combustion chamber, and between the receiver
100 and the water tank and a valve acted upon by the pressure within the receiver for regulating the pressure in the water tank, for the purpose set forth.

14. The combination with a liquid-containing generator, of a regenerative combustion chamber consisting of a primary and a secondary chamber, the primary chamber protruding into the secondary chamber and being adapted to receive heat from the secondary chamber, and means for delivering
110 solid fuel and air to the primary chamber, the secondary chamber being in communication with the liquid of the generator.

In testimony whereof I affix my signature
115 in presence of two witnesses.

GEORGE B. HAYES.

Witnesses:

A. J. O'BRIEN,
F. E. BOWEN.