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GAS GENERATOR APPARATUS FOR PRODUCING COMBUSTIBLE GASES.

APPLICATION FILED NOV. 27, 1906.

909,920. Patented Jan. 19, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

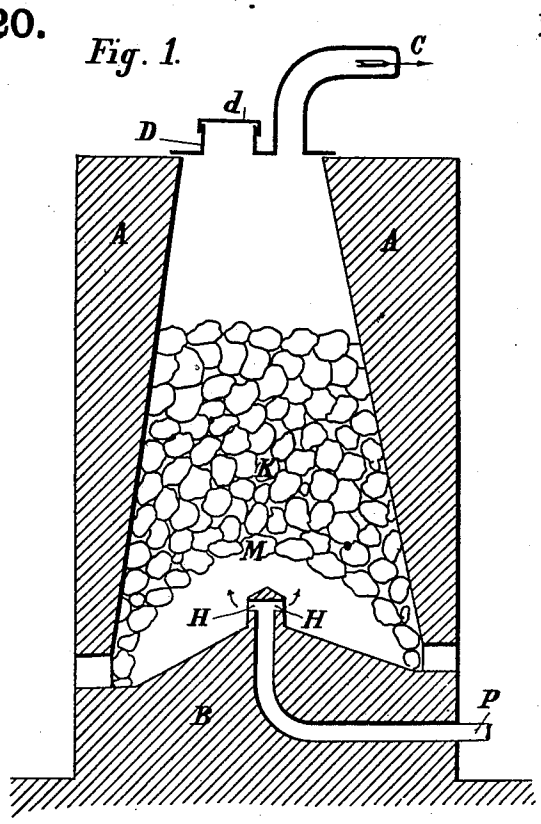

Fig. 2.

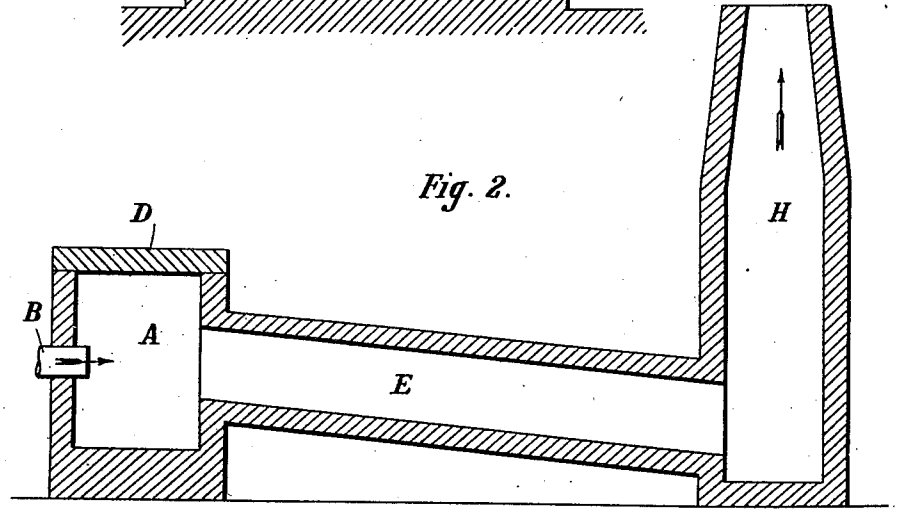

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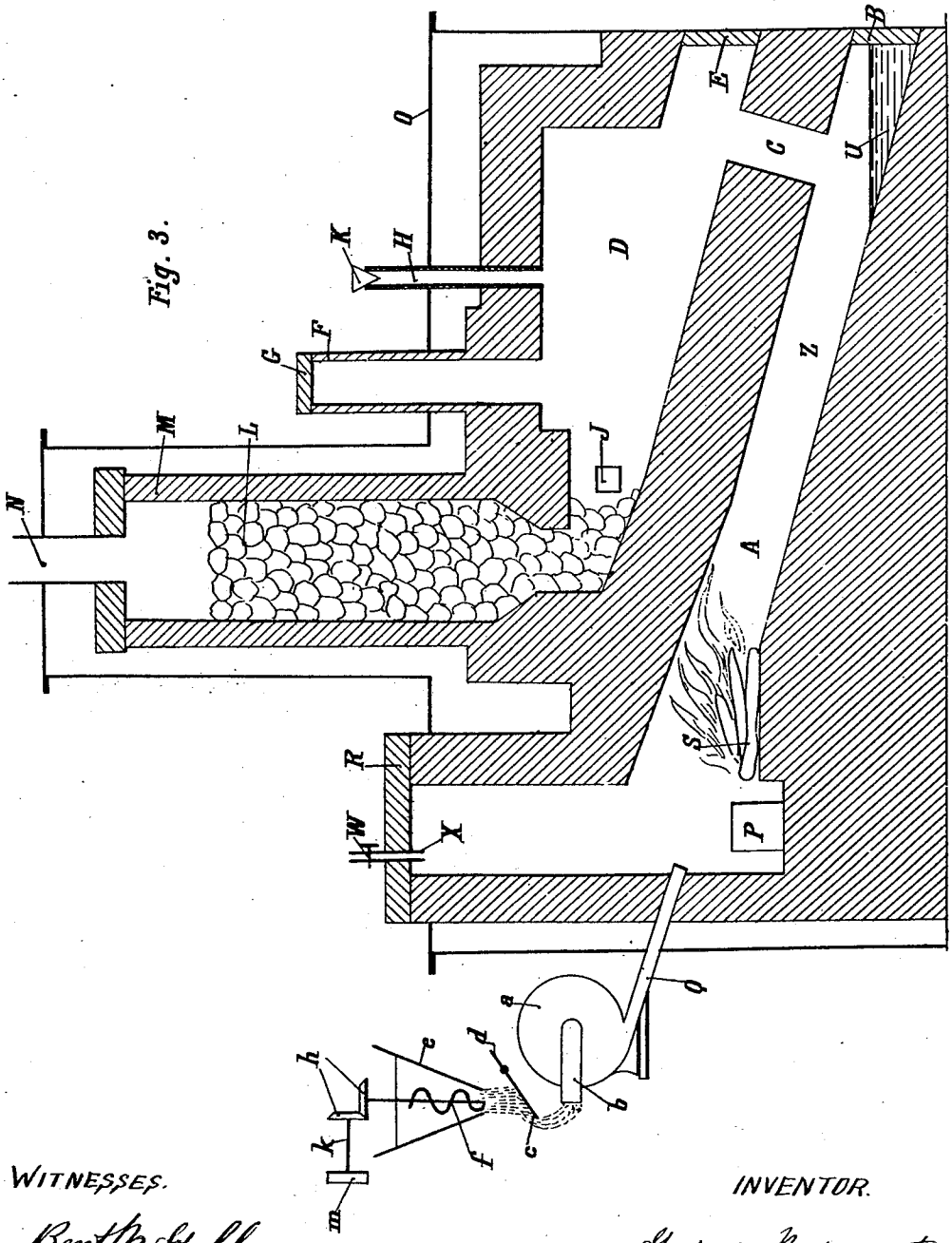
Fig. 3.



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UNITED STATES PATENT OFFICE.

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GAS-GENERATOR APPARATUS FOR PRODUCING COMBUSTIBLE GASES.

No. 909,920. Specification of Letters Patent. Patented Jan. 19, 1909.

Application filed November 27, 1905. Serial No. 289,310.

To all whom it may concern:

Be it known that I, GEORGES MARCONNET, a citizen of the Republic of France, residing at Paris, France, have invented Improvements in and Relating to Gas-Generator Apparatus for Producing Combustible Gases, of which the following is a specification.

In gas generator apparatus for the production of combustible gases (mixtures of oxid of carbon and of hydrogen) the charge of coal and the supply of air necessary to combustion are supplied separately. This charging of coal is generally effected at intervals more or less apart at the upper part of the apparatus while the air arrives at another point in a continuous manner; the combustion which is thereupon produced is slow and proceeds at a relatively low temperature. When in this way there is supplied to a gas generating chamber a considerable quantity of coal the different parts of this combustible first become heated by conductibility and then distillation and combustion are produced. The different parts of the combustible in contact being at increasing temperatures the result is that when they contain vitrifiable portions they easily become stuck together or to the walls of the chamber and so hinder the free delivery of air to the apparatus. If on the contrary the combustible is rich in cinders these also hinder the regular afflux of air, and, finally, if the combustible contains a large proportion of hydrocarbons these are not completely decomposed because they have been submitted for too short a time to a high temperature in the presence of oxygen. Furthermore a gas generator operating in such a manner cannot be fed with a combustible in the state of fine dust, that is to say a comparatively cheap combustible, because the necessary air cannot traverse the resultant mass.

The principle of the present invention consists in treating the combustible, not in a slow manner with intermittent charging and at a relatively low temperature, but in charging it in an automatically continuous manner and in burning it rapidly at the highest practical temperature which it may be possible to attain. These results are obtained by an improved method of feeding carbon and air differing completely from those employed up to the present time; by this improved feeding method the reaction is performed efficiently and at a very high temperature.

The gas generator is fed by means of an afflux of air which acts as a vehicle for also conveying a given quantity of pulverulent coal; this constant mixture of air to support combustion and combustible arrives in a continuous manner into the apparatus in such a way that the combustion of the molecules of carbon in presence of the air is so to speak instantaneous; it results therefrom that the combustion is extremely rapid and that a very high temperature is produced.

The coal is first reduced to impalpable powder by any appropriate process.

By way of illustration Figure 1 of the accompanying drawings represents a vertical section of one of the forms of application which permits of clearly explaining the principle above set forth. Figs. 2 and 3 are similar views indicating other forms which will be hereinafter more particularly referred to.

The apparatus shown in Fig. 1 comprises a casing A of refractory bricks or of metal, resting upon a foundation B; a tubular outlet C for the combustible gases and a charging orifice D closed by a cover *d* are arranged at the upper part. In the chamber A is a mass of combustible in lumps K. At a certain point or points of the base B are placed one or more nozzles H connected to the pipe P and leading the mixture of determined proportions of air and of coal dust in suspension therein to the chamber.

The zone M in which this mixture arrives is previously brought to a high temperature sufficient to assure the ignition of the mixture of air and coal dust. The zone M rapidly becomes incandescent and there is produced combustion between the air and the powdered coal, the resulting gases emerging by the outlet C. It is a mixture of oxid of carbon and hydrogen.

The mixture of air and coal dust is projected into the apparatus by the aid of a blower, a force pump or any other appropriate apparatus connected to the pipe P.

In order to obtain the maximum effect of gasification without the column of lump combustible being rapidly used up the regulation of the admissions of the air and coal powder mixture may be effected in such a way that the coal powder alone fulfils all the functions of heating and of distillation

the column of lump combustible simply acting as a mass in which the zone of very high temperature is imprisoned. At the same time the column of lump combustible assures the complete decomposition into oxid of carbon of the gases resulting from an insufficiently well regulated combustion of the coal dust.

It will be understood that acting thus upon the pulverulent materials the combustion is instantaneous and that considerable quantities of coal can be burned in a confined space, an extremely high temperature being thereby produced. By reason also of this very high temperature it is possible, if desired, to entirely dispense with the column of lump combustible and to burn the mixture of air and coal dust directly in a refractory chamber in such a way as to produce only oxid of carbon and hydrogen.

Fig. 2 of the accompanying drawings represents one of the arrangements which may be employed to arrive at this result.

A is a refractory chamber closed by a cover of the same material D. In this chamber is located a pipe B supplying the mixture of air and coal dust. Communicating with the opposite part of the chamber A is one end of a pipe E the other end of which terminates at a chimney H likewise formed of refractory material.

To set the apparatus working the cover D is lifted and any suitable combustible such as wood or coal is ignited in the chamber A, combustion being accelerated by first causing air to arrive by the pipe B and then air holding in suspension coal dust. The mixture ignites and continues to burn heating the walls of the chamber A which so rapidly attain a very high temperature.

By regulating the respective quantities of air and coal it is possible to readily insure that the gases emerging from the chimney contain nothing but oxid of carbon and hydrogen.

The temperature of certain parts of the apparatus is carried to about 2000° so that the carbonic acid which might be produced is decomposed, the equivalent oxygen liberated reforming oxid of carbon in the presence of the unburned coal, in such a way that only oxid of carbon and hydrogen emerge from the chimney.

In the two arrangements above described the mixture of air and coal in powder may be led into the combustion chamber either by suction or by forcing at the same time as a certain quantity of vapor of water destined to enrich the gas in hydrogen.

The temperature obtained in the zone of combustion is such that the cinders of the combustible are brought to complete fusion and are run off at the base of the apparatus by any appropriate arrangement. Furthermore to the coal powder may be added such fusing material that will facilitate the production of the fluidity of the natural elements of the cinders.

The combustible gas obtained by the processes above described may serve, by mixing it with a convenient quantity of air, for the feeding of a gas motor, for the heating of boilers or for any other heating or lighting purposes.

Fig. 3 represents another construction of apparatus for the application of the improved feeding method.

e is a hopper containing the powdered coal, *f* is a feed screw in the hopper operated by means of bevel gear wheels *h* which are driven from a pulley *m* mounted upon the shaft *k*. The speed of this shaft may be regulated by any suitable means.

Rotation of the screw *f* causes the powdered coal to fall in quantity according to the rate of rotation of the screw. This rain of coal falls upon a plate *c* that is jointed at *d*, it then slides upon the plate and falls off its lower edge in front of the suction orifice *b* of a blower *a*.

By moving the plate *c* nearer a more vertical position the falling shower of coal is brought nearer the orifice of the pipe *b*, and by moving it into a position nearer the horizontal, the fall of the coal takes place at a greater distance from the extremity of the pipe *b*.

When the blower is actuated it draws in by the pipe *b* both air and coal dust. The quantity of coal dust drawn in is greater or less as the plate is moved nearer to or further from a vertical position. For a fixed quantity of air drawn in by the blower it is therefore possible to cause to be drawn in thereby an accurately measured quantity of coal dust, and consequently so adjust the working that the air drawn in carries exactly the quantity of coal necessary to insure that under the action of combustion there shall be produced only oxid of carbon. The quantity of air drawn in by the blower is moreover capable of regulation either by a throttling device in the orifice of the pipe *b* or in a more desirable manner by varying the number of revolutions which the blower makes. For this purpose there is preferably employed a blower worked by an electric motor of variable speed.

The mixture of air and coal dust is forced from the blower into a pipe Q which opens into an inclined passage A of refractory material.

At the commencement of an operation, for the first starting of this gas generator, the cover R is raised and some small pieces of lighted wood are placed on the small hearth S. The coal dust coming in contact with the fire on this small hearth takes fire and forms a blowpipe flame which extends into the pipe A Z. The gases resulting from the combus-

tion are oxid of carbon along with hydrogen coming from the combustion of the hydrocarbons. The temperature rapidly becomes elevated which helps to decompose into oxid of carbon the carbonic acid which has nevertheless been able to form since the start of the combustion. Under the action of this very high temperature the scoriæ, slag and clinkers fuse, run down upon the inclined base of the flue A Z and collect at the lower part U against the door B in the form of a liquid glass. The scoriæ are discharged every six or eight hours by opening the door B, the glass then running out by gravity, and the apparatus is then again ready for another equal period of working. During this cleaning out, which lasts on an average less than a minute, the blower is stopped. It very rarely happens that the glass does not completely run out, it may however in such cases be assisted to come out with a fire iron, and also, if the glass is too cold to run easily, air and coal may be blown in with the blower while leaving the door B open. There is then formed at B a violent jet of flame which heats up the glass and facilitates its flowing.

With rich hydrocarbons there is obtained a good gas rather rich in hydrogen; but if with hydrocarbons less rich it is desired to yet obtain hydrogen, a fine jet of steam is delivered into the apparatus by a pipe X which is furnished with a controlling cock W.

The oxid of carbon arriving at the lower portion of the flue A Z passes up through the passage C into the chamber D. The combustion is completed in the chamber D and from the chamber there opens a producer chamber M likewise of refractory material. In the chamber M there is piled up a column of coke L which acts as a decarburizing column in cases where, owing to bad regulation, the gas might yet contain an appreciable proportion of carbonic acid. The coke is kept in a red hot state by the gases of the combustion. Finally the poor gas produced escapes by the conduit N to supply say a motor, passing through a cooler and a washer. It is preferable to employ as a washer a blower having water injection; this blower will also facilitate by its suction the passage of the poor gas through the column of coke L.

At the commencement of the operation, when the gas generator is not yet hot enough there is left unburned coke dust which may obstruct the interstices between the pieces of coke. To obviate this inconvenience the gases are exhausted through an auxiliary pipe F by raising the cover G when the apparatus is first started.

It is nevertheless important at all times that the column of coke L be red at the moment when the apparatus, being hot, it is desired to utilize the gas, so that this column may immediately play the part of a decarburizer for which it is intended. To attain this object there is opened, at the moment of commencing to utilize the gas a side pipe J which communicates with the outer air and by which an aspiration of fresh air is produced which effects the lighting of the coke column.

During the working of the gas generator the state of the gas may be tested by raising the conical plug K of the pipe H from which there then issues immediately a jet of gas which ignites. Finally, the door E serves for the exit of clinkers which may accumulate below the coke column, and the door P permits the removal of cinders or clinkers which may be deposited adjacent to the hearth S.

The entire masonry constituting this apparatus is inclosed in a metallic casing from which it is separated by an insulating body so as to effectually prevent radiation from the apparatus.

What I claim is:—

1. In gas producing apparatus a chamber of refractory material, a downwardly inclined flue in communication with said chamber, an upwardly inclined flue communicating with said downwardly inclined flue, a coke chamber with which said upwardly inclined flue communicates, a gas outlet from said coke chamber, means for feeding adjustable quantities of coal dust and air to said chamber of refractory material and means for removing vitreous residues from the lower portion of said downwardly inclined flue, substantially as set forth.

2. In gas producing apparatus, a chamber of refractory material, a downwardly inclined flue in communication with said chamber, an upwardly inclined flue communicating with said downwardly inclined flue, a coke chamber with which said upwardly inclined flue communicates, a gas outlet from said coke chamber, a blower for forcing air and coal dust into said chamber of refractory material, and means for removing vitreous residues from the lower portion of said downwardly inclined flue, substantially as set forth.

3. In gas producing apparatus, a chamber of refractory material, a downwardly inclined flue in communication with said chamber, an upwardly inclined flue communicating with said downwardly inclined flue, a coke chamber with which said upwardly inclined flue communicates, a gas outlet from said coke chamber, a blower adapted to deliver air into said chamber of refractory material, an inclined plate located above the air inlet of said blower, in such position that powdered material dropping off the lower edge of said plate falls opposite the mouth of the air inlet of said blower in the path of the air, means for delivering coal dust onto said plate, and means for removing vitreous residues from the lower portion of

said downwardly inclined flue, substantially as set forth.

4. In gas producing apparatus, a chamber of refractory material, a downwardly inclined flue in communication with said chamber, an upwardly inclined flue communicating with said downwardly inclined flue, a coke chamber with which said upwardly inclined flue communicates, a gas outlet from said coke chamber, a rotary blower adapted to deliver air into said chamber of refractory material, means for adjusting the speed of said blower, a hopper for powdered fuel above said plate, means for delivering controlled quantities of fuel from said hopper on to said plate, and means for removing vitreous residues from the lower portion of said downwardly inclined flue substantially as set forth.

5. In gas producing apparatus, a hopper for powdered fuel, adjustable means for discharging fuel from said hopper, an adjustable inclined plate below the delivery orifice of said hopper, a rotary blower the inlet to which is located opposite powdered fuel falling from the lower edge of said plate, a combustion chamber into which said blower is adapted to deliver a charge of powdered fuel and air, means for supplying fuel into said chamber when starting the apparatus, a downwardly inclined flue leading from said chamber, a door closed passage at the lower end of said downwardly inclined flue, an upwardly inclined flue communicating at its lower end with the lower end of said downwardly inclined flue, a vertically extending chamber adapted to contain a column of coke communicating at its lower end with the upper end of said upwardly inclined flue, a gas outlet conduit at the upper end of said vertical chamber, a door closed clinker removing passage at the lower end of said upwardly inclined flue, an auxiliary gas outlet passage from said upwardly extending flue, a small plug controlled passage through which gas from said upwardly extending flue can be withdrawn for testing, and an air inlet passage to said upwardly extending flue, substantially as set forth.

Signed at Paris, France this sixteenth day of November 1905.

GEORGES MARCONNET.

Witnesses:
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H. C. COXE.