

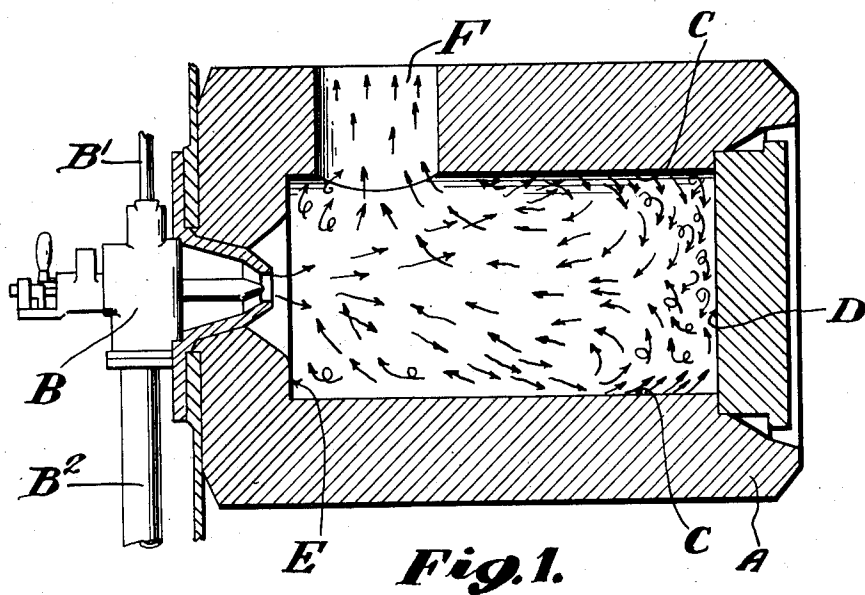
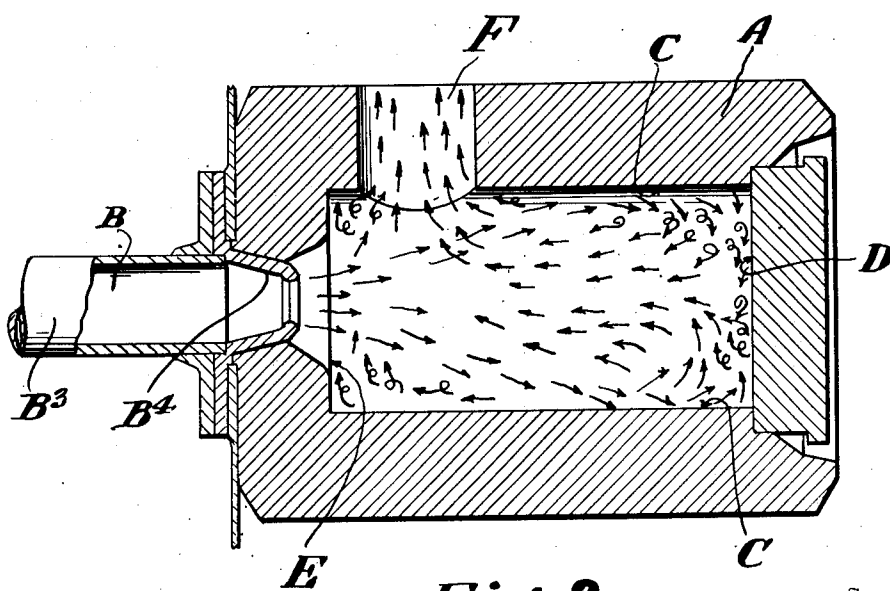
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GENERATION OF GAS

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GENERATION OF GAS

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This invention relates to the generation of gas by the process which consists in subjecting fuel and air to reactive heat in a zone of partial combustion.

The term fuel is employed in this specification to designate all kinds of pulverized fuel such for example, as powdered coal and coke and all kinds of liquid fuel such for example as crude petroleum and all other types of fluid such for example as colloidal mixtures of liquid and pulverized fuel.

Difficulties are often experienced in such processes in preventing the deposition of non-reacted carbonaceous material or ash within the combustion chamber or generator.

Theoretically carbon deposition can be avoided when oil fuel is used by ensuring that the fuel is completely gasified without coming into contact with the interior surfaces of the generator. In practice this would necessitate the employment of a generator of comparatively large size and the maintenance therein of a sufficiently high temperature. Where it is desired to react an amount of fuel relatively large to the combustion space employed it is extremely difficult if not impossible to operate so that complete gasification of the fuel takes place without it coming into contact with the interior surfaces of the generator.

The object therefore of the present invention is to permit the fuel to contact with one or more surfaces within the generator prior to its complete gasification whilst at the same time hindering the deposit within the generator of unreacted or partially reacted particles.

As a result of extensive experiments I have found that the above object can be attained by, (1) so regulating the quantity of fuel that the volume of gas produced and its momentum is sufficient to ensure that deposition of particles by gravity within the generator cannot occur, (2) establishing the fuel and air in process of combustion in a backwardly tending swirling motion by causing the air or gas stream and some or all of the unreacted or partially reacted particles to contact with one or more suitably disposed surfaces within the generator.

The above mentioned backward tendency in the motion of the fuel and air in process of gasification may be produced by giving to the same a suitable vortical swirling motion at some point or points in its path of travel through the generator.

The production of this swirling motion may be effected in various ways. For example a vortical swirling motion may be established by causing the incoming stream of fuel and air to spread outwardly and to contact first with the side or lateral walls of the generator from which the stream in process of gasification is deflected onto the opposing end wall. As a result the stream is caused to turn in on itself towards the centre of the generator. Or the stream of fuel and air may be caused to strike against one or more suitably shaped and positioned baffles within the generator. It may thus be established in a backwardly tending swirl even in operations wherein its general path of progression may be maintained in a generally forward direction.

With the use of low pressure air of approximately fourteen inches of water, I have been able to produce heated gas in the quantity of 7.65 times the volume of the gas generator per second and at this rate of production I have found that deposition of the particles by gravity does not occur.

The swirling motion established in accordance with this invention must not be confused with the progressive spiral or tangential swirl heretofore imparted initially to the fuel stream as it is projected into the gasification chamber as such swirling stream, besides being unsuitable for the purpose of the present invention is employed solely for the purpose of increasing the effective path which the fuel can travel within the gasification chamber.

A process for the generation of gas according to the present invention consists broadly in projecting fuel and air into a gasification chamber in such quantity that the volume of gas produced and its momentum is sufficient to ensure that deposition of particles by gravity within the gasification chamber cannot occur and in establishing the fuel

and air in process of gasification in a backwardly tending swirling motion by causing the air or gas stream and some or all of the unreacted or partially reacted particles to contact with one or more surfaces within the gasification chamber.

It is desirable in process according to this invention to establish the fuel in a finely disseminated state. In fact it appears from my experiments that the reduction of the fuel particles to as small a size as possible before subjection to reactive temperatures is of much greater importance for effective operation than the maintenance of high temperatures at the point of admixture. For various types of pulverized fuel the recommended fineness is that of the usual specification viz:—95% to pass 100 mesh and 85% to pass 200 mesh. In the case of liquid fuel, such as oil, the establishment of the liquid particles as a very fine mist, with a certain amount of vaporization of the lighter constituents, greatly facilitates effective operation.

In order that the invention may be carried into practice the same will now be described by way of example by aid of the accompanying somewhat diagrammatic drawings which illustrate a suitable form of gas generator adapted in one instance for burning pulverized or powdered fuel and in the other instance for burning oil and other liquid fuels and in which:—

Fig. 1 is longitudinal section of the generator adapted for burning oil and other liquid fuels and Fig. 2 is a similar view of the same type of generator adapted for burning pulverized and powdered fuels.

The gas generator or partial combustion chamber A illustrated in which the internal diameter is preferably half the internal length is of cylindrical cross-section, the injector B being arranged co-axially. The fuel entering from the relatively narrow pipe B¹ at the top of the injector B in process of gasification takes approximately the path indicated by the arrows, the same being projected first against the side or lateral surface C from whence it is deflected onto the opposing end wall D. The air is adapted to enter from the relatively wide pipe B² at the bottom of the injector. As a result the fuel and air in process of combustion are established in a backwardly tending swirling motion. The particular swirl established by the means illustrated is a vortical or inturning swirl which causes the hot products of partial combustion to turn inwards towards the centre of the generator and thence to travel in a returning direction towards the front wall E of the generator, thus intermingling with the incoming fuel and air and gasifying the same before passing out through the gas outlet orifice F which is at right angles to the axis of the generator and disposed in that portion of the generator nearest to the in-

jector. In the generator for burning powdered and pulverized fuels which is shown in Figure 2, the injector B used only consists of the pipe B³ having a nozzle B⁴ through which the powdered fuel is projected by means of the primary air.

In operating according to this invention the quantity of fuel flowing into the generator is essentially such that the volume of gas produced and its momentum is sufficient to prevent the deposition by gravity of particles of fuel within the generator.

As an alternative to the method of establishing the swirling motion above described the swirl according to this invention may be established by providing one or more inwardly projecting baffles not shown within the interior of the generator, the faces of such baffles which oppose the incoming fuel and air stream being suitably curved to produce the desired backwardly tending effect. By arranging more than one baffle or set of baffles in tandem the swirl may be established at different points throughout the length of the generator.

The swirl according to this invention may also be established by suitably shaping the interior surface of the generator.

In addition the fuel and air may be introduced into the generator in a previously established swirling motion of the progressive spiral type in which case such spiral swirl may be established by any of the present standard methods therefor.

Facilities may be provided for continuing reaction beyond the outlet by the employment of refractory material and other means as may be found desirable.

In operating according to this invention the temperatures employed at the point of admixture of the fuel and air may be varied according to the requirements or type of apparatus and the point at which the admixture is commenced. Either or both of the constituents of combustion may be preheated by suitable means to any requisite temperature.

Suitable ignition or heating equipment for the preliminary heating of the generator prior to its use for gas production may be also provided. For this purpose, according to one form, a pilot flame may be utilized to ignite the fuel introduced together with means for modifying the ratio and quantities of fuel and air introduced so that complete or practically complete combustion may be secured and a rapid heating of the chamber secured thereby.

Any alternative method of preliminary heating may be used, for example, oil being substituted for pulverized fuel or, if desired, the preliminary heating can be effected electrically or by other suitable means.

As soon as the gas generator is raised to a temperature approximately 600° C. or at such higher initial temperature as is desired, the

ratio and quantities of fuel and air necessary for conversion to a fixed gas may be modified by the provision of separate controls for both the air and the fuel supplies.

When desired, any part of the heat in the uncooled exit gases may be employed for generating or superheating steam and also, if desired, for preheating the fuel and for the endothermic heat absorption in the reaction with steam of any carbonaceous materials whether contained within the product gases or separately therefrom; for example, steam may be admitted, at or close to, the gas outlet F shown in Figure 1 and subjected to reaction with carbonaceous materials by means of the heat of the gas into which it is introduced and the heat radiated from the adjacent refractory walls.

Provision may be made in any suitable way and at any selected point for the enrichment of the gas by means of an oil spray or otherwise and for the subsequent fixation of the gases or vapors so generated.

Satisfactory results are obtained in the operation of this process by the establishment of conditions in which, within a second or a fraction of a second, there is effected an introduction of fuel and air into the generator, their subjection to reactive conditions while in active motion, their conversion, and the withdrawal of the product gases.

These conditions, however, are not prescribed as essential and under certain applications of this principle and certain forms of reaction zone, the time employed in this cycle may be considerably extended.

When the process according to this invention is employed for the production of a fixed combustible gas, the ratio of air to fuel can be controlled to produce the minimum quantity of carbon dioxide and the highest practicable percentage of carbon monoxide, hydrogen, and hydrocarbon gases.

When desired, the generated gases may be subjected to further treatment for the elimination of any non-gaseous particles commingled therewith, such as by the use of scrubbers or by electrical precipitation or by static filters (not shown).

In operations where the gas is to be employed for the heating of furnaces and boilers and where prior cleaning is not essential, they may be directly admitted to such furnaces or combustion chambers for the complete burning therein of the gas generated by this process.

Modifications may be made, however, in the type of generator herein described and the mode of operation to permit of the complete and continuous combustion of fuel therein and the employment of heat thus generated for any useful purpose.

Claim:

A process for generating combustible gas, which comprises heating a small combustible

gas generator to a temperature of about 600° C., injecting therein a conical stream of an ignited mixture of fuel and air with the air in insufficient quantity to produce complete combustion, causing the larger end of the stream to impinge upon surfaces arranged to produce introversion of the outer parts of the stream at its larger end and thereby cause a back flow centrally of the stream and thereby gasify unburnt fuel, and withdrawing the back flowing stream laterally through the smaller portion of the conical stream.

In testimony whereof I hereby affix my signature.

E. S. SUFFERN.

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