

UNITED STATES PATENT OFFICE.

BYRON E. ELDRED AND CARLETON ELLIS, OF NEW YORK, N. Y., ASSIGNORS TO COMBUSTION UTILITIES COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PROCESS OF PRODUCING GAS.

No. 869,486.

Specification of Letters Patent.

Patented Oct. 29, 1907.

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To all whom it may concern:

Be it known that we, BYRON E. ELDRED and CARLETON ELLIS, citizens of the United States, and residents of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Suction Gas-Producer Process, of which the following specification and accompanying drawings disclose as an illustration an embodiment thereof, which we regard as one of the best of the various forms in which the principles of our invention may be applied.

This invention relates to the art of making gas by the producer process as distinguished from the retort and water gas processes.

It relates to that branch of the art wherein the gas producer is functionally remote from the consuming apparatus and may therefore be an entirely independent structure, although independence of structure is not absolutely necessary to the practice of our invention, and it is possible to combine the gas producing and consuming apparatus in a single structure provided its organization be such as to preserve the essential functional characteristics.

Our invention, however, relates particularly to the production of a combustible gas containing little or no hydrogen, particularly adapted for use in internal explosion engines. It has been found that hydrogen is an undesirable constituent of gas used for this purpose. In all gas producers operated by steam the presence of hydrogen is unavoidable as the dissociation of the steam in its passage through the bed of fuel in the producer gives rise to this constituent in large quantities. In order to allow of a continuous operation of the producer and to keep its temperature sufficiently low to prevent the formation of clinker, slag or soot in objectionable quantities, it is necessary to bring about within the mass of fuel an endothermic reaction of some sort. In this way the high temperature of the producer may be avoided and the heat generated by the combustion of carbon to carbon monoxid largely conserved and delivered from the producer in the form of potential heat energy of combustible gas. Steam has been up to the present time practically the only endothermically reacting body selected for this purpose. Carbon dioxid is however far superior to steam in this connection, owing to the facility with which it dissociates and to its cheapness as compared with steam. It has been found difficult to secure carbon dioxid in sufficiently large quantities—that is to say in a concentrated form—for the purpose of satisfactorily regulating and controlling the temperature of the producer and of the constitution of its evolved gases.

The object of the present invention is to provide a method for securing carbon dioxid in the quantities desired and in an economical manner to provide for

its suitable dissociation in the gas producing apparatus and to deliver it in such a manner to the gas consuming apparatus as to effectually conserve the largest amount of energy. For this purpose we make use of the gases arising from the furnaces or kilns used in the calcination of lime or cement, and we preferably use in connection with the operation of said kilns the process of Byron E. Eldred, the same being described in United States Letters Patent 692,257, as such a process we have found gives rise to stack or waste gases carrying large and useful amounts of carbon dioxid. The gases from a kiln of this description, or from any lime kiln of suitable design operated in other ways, are conducted to the gas producer, which consists of a vessel carrying a bed of fuel of such depth as is necessary to effect the endothermic reaction hereinbefore mentioned. To the gases from the lime kiln may be added at any appropriate point prior to their entrance into the producer a certain amount of air, the quantity used being dependent upon the extent to which we desire union of the carbon with the oxygen of the air and the extent to which we desire to oxidize carbon from the oxygen given up by carbon dioxid in passing through the producer. The mixture of stack gases and air is passed through the bed of fuel in any suitable manner. In some cases we prefer to enter the gaseous mixture into the lower part of the producer and allow it to be carried upwards through the mass of fuel. Under other circumstances with fuel of a different character or for other reasons, evident to one skilled in the art to which this appertains, we prefer to enter the gaseous current at other points in the producer, in some cases in fact entering the stack gases at the top of the producer and withdrawing the combustible gas from the lower part of the producer, thus securing a down draft effect. The combustible gas delivered from the producer is drawn by means of a mechanical draft or suction appliance placed in the conduit leading from the producer and is sent to the place of consumption, which generally as hereinbefore mentioned is a gas engine or a battery thereof in which the combustible gas is used for effectually generating mechanical power in any approved manner. For gas engine purposes purification of the gas is desirable and a scrubber or washer and a gas holder may be introduced into the system.

In the accompanying diagrammatic drawings I represents a lime kiln having the fire box 2 and cooler 3 from which the calcined lime is withdrawn. Lime rock is introduced at the top of the kiln at 4. The gaseous products of combustion and of the decomposition of carbonate of lime and carbonate of magnesia, in limestones, dolomite, etc. are taken at 4^a by means of flue 5 to the producer 6. An opening in this flue at 7 serves to admit the required amount of air and adjustment of this air supply may be exactly made by means of the valve 8. A gate or valve 9 is placed in the flue

between the air inlet and the lime kiln in order to assist in controlling the relative proportion of stack gases and air admitted to the producer. Between the air inlet and the gas producer is placed a blast gate 10 to control the volume of the gaseous mixture entering the producer, the composition of said gaseous mixture having been previously regulated by the adjustment of valves 8 and 9. The gas is shown entering the producer through twyers 11 and impinging upon the cone 12, from which it is dispersed in various directions and passes uniformly through the fuel to the receptacle or gas chamber 13 at the top of the producer. From this point it is drawn through conduit 14 and scrubbing or washing tower 20 by means of the suction fan 15 and is delivered to gas-holder 21 and finally to the cylinder of the gas engine 17. Diluent gas may be introduced through pipe 22 and valve 23 into 14 in case the oxygen content of the diluent gas is sufficiently low to be used for this purpose.

Our method of operation is as follows:—Lime stone is fed into the kiln at 4, preferably at frequent and regular intervals and the lime stone is drawn from the coolers of said kiln at corresponding intervals. The calcining fires are preferably regulated as to the temperature and volume, of flame and duration of combustion by means of the process described in United States Letters Patent 692,257 hereinbefore referred to. By applying the principles set forth in this patent and by observing proper care of the kiln a gas of uniform quality and carrying 25 to 35% of carbon dioxid passes from the top of the kiln as waste gas. Such portion of it as is desired for the gas producer is drawn through flue 5 by the suction produced by the suction fan 15. Air is admitted through inlet 7 and the mixture passes to the gas producer or the batteries thereof. A coal fire having been previously kindled in the producer and a depth of fuel bed of from two to four feet in thickness or more or less, according to the nature of the fuel having been secured the valves 8 and 9 are adjusted to secure the temperature desired for the fuel in question. The temperature of a gas producer must be conducted on a much lower plane than is the case in most furnace or firing operations. Prevention of clinker or slag in the gas producer is vital. For that reason the endothermic constituent of the draft current supplied to the producer must be introduced in such amount as to keep the fuel bed ordinarily at a low red temperature. Increase in the aperture of valve 8 and decrease in aperture of valve 9 increases the temperature of the producer, while vice versa, increase in the opening of 9 and decrease in the opening of 8 reduces the temperature of the producer. Coals of different sorts have different clinkering temperatures so that it is impossible to lay down strict rules for the aforesaid adjustment. The information herewith given is sufficient to enable one skilled in the art of operating gas producers to successfully maintain the combustion at the proper rate and to regulate the temperature to meet existing conditions. For the proper observation of the temperature of the producer peep holes such as are shown at 16 are desirable. The combustible gas as produced is drawn through the suction fan 15 and delivered to the gas engines 17 aforesaid. A damper 18 placed in the conduit 14 may be adjusted from time to time to regulate the volume of the com-

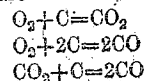
combustible gas drawn from the producer. It is also desirable to have attached to the suction fan a speed regulator of any well known type to determine the volume of gas delivered to the gas engine and to thus have a control separate and independent from the various dampers and other adjusting devices hereinbefore described.

In the application to a battery of gas producers supplying a number of gas engines it is necessary to have a sufficient number of lime or cement kilns to furnish the requisite amount of stack gas required in the operation of this process; and the connections between said lime and cement kilns, producers and gas engines are such as will be apparent to anyone skilled in the art from the description herewith given.

We are aware of proposals for the use of lime kiln gases in the generation of combustible gas which involve the use of complicated regenerative or preheating devices etc., and we do not lay claim to such as a part of the present invention.

We do not limit ourselves to any particular type of lime or cement kiln or gas producer, nor to any particular method of sucking the gases from said lime kiln through the gas producer, although we prefer to use a rotary suction fan for the purpose.

When the oxygen of the air burns to carbon dioxid there is no change in volume; consequently the carbon dioxid found in the products of ordinary combustion is associated with approximately four parts by volume of nitrogen just as the oxygen of the air is associated with approximately four parts of nitrogen. If this oxygen or oxygen and carbon dioxid mixture is used for gas production in the gas producer the reactions which take place are



But in any case the greatest amount of carbon monoxid that can be obtained is twice that by volume of the total free and combined oxygen. This would result, if reduction were complete, in a combustible gas containing one part of carbon monoxid to two parts of nitrogen by volume. In many instances such a gas is not well adapted for internal explosion engines owing to the great volume of nitrogen which it contains. We do not make use in our process of gases of this description, and we do not employ the products of ordinary combustion. Our process involves the use of carbon dioxid associated with less nitrogen than that from ordinary products of combustion, or in other words we use as a producer draft a gaseous mixture containing less nitrogen than that found in the products of ordinary combustion. We thereby secure a gas containing sufficient carbon monoxid to make it highly satisfactory for the operation of gas engines, and for many other purposes where a gas of high thermal value is desired. The process, therefore, must be conducted in such a way as to secure a fairly complete reduction of the carbon dioxid in the quantity and under the conditions above stated. Owing to the decrease in volume of the inert gases, due to the employment of a producer draft containing less nitrogen than that found in ordinary products of combustion, it will be observed that less sensible heat is abstracted from the producer, consequently more carbon dioxid may

be used than is the case with ordinary products of combustion.

What we claim is,

1. The process of producing uniform gas suitable for power purposes which consists in sucking a mixture of lime kiln waste gases and air in adjusted proportions through a deep bed of ignited fuel, diluting the produced gas to a standard strength by regulated additions of a diluting indifferent gas and collecting the standardized gas for use.
2. The process of producing uniform gas suitable for power purposes which consists in sucking a mixture of lime kiln waste gases and air in adjusted proportions through a deep bed of ignited fuel, diluting the produced gas to a standard strength by regulated additions of lime kiln waste gases and collecting the standardized gas for use.
3. The process of producing gas suitable for power purposes which consists in collecting waste gases from a coal

burning lime kiln, admixing the same with regulated amounts of air, sucking the mixture through a deep bed of ignited fuel, purifying the produced gas and collecting the same for use.

4. The process of producing uniform gas suitable for power purposes which consists in collecting waste gases from a coal burning lime kiln, admixing the same with a regulated amount of air, sucking the mixture through a deep bed of ignited fuel, bringing the produced gas to a standard strength by regulated additions of lime kiln waste gases, purifying the gas and collecting the same for use.

Signed at New York city, in the county of New York, and State of New York this 30th day of January, A. D. 1905.

BYRON E. ELDRED.
CARLETON ELLIS.

Witnesses:

JAS. K. CLARK,
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