

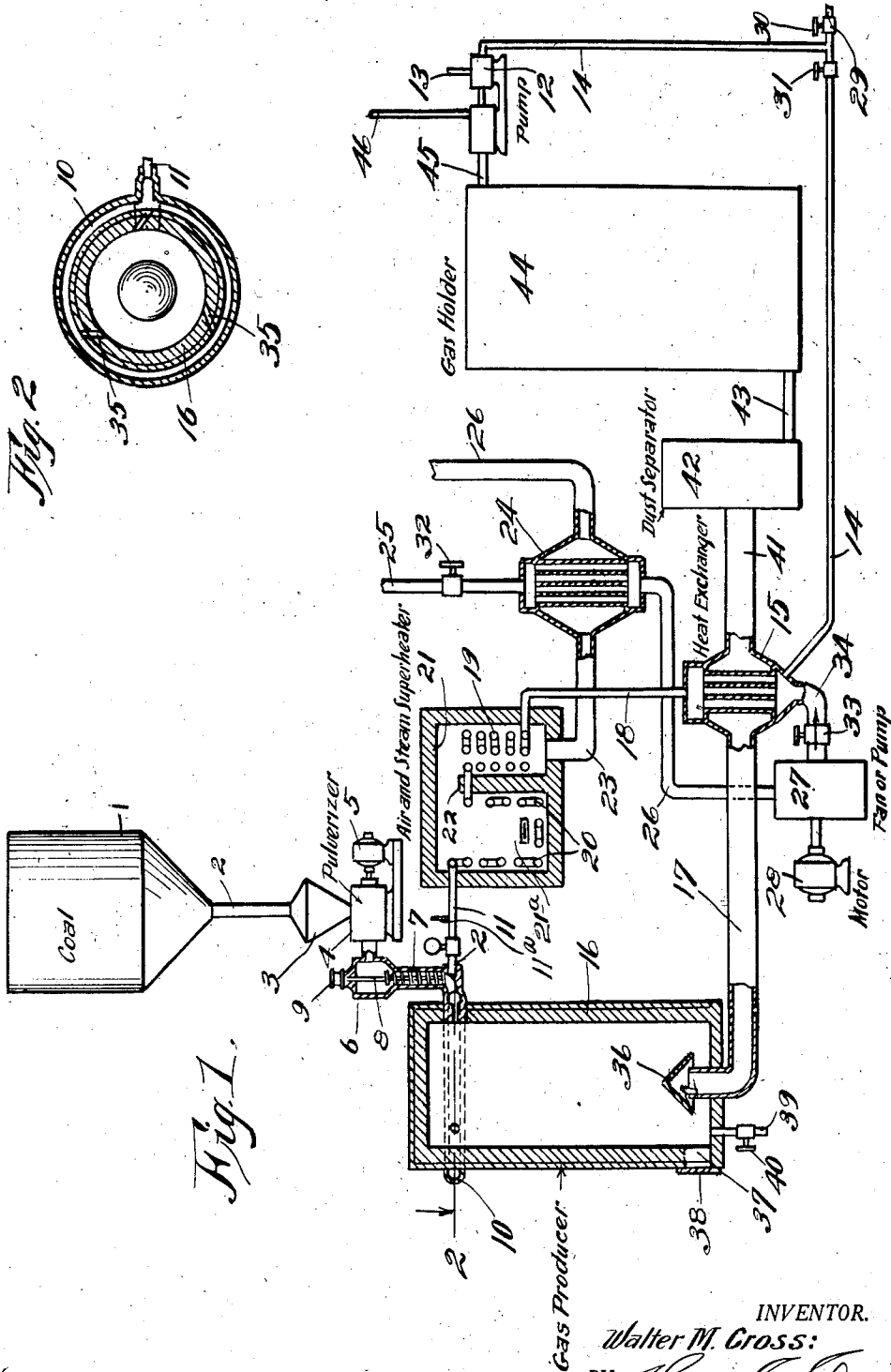
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PROCESS OF MAKING PRODUCER GAS

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PROCESS OF MAKING PRODUCER GAS

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This invention relates to improvements in gas producers and refers more particularly to a system in which gas of a relatively higher B. t. u. content is produced than that manufactured at the present time in gas producers utilizing either oil or coal as the charging medium.

Among the objects of the invention are to provide a gas producer which is not subject to coking or clinkering, free from shut-downs or low gas production periods, to provide a gas producer in which gas is made having a relatively high heat unit content, and to provide a gas producer relatively cheap to operate because of the economical use of the exhaust steam, and waste heat from the gas made in the producer.

The system provides furthermore for the creation and maintenance of temperatures controlled at substantially the reaction temperature of the formation of carbon-monoxide and hydrogen from coal and steam which is in the neighborhood of 900° F.; to provide a coal dust gas producer which gives the contents a whirling or spiral motion while the materials are undergoing reaction, and in general to provide a system hereinafter described in more detail.

Fig. 1 is a diagrammatic side elevational view of the gas producing system.

Fig. 2 is a view taken along the line 2—2 in Fig. 1.

Referring to the drawings, at 1 is shown a coal hopper or bin, which communicates through a conduit 2 with a funnel like feed hopper 3, which is mounted upon the pulverizer 4. The pulverizer is driven by means of a motor diagrammatically shown at 5, or by any other suitable available source of power. The discharge from the pulverizer is delivered into the bin 6 and a screw conveyor 7 driven by a shaft 8 upon which a pulley 9 is mounted. The pulley 9 upon the shaft is driven from any suitable source of power, not shown. The pulverized material, such as coal or coke, which is fed by the screw conveyor passes into the annular duct 10, surrounding the gas producer near its top. To this annular space, or duct is also fed air

and superheated steam through the pipe or conduit 11.

The superheated steam is supplied by the exhaust or discharge from the pump 12, and has a steam inlet line 13 and an exhaust or discharge line 14. The steam passing through the line 14 is directed through a heat exchanger 15 where it is brought in heat exchange relation with the highly heated gas withdrawn from the producer 16 through the pipe 17. After being preheated by the hot gas the steam passes through pipe 18 and is circulated through a series of banks of coils designated as 19 and 20 in the air and steam superheater 21 the superheated steam and air thus passes to the gas producer through the line 11 on which is placed the thermometer 11^a for indicating the degree of temperature to which the air and steam have been superheated.

The air and steam superheater is fired either by gas, oil or coal, the combustion gases passing from the chamber 21^a over the baffle wall 22 and downwardly through the chamber in which the coil 19 is positioned. These partially spent combustion gases are directed thence through a flue 23 and into the heat exchanger 24, where they are brought in heat exchange relation with cool air through the pipe 25. After being cooled by the heat transfer in the exchanger 24 the combustion gases pass off to a flue 26.

The air, as suggested, introduced through the pipe 25 receives heat from the combustion gases in the exchanger 24 and passes through the line 26 to an air pump 27 driven by a motor 28. By means of the pump the air is discharged through the second heat exchanger 15 in which it is combined with the steam introduced thereto through the line 14. In the exchanger 15 the preheated air and steam receives additional heat from the highly heated gas discharge from the producer through the line 17. The combined air and steam pass through the line 18 and receive their final raise in temperature in the superheater 21. The discharge line 29 controlled by a valve 30 serves as a means for diverting a portion of the steam exhaust from the pump while the steam introduced to the

system is regulated by a valve 31 in the line 14. In the same manner the injection of air is controlled by valves 32 in the line 25 and 33 in the line 34 which connects the pump 5 27 with the heat exchanger 15.

Returning to the construction of the gas producer and the method of manufacturing gas from the fuel supplied through the screw conveyor and conduit 10 and the air and superheated steam supplied through the line 11, these materials are introduced to the producer through tuyères or injection nozzles 35, which are set at an angle in order that the materials will be injected substantially tangentially into the circular producer. The producer is highly insulated to prevent insofar as is possible a loss of heat by radiation. The mixture or charge, as suggested, is given a whirling or spiral motion on its injection 10 into the producer and continues this whirling turbulence throughout its travel from the top of the producer to the bottom where the gas passes out through a baffle discharge line 17. The hood 36 separates solid impurities such as dust from the gas. The producer 15 is equipped with a cleanout hole 37 which is covered by a removable plate 38. In the bottom of the producer is a molten slag draw-off pipe 39, controlled by a valve 40.

The producer gas discharged through the line 17 passes through the heat exchanger 15 where it gives up a considerable part of its heat to the steam and air introduced through the pipes 14 and 34 respectively. From the exchanger the gas passes through the pipe 35 41 into the dust separator 42, the marketable gas being delivered through a line 43 to a gas holder 44 from which it may be withdrawn and distributed by the pump 12, which has a suction line 45 communicating with the gas holder and a discharge line 46 for delivery of the gas to the mains or other desired delivery point.

In the system it is contemplated to heat the mixture of air and steam to a temperature 45 of reaction by passing it through a heat exchanger and then through the superheater in series. By raising the mixture of air and steam to this reaction temperature it is unnecessary otherwise to rely upon a partial combustion of the air in the producer to maintain the heat of reaction and thereby reduce the quality of the gas made.

The introduction of the air and steam mixture with the pulverized coal or oil in such a way as to promote a high degree of turbulence in the reacting stage or producer, while operating, effects not only an intimate combination of the constituents, but improves the character of the gas produced. The process is continuous, as contrasted with the normal type of gas producer operation, in which a considerable period of the operation is taken up with the heating of the producer to the 60 desired reaction temperature, or the tempera-

ture at which the air and steam will combine with the pulverized fuel or oil constituents to produce the quality of gas desired.

The producer is free from the difficulties incidental to coking and channeling common to most gas producers. The coking and channeling materially slows down the production of the producer and seriously affects its efficiency.

In the present assembly or construction there is provided a means for superheating steam and air mixtures more or less according to the number of B. t. u.'s required in the gas. Thus, when a gas is desired having a high B. t. u. content, a very small amount of air and relatively large amount of steam heated to a temperature of in the neighborhood of 2200° F. is used for introduction to the producer to be combined with the coal dust. Due to the fact that so much heat is brought in by means of the air and steam mixture, there will be relatively little combustion required to keep the temperature of the gas producer at a proper reaction temperature for the economical production of the producer gas.

Under the above conditions the dilution by nitrogen of the atmosphere is greatly minimized and accordingly the gas has a correspondingly higher heating value per cubic foot.

For example, when Southern Illinois bituminous coal is used and the steam and air are heated to say 2500° F. where they enter the gas producer, the B. t. u. value of the gas passing out of the system will be about 300 per cubic foot, more or less, according to the volatile hydrocarbon content of the various Southern Illinois coals. For any particular coal or other fuel the B. t. u. content of the gas will remain practically the same continuously, so long as the coal, steam and air are fed in at a uniform rate and the steam and air are heated to a particular temperature, of say 2500° F. A typical sample analysis of gas made by this continuous process under these conditions of continuous operation with powdered bituminous coal having a volatile content of say 32% is substantially as follows:

	Per cent by volume
Carbon dioxide (CO ₂)	1.2
Carbon monoxide (CO)	27.3
Hydrogen (H ₂)	33.6
Methane (CH ₄)	7.5
Illuminants (C _n H ₂ N)	2.8
Per cent by difference	
Nitrogen (N ₂)	27.6

When transportation distances are relatively small, and it is not desired to produce a gas having such high B. t. u. value, the steam is superheated to a lesser degree. In such a case unsuperheated steam may be used where only a gas having a B. t. u. content of 125 per cubic foot of producer gas would be required.

In other cases where the producer gas is to be used in internal combustion engines there would be no object in using a very dilute gas.

In the present construction means are provided for pulverizing the coal and for blowing it or transferring it into the gas producer by means of superheated steam and air. The steam, preferably that taken from a pump such as a gas distributing pump, is superheated by being brought in heat exchanging relation with the gas from the producer, and also by a supplementary heater. The gas from the producer may come off at temperatures as high as 2200° F. and a large amount of this heat may be conserved or utilized by transmission to the steam and air which is being supplied to the producer. A large amount of heat in the gas is ordinarily lost in the ordinary practices and the recovery shown in the present custom will effect a saving so that the actual cost of heating the air and steam is greatly minimized over what has been the general practice heretofore.

Briefly, then, the novelty in the present invention lies primarily

(1) In the making of producer gas from carbonaceous material, preferably in a finely divided condition. This carbonaceous material may consist of coal dust, or heavy oil having a relatively high carbon content.

(2) The system affords a process for producing a gas for relatively high B. t. u. content by superheating the steam and air required for the production of producer gas to a controlled predetermined temperature corresponding or above the minimum reaction temperature.

(3) The combination and utilization of the exhaust steam from pumps and the heat exchanging equipment by means of which the heat of the gas discharged from the producer is transferred to the air and steam being introduced thereto. Also the use of supplementary superheater for the air and steam in combination with a heat exchanger in the flue of the superheater for taking advantage of the heat of the flue gases.

(4) A means for withdrawing the slag continuously while the gas producer is operating and for burning the fuel advantageously.

(5) A process in which the steam and air are heated substantially to or above the reacting temperature. A condition which promotes the rapidity of gas production during which reaction the carbonaceous material combines with the steam and air to form carbon-monoxide and hydrogen in a desired and controlled relation.

(6) The placing of the inlet for the carbonaceous material and steam in a position on the producer so that the mixture is projected into the producer approximately tangentially to the inner surface of the cylindrical wall of the producer, thus giving

greater turbidity to the constituents undergoing reaction, which promotes a more complete combination.

I claim as my invention:

A continuous process of making producer gas, comprising the steps of charging a pulverized solid carbonaceous fuel into the top of a reaction chamber, simultaneously charging a preheated mixture of air and steam into the top of said reaction chamber, said mixture of air and steam being preheated to a constant predetermined temperature of reaction whereby producer gas results when charged in the chamber with the fuel, and withdrawing producer gas from the bottom of the chamber at a temperature of substantially 2200° F. 70 75 80

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