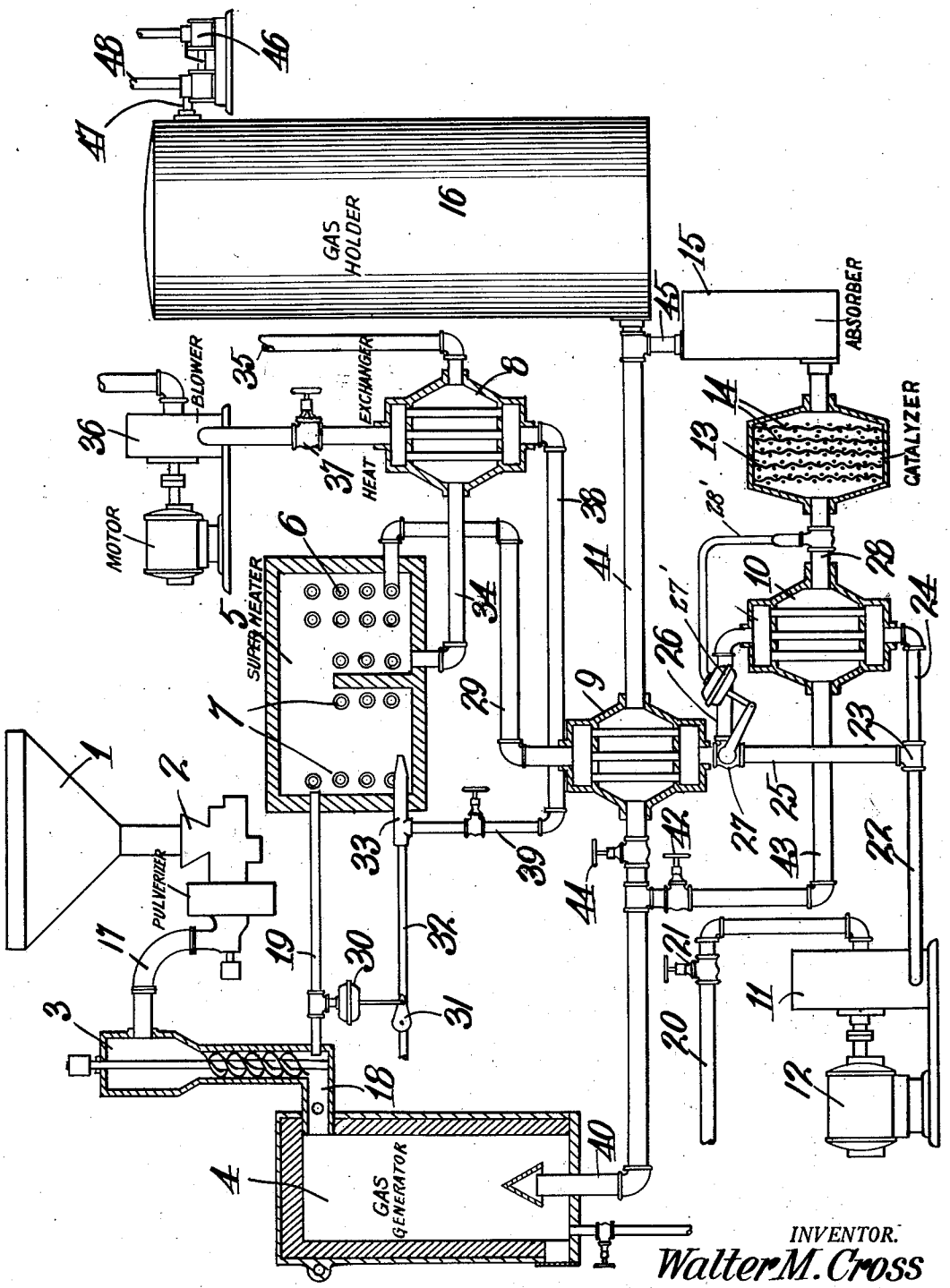
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METHOD OF MAKING WATER GAS

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METHOD OF MAKING WATER GAS

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This invention relates to improvements in a method of making water gas and refers more particularly to a method and system in which gas of relatively high B. t. u. content is produced.

The method contemplates the use of a hydrocarbon or carbonaceous material with steam alone, the steam being preheated to a sufficient temperature and used in sufficient quantities to carry all the heat necessary for the reaction between the steam and the carbonaceous material.

The application is a continuation in part of a co-pending application, Serial No. 151,420, filed November 29, 1926.

The novelty in the invention lies primarily in making gas having a high B. t. u. content suitable for transporting long distances in pipe lines. This is accomplished by supplying steam alone which is used to carry heat into the gas generator itself, and sufficient excess of steam and steam at such a high temperature is employed as to permit continuously carrying on the reaction by which carbon or carbonaceous material is converted into carbon monoxide and hydrogen. Since there is concerned a high endothermic action in such gas manufacture, a large excess of steam must be used over the minimum required for carrying on the action. The use of steam alone to bring the heat into the reaction, eliminates the diluting effect which air has on account of the residual nitrogen which remains after the oxidation of the carbonaceous material in usual gas making processes.

By this process also additional enrichment of the gas is achieved by means of passing the water gas, which is substantially free from nitrogen, through a catalyst which has the effect of converting the carbon monoxide and hydrogen into carbon dioxide and methane. The carbon dioxide is then absorbed out so that the methane remains as a rich marketable gas.

The single figure is a diagrammatic elevational view of a form of apparatus capable of being used in carrying out the process, with parts in section.

Referring to the drawing, at 1 is shown a coal bin. 2 is a pulverizer, 3 an automatic screw conveyor, 4 a gas generator, and 5 a superheater furnace in which are positioned banks of coils 6 and 7. 8, 9 and 10 are heat exchangers, 11 is a blower fan driven by a motor 12. 13 is a catalyst in which is positioned a plurality of nickel screens, iron oxide or other metallic catalysts, diagrammatically shown at 14. 15 is a carbon dioxide absorber and 16 a gas holder.

In operation, coal, lignite or other solid carbonaceous material is introduced into the hopper or bin 1 and is fed into the pulverizer where it is disintegrated into a finely divided condition. From the pulverizer 2 it is discharged through a pipe 17 to a screw conveyor 3 through which it is automatically fed to the charging line 18. At the charging inlet the pulverized carbonaceous material may be replaced by finely divided hydrocarbon oil which may be introduced directly to the charging pipe. In any event this hydrocarbon or carbonaceous material is injected with steam supplied through the pipe 19.

Steam is introduced to the system through the pipe 20 controlled by a valve 21, and may be procured from any desirable source, preferably exhaust steam under low pressure. This steam is picked up by the blower 11 and is directed through the pipe 22 which connects with a T-connection 23. A line 24 connected into one side of the T has communication with the heat exchanger 10 and a pipe 25 connects into the remaining connection of the T and acts as a by-pass around the heat exchanger. The discharge from the heat exchanger terminates in a line 26 which is fitted into a two-way valve 27 into which is also connected the by-pass 25. The two-way valve 27 is manipulated from a thermostatic control which is connected with the discharge line 28 from the heat exchanger, through small auxiliary line 28'. The thermostatic control device appears in the drawing at 27'. This control device actuates the valve 27 by the temperature of gas passing through the heat exchanger and which is brought in heat exchange relation with the incoming steam. The temperature of the gas entering the catalyzer controls the thermo-

static element of the thermostatic control to maintain the temperature of the gas entering the catalyzer constant. If the temperature drops below the desired figure, more steam is admitted, and if the temperature is too high the steam supply is lessened. Thus it is seen that the temperature of the gas entering the catalyzer is kept constant.

In any event the steam supplied to the system is either directed immediately to the heat exchanger 9 through the by-pass connection 25, or by actuation of the valve 27 it may be directed through the heat exchanger 10 or a portion passed through both lines, according to the temperature of the discharged gas from the heat exchanger 10.

The steam supplied to the system and passing through the two-way valve 27 is directed thence through the heat exchanger 9 and through pipe connection 29 to the bank of tubes 6 positioned in the furnace 5. Here the steam is superheated, passing both through the bank of tubes 6 and the adjacent bank of tubes 7 of the adjoining compartment of the superheater. Within the tubes 6 and 7 the steam is superheated to a temperature ranging from 2000 to 3000° F. Silica tubes have been found adaptable to this use and capable of withstanding the high temperatures. Normal temperatures of the order of 2700° F. or thereabouts are used, as these temperatures have been found sufficient to maintain proper gas making conditions in the gas producer with the carbonaceous material supplying sufficient heat to continuously carry on the reaction taking place. The temperature of the steam is automatically regulated by a temperature control device 30 interposed in the line 19 and manipulating the valve 31 in the fuel supply line 32 of the burner 33. The flue gases from the superheater are discharged through the pipe 34 and pass through the heat exchanger 8 from which they are discharged into a chimney or stack, not shown, through the flue gas line 35. Air supplied to the burner 33 is introduced through the pipe 36 controlled by a valve 37, and is forced by a suitable pump through the heat exchanger 8 where it is brought in heat exchange relation with the flue gases. Passing from the heat exchanger it is directed at high temperatures through the duct 38 and pipe 39 to the burner 33.

The gas from the generator is discharged at temperatures in the neighborhood of 1500° F., more or less, through the pipe 40 and may be directed through the heat exchanger 9 and pipe 41 immediately to the gas holder 16 by closing the valve 42 in the pipe 43. In this operation the catalytic action is dispensed with and the gas discharged from the generator directly into the holder and stored for use.

In order to procure an improved type of gas in so far as its B. t. u. content is concerned, the valve 44 in the line 40 may be partially closed and the valve 42 partly open so that a portion of the gas is diverted through the line 43 and passed through heat exchanger 10, catalyzer 14 and CO_2 absorber 15 after which it is combined with the gas passing direct through the exchanger 9 and line 41 by a connecting pipe 45 which communicates between the CO_2 absorber and the line 41. To distribute the gas a pump 46 is connected to the gas holder by a suction line 47 and the gas drawn off from the gas holder and discharged to consumers through the pipe 48. Operations with or without the catalytic stage are contemplated as well as a combination of the two operations.

It is recognized as being old practice to utilize superheated steam with carbonaceous material to make water gas and there is no attempt in the present disclosure to lay any claim to such an operation. It is, however, thought to be a new practice to superheat the steam to a sufficient degree and automatically control the temperature of the superheat so that it is unnecessary with the use of excess steam to add air or other oxidizing material to supply heat for the reaction which is continuously carried on in the gas producer. It is thought to be novel practice also to direct gas produced in this manner over a catalyzer and through an absorber to purify the gas and have as a resultant manufactured product a gas of relatively high B. t. u. content, which in accordance with this practice may be as high as 800 B. t. u.'s per cubic foot.

The operation contemplates the production of gas by the use of superheated steam heated sufficiently high to supply the adequate heat to continuously carry on the gas producing operation and subsequently collect the gas, and an additional operation which contemplates the passing of this gas through a catalyzer by which carbon monoxide and hydrogen are converted into carbon dioxide and methane and passing the mixture through an absorber to remove the carbon dioxide.

I claim as my invention:

1. A continuous method of making combustible gas, comprising the steps of charging solid pulverized carbonaceous material to a stage of reaction with steam, said steam being heated to or above a predetermined temperature of reaction whereby hot gas containing carbon monoxide and hydrogen results, subsequently passing the hot gas into contact with a nickel catalyzer whereby methane is formed from carbon monoxide and hydrogen, and automatically controlling the temperature of the gas entering the catalyzer.

2. A continuous method of making a combustible gas, comprising the steps of charging solid pulverized carbonaceous material to a stage of reaction with steam, said steam be-

ing heated automatically to or above a predetermined temperature of reaction whereby hot gas containing carbon monoxide and hydrogen results, subsequently subjecting the gas to the action of a nickel catalyst to form methane and carbon dioxide from the carbon monoxide and hydrogen, automatically controlling the temperature of the gas entering the catalyzing stage, and separating the carbon dioxide from the gas.

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