UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING NATURAL GAS TO CONVERT IT INTO ILLUMINATING-GAS.

SPECIFICATION forming part of Letters Patent No. 345,980, dated July 20, 1886.

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To all whom it may concern:

Be it known that I, JOHN MCKAY, a citizen of the United States, residing at Titusville, in the county of Crawford and State of Pennsylvania, have invented a new and useful Improvement in the Process of Treating Natural Gas and Converting it into a Fixed Gas Suitable for Illuminating Purposes; and I do hereby declare that the following is a full, clear, and exact description of my invention, which will enable others skilled in the art to which it appertains to make and use the same.

The object of my invention is to treat natural gas and convert it into a fixed gas suitable for illuminating purposes, as hereinafter fully set forth.

By the term "natural gas" I refer to the natural gas of the earth as it is found in various parts of the world, and notably near Pittsburg and the oil regions of Pennsylvania; but, wherever found, natural gas has never given any satisfaction when burned for illuminating purposes. When it is used, the flame from the burner is uncertain, flickering, unsteady, and flabby; it has a great tendency to topple over, the movement of the air in the room having a great influence upon it; it smokes at one moment and the next moment it "blows"—that is, burns with a blue flame and sputtering noise—and it is of a very low candle power. In fact, it acts like a mixture of gases that are not thoroughly united and fixed. Add to this that natural gas from each source differs in composition, and also natural gas from the same source varies in its composition and properties from time to time, and it will be seen that it is not practical to use this gas as an illuminating-gas until it has undergone some treatment whereby it becomes converted into a fixed uniform gas of satisfactory specific gravity and illuminating-power. It will be seen, also, that any process that is to succeed in converting natural gas into an illuminating-gas must be capable of ready adaptation to the changing condition of the problem and the varying qualities of the natural gas itself. This I have accomplished in my process by having under immediate control the regulation of the steam, natural gas, hydrocarbons admitted, and the heat to which they are subjected.

My process of treating natural gas and converting it into an illuminating-gas is as follows: I introduce into the bed of fuel of any water-gas apparatus or generator or retort a stream of natural gas and steam, and cause the steam and natural gas to pass through the bed of highly-heated fuel, whereby decomposition and recomposition of the steam and natural gas are effected. With the gas thus formed I then mix any suitable hydrocarbon sprayed in at any suitable point above the fire, and the combined gases formed from the steam, natural gas, and hydrocarbon may be subsequently passed through a heated fixing-chamber or superheater, if found necessary. The hydrocarbon I spray in by means of a jet of natural gas or steam, or simply under pressure, as may be found best suited to the circumstances. The entrance of the natural gas and steam is separately controlled by valves, so that I can introduce natural gas commingled with steam in any proportion, or either the steam or natural gas by itself, if so desired.

I do not intend to limit myself to any form of generator, as my process is equally applicable to any form of closed retort containing a bed of fuel. Nor do I limit myself to the use of a hydrocarbon sprayed into the gas after it has passed through the fire, as this part of the process, according to the quality of the natural gas and the candle power sought, may be omitted entirely; or the hydrocarbon may be mixed with the natural gas either before or after the natural gas passes through the bed of fire. Nor is it necessary to always use a superheater or to pass steam in connection with the natural gas through the bed of fuel. In point of fact I have manufactured gas for illuminating purposes on a commercial scale by this process, and I am convinced that simply passing natural gas, either alone or in connection with steam, through a bed of highly-heated fuel, not only converts the natural gas into a gas that will burn without the objectionable characteristics of the natural gas, but also enriches it, possibly by the formation of hydrocarbon gases from the direct union of the carbon of the fuel and the hydrogen of the natural gas or steam.

In order to more fully illustrate my mean-

ing, I will describe some of the modifications of my process which I have used, and I do not claim that any one of the methods is the more effective, for the choice of methods depends upon the quality of the natural gas used and the candle power desired in the resulting illuminating-gas. After the bed of fuel in the apparatus was brought to the proper heat by means of an air-blast or otherwise, I introduced a jet of steam into the bed of fuel and caused it to pass through said fuel. At the same time I gradually turned on a stream of natural gas, which, entering the apparatus or retort by the same pipe with the steam, also passes through the bed of fuel with the steam. By valves separately controlling the entrance of the steam and natural gas I mix these together in any proportion, or cut off the supply of steam altogether and introduce the natural gas alone.

One advantage in using the natural gas alone is that the bed of fuel does not waste away so quickly nor become so quickly cooled as when steam is also used. In this way the steam or natural gas, or a mixture of both, comes into intimate and direct contact with the highly-heated fuel, and decomposition and recomposition are thereby effected, which result in converting the natural gas into a fixed illuminating-gas of greater or less candle power. A sample of the gas as fast as made is burned through suitable burners in front of the operator. When the operation has gone on some time and the bed of fire has become so cooled that no decomposition of the natural gas takes place, the flame of these burners will immediately show that such is the case by burning with all the characteristics of natural gas which I have before noted. The operation is then stopped and the bed of fuel is again raised to the proper temperature by an air-blast or otherwise, then the natural gas again introduced, as before.

By the process above described I have produced an illuminating-gas of greater or less candle power; but where an additional candle power is desired I have introduced a jet of hydrocarbon above the fire, as before described, or have carbureted the natural gas by any suitable means before its introduction into the bed of fuel. Should the gas formed by any of the foregoing modifications of my process be thought to need further fixing, I can pass it through any suitable heated fixing-chamber or superheater.

Having spoken several times of carbureting the natural gas either before or after its introduction into the bed of highly-heated fuel, I will now describe more in detail how I have done this. I place a tank containing some suitable hydrocarbon—such, for instance, as crude petroleum—at such a height above the point of introduction into the gas apparatus or retort that it will flow in by its own gravity. When the oil issues from the tank, it drops about a foot through the air before entering the pipe that leads to the gas apparatus, and this pipe is provided with a funnel at its upper end to receive the oil. The object of this arrangement is to enable the operator standing in front of the apparatus to always see how large a stream of oil is flowing in, or to note its stoppage should anything occur to obstruct the flow of oil from the tank. I place close to the end of the pipe, where the oil flows into the apparatus or retort, another pipe for the introduction of steam or gas, with its opening so adjusted that the jet of steam or gas entering under pressure impinges against the inflowing stream of oil and atomizes it or breaks it up into fine spray, whereby it is the more quickly and effectively subjected to the action of the heat within the retort.

Outside of the apparatus I have a suitable arrangement of pipes and valves, so I can introduce either steam or gas, or both, to spray in the oil. The object of this is that should the heat at the beginning of the operation be so high that there is danger of so decomposing the hydrocarbon that its carbon would be deposited as lamp-black, then I use a jet of steam to spray in the oil and protect it from the excessive heat; but when the operation has gone on some time and the heat is somewhat reduced I have found it best to economize the heat by cutting off the steam and spraying in the oil with a jet of natural gas. This jet of hydrocarbon may be introduced, as above described, anywhere above the fire or in the heated fixing-chamber or superheater, if one is used, according as is found best with the particular form of apparatus to which my process is applied.

Another mode of carbureting which I have used is to carburet the natural gas before its introduction into the bed of fuel. This may be done by carbureting the natural gas either alone or in connection with steam in any suitable carburetor before introducing the natural gas into the bed of the highly-heated fuel. As an instance of one way of accomplishing this result is the following: I introduce the natural gas into the base of a gas-scrubber, preferably one the same or similar in form and operation to the one invented by me and for which I received Letters Patent, (No. 328,131,) and at the same time introduce into the top of the scrubber above the revolving brush a jet of crude petroleum or naphtha, or a jet of crude petroleum mingled with a jet of steam. The revolving brush being put in motion, and the liquids descending and meeting the ascending gas, they become intimately mingled and the gas is carbureted.

In introducing the natural gas and steam into the bed of fuel I find it often best to introduce the steam alone at first, and afterward turn on the natural gas and turn off the steam. My object in this is to partially cool the surface of the fuel where the natural gas enters and prevent the deposit of lamp-black, which might otherwise occur if the natural gas were subjected to the heat of the fuel immediately after it has been raised to an intense heat by the air-blast or otherwise. At the end of the

operation, after the natural gas is turned off, I run steam alone through the fuel for a few moments before the apparatus is opened for the entrance of the air, to make sure that no natural gas is left in the apparatus or retort to cause an explosion.

Should the gas formed by any of the foregoing modifications of my process be thought to need further fixing, I pass it through any suitable heated fixing-chamber or superheater.

It will be seen from the above description of my process that it can be applied to any form of water-gas apparatus now in use, and does not require new and costly machinery nor skilled labor to make it a success.

I find that by treating natural gas, as above described, by passing it through a bed of heated fuel, not only is the natural gas converted into a fixed gas of improved illuminating-power, but its volume is also materially increased. This increase in volume, as well as the conversion of the natural gas into a fixed gas of improved candle power, I believe, is due not to heat alone, but to the fact that the natural gas is subjected to the influence and action of highly-heated carbon, with which it comes into direct and intimate contact, with the result that chemical changes take place and the natural gas is converted into a fixed gas of greater volume and illuminating-power.

The energy represented by the changes in composition and the increase of volume in the resulting gas is the equivalent of the amount of fuel destroyed or absorbed during the operation.

Most natural gas contains silicon or its compounds, generally in the form of an extremely fine sand, which is blown out of the wells with the natural gas and travels in the pipes long distances. In my process as above described this substance is removed in the bed of highly-heated fuel, and shows its presence in the increased amount of silicious slag or clinker that is obtained when natural gas is treated over the amount usually obtained from the same fuel when making water-gas.

In this application I do not claim the processes of treating natural gas for converting it into illuminating-gas by passing it, in connection with steam, through a body of heated fuel; or by passing natural gas, in connection with steam, through a body of heated fuel, and then carbureting it; or by passing natural gas, in connection with steam, through a body of heated fuel, then carbureting it, and finally passing it through a heated fixing-chamber, as such methods of operating are made the subject of a patent granted to me April 20, 1886, No. 340,232. Nor do I claim herein the process of first carbureting the natural gas, and passing it, in connection with steam, through a body of heated fuel, and from thence through a superheater, as such a method of operating is made the subject of a patent granted to me April 20, 1886, No. 340,231. Nor do I claim the process of manufacturing gas herein, which consists in converting natural gas of varying quality into an illuminating-gas by passing natural gas through a body of highly-heated fuel, or by passing it through a body of highly-heated fuel and then through a heated fixing-chamber or superheater. Nor do I claim herein the process of treating natural gas for converting it into an illuminating-gas by passing it through a bed of highly-heated fuel, and then mixing with such gas hydrocarbon vapor for forming an illuminating-gas of the desired candle power; or by passing it through a bed of highly-heated fuel, and then mixing with such gas hydrocarbon vapor for forming an illuminating-gas, and finally passing the mixture of gases thus formed through a heated fixing-chamber or superheater; or the process of manufacturing gas which consists in converting natural gas of varying quality into an illuminating-gas of the desired candle power by first carbureting the natural gas or mixing with it any suitable hydrocarbon, and then passing the natural gas thus carbureted through a body of incandescent or highly-heated fuel, whereby it comes into intimate and direct contact with said fuel, and decomposition and recomposition are thereby effected, and the natural gas and hydrocarbon are converted into a fixed illuminating-gas; or the process of manufacturing gas which consists in converting natural gas of varying quality into an illuminating-gas of the desired candle powder by first carbureting the natural gas or mixing with it any suitable hydrocarbon, and then passing the natural gas thus carbureted through a body of incandescent or highly-heated fuel, whereby it comes into intimate and direct contact with said fuel, and decomposition and recomposition are thereby effected, and then passing the mixture of gas thus formed through a heated fixing-chamber or superheater, as such methods of operating are made the subject of a separate application.

What I claim as my invention is—

1. The process above described of manufacturing gas, which consists in converting natural gas of varying quality into an illuminating-gas of the desired candle power by passing the natural gas through a body of incandescent or highly-heated fuel, whereby it comes into intimate and direct contact with said fuel, and decomposition and recomposition are thereby effected and the natural gas is converted into a fixed gas, and simultaneously carbureting such gas by injecting into it a suitable proportion of hydrocarbon by means of a jet of natural gas, steam, or its equivalent, as herein specified.

2. The process above described of manufacturing gas, which consists in converting natural gas of varying quality into an illuminating-gas of the desired candle power by passing the natural gas through a body of incandescent or highly-heated fuel, whereby it comes into intimate and direct contact with said fuel, and decomposition and recomposition are thereby effected; and simultaneously

carbureting such gas by injecting into it a suitable proportion of hydrocarbon by means of a jet of natural gas, steam, or its equivalent, as herein specified, and finally passing the mixture of gases thus formed through a heated fixing-chamber or superheater, whereby the natural gas is converted into a fixed illuminating-gas of the desired candle power.

3. The process above described of manufacturing gas, which consists in converting natural gas of varying quality into an illuminating-gas of the desired candle power by first carburetting the natural gas by mixing it with any suitable hydrocarbon, and then passing the natural gas thus carbureted in connection with steam through a body of incandescent or highly-heated fuel, whereby it comes into intimate and direct contact with said fuel, and decomposition and recomposition are thereby effected, and the natural gas and steam and hydrocarbons are converted into a fixed illuminating-gas.

4. In connection with the above-described process of converting natural gas into an illuminating-gas by passing it through a bed of highly-heated fuel, the method of introducing the natural gas into the bed of fuel by first passing steam through the bed of fuel, and afterward passing through said fuel the natural gas and shutting off the steam, as herein described, and for the purpose set forth.

5. The process above described of manufacturing gas, which consists in converting natural gas of varying quality into an illuminating-gas of improved candle power by passing natural gas, together with steam, through a body of incandescent or highly-heated fuel, whereby it comes into intimate and direct contact with said fuel, and decomposition and recomposition are thereby effected, and then passing the gases thus formed through a heated fixing-chamber or superheater, and natural gas and steam become converted into a fixed illuminating-gas of improved candle power.

JOHN McKAY.

Witnesses:
ERASTUS T. ROBERTS,
JOSEPH KONRAD.