UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN MANUFACTURE OF GAS FOR BURNING AND LIGHTING.

Specification forming part of Letters Patent No. **169,037**, dated October 19, 1875; application filed April 24, 1875.

To all whom it may concern:

Be it known that I, THOMAS BOVERTON REDWOOD, of Fairlawn Finchley, in the county of Middlesex, England, a subject of the Queen of Great Britain, have invented or discovered new and useful Improvements in the Manufacture of Gas for Burning, to produce light or heat; and I, the said THOMAS BOVERTON REDWOOD, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof—that is to say:

This invention has for its object the production of a permanent gas, consisting of a mixture of water-gas, and a gas rich in carbon, produced from petroleum and other hydrocarbon oils, including the oils obtained from coal, shale, peat, and other sources. As met with in commerce these oils often contain solid hydrocarbons, such as paraffine. They are mixtures in various proportions of several proximate constituents, differing in density and volatility, but consisting, for the most part, of carbon and hydrogen in proportions, which, in some of their constituents, accord with, and in others differ but slightly from, those in which the same elements exist in olefiant gas, or other permanent hydrocarbon gases, which are the most valuable light-producing constituents, of the richest and best description of coal-gas, or of gas suitable for burning as a source of light.

It has long been known that by the application of heat the hydrocarbon oils, such as I have alluded to, may be made to yield a gas tolerably rich in carbon. The principal difficulty experienced in getting a good permanent gas, rich in carbon, from hydrocarbon oils, has been that of so regulating and applying the heat as to insure the conversion of the oils, or their vapors, into permanent gas without, at the same time, causing much of the carbon, which is the true source of light during the combustion of gas, to be deposited in a solid shape. It is necessary to apply a temperature above that of visible redness in order to change the vapor of the oil into permanent gas, and there appears to be but a small range of temperatures through which that change can be effected in contact with most solid substances, without converting part of the oil into a species of tar, and at the same time causing a deposition of solid carbon from the gaseous product.

By the method hereinafter described the liquid hydrocarbons alluded to, or their gaseous products, together with water-gas, may be subjected to a higher temperature than it has been found practicable to apply to them by the usual methods, without causing a deposition of solid carbon. Liquid hydrocarbons, or their vapors, when heated in contact with metallic copper or an alloy of copper, such as brass or gun metal, will bear the application of a higher temperature than can be applied to them by contact with other substances without depositing solid carbon, and the range of temperature, at which the conversion of the oils into permanent gas, without loss of carbon, takes place, is thus enlarged, so that a more uniform and satisfactory result may be practically attained, and an important economy effected.

I have found that if the liquid hydrocarbons or their vapors be introduced into a hot chamber, together with a permanent gas, such as water-gas, which is either previously or immediately heated to a temperature, which, in a metal or other solid body, would be represented as that of bright redness, the vapors of the hydrocarbon oils may, under these circumstances, be subjected in contact with copper, or an alloy of copper, to a cherry-red heat, and will thus be more completely and satisfactorily converted into a permanent gas than would otherwise be the case.

My improved process for the manufacture of gas for burning is founded upon the foregoing facts. The vapors of liquid or solid hydrocarbons, such as I have described, are converted into permanent gas with little or no deposition of carbon, with the intervention of water-gas, by the following method: The water-gas I use is obtained by the well-known process of passing superheated steam over the surface of incandescent carbon at a high temperature, when a mixture of hydrogen gas and carbonic oxide is produced together with some carbonic acid, which is removed by means of slaked lime before using the gas. The purified water-gas, so produced, is intro-

duced simultaneously with the hydrocarbon oil, or its vapors, both being gradually and continuously introduced, as the conversion takes place, into the cylinder or converting-chamber, composed of copper or an alloy, consisting principally of copper, such as brass, filled with scraps or turnings, or wire, or wire-gauze of the same material, so arranged as to conduct the heat as equally as possible to every part of the chamber, and to present as large a heating-surface as passible to the vapor. In this way the cylinder and its contents may be maintained at a temperature of from bright redness to, and including what is usually called, a cherry-red heat, at which latter temperature it may be kept without causing any material deposition of carbon from the gas produced; and in order to prevent too great a reduction of temperature, by the introduction of the water-gas, I convey this gas through red-hot tubes before it enters the cylinder or converting-chamber. The proportion of water-gas used in this process, in relation to the hydrocarbon oils, may be regulated by suitable valves or taps, so as to yield a mixed gas having an illuminating power, such as may be required for burning as a source of light, or otherwise, it may be further mixed with a richer gas, made without or with a smaller quantity of water-gas or with water-gas itself.

The gas produced by this method should be passed through a condenser, or scrubber, or both, for the purpose of removing the visible vapor of unconverted oil, a portion of which will be carried over in the process, and as this unconverted oil may constitute a material part of the oil used in the process, it is important that efficient means should be adopted for recovering it, so that it may be reintroduced into the hot cylinder and finally converted into permanent gas. I have found that the oily particles, the presence of which gives to the gas the character of visible vapor, are retained in suspension in the gas and carried to a considerable distance while the gas is rapidly flowing through the pipes, but they soon subside when the gas is at rest, as occurs in the gasometer. It will be found advantageous as a means of promoting the separation and collection of the suspended oil particles after passing the gas through the ordinary tubular condensers, such as are used at gas-works, to allow it to pass in small jets through water or petroleum, using in the latter case one of the less volatile varieties of petroleum and avoiding the renewal of the water or petroleum unnecessarily, as these liquids, when used in excess, and before they have become saturated by contact with the gas, would dissolve out some of the most valuable constituents of the gas. After having deprived the gas of suspended particles of unconverted oil, it should be passed through a dry lime purifier to insure the absence of carbonic acid, but no other purification will be necessary, except when a crude hydrocarbon oil, which may contain a little sulphur, has been employed in the process, in which case the lime purifier should have a layer of oxide of iron at the bottom for the removal of sulphureted hydrogen. The general arrangement of apparatus required for conducting the process need not differ much, excepting in its greater simplicity and much smaller extent from that adopted in the manufacture of coal-gas. The water-gas may be made by passing superheated steam through a cylinder filled with charcoal or other form of carbon, such as coke, breeze, or peat charcoal, kept at a full red heat. An ordinary gas-retort may be used for this purpose, but there is some advantage in having the cylinder set in a vertical position and the steam made to enter at the bottom while the water-gas passes off at the top. If the carbonaceous matter used should contain any sulphur, a little sulphureted hydrogen would be formed, which, as well as any carbonic acid that may be present, must be removed from the water-gas, and for this purpose it will be desirable to have a layer of oxide of iron, such as is commonly used in gas purification, at the bottom of the lime purifier, by which the carbonic acid is to be taken out. The water-gas thus produced and purified may be used at once or stored in a gasometer for use. The conversion of hydrocarbon oils into permanent gas with the intervention of water-gas may also be effected in a gas-retort, if this be lined inside with copper or an alloy of copper, filled with scraps, turnings, wire, or wire gauze of the same metal, and provided with the means of introducing a regulated supply of the hydrocarbon oils, and of water-gas. The exit-pipe, by which the gas is conveyed away from the hot cylinder or retort, to the extent to which such pipe is exposed to a strong heat, should be of the same material as the cylinder or its inner surface, or otherwise some of the gases richest in carbon may be decomposed when subjected to a high temperature, and deprived of part of their carbon, and to a corresponding extent of their light-producing power. If the arrangements of existing gas-works be not utilized or adopted, cylinders may be used of any convenient size or form, in which, however, it is desirable to provide for the means of heating them throughout to the required extent, and these cylinders may be either made entirely of copper or an alloy of copper, or they may have an outside covering of other material to protect the metal within from the destructive effects of the fire. When previously-heated water-gas is used in the process, the fire by which the cylinder or converting-chamber is heated may be made to heat pipes through which the water-gas is conveyed to the hot chamber, and it will be found advantageous, for the preservation of these pipes, that they should be embedded in and surrounded by powdered lime to prevent their oxidation and destruction from this cause.

In fitting up apparatus specially for the pur-

pose of making gas by the processes herein described, it will be found advantageous to have the condensing and oil-separating arrangements at a higher level than that of the converting-cylinders so that the oil that is condensed and separated from the gas after leaving the converting-cylinder may be brought back to the cylinder by its own gravity.

What I claim is—

The hereinbefore-described improvement in the manufacture of permanent gas rich in carbon, which consists in bringing hydrocarbon vapor, together with water-gas, into contact with a largely-extended and highly-heated surface of copper or an alloy of copper.

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Witnesses:

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