

(No Model.)

M. LOROIS.  
PROCESS OF MANUFACTURING GAS.

No. 529,453.

Patented Nov. 20, 1894.

FIG. 1.

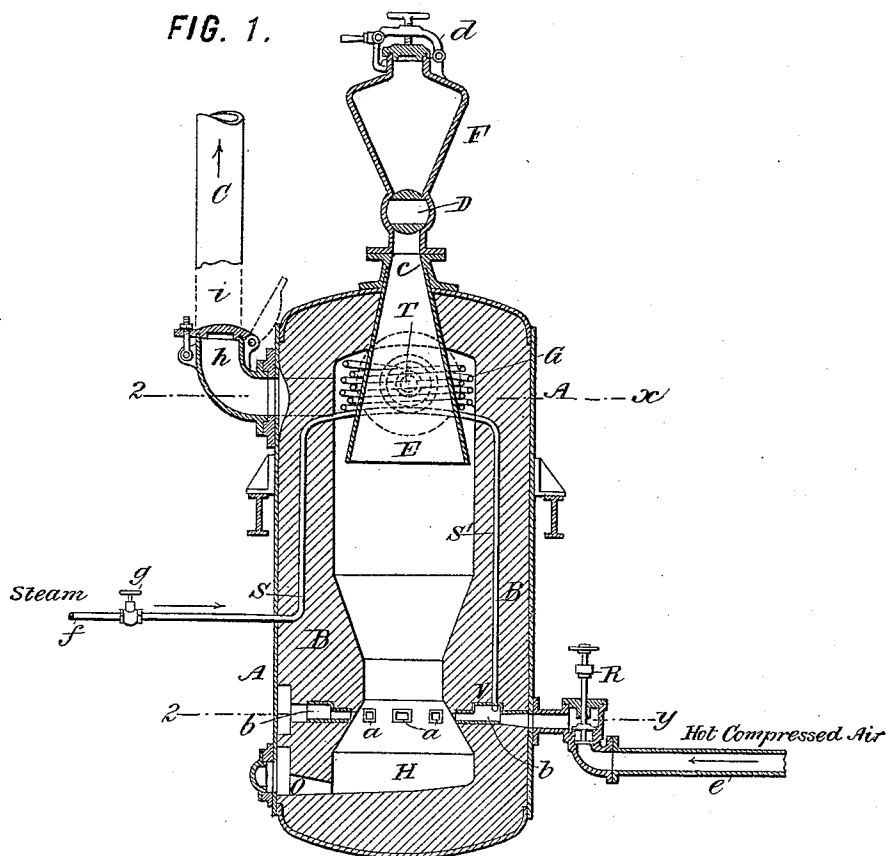
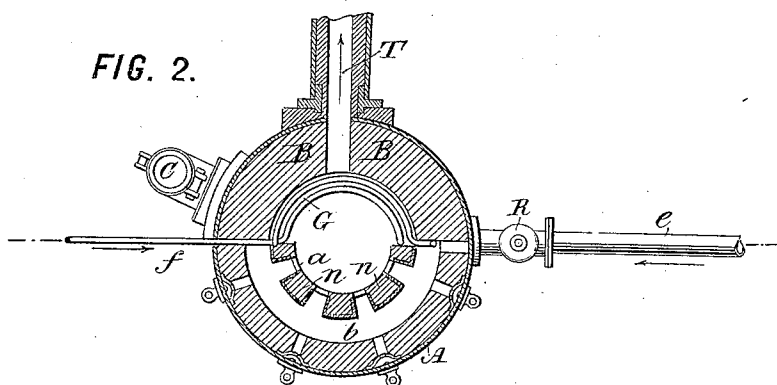


FIG. 2.



WITNESSES:

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# UNITED STATES PATENT OFFICE.

MAURICE LOROIS, OF NANTES, FRANCE, ASSIGNOR TO THE SOCIÉTÉ ANONYME  
DES MOTEURS THERMIQUES GARDIE, OF SAME PLACE.

## PROCESS OF MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 529,453, dated November 20, 1894.

Application filed May 23, 1894. Serial No. 512,219. (No specimens.) Patented in France July 30, 1892, No. 223,360; in Spain September 7, 1892, No. 13,850; in India September 9, 1892, No. 257; in England September 13, 1892, No. 16,413; in Belgium September 26, 1892, No. 101,511; in Switzerland September 26, 1892, No. 5,877; in Luxemburg September 27, 1892, No. 1,696; in Italy September 27, 1892, XXVII, 32,757; in Cape of Good Hope October 11, 1892, No. 268; in Victoria October 21, 1892, No. 10,073, and in New South Wales October 24, 1892, No. 4,066.

*To all whom it may concern:*

Be it known that I, MAURICE LOROIS, a citizen of the Republic of France, residing in Nantes, (Loire-Inférieure,) France, have invented certain new and useful Improvements in Processes of Manufacturing Combustible Gas, of which the following is a specification.

The present invention is the subject of Letters Patent in France, No. 223,360, dated July 30, 1892; in England, No. 16,413, dated September 13, 1892; in British India, No. 257, dated September 9, 1892; in New South Wales, No. 4,066, dated October 24, 1892; in Cape of Good Hope, No. 268, dated October 11, 1892; in Victoria, No. 10,073, dated October 21, 1892; in Belgium, No. 101,511, dated September 26, 1892; in Luxemburg, No. 1,696, dated September 27, 1892; in Italy, Vol. 27, No. 32,757, dated September 27, 1892; in Spain, No. 13,850, dated September 7, 1892, and in Switzerland, No. 5,877, dated September 26, 1892.

This invention relates to improved means for producing combustible gas by passing air and steam in contact with incandescent carbonaceous matter.

Heretofore in the making of so called producer gas or water gas by passing either air or steam, or both together, through a mass of incandescent fuel, the process has either been conducted practically without pressure, that is at atmospheric pressure or a close approximation thereto, or else if a pressure has been maintained in the producer, the process has been conducted at a low temperature by reason of the constant and rapid cooling of the contents of the producer. In either case the formation of the gas is accompanied by the formation of hydrogen carburets of high equivalence and ammoniacal products, as ammonia or cyanides, so that the produced gas requires to be washed or scrubbed and otherwise treated for the removal of the ammoniacal and tarry and other heavy carbonaceous impurities. My improved process overcomes these difficulties and produces a gas having properties different from any heretofore known.

In carrying out my process I employ a closed gas producer constructed so as to stand considerable pressures, and lined with a refractory and non-conducting lining of sufficient thickness to retain the highest temperatures attained and avoid loss of heat. This producer is charged with coal or other carbonaceous fuel, which at starting is brought to a state of incandescence, and thereafter there is introduced to the producer highly heated compressed air at a pressure of three kilos and upward per square centimeter, and a relatively small volume of highly superheated steam at a pressure at least equaling that of the compressed air, the pressure stated being maintained in the producer during the passage of the air and steam through it and through the mass of incandescent fuel. It results from this process that a partial combustion occurs between the oxygen of the air and the carbonaceous fuel, whereby hydro-carbon gases of low equivalence are formed, while at the same time the steam is decomposed and serves to enrich the gas. The effect of the high pressure and high temperature produced and maintained in the gas producer is to prevent the formation of hydrocarbons of high equivalence, and on the other hand to favor the production of hydrocarbons of low equivalence, so that the resulting gas is devoid of condensible carburets and tar, pitch, light or heavy oils, &c., and contains only the hydrocarbons  $C_2H_4$  in relatively considerable quantity, and but very little of the hydrocarbons  $C_4H_4$ . Further, no trace of ammoniacal products, ammonia or cyanides, is found in the gas, the high pressure and temperature under which the process is conducted favoring the combination of carbon, and not that of nitrogen.

This new gas burns in the open air with an illuminating flame and without any smoke. Its calorific power at zero centigrade and seven hundred and sixty millimeters pressure, exceeds sixteen hundred calories per cubic meter, according to tests made by A. Witz, engineer of arts and manufactures at Lille, France. Its average composition as ascer-

tained by more than one hundred analyses by W. Maisonneuve, engineer of arts and manufactures, is as follows by volume, the gas being made from Swansea anthracite coal in the producer, and the analyses made from gas taken direct from the producer:

|                                     |      |
|-------------------------------------|------|
| H .....                             | 15   |
| CO .....                            | 24.5 |
| C <sub>2</sub> H <sub>4</sub> ..... | 5.5  |
| C <sub>4</sub> H <sub>4</sub> ..... | 0.5  |
| CO <sub>2</sub> .....               | 3    |
| O .....                             | 0.5  |
| N .....                             | 51   |

For demonstrating the chemical results of my new process of producing gas under high pressure and at an extremely high temperature, I give below a tabulation of two analyses, the one made of gas produced by my process, and the other of so called Dowson gas produced without pressure by a process otherwise nearest to mine, and taken from the Dowson gasometer after having been purified and cleared of the condensible carburets, pitch, tar, &c., and the ammoniacal products with which it becomes charged from the producer, while the Lorois gas was taken direct from the producer.

Composition by volume at zero centigrade —76:

|                                     | Dowson gas. | Lorois gas. |
|-------------------------------------|-------------|-------------|
| H .....                             | 18.73       | 15.         |
| CO .....                            | 25.07       | 24.         |
| C <sub>2</sub> H <sub>4</sub> ..... | 0.31        | 5.5         |
| C <sub>4</sub> H <sub>4</sub> ..... | 0.31        | 0.5         |
| N .....                             | 49.08       | 51.5        |
| O .....                             | 0.03        | 0.5         |
| CO <sub>2</sub> .....               | 6.57        | 3.0         |
|                                     | 100.00      | 100.00      |

Calorific power in calories per cubic meter:  
1311.10 1648.95

This comparison shows the difference in richness in these two gases, and shows the extraordinary increase in calorific power resulting from my improved process.

The principal advantages of my process are the following:—

First. The produced gas being permanent, completely free from condensible carburets, and leaving no deposit in the pipes through which it is conducted, I am enabled to suppress all scrubbers, washers, condensers and other such apparatus heretofore commonly and necessarily employed in order to procure a pure and non-condensable gas.

Second. By reason of the production of the gas being instantaneous so that it may keep pace with the consumption, I am enabled to suppress the gasometers heretofore employed for storing great quantities of gas to compensate for variations in the consumption, thereby effecting a very important reduction in the gas producing apparatus, and enabling the gases to be passed immediately directly from the producer to the point of consumption, and

rendering feasible its application to gas motor engines in a manner hitherto acknowledged to be impossible. These important results are due to the formation of the gas at a high temperature and under a pressure of three kilos or more, whereby an instantaneous production of the gas takes place in consequence of a definite increase of weight or density of the elements present, and which by an increase in speed of their circulation, enables the efficiency of the apparatus to be enormously increased.

The pressure of three kilos which I have stated is as I have found by experiment the minimum pressure at which the results stated are attained; that is to say, it is only on reaching this pressure that I begin to obtain a combustible gas free from any condensable carbon. Below this pressure this result is in part produced but the result is incomplete, the improvement becoming the more evident the higher the pressure and the higher the corresponding temperature, and becoming complete at a pressure of three kilos and upward.

Having now fully described the novel and essential features of my improved process, I will proceed for the sake of facilitating its practical application by those skilled in the art, to describe the preferred form of apparatus for carrying out this process with reference to the accompanying drawings, wherein—

Figure 1 is a vertical transverse section of the gas producer and its accessories; and Fig. 2 is a transverse section thereof, one half being cut in the plane of the line 2—x in Fig. 1, and the other half in the plane of the line 2—y in Fig. 1.

The producer consists of an upright vessel having a shell A of iron or steel plate adapted to sustain a heavy internal pressure, and provided with a refractory lining B of considerable thickness in order efficiently to retain the heat. All openings into the shell A are hermetically closed in order to maintain a pressure therein, and for introducing coal or other solid fuel without permitting the escape of air, a hopper F is provided communicating by a valve D with the interior of the producer, and having a tight fitting cap d. By closing the valve D, opening the cap d, filling the hopper F with coal, then closing the cap d and opening valve D, the coal is permitted to fall into the producer. To keep the coal from filling the upper part of the producer, the latter is formed with a conical hood E. In the lower part of the lining B, tuyeres a a are provided for introducing the superheated steam and compressed air into the producer chamber. The lining is thickened just above these tuyeres to make a contracted throat in the producer chamber. In the lining B an annular passage b is formed communicating with the tuyeres, and into this passage compressed air from any suitable air compressor is introduced through a pipe e, this air being highly heated by passing it through any suit-

able heating apparatus. Not shown. Steam from any suitable steam boiler or generator is introduced by a pipe *f* controlled by a valve *g*, which pipe enters the lining *B* and passes to the upper part of the producer chamber, where it is formed into a superheating coil *G*, and from this coil a steam pipe *S'* extends down through the lining *B* into the annular passage *b*. The bottom portion *H* of the chamber constitutes an ash pit, through which the ashes may be removed when necessary through an opening *O*, which ordinarily is hermetically closed by a door.

The operation is as follows: For starting the fire a smoke-stack *C* is connected with a flue *h* by throwing open a cap *i* to establish a draft, and a fire is kindled with fuel in the producer chamber as in any ordinary furnace, air being supplied at low pressure through the pipe *e* until the entire mass of fuel is ignited and rendered incandescent. Then the smoke-stack *C* is disconnected, the cap *i* hermetically closed, and steam and heated compressed air are introduced. The steam is highly superheated in the coil *G* by the hot gases in the upper part of the producer, and the superheated steam mingles with the hot compressed air in the annular passage *b*, and the mixed gases enter the producer chamber through the tuyeres *a a* and flow up through the mass of incandescent fuel, being thereby converted into a fixed gas, which gas after circulating around the superheating coil *G* passes out through the gas outlet pipe *T*, its outflow being sufficiently obstructed to maintain the required pressure of three kilos or over.

I make no claim in my present application to the above described apparatus, since the same is already claimed in an application for patent which I have heretofore filed, Serial No. 501,166, dated February 23, 1894.

As will be apparent from the foregoing description, the principal and indispensable agent in the successful practice of my invention, is the maintenance of an extremely high temperature, to the accomplishment of which the performance of the process under a suffi-

cient degree of pressure is conducive, and to the same end I make use of the superheating of the air and the superheating of the steam. Equally important is it to prevent any cooling of the contents of the producer through its walls, as any considerable loss of heat in this way would prevent or obstruct the formation of the gases under the essential conditions indicated, the gas produced at a lower temperature being very much less rich, and furthermore charged with condensible hydrocarbons and with ammoniacal products. For these reasons it is indispensable to conduct the process in a producer having a thick wall or lining of firebrick or other refractory non-conducting material.

In conducting my process, any fuel rich in carbon can be utilized for the manufacture of combustible gas under pressure, notably petroleum or other liquid hydrocarbons. Such liquid fuels can readily be introduced by spraying or atomizing them into the producer and are the best used in co-operation with coal or solid fuel, although the process may be operated by the use of liquid fuel only.

I claim as my invention—

1. The improved process of making combustible gas which consists in passing superheated air in contact with carbonaceous fuel at an exceedingly high temperature, and while maintained under a pressure of three kilograms or upward per square centimeter, substantially as and to the effect specified.

2. The improved process of making combustible gas which consists in passing superheated air and superheated steam together in contact with ignited carbonaceous fuel at an exceedingly high temperature, and while maintained under a pressure of three kilograms or upward per square centimeter, substantially as and to the effect specified.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

M. LOROIS.

Witnesses:

F. NAIFOUNEURE,  
C. DEVAL BESNOUET.