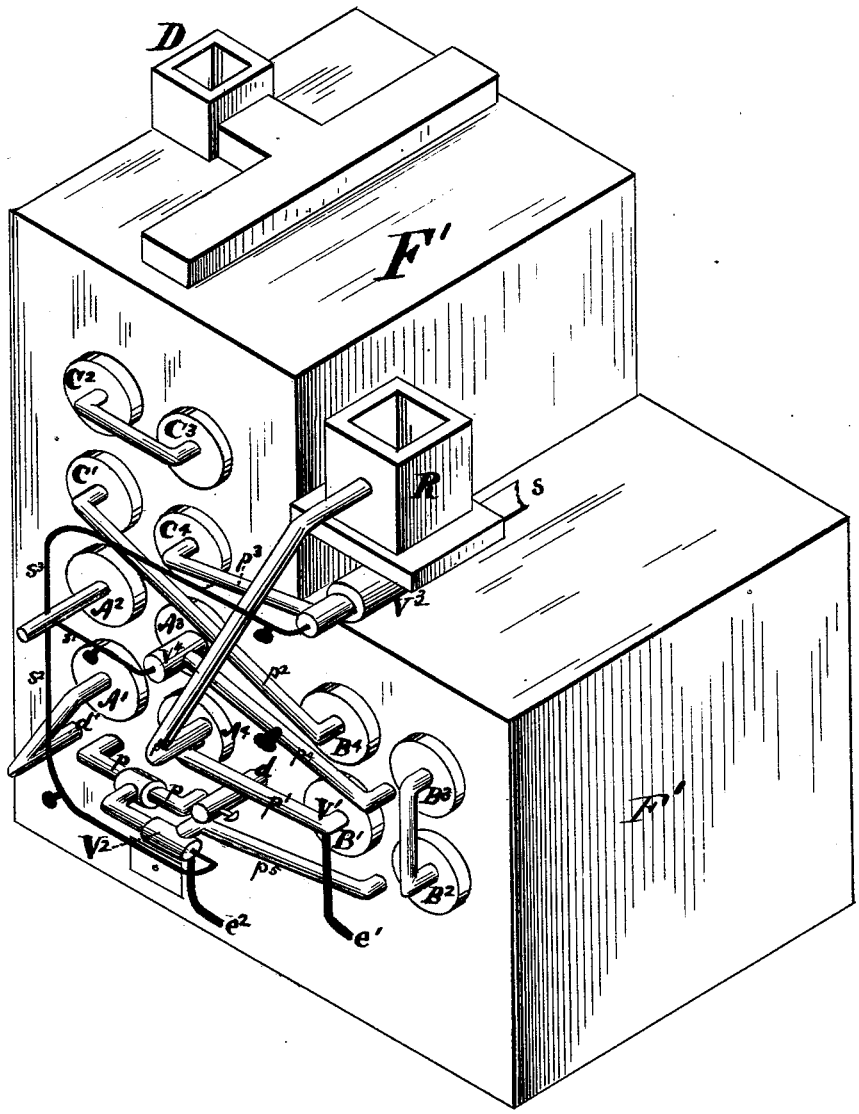
2 Sheets—Sheet 1.

C. GEARING.

Process and Apparatus for Manufacturing Illuminating Gas.

No. 204,554. **Patented June 4, 1878.**

Fig. 1



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J. S. Brown,

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Inventor

Charles Gearing

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2 Sheets—Sheet 2.

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Fig. 3.

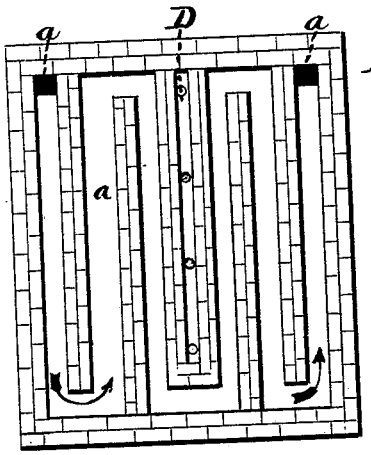


Fig. 7

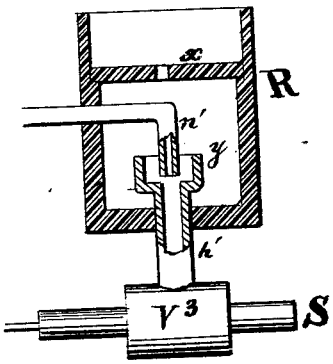


Fig. 6

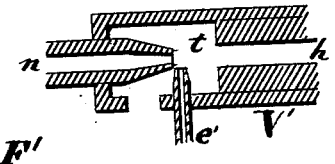


Fig. 4

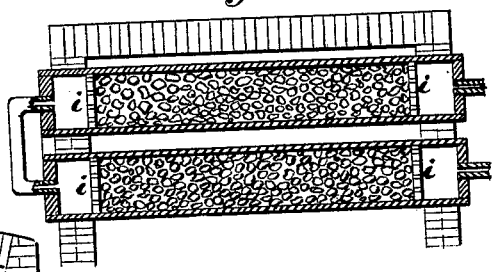
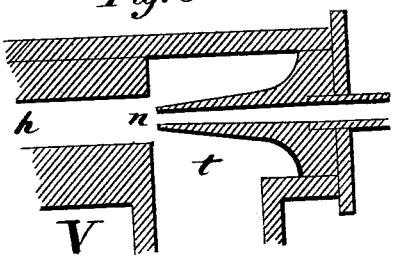


Fig. 2

Fig. 5



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UNITED STATES PATENT OFFICE.

CHARLES GEARING, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR OF ONE-HALF HIS RIGHT TO SAMUEL HARPER, OF SAME PLACE.

IMPROVEMENT IN PROCESSES AND APPARATUS FOR MANUFACTURING ILLUMINATING-GAS.

Specification forming part of Letters Patent No. **204,554**, dated June 4, 1878; application filed May 8, 1878.

To all whom it may concern:

Be it known that I, CHARLES GEARING, of Pittsburg, Allegheny county, Pennsylvania, have invented a new and useful Improvement in Processes and Apparatus for the Manufacture of Gas for Illuminating and other Purposes, of which the following is a specification:

My invention relates to the manufacture of gas from petroleum or other liquid hydrocarbons and steam; and consists in a furnace containing a series of retorts with suitable connections, constructed and arranged for automatic action, whereby vaporized hydrocarbon and gases evolved from steam superheated in closed retorts in contact with silicious bowlders, or with bowlders and fragments of iron, are combined to constitute a fixed gas by the process hereinafter described.

In the drawings, Figure 1 is a perspective view of my gas-generating furnace. Fig. 2 is a vertical section of the same. Fig. 3 is a plan view of the top of the main furnace with the covering removed. Fig. 4 is a sectional view of two adjacent retorts with their contents. Fig. 5 is a sectional view of the exhauster or vacuum-producing device with which I maintain a continuous flow of gaseous elements through the retorts. Fig. 6 is a sectional view of my device for feeding petroleum to the vaporizing-retorts. Fig. 7 is a sectional view of my device for introducing pulverized carbon into the final product of the furnace.

I construct my furnace in two distinct parts, F^1 and F^2, each inclosing a chamber containing benches of retorts, which are horizontal cylinders, whose ends project through the walls of the furnace, and are connected together by external pipes, so as to form three groups or series, A, B, and C.

In the apparatus shown, with which I have produced by actual experiment the results claimed, each group or series of retorts contains four elements; but I do not limit myself to this number.

The groups are connected by connecting-pipes in the order of the letters A B C, and the elements of each series in the order indicated by figures A^1 A^2 A^3, &c., this designation also illustrating the order of progression of the process.

The main chamber f^1 of the main furnace F^1 is a reverberatory chamber, in which the necessary heat is maintained, as hereinafter explained.

The inner lining of the chamber and of the auxiliary chamber f^2 is of fire-brick or other refractory material, and the outer walls of ordinary brick, leaving between the two, on two opposite sides and top of F^1, a space partitioned into horizontal return-flues *a*, as shown by the top view, Fig. 3, forming a continuous passage, in which air drawn from the outside is heated and transmitted into the auxiliary chamber f^2 for heating the retorts B externally, whence it is afterward drawn to aid combustion in f^1, and may be also otherwise utilized, as will be explained.

At the bottom or beneath the chamber f^1, and connected with it by flues *c c*, is a fire-place, *b*, used for generating the heat necessary to the operation. Two horizontal tubes, *o*, *o*, closed at their rear ends and communicating with the fire-place by channels *g g*, leading diagonally downward at intervals of eight inches, or thereabout, are laid in the masonry at the sides of the fire-place *b*, and are used for supplying air or superheated steam in aid of combustion.

A pipe entering at *d* and emerging at *d'* between the lining and outer wall, passing around the chamber f^1 on three sides, is used for superheating the steam prior to its introduction into retorts A.

V^1 (shown in section in Fig. 5) is the vacuum-producing device, which I denominate the "exhauster," and is used at various points to maintain the continuity of the process by vacuums produced in the connecting-pipes by a jet of decomposed steam projected from a nozzle, *n*, into the mouth of an exit-tube, *h*, in an inclosed chamber, *t*. In the apparatus shown I use three of these, (indicated by the letters V^2 V^3 V^4.)

For feeding petroleum into the vaporizing-retorts, I use an atomizer, (shown in section in Fig. 6,) in which the oil-feeding pipe *e* is extended up within the vacuum-chamber *t*, and

terminates at the mouth of and stands at right angles to the steam-injecting nozzle *n*.

All the retorts contain bowlders or rounded silicious stones, held between interior perforated heads *i*, which serve to mingle and distribute the gases passing through among the bowlders. I have found the final result to be improved by distributing in the steam-decomposing retorts A^1 A^2 A^3 A^4 fragments of iron of the size of a goose-egg, or thereabout, uniformly with the bowlders, in the proportion of about one-third iron to two-thirds bowlders. All the other retorts contain stones or bowlders only, and these as nearly pure silica as can be obtained from the ordinary river deposits used in their natural state.

I have found, after a course of experiments extending over years, that these silicious bowlders produce far better results than any other materials, such as fire-brick, &c., and prevent any residuum or carbon deposits in the petroleum-retorts, and also facilitate the decomposition of steam.

The first series of retorts, A, is used for heating and decomposing steam, or for heating steam to such a degree that its gases will more readily combine with the hydrocarbon gases in the subsequent operation. These retorts are of cast-iron, capable of resisting an internal pressure of fifteen or twenty pounds to the square inch.

The second series, B, is for the vaporization of the hydrocarbon in contact with the superheated or decomposed steam.

The third series, C, is for the more perfect combination of the gases thus produced into a fixed gas for use. The last two series of retorts may be constructed of fire-clay.

A chimney, D, is provided for the escape of the waste products of combustion. The box R, connected by its outlet-tube *h'* with the final exit-tube S of the furnace, is used for impregnating the final product of the apparatus with pulverized carbon, when it is desired to use the gas for fuel purposes, in which a mechanical admixture of carbon is of advantage in increasing its heating properties. A pipe, p^4, connects the chamber f^2 with retort A^3 through the siphon V^4, through which air may be drawn to dilute the gas when used for fuel purposes. A similar pipe, p^5, connects the chamber f^2 with siphon V^2, to supply heated air for combustion in the fire-place *b*.

Having thus described the parts and indicated their functions, the operation will be readily understood, and is as follows: The furnace being heated (as will be hereinafter explained) to a cherry-heat, steam from an ordinary steam-boiler is admitted into pipe *d*, being superheated in its passage around the furnace, as before explained, and emerges at *d'*, whence it passes into retort A^1, and from one to another of the series of retorts A in order, by their connecting-pipes, emerging from A^4, and passing into retort B' through pipe p^1 and oil-feeding device or atomizer V^1. The jet of steam, or the gases evolved from its decomposition, passing through the chamber of the atomizer, draws into it through the pipe e^1, connected with a reservoir, a quantity of petroleum, which is carried with the jet into the retort, the quantity being regulated by a suitable valve in the supply-pipe e^1.

By this means the mechanical separation of the petroleum into minute particles contributes to its partial vaporization by the heated steam, and its combination therewith before entering the retorts, and greatly facilitates the subsequent complete vaporization and combination with the steam-gases in the retorts.

The combined gases pass thence, through the series of retorts B, in contact with the heated surfaces of the contained stones or bowlders, and from the series B to series C, through pipe p^2, where the highest temperature of the furnace is encountered. In their passage through retorts C the gases are brought, as before, into contact with a large extent of heating-surface afforded by the silicious bowlders, and in a state of comparative subdivision, and a thorough combination is effected and a fixed gas produced, which is drawn off by exhauster V^3, and forced through pipe S to a holder.

The combustion necessary to maintain the required heat of the furnace and retorts may be produced by fuel in the ordinary manner upon a grate in fire-place *b*; but I prefer to use petroleum, at least for maintaining the heat, and have done so in two ways, which I will explain.

A shallow metal pan is placed upon the grate of the fire-place *b*, and filled with small bowlders of the same character, except as to size, as those in the retorts, after the furnace is partially heated. I admit superheated steam through pipe S^2 from retort A^2, passing through exhauster V^2, which also serves as an injector, whence it is injected into pipes *p p*, and, through horizontal tubes or channels *o o* and *g g*, into the fire-place *b*. By means of the injector V^2 a quantity of petroleum is drawn in through supply-pipe e^2, partially vaporized, and projected, with the steam-gases, into the fire-place *b*. Heated air is also drawn from chamber f^2 through pipe p^5, and follows the same course. By channels *g g* the combined current is projected upon the bowlders of the pan, before mentioned, and intense combustion ensues, the inflamed gases passing up through channels *c c* into combustion-chamber f^1. The amount of air and petroleum is regulated by valves in the respective feed-pipes.

I prefer, however, another mode, which consists in admitting the pretroleum into a horizontal pipe laid in the bottom of the pan before mentioned, where it feeds by gravity from an elevated reservoir, and is vaporized and inflamed by the combined current of heated air and steam-gases projected upon it from tubes *o o* and channels *g g*, as before described.

In using the final product of gas for fuel purposes, it is desirable to dilute it by an admixture of air, which is drawn from chamber f^2 through pipe p^4, and projected by siphon

V^4, operated by steam-gases admitted through s' into retort A^3, whence it follows the course before described. For use in this connection, pulverized carbon in the form of coal, coke, charcoal, or other carbonaceous material, is placed in the box R, and drawn through the perforated partition x into the lower part y, which is a vacuum-chamber produced by an adaptation of my vacuum device, as shown in Fig. 7. A jet of the steam-gases issues through nozzle n', being drawn from retort A^4 through pipe p^6, passing thence into the mouth of tube h' leading into the final exit-tube S, by which the particles of carbon are carried and mechanically mingled with the final product of the furnace. In this case the gas is not passed into a holder, but used for fuel at the point of final exit, when the particles of carbon are ignited by the combustion of the gas.

The process herein described and the circuit of operations through my apparatus are, as will be seen, continuous and automatic, and may be regulated by suitable valves in the connecting-pipes to graduate the admission of steam-gases, air, or petroleum, as may be necessary.

Having described my invention, what I claim is—

1. In a gas-generating furnace such as described, the combination of the main combustion-chamber f^1, having air-passages a, auxiliary chamber f^2, and series of retorts A B C, constructed and arranged for operation substantially as and for the purpose specified.

2. In a gas-generating furnace such as described, the combination of a combustion-chamber, f^1, having air-passages a in its walls, fire-place b, having side flues o and branches g, and channels or flues c, arranged for operation substantially as set forth.

3. The process for the manufacture of gas, consisting, first, in superheating and decomposing steam; then passing it, together with petroleum, through retorts containing silicious bowlders at a high temperature; and, lastly, in passing these gaseous products through other retorts containing silicious bowlders at a high temperature, to thoroughly combine the gaseous elements into a fixed gas for illuminating purposes, substantially as described.

4. In a gas-generating furnace such as described, the steam superheating and decomposing retorts A, filled with silicious bowlders, with iron fragments interspersed, substantially as described, and for the purpose specified.

5. In combination with a main chamber, having air-passages a in its walls and auxiliary chamber f^2, containing retorts of a gas-generating furnace such as described, the return air-flue p^4, substantially as and for the purpose specified.

6. In combination with a gas-generating furnace having a main combustion-chamber, f^1, and an auxiliary chamber, f^2, heated by a current of air at high temperature, a return-flue, p^5, and exhauster V^2, arranged and operating substantially as and for the purpose described.

In testimony whereof I have set my hand.

CHARLES GEARING.

Witnesses:

J. S. BROWN,

L. M. HOSEA.