(No Model.)

L. D. YORK.

APPARATUS FOR PRODUCING AND BURNING GAS.

No. 294,301. Patented Feb. 26, 1884.

Fig: 2.

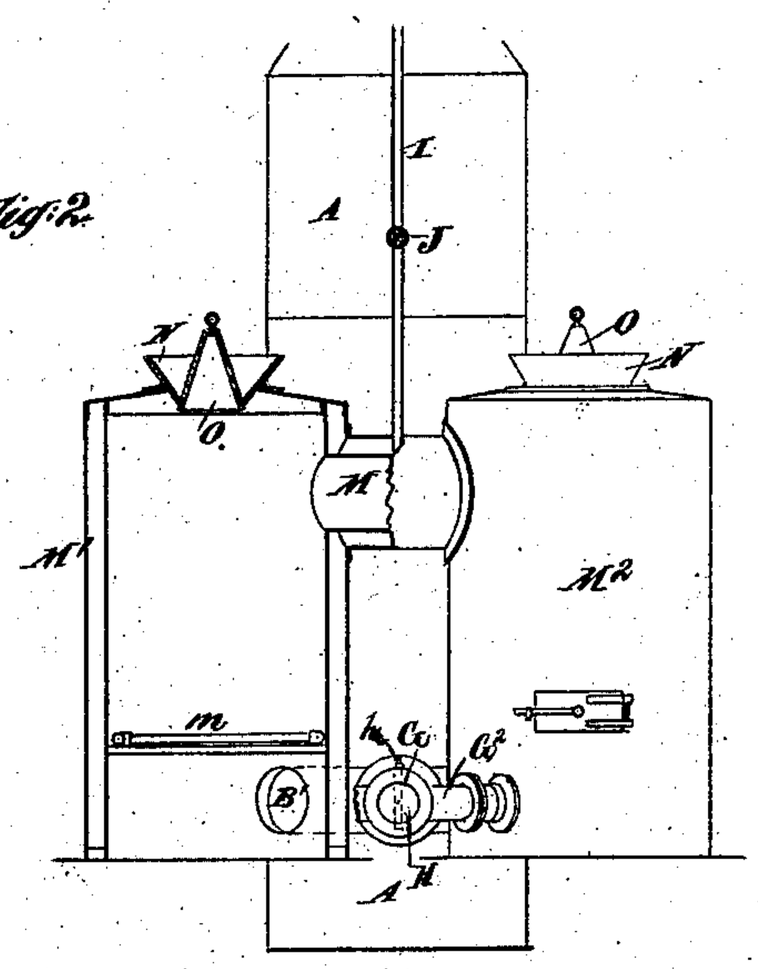


Fig: 1.

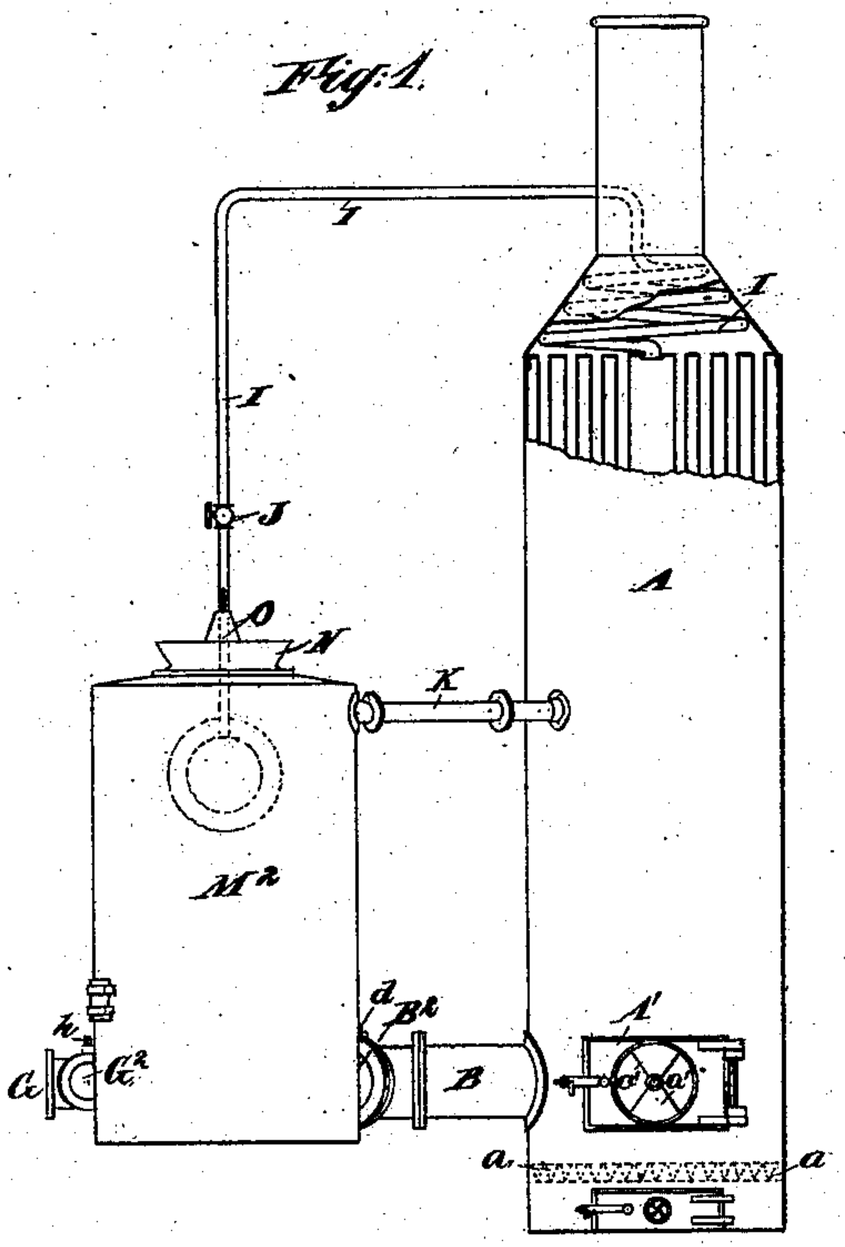
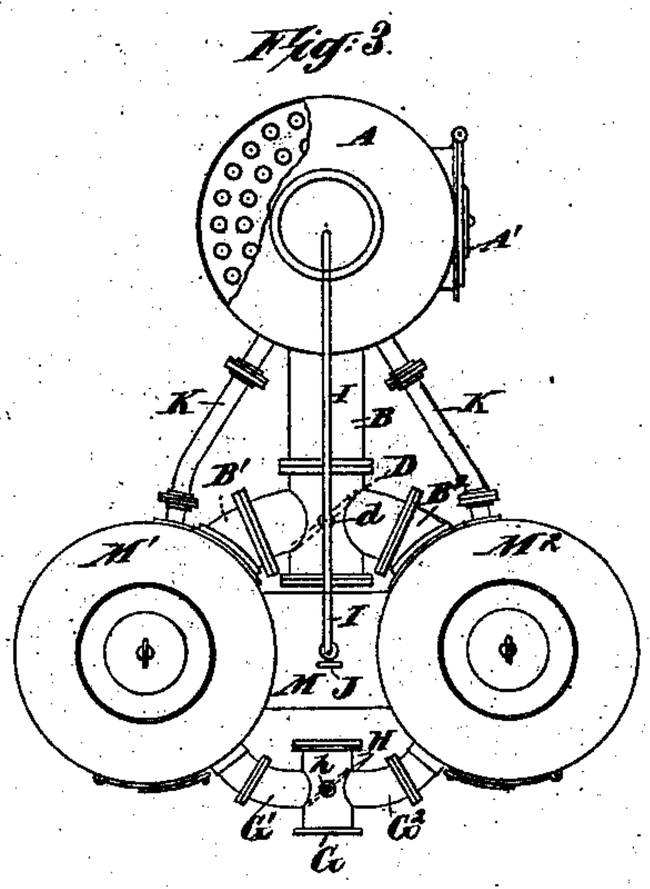


Fig: 3.



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UNITED STATES PATENT OFFICE.

LEVI D. YORK, OF PORTSMOUTH, OHIO.

APPARATUS FOR PRODUCING AND BURNING GAS.

SPECIFICATION forming part of Letters Patent No. 294,301, dated February 26, 1881.

Application filed January 14, 1884. (No model.)

To all whom it may concern:

Be it known that I, LEVI D. YORK, of Portsmouth, Scioto county, in the State of Ohio, have invented certain new and useful Improvements in Apparatus for Producing and Burning Gas to Produce Heat for Steam-Generating and other Purposes, of which the following is a specification.

The accompanying drawings form a part of this specification, and represent what I consider the best means of carrying out the invention.

Figure 1 is a side elevation. Fig. 2 is an elevation at right angles to Fig. 1, with certain portions broken away. Fig. 3 is a plan view, partly in horizontal section.

Similar letters of reference indicate corresponding parts in all the figures.

A is an upright boiler, having its main body thickly filled with upright tubes. It may be in all respects like an ordinary vertical tubular boiler; but it is not necessary to have so liberal provisions for burning coal, because the principal portion of the fuel is to be supplied in a gaseous form. A fire of coal is kept on the grate *a*, and a small quantity of air is allowed to flow up through it in the ordinary manner, to support the combustion and maintain a fire there sufficient to insure the ignition of the torrent of gas which is poured in above.

The door A′ of the furnace is perforated, as indicated by *a′*, and arranged to supply a liberal quantity of air, flowing into the furnace in separate streams. This mingles with the gas and presents the air favorably to insure complete combustion. The large quantity of gas required is received through a pipe, B. This is branched, as indicated by B′ B², (see Fig. 3,) and the connection is controlled by a valve, D, which is mounted on a vertical shaft, *d*, which extends out through a tight-fitting bearing, and is provided with means (not represented) for taking hold of and turning it. By partially turning this valve, the gas may be received either through the branch B′ or the branch B². These branches connect, respectively, with upright cylinders M′ M², which are each provided with a grate, *m*. These grates are formed of tubes kept filled with water, for purposes which will presently appear. The branch pipes B′ B² connect with the chambers below the grates *m*. So, also, do two smaller pipes, G′ G², which are branches from the pipe G, which brings air forced by blowing or pumping mechanism. (Not represented.) The flow of the air is controlled by a valve, H, which is fixed on a vertical spindle, *h*, extending out through a tight bearing, and adapted to be conveniently seized for turning it partially in one direction and the other, so as to direct the air into the base either of M′ or M², as preferred.

The top of each cylinder M is equipped with a funnel, N, each controlled by a close-fitting conical valve, O, held up to its seat by a lever or other convenient means. (Not represented.) The space in each cylinder M′ M² above the grate *m* is kept nearly filled with coal of a good gas-producing quality. It is supplied from time to time through the funnels N by momentarily lowering the valves O; but care must be taken not to charge these cylinders so high as to obstruct the flow in either direction through the connecting-pipe M. The mass of coal in each cylinder is ignited and kept at a high temperature, although actual burning only occurs in one at a time, as will appear further on.

I have not deemed it necessary to represent the pipe which conducts the steam from the upper portion of the boiler A to a steam-engine or other point where it will be utilized. The provisions for this purpose may be arranged in any ordinary or suitable manner.

I is a pipe, which may be of only small diameter, coiled in the smoke box or chamber above the boiler. This takes steam from the upper portion of the boiler, and, after leading it around in the hot products of combustion, so as to insure that it is perfectly dry and somewhat superheated, conducts it down, and, controlled by a valve, J, discharges it into the connection M. The quantity of steam thus admitted may be slight. It mingles with the gases after they have been formed in the first chamber, as M′. Descending with the gas in the second chamber, M², the steam is decomposed in the manner well known in the manufacture of water-gas. The oxygen of the steam joins with the coal or coke to make carbonic dioxide or monoxide, and the hydrogen remains

free in the gas and contributes largely to its heating-power when it is ignited and burned.

In what I esteem the most complete form of the invention, each cylinder M′ M² is, in addition to an internal lining of fire-brick of any required thickness, provided with a double wall, the space between being filled with water from a pump or other source. (Not represented.) Any steam which is generated in this water-jacket thus formed may flow into the boiler A through the pipes K. Preferably the water-supply for the boiler is pumped into these jackets and kept at a high temperature, with a more or less constant current of heated water flowing through the pipes K into the boiler A.

Operation: The valve H being set to put G in communication with G′, a constant flow of air, received at a pressure of one or more pounds per square inch, flows through the pipes G G′ into the base of the cylinder M′. This fills the chamber in the base of this cylinder with fresh air, which, as the valve D now closes the communication from this chamber to the furnace of the boiler, finds no other way of escape but to flow upward through the interstices in the tubular grate *m*, and supplies oxygen to the mass of ignited coal in this cylinder. The effect is to produce ordinary complete combustion of the lowest particles of the coal. The gaseous products of combustion, in the form of carbonic oxide, (carbon monoxide,) flowing upward through the mass of gas-coal above, maintains the latter at a high temperature, and expels therefrom large volumes of gas, which mingles with the products of combustion in the upper portion of M′, flows across through the liberal connection M, and fills the upper portion of M². It thence flows downward through the mass of coal in M², distilling still more gas, with which it combines, and the whole flows from the base of M², through the pipes B² and B, into the furnace of the boiler, where it receives the finely-divided air and is burned, as above described. After this action has proceeded for a certain length of time, the valves D and H are simultaneously shifted in position, each being turned about a quarter-revolution. This puts the air-receiving pipe G in communication with G², and consequently with the base of the cylinder M², and puts the pipe B in communication with the branch B′, and consequently with the base of M′. Now, the action goes on as before; but the flow through M M′ M² is in the reverse direction, the flow being upward through M², and thence across through M, and downward through M′. Fresh coal may be supplied to each cylinder at intervals, either at the time of moving the valves and changing the flow or at any other time, as may be preferred. The alternate combustion in the two cylinders M′ M² maintains the high temperature required. The gaseous products of combustion from the coal or coke which receives fresh air becomes changed to carbonic oxide in its subsequent movement through the interstices in the large quantities of incandescent coal which it has to pass. The result is a highly combustible mixture, which, on being supplied with air in the furnace of the boiler A, generates an intense heat, and produces steam rapidly and economically.

The water-jackets around the gas-producing cylinders M′ M² greatly increase the efficiency of the apparatus for generating steam, because they increase the amount of efficient heating-surface available. Making the grates *m* of tubes and keeping them filled with water, with provisions for active circulation, enables the grates to endure what would otherwise be a too-intense heat when they are subjected to the downward flow of the hot gas from the mass of coal and coke above. When a water-jacket is employed, the connection of these grates may be directly thereto. If the water-jacket is omitted, special provisions should be made by suitable pipes for maintaining a constant circulation of water through the grate-bars.

In burning highly bituminous or smoking coal, this invention contributes to the diminution of the smoke by the complete manner in which the combustion is carried out.

It will be understood that in passing the air through the ignited gas-producing coal in proper quantities perfect combustion will take place in the lower part of the mass or body of the coal in one of the cylinders, producing carbonic acid, (carbon dioxide,) which passes upward and is reconverted by the upper portion of the coal into carbonic oxide, (carbon monoxide)—an inflammable gas—while the heavy or gas-producing portions of the coal, for want of air to burn them, distill off in the form of hydrocarbon gases and vapors surcharged with carbon. The superheated steam, meeting these, causes mutual decomposition, producing carbonic oxide, with hydrogen in addition, thus largely increasing the volume of inflammable gas at small cost.

In former efforts to manufacture and consume gases, a single gas-producer has been surrounded by a water-jacket connected to the boiler which the gas is to heat. Water-grates have been long known as means for supporting fuel burning with a downdraft. Two gas-producing furnaces have also been used, connected so that the draft will be up through one and down through the other. Steam has been introduced to the bottom or top of a mass of incandescent coal, and caused to pass through the same, being decomposed thereby.

It is not new, broadly, to use two gas-producers in connection with provisions for reversing the movement of air and gases up through one and down through another; but I attach much importance to the fact that in my apparatus I treat bituminous coal in the two gas-producers with the reverse current and superheated steam, thereby utilizing the gaseous constituents of the coal; also, to the maintaining incandescent solid fuel as an igniter, so as to overcome the difficulty peculiar to the reversible current; also, to the introducing steam which has been already superheated by the waste heat from the boiler into the pas-

sage M, which thus mingles with the gases as they traverse said passage in alternate opposite directions; also, to the arrangement of my branched pipes G G′ G² and B B′ B², with their respective valves H *h* and D *d*, as simple and convenient means for effecting the changes of direction of the currents.

I claim as my invention—

1. The steam-boiler A, and furnace for burning solid fuel to maintain an igniter for the gas, the pipe B, valve D *d*, and branches B′ B², and the two gas-producing furnaces M′ and M², with connecting-passage M, combined and arranged for joint operation as herein specified.

2. The two furnaces M′ M² and connection M, in combination with means, I, for introducing superheated steam into M to mingle with the gaseous products of combustion and traverse therewith down through the second furnace, and with means, as D H, for causing the flow alternately in opposite directions, as herein specified.

3. In combination with the steam-boiler A, the cylinders M′ M² and their connections, as described, and air-inlet, the valves D and H, adapted to be operated simultaneously to direct the flow of gas through the furnaces alternately in reverse directions, as may be required, substantially as set forth.

In testimony whereof I have hereunto set my hand, at Portsmouth, Ohio, this 28th day of December, 1883, in the presence of two subscribing witnesses.

LEVI D. YORK.

Witnesses:
T. C. ANDERSON,
J. R. HUGHES.