(No Model.)

2 Sheets—Sheet 1.

W. H. BRADLEY.

PROCESS OF AND APPARATUS FOR MANUFACTURING HYDROGEN GAS.

No. 265,915. Patented Oct. 10, 1882.

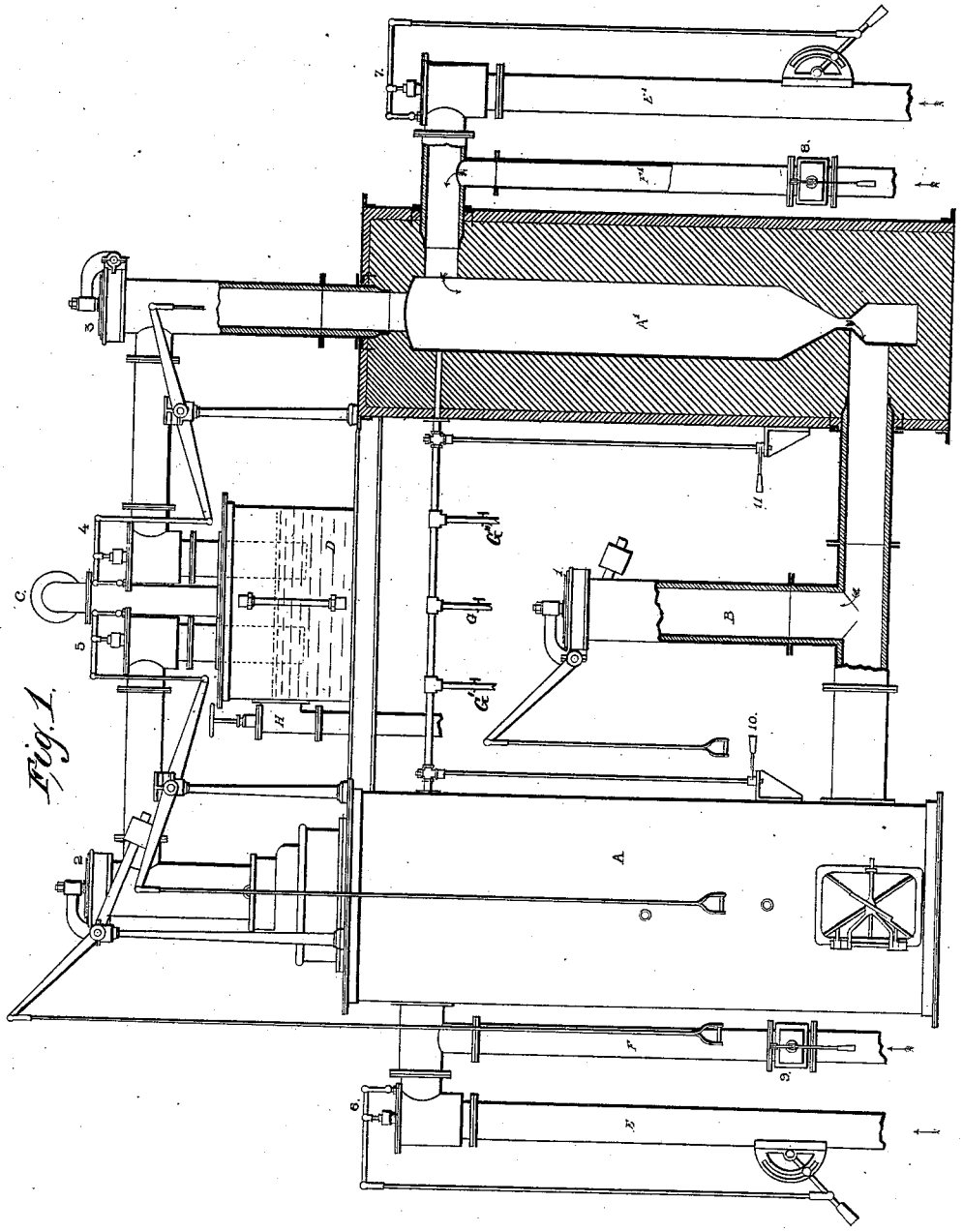

Fig. 1.

WITNESSES

Orazio Fuga

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INVENTOR

W. H. Bradley

(No Model.)

2 Sheets—Sheet 2.

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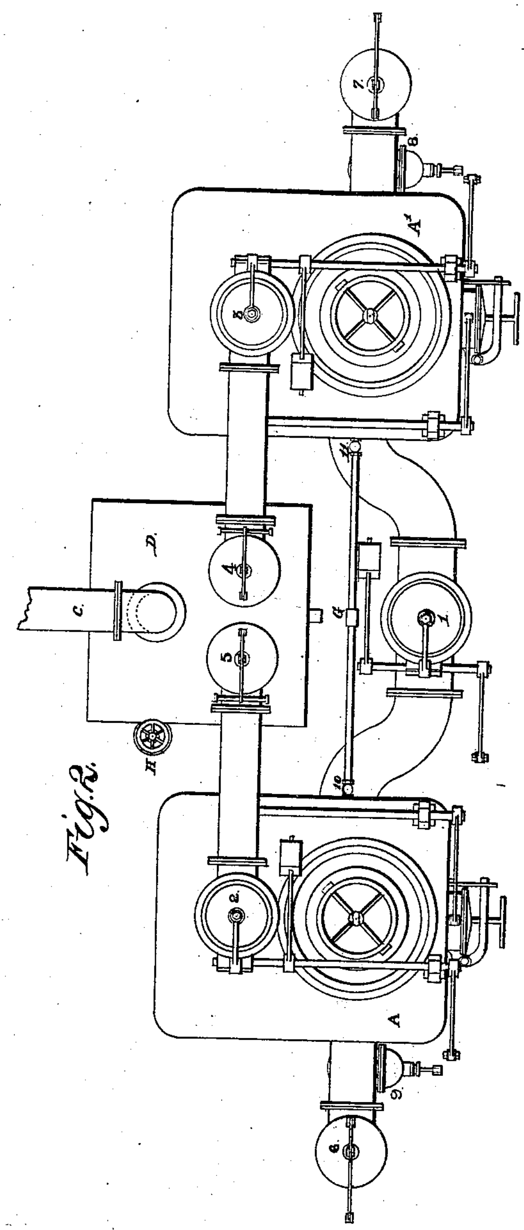

Fig. 2.

WITNESSES

Orazio Lugo

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UNITED STATES PATENT OFFICE.

WILLIAM H. BRADLEY, OF NEW YORK, N. Y.

PROCESS OF AND APPARATUS FOR MANUFACTURING HYDROGEN GAS.

SPECIFICATION forming part of Letters Patent No. 265,915, dated October 10, 1882.

Application filed September 9, 1882. (No model,)

To all whom it may concern:

Be it known that I, W. H. BRADLEY, of the city, county, and State of New York, have invented new and useful Improvements in Processes of and Apparatus for Manufacturing Hydrogen Gas, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 represents an elevation of the apparatus, part in section, and Fig. 2 a plan of the same.

Similar letters and numbers on each figure indicate corresponding parts.

The invention relates to the economical production of hydrogen gas, to be used primarily for the manufacture of illuminating-gas or for any other purpose where it may be required.

It is well known that if steam be decomposed in the presence of hydrocarbon at a high temperature the resultant gases are a mixture of carbonic acid and hydrogen, with a small percentage of carbonic oxide and marsh-gas. When the hydrogen is used for the manufacture of illuminating-gas the presence of the marsh-gas is useful, and it is allowed to remain; but for most purposes the carbonic-oxide and carbonic-acid gases should be eliminated, and to accomplish this result is the object of my invention.

In the drawings, A represents a front elevation. A′ represents a sectional elevation; B, the blow-off valve and purge-pipe; C, the "take-off" pipe; D, the wash-box or hydraulic seal; E and E′, the inlet-pipe for furnace or heating gas; F and F′, the air-pipe; G, the inlet-pipe for steam and hydrocarbon; G′ G″, the inlet-pipes for superheated steam; H, overflow-valve for regulating the hydraulic seal. Numbers 1, 2, 3, 4, and 5 are purge or blow-off valves for use in heating up, as hereinafter described, or to furnish free egress for the air contained in the apparatus. Numbers 6 and 7 are inlet-valves for admitting or shutting off furnace-gas; numbers 8 and 9, inlet-valves for admitting or shutting off air to induce combustion of furnace-gas in the interior of chambers A and A′; numbers 10 and 11, levers connected with cocks similarly numbered on plan to admit or shut off steam and hydrocarbon.

To carry my invention into effect I proceed as follows: The chambers or generators A and A′ are filled with lumps of caustic lime. The inlet-valves 6 and 7 in the pipes E and E′, conveying furnace-gas from a carbonic-oxide-gas generator, (not shown,) and the inlet-valves 8 and 9 in the air-conveying pipes F and F′ being also opened, and all other valves being closed, except the purge-valve 1, the mixture of air and carbonic oxide is ignited and allowed to burn until the lump lime in the two chambers has become highly heated. During this operation the outlet-valve 1 in pipe B should be kept open to allow the products of combustion to freely pass off. When the lime in chambers A and A′ is sufficiently heated the valves 6 and 7 in pipes E and E′ and the valves 8 and 9 in pipes F and F′ are closed. Valve 10 in pipe G is then opened, admitting steam from an ordinary boiler and superheater (not shown) charged with hydrocarbon vapor; or, if preferable, liquid hydrocarbon may be admitted through a pipe similar to the steam-pipe. The valve 1 in pipe B is then closed and valve 3 in top of chamber A′ opened for an instant in order to allow the remaining air to escape. Then valve 3 is closed and valve 4 opened, when the gas passes through the hydraulic seal in wash-box D, and finally through "take-off" pipe C, the office of the lime in the second chamber, A′, being to extract the carbonic acid generated at the same time with the hydrogen by the decomposition of the steam and hydrocarbon in chamber A. When the heat in chamber A has become reduced below the decomposing degree the steam and hydrocarbon are shut off and Siemens's furnace-gas and air admitted and ignited in chamber A′, in like manner as above described for chamber A. Chamber A′ then becomes the decomposing-chamber.

During the process of heating the lime in chamber A′ superheated steam is introduced into chamber A, and the same operation is repeated as before mentioned, thus making an alternate producing apparatus. It may, however, be found more economical to use chamber A as the decomposing-chamber and chamber A′ as a purifying-chamber. Thus, instead of being an alternate producing apparatus, it could be used as a continuous one. The operation would then be substantially as follows: Chambers A and A′ being filled with lumps of caustic lime, and the lime in both chambers heated

as above indicated, and the valves operated as above described, steam and hydrocarbon are introduced in chamber A, where they are decomposed into hydrogen and carbonic-acid gases, which pass to the other chamber, also containing highly-heated lime, where the carbonic acid is wholly extracted, and the hydrogen passing the seal-box D is collected. As soon as the temperature of the lime in the decomposing chamber has become too low to induce the decomposition of the steam and hydrocarbon, valve 10 is closed and the purge valves opened. The lime in chamber A is again heated and superheated steam is introduced into the other chamber, by which latter operation the carbonic acid which the highly-heated lime had absorbed during the passage of the mixture of hydrogen and carbonic acid is expelled.

The time required to heat the lime in one chamber and that required to expel the carbonic acid from the carbonate of lime in the other by means of superheated steam is about the same, so that the operation may be substantially continuous and economical and practical. On the same principle in substance, I have erected an apparatus with which, during experiments, I have produced an aggregate of eighty-four thousand cubic feet of gas.

In the practical working of the above-described apparatus it may be required to use more than one purifying-chamber to one decomposing-chamber, especially when the purifying-chamber is of less cubic capacity than the other.

The absorption of carbonic-acid gas by heated lime and its subsequent elimination by means of superheated steam from the comparatively dry carbonate of lime are, I believe, new, and they form an important part of my invention in connection with my apparatus.

In order to produce carbonic-acid and hydrogen gases alone, the steam must be rather in excess as regards the hydrocarbon used or introduced into the decomposing-chamber, so that a small amount of undecomposed watery vapor may pass with the gases, and, coming in contact with the dry heated lime in the purifying-chamber, may form a hydrate of lime capable of effecting the extraction of the carbonic acid; but when subsequently dry and highly-superheated steam is introduced into the purifying chamber or chambers the carbonate of lime is again rendered an oxide of calcium. This operation can be often repeated.

I am aware that several attempts have been made to extract carbonic-acid gas by means of dry lime; but so far none have been successful. They have failed because the lime intended to exhaust the carbonic acid has not been sufficiently heated and steam has not been introduced. If carbonate of lime be heated in a tube until it begins to give off carbonic-acid gas, and the heat is then lowered to such a degree that the evolution of gas ceases, this evolution will immediately recommence if steam be passed through the tube, for at a high temperature the affinity of carbonic acid for lime is not sufficient to keep it from mingling with steam. Thus while carbonate of lime gives up its carbonic acid when heated to redness in steam or the open air, quicklime, on the other hand, absorbs carbonic acid in very great abundance when heated very hot in an atmosphere of that gas.

The decomposing-chamber may be filled either with lime alone or with any other refractory material, such as oxides of aluminium and magnesium. The latter will accomplish the same result as the oxide of calcium, provided, however, that, as in the case of lime, the quantities of the bodies present which act upon each other are substantially in equivalent proportion and in the presence of sufficient heat.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. In the manufacture of hydrogen gas by the decomposition of steam and hydrocarbon in contact with a body of heated lime, the process of revivifying the lime used in purifying the gas, which consists in decarbonating the comparatively dry carbonate of lime or carbonates of the alkaline earths by subjecting it, while in a heated condition, to the action of superheated steam, substantially as above described.

2. The within-described apparatus for the manufacture of hydrogen gas, consisting of two or more vertical chambers, A and A′, the gas and air supply pipes, the steam and oil supply pipes, and a gas-eduction pipe connected with the top thereof, and a purge-pipe connected with the bottom thereof, and suitable valves in the inlet and outlet pipes, all combined and operating substantially as described.

WILLIAM H. BRADLEY.

Witnesses:
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CHAS. G. SMITH.