

(No Model.)

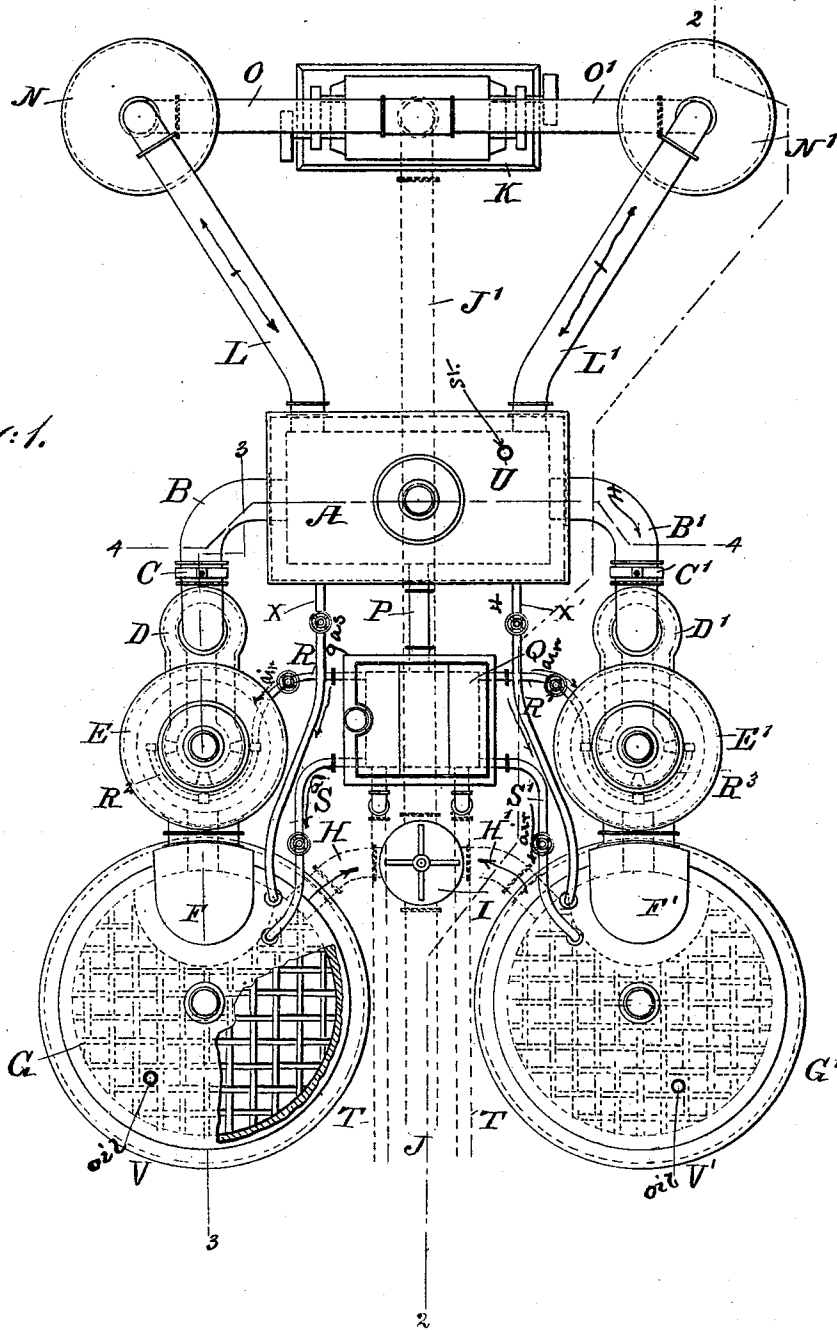
3 Sheets—Sheet 1.

G. M. WESTMAN.
PROCESS OF MANUFACTURING GAS.

No. 517,202.

Patented Mar. 27, 1894.

Fig: 1.



WITNESSES:

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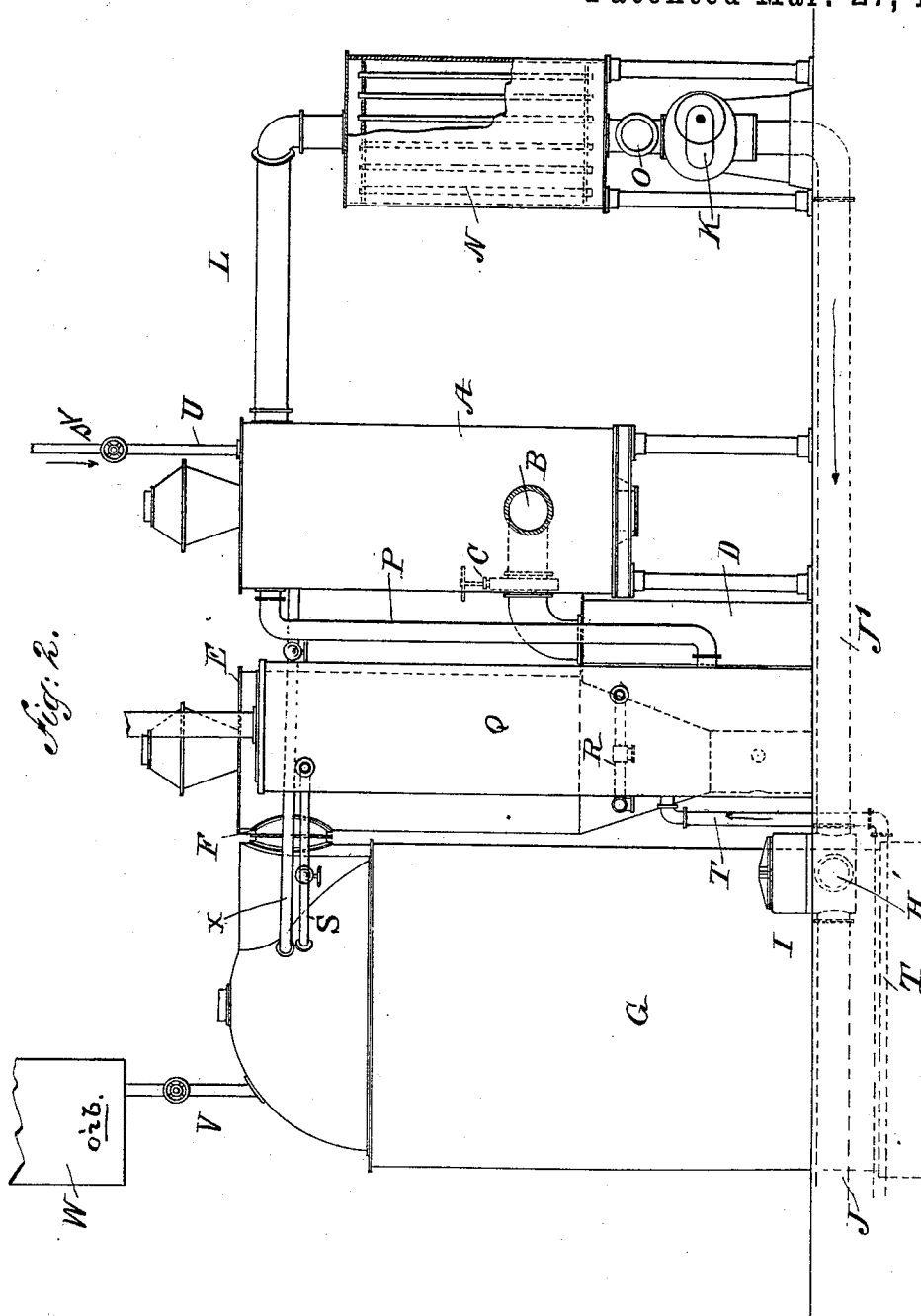
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3 Sheets—Sheet 3.

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Fig. 4.

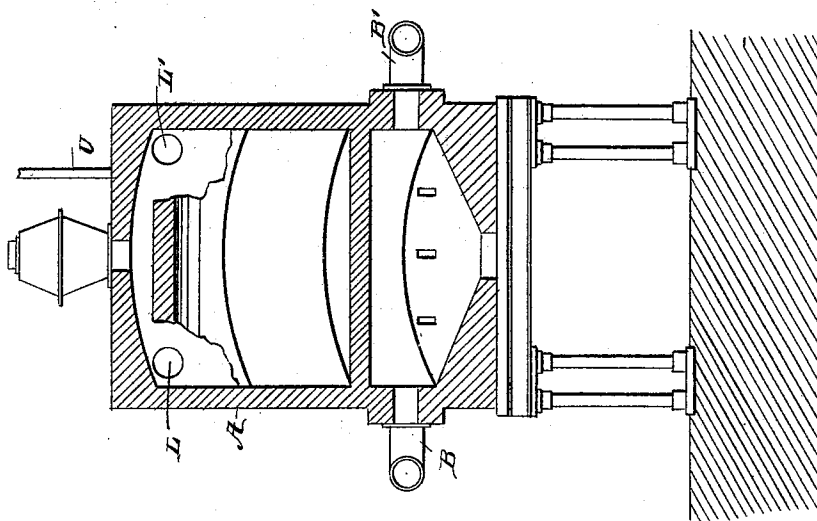
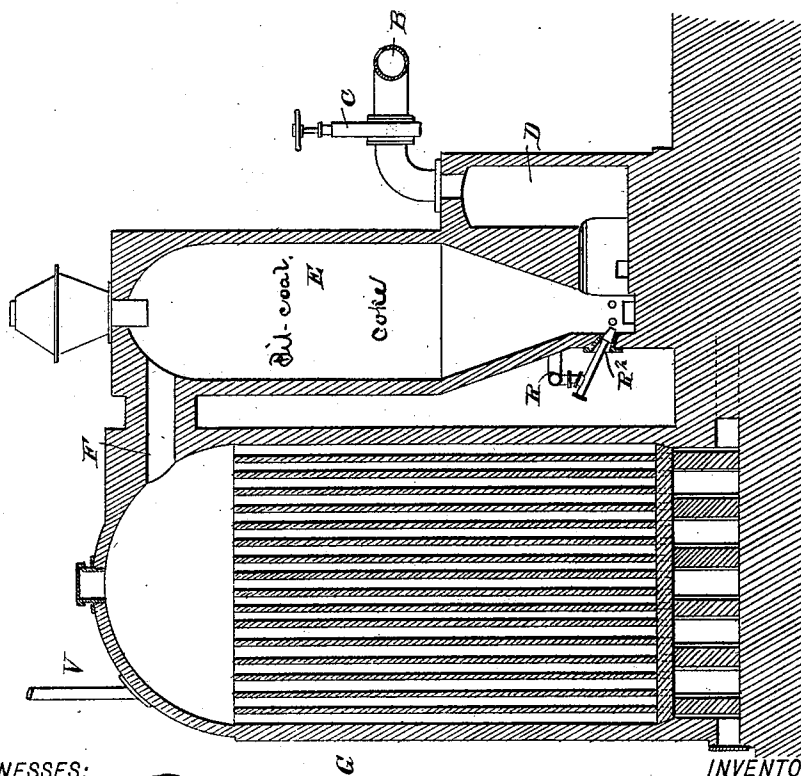


Fig. 3.



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UNITED STATES PATENT OFFICE.

GUSTAF M. WESTMAN, OF HACKETTSTOWN, NEW JERSEY.

PROCESS OF MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 517,202, dated March 27, 1894.

Application filed December 5, 1892. Serial No. 454,088 (No model.)

To all whom it may concern:

Be it known that I, GUSTAF M. WESTMAN, a subject of the King of Sweden and Norway, at present residing at Hackettstown, in the county of Warren and State of New Jersey, have invented a new and Improved Process of Manufacturing Gas, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved process for cheaply manufacturing gas for general purposes, and of a quality resembling natural gas.

The invention consists in passing a mixture of gases through iron oxide contained in a reducing furnace to produce iron sponge, the said mixture of gases consisting partly of newly formed gases and partly of gases previously passed through the iron oxide and afterward heated and carburated, then passing steam through the iron sponge to reconvert the latter into iron oxide and to produce hydrogen, and then passing the latter through glowing coke to take up and combine with the carbon contained in the glowing coke, and finally discharging the thus resulting gas. In order to carry this process into effect I employ a furnace preferably of the construction shown in the accompanying drawings forming part of this specification and in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a plan view of the improvement with parts in section. Fig. 2 is a sectional side elevation of the same on the line 2—2 of Fig. 1. Fig. 3 is a rectangular side elevation of part of the same on the lines 3—3 of Fig. 1; and Fig. 4 is a cross section of part of the improvement on the lines 4—4 of Fig. 1.

The reducing furnace A, of any approved construction is connected at or near its bottom and on opposite sides with flues B and B' containing valves C and C' respectively, and leading to chambers D and D' respectively, connected with the lower ends of the coke wells E and E' respectively, of any approved construction and charged with bituminous coal.

The coke wells E and E' are connected at or near their upper ends by flues F and F' respectively, with the upper ends of regenerators G and G' respectively, of any ap-

proved construction, and connected at or near their lower ends by pipes H and H' respectively, with a valve I adapted to be connected by a pipe J with a chimney or other draft flue and connected by a pipe J' with a blower K of any approved construction. From the upper end of the reducing furnace A lead the pipes L and L' to coolers N and N' respectively of any approved construction and connected at their lower ends by pipes O and O' respectively with the inlet of the blower K. From the upper end of the reducing furnace A leads a pipe P which connects with the lower end of a hot blast chamber Q. The upper end of the reducing furnace A, is also connected by the pipes X and X' with the upper ends of the regenerators G and G', to pass the surplus gases from the reducing furnace into the regenerators to be burned therein for assisting in heating the said regenerators.

The hot blast chamber Q is connected near its lower end by pipes R and R' with tuyeres R² and R³ respectively, discharging into the coke wells E and E', respectively. From the upper end of the hot blast chamber Q lead the pipes S and S' into the upper ends of the regenerators G and G' respectively, and the said hot blast chamber Q is connected near its lower end by pipes T with a blower (not shown).

Into the top of the reducing furnace A leads a steam pipe U for passing steam through the iron sponge contained in the reducing furnace so as to reconvert the iron sponge into iron oxide, at the same time producing hydrogen.

Into the domes of the regenerators G and G' discharge oil supply pipes V and V' respectively, connected with an oil tank W containing the necessary oil for carburating the gases, as hereinafter more fully described.

The operation is as follows: The reducing furnace A is filled with iron ore, and the coke wells E and E' are charged with bituminous coal in the usual manner, it being understood that new charges of bituminous coal are introduced in the top of the coke wells from time to time, while the iron in the furnace A remains therein, but is changed from iron oxide into sponge iron, and back again into

iron oxide, as hereinafter more fully described. When the furnace is in operation, part of the plant is used for circulating gases from the top of the reducing furnace through one of the coolers, the blower K, one of the previously heated regenerators, the corresponding coke well, and back to the reducing furnace, the said circulating gases being carburated in the coke well in which also carbonic oxide gases are constantly and newly formed by heated air coming from the hot blast chamber Q into which fresh air is forced and heated therein, the fresh air coming from the pipes T connected with a blower not shown. The hot blast chamber Q is of the ordinary construction and is always heated by surplus gases from the furnace A and passed from the latter into the said chamber by the pipe P. The fresh air passes through pipes in the hot blast chamber and the said pipes are heated externally by the said surplus gases in the usual manner. Now, if the coke well E and the regenerator G are in use together with the furnace A, the cooler N, the blower K, and the hot air chamber Q connected by the open pipe R with the coke well E, the valve in the other pipe R' is closed to disconnect the hot air chamber Q and coke well E'. The other regenerator G' is then disconnected with the pipe J', but is connected by the valve I with the pipe J leading to the chimney or other draft flue. Now, fresh air forced through the pipes T into the hot blast chamber Q is heated therein and passed in this condition through the pipe R and tuyeres R² into the coke well E to form in the latter with the coke derived from the bituminous coal, carbonic oxide gases, nitrogen and hydrogen. As the latter is indifferent in its chemical action as far as the gases to be formed are concerned, it is not necessary to further consider the said nitrogen except in its usefulness as a transporter of heat to reduce the iron ore in the reducing furnace. The gases which have passed through the ore in the reducing furnace A are passed from the latter through the pipe L into the cooler N in which the gases pass through pipes surrounded by a cooling medium such as water to reduce the temperature of the gases before passing to the blower K, thus protecting the latter from the otherwise evil effects of the hot gases. The gases then pass through the blower K and are forced by the latter through the pipe J', the valve I and pipe H into the previously heated regenerator G, so that the gases are highly heated therein and then forced through the flue F into the coke well E in which the gases are carburated. The carburated gases cause the above described newly formed carbonic oxide gases in the same coke well to follow them into the reducing furnace and through the ore therein to finally pass from the reducing furnace to the pipe L, cooler N, back to the blower to complete the circulation. The above described operation is repeated over and over again until a certain amount of iron sponge is formed in

the reducing furnace A. Part of the surplus gases accumulating in the upper end of the reducing furnace A pass through the pipe X' into the regenerator G' to be burned therein to assist in reheating this regenerator. Another small part of the said surplus gases is conducted through the pipe P into the hot blast chamber Q to heat the latter. Now, it is understood that when the regenerator G is heating the above mentioned circulating gases the other regenerator G' is heated by burning surplus gases from the reducing furnace and new formed gases derived from the coke well E' together with air from the hot blast chamber Q and passed from the latter by the pipe S' into the said regenerator G'. The products of combustion in the regenerator G' are discharged through the pipe H' and the valve I, into the pipe J leading to the chimney. When a sufficient quantity of iron sponge has been formed in the reducing furnace then the circulation is stopped and the valve C is closed and the valve C' is opened and steam is now introduced through the pipe U into the top of the reducing furnace A and a new charge of bituminous coal is introduced into the upper end of the coke well E'. The steam by passing through the hot iron sponge is changed into hydrogen and iron oxide is formed. By passing this hydrogen through the hot coke in the coke well E', the hydrogen is carburated and the hot gases rising in the coke well E' expel the natural gases from the said new charge of bituminous coal placed in the upper end of the said coke well E'. The resulting gases are now passed into the regenerator G' into which oil is now introduced by the oil supply pipe V' thereby carburating and fixing the resulting gases which are now withdrawn and passed to a gas holder in the usual manner. At the same time that this operation takes place in the regenerator G' and the companion coke well E' connected therewith, air is forced by a blower into the hot blast chamber Q and passed from the latter through the tuyere into the other coke well E. The gases formed in this coke well are passed into and burned at the top of the regenerator G with hot air coming from the hot blast chamber Q and the product is carried through the pipe H, the valve I and pipe J, to the chimney. By the process just described, the regenerator G is heated to be in proper condition when the next change is made, for heating circulating gases, as above described. It is expressly understood that a new charge of bituminous coal is put into the respective coke well E or E' previous to passing steam into the reducing furnace A, so that the hydrogen in passing into the respective coke well and through the glowing coke, is carburated and the hot gases come in contact with, and expel the natural gases contained in the new charge of bituminous coal.

It is understood that the process above described is not intended as a continuous process.

It is understood that by the process above described, I am enabled to produce more iron sponge from a certain quantity of coal than can be produced by any other process heretofore practiced, and it follows that the large quantity of iron sponge produced permits of producing a large amount of hydrogen and consequently more gas is the final result.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. The herein described process for manufacturing gas, consisting in passing a mixture of gases through iron oxide contained in a reducing furnace to produce iron sponge, the said mixture of gases consisting partly of newly formed gases and partly of gases previously passed through the ore and afterward heated and carburated, then passing steam through the iron sponge to reconvert the latter into iron oxide and to produce hydrogen, and then passing the latter through glowing coke to take up and combine with the carbon contained in the glowing coke and also take up the natural gases contained in a new charge of bituminous coal placed in the coke well,

and finally discharging the thus resulting gas, substantially as shown and described.

2. The herein described process for manufacturing gas, consisting in passing a mixture of gases through iron oxide contained in a reducing furnace to produce iron sponge, the said mixture of gases consisting partly of newly formed gases and partly of gases previously passed through the ore and afterward heated and carburated, then passing steam through the iron sponge to reconvert the latter into iron oxide and to produce hydrogen, and then passing the latter through glowing coke to take up and combine with the carbon contained in the glowing coke and also take up the natural gases contained in a new charge of bituminous coal introduced in the coke well, and then carburating the resulting gases by means of oil, and then fixing the gases in the regenerators, substantially as shown and described.

GUSTAF M. WESTMAN.

Witnesses:

THEO. G. HOSTER,
E. M. CLARK.