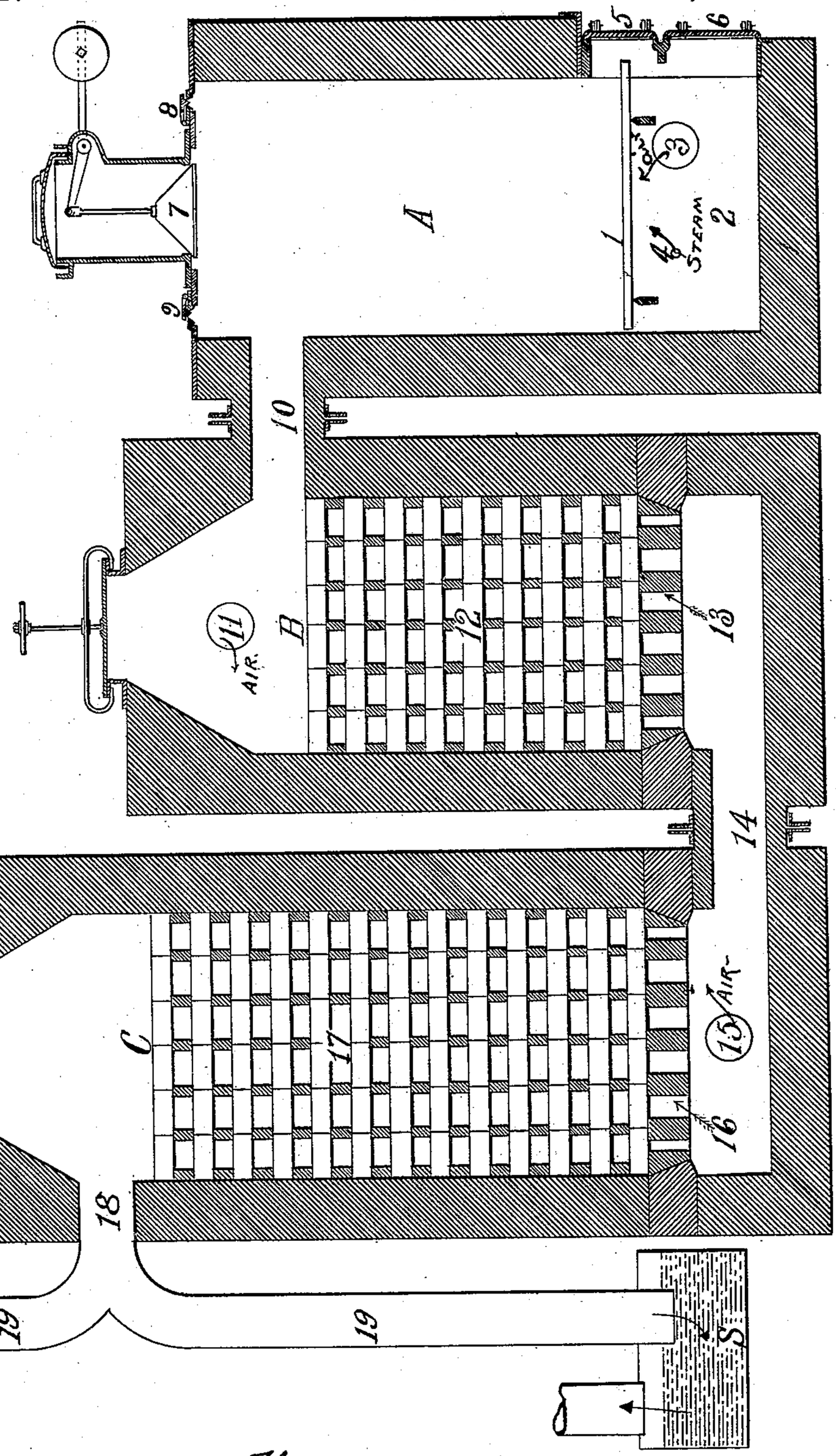
(No Model.)

H. M. YOUNG.

PROCESS OF MANUFACTURING GAS.

No. 507,252. Patented Oct. 24, 1893.



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PROCESS OF MANUFACTURING GAS.

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To all whom it may concern:

Be it known that I, HAYDEN M. YOUNG, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Processes of Manufacturing Gas; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

The object of my invention is to adapt the so called "producer" gas such as commonly used in iron mills, glass factories and the like to domestic uses by lessening its volume, concentrating its heat value and fixing its hydrocarbons; and the invention consists in the improvement hereinafter described and particularly pointed out in the claims.

It is proposed to accomplish my result by the method or process now hereinafter described. Apparatus for this purpose may be varied considerably according to varying requirements of situation, capacity, &c., and also with reference to varying preferences of construction or connection as hereinafter pointed out; but the accompanying drawing shows an apparatus generally suitable for the purpose and may be used to describe the process.

The drawing shows a vertical section of the combined apparatus, the several chambers and connecting flues being cylindrical.

A is a generating chamber, or simply a Wellman producer, having grate bars, 1, ash pit, 2, double doors, 5, 6, air inlets, 3, steam inlets, 4, feeding port, 7, poke holes, 8 and 9, and a flue, 10, leading into the fixing chamber, B. Said fixing chamber B has near the top an air port, 11, and lower down a mass of loosely arranged fire brick or other refractory material 12, supported upon an arch, 13, and having beneath said arch a flue, 14, connecting with a second fixing chamber, C, the said chamber C having at its base an air port, 15, and over the same an arch, 16, supporting another mass of loosely arranged fire brick or other refractory material, 17, and having above the said mass an outlet, 18, leading into a bifurcated pipe, 19, one prong of which pipe leads upward to the escape vent, 20 (which latter has a cap or valve, D) and the other prong of which pipe leads downwardly into the water seal, S.

To operate according to the invention, I proceed by distinct steps.

Step one: The valves to the air ports, 3, 11, 15, and the steam port, 4, being closed, and the cap valve, D, being open, I start a fire on the grate bars, 1, in the furnace, A, using kindling wood and coal and allowing the feeding port, 7, to remain open so as to assist the natural draft. When the fuel has become well ignited, I close the doors, 5, 6, and also the feeding port, 7, then turn on the air blast, at the port, 3, and let the products of combustion escape through the outlet vent, 20. As the fire advances, I charge additional coal, from time to time, through the feeding port, 7, until finally I get a bed of bright red coals, three to four feet thick, above the grate bars. This can be determined by looking into the furnace through the poke holes, 8, 9. Step two.—When the fuel bed attains this condition the products escaping therefrom have become combustible. I now open the valves to the air ports, 11 and 15, and to the steam port, 4. The gases ignite in each of the chambers B and C, and the heat of the combustion of the gases is gradually imparted to the masses of refractory material, 12 and 17. All the products of combustion are meanwhile escaping as before through the outlet vent, 20. I continue this operation until the refractory material in the chambers B and C become heated up to a yellow or approximately white temperature. Step three.—I then shut off the air blasts at 11 and 15, close the cap valve D, and immediately drop through the feeding port, 7, a full charge of fresh bituminous coal, preferably well-broken up, into the furnace chamber A. The heavy smoke immediately arising, and made up of soot and tarry vapors, is carried by the current of gases through the flue, 10, and down through the mass of refractory material in chamber B, thence through the flue, 14, up through the mass of refractory material in chamber C, thence out through 18 and down through 19 to the water seal, S. In the meantime it has ceased to be smoke. The floating particles of soot and the carbon released from the tarry vapor, have been left in the hot masses of refractory ma-

terial, while the residual hydrogen and gasified hydro-carbon have taken a place among the fixed gases of the output. But the now red-hot carbon, or soot, lodged in the masses of the refractory material is not suffered to remain there. Some of the air from the air port, 3, and some of the steam from the steam port, 4, have passed up through the fuel bed in furnace A, in a free state, and also not a little carbonic acid gas has escaped from the said fuel bed without being converted into carbonic oxide. These otherwise deleterious ingredients in the producer gas become quite useful in the fixing chambers, B and C. While the smoke was still passing through the apparatus, these three agents (free air, free steam, and carbonic acid gas) were at work appropriating the free carbon or soot deposited as aforesaid in the refractory material, almost as fast as it was lodged; and now after all the smoke from the charge of coal has passed out and the current of gases has become clear again, it is a matter of but a short interval until the refractory material is quite divested of this sooty coating. In some cases however it may be desirable to reheat the refractory material before the carbon is entirely gasified and the invention is consistent with either an entire or partial removal, at any particular stage, of such deposit of carbon. Step four.—This process of first driving the surplus carbon out of the hydro-carbon vapor and then converting the freed carbon into carbonic oxide by the agencies named, has required as it has absorbed, a great deal of the heat stored in the refractory material, and instead of the refractory material being now at a yellow heat, its temperature is down to perhaps a cherry red. I must restore the yellow temperature in the refractory material before another charge of coal is made into the furnace A. So I open the cap valve D, turn on the air blast at 11 and 15, and heat up the fixing material again (as in step two) preparatory to a new charge of coal in furnace A. When this is done I repeat step three. Thus the alternations go on indefinitely.

The amount of coal fed in a single charge and the length of interval between the charges will depend of course upon the rate at which I am operating, since I can operate either slow or fast, by regulating the various air blasts, 3, 11, and 15, and the steam blast, 4, accordingly.

It is not essential to introduce a full charge of coal at once as above described and the invention will not be departed from by charging the coal more or less gradually and in successive portions or in two or more small successive charges with short intervals varying according to the condition in respect to heat of the refractory material, the nature of the coal, the rapidity of operation and other circumstances. My general gage is the condition of the fuel bed in chamber A. This fuel bed should be kept in depth or thickness about three feet or more; and then it should be kept in a state of ignition throughout, the color of the heat not being allowed to fall below a bright red or cherry, as seen from above. These conditions can at all times be ascertained and taken care of by poking and inspecting through the poke holes, 8 and 9. I preferably introduce as much steam and as little air as consistent with these conditions of the fuel bed. Slight variations however in the air or steam supply or brief and occasional variations of more considerable extent whether accidental or designed will not substantially change the process herein described and claimed. It is however, important that combustion with a comparatively low temperature be maintained in the fuel bed by practically continuous blasts of air and steam and that after bituminous coal has been charged and its more volatile constituents or a considerable part of them have been used to enrich the gas products substantially as set forth, the residual coal thus deprived of a consideral part of its hydrocarbon, shall be used to make gas by the continuance of the air and steam supply and said gas be burned to heat refractory material preparatory to the subsequent charging of fresh coal, the outlet valve, as D, being open at such time to discharge the products of complete combustion elsewhere than into the holder of the enriched gas made as stated.

Should it be desirable for any purpose as for illumination, for instance, to specially enrich the gas with a larger hydro-carbon element, this can be done by burning somewhat more of the gases than is required when coal only is used in the manufacture, and introducing into the top of the chamber B, any liquid hydro-carbon, such as petroleum or any of its distillates. It is not pretended however, that such a gas would equal in light giving qualities the illuminating gas made by the lately improved methods of water gas manufacture. It is claimed however, that it would at least equal natural gas, which is used for that purpose in many small towns. I have said that apparatus for this purpose may be considerably varied. In the first place, the chamber A may be constructed in any form used in producer gas or water gas manufacture, for generating purposes. In the next place, two or more of these producers or generators may be connected with the same fixing chamber or chambers, and be operated altogether or not altogether, according as desired by the use of valves in the respective flues corresponding to the flue 10. Again, I may have one mass of refractory material or two such masses, and whether one or two, I may arrange it or them, in any way usual or known in such cases.

Heretofore in an operation involving the alternate "blowing up" of the fuel bed it has been proposed to admit air and steam sparingly to the incandescent fuel for the purpose of sustaining the heat and prolonging

the operation as set forth in Patent No. 325,766 granted September 8, 1885, to Potter and Boeklen. In such process however the fuel bed is not supplied continuously with air and steam in constant quantity as air alone is supplied during the blowing up operation. It is also incident to this prior method that a part of the coal is removed from the fuel bed and that a fixing retort is externally heated by a separate fire. It has also been proposed to blast bituminous coal continously with air and steam and utilize the entire product for mixing with coal or oil gas from retorts. It has also been proposed to continuously blast a depth of ten feet or more of fuel with air and steam to produce with gas and tar an exceptional quantity of ammonia.

I am aware that it has been proposed to blast a bed of bituminous coal with air and steam in an approximately continuous manner to make an illuminating gas, the coke produced by the blasts and which would otherwise impoverish the gaseous products being transferred to a secondary combustion chamber to be there burned for heating a fixing retort, and also that it has been proposed to divide the gaseous current continuously produced by blasting bituminous coal with air and steam and to conduct the richest portion thereof through a retort and simultaneously burn another portion under the retort to heat the same. I am also aware that bituminous coal has been blasted continuously with air and a small quantity of steam to generate a temperature sufficiently high to continuously heat a body of refractory material, steam being admitted in considerable quantity above the fuel bed; and these methods I do not claim. I neither transfer any part of the fuel charge to externally heat a retort as in the former cases nor maintain a high heat in the fuel bed as required in the last case. My improvement involves the introduction of substantially as much steam to the fuel bed as consistent with constant combustion which use of steam results in a comparatively low temperature in the burning fuel at all times and one too low to heat the fixing chamber. To effect this latter object I burn the gaseous products of the continuous blasts at times between coal charges when they are poorest in quality after the smoke and volatile hydro-carbons of the fresh charges have been passed through the refractory material and fixed. I thereby avoid the necessity either of a supplementary fuel bed or of a highly heated primary bed and am able to keep the latter at a low temperature and to generate a higher heat at the point where it is needed for fixing purposes by combustion of the gas at the time when the said gas is poorest in quality. My process therefore differs from the ordinary "producer-gas" method mainly in that the volatile hydrocarbons of bituminous coal are used exclusively to enrich a part of the producer gas and the heat value of another part of the same is used to fix said enriched portion, thereby diminishing the total volume of the producer gas and making a gas that is proportionately increased in value as its volume is reduced.

Having fully described my invention, what I claim is—

1. The improvement in the art of making gas which consists in continuously blasting an ignited mass of bituminous coal with air and steam, to form a producer gas, the air being supplied in practically the smallest and the steam in practically the largest quantity consistent with constant combustion; charging fresh coal with intermissions; burning the gas immediately before a charge is made to heat refractory material; and passing the gases immediately after a charge is made through the said refractory material, to form a fixed gas of enriched quality; substantially as set forth.

2. The improvement in the art of making gas from bituminous coal which consists in continuously blasting an ignited mass of the coal with air and steam to form a producer gas, the air being supplied in practically the smallest and the steam in practically the largest quantity consistent with constant combustion; continuously passing the gas through refractory material; intermittently burning the gas to heat the refractory material; intermittently charging fresh coal to replenish the fuel bed, the charge of coal being made immediately after the refractory material is heated, and the refractory material being heated after the condensible hydrocarbons distilled from the charge have passed through the said refractory material and after the resultant deposit of carbon upon said refractory material has been wholly or partially gasified, substantially as set forth.

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