(No Model.)

A. G. GLASGOW & A. C. HUMPHREYS.

METHOD OF AND APPARATUS FOR CARBURETING WATER GAS.

No. 581,909. Patented May 4, 1897.

Fig. 1.

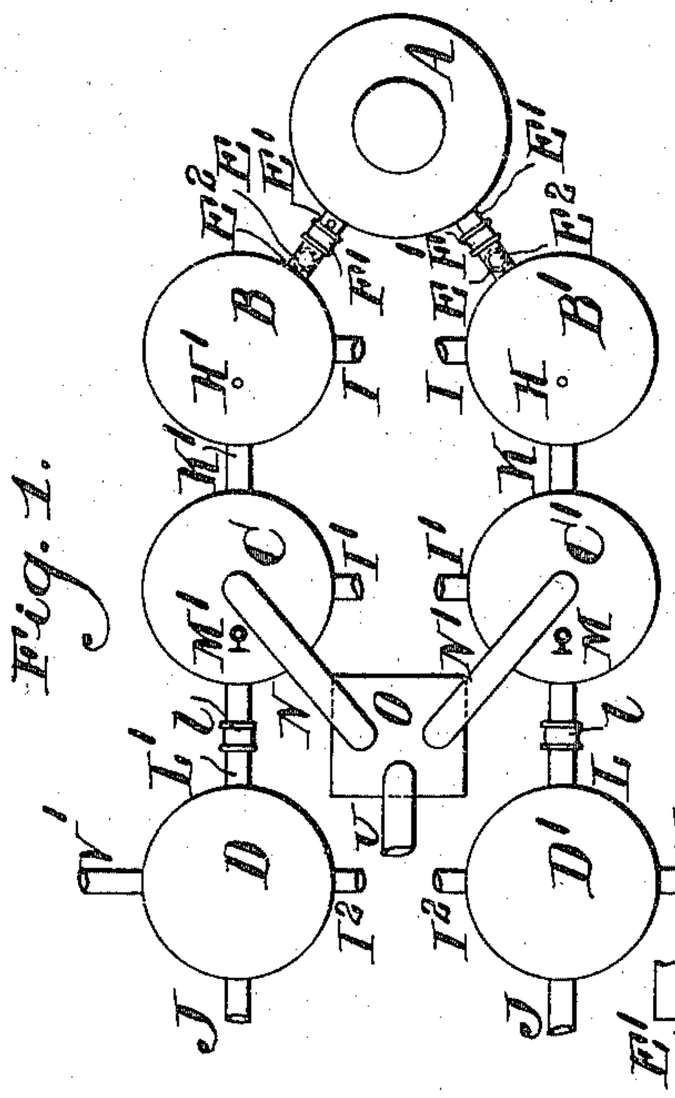


Fig. 2.

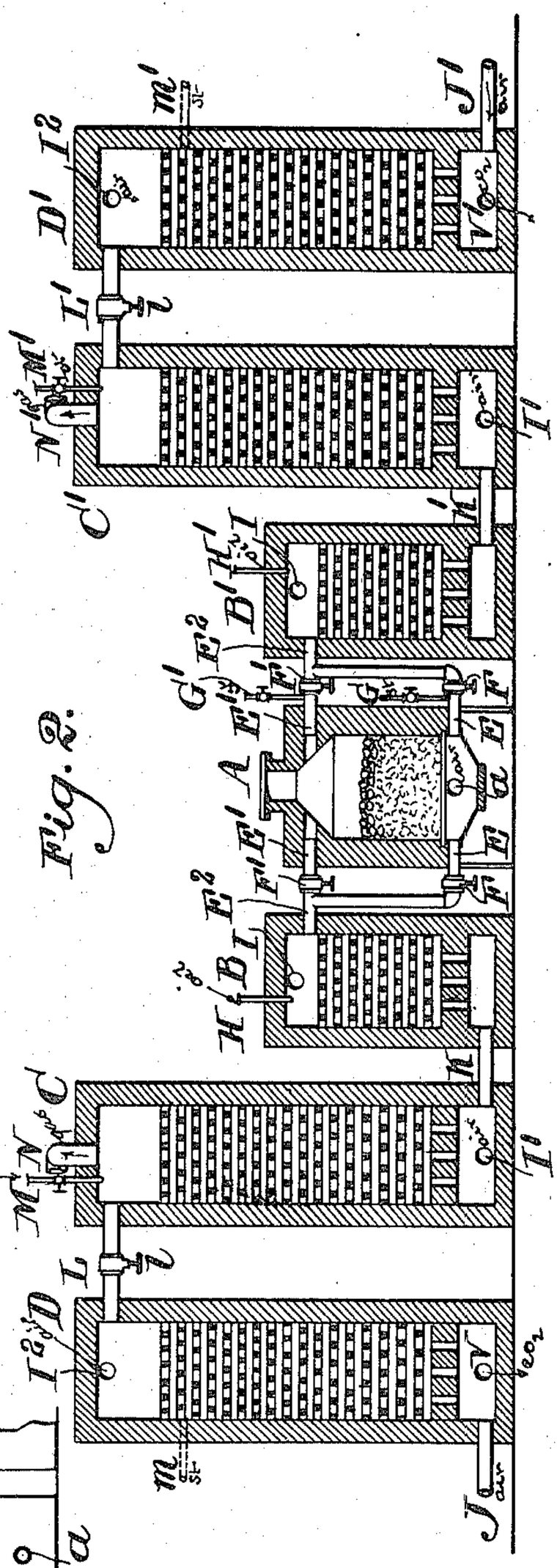


Fig. 3.

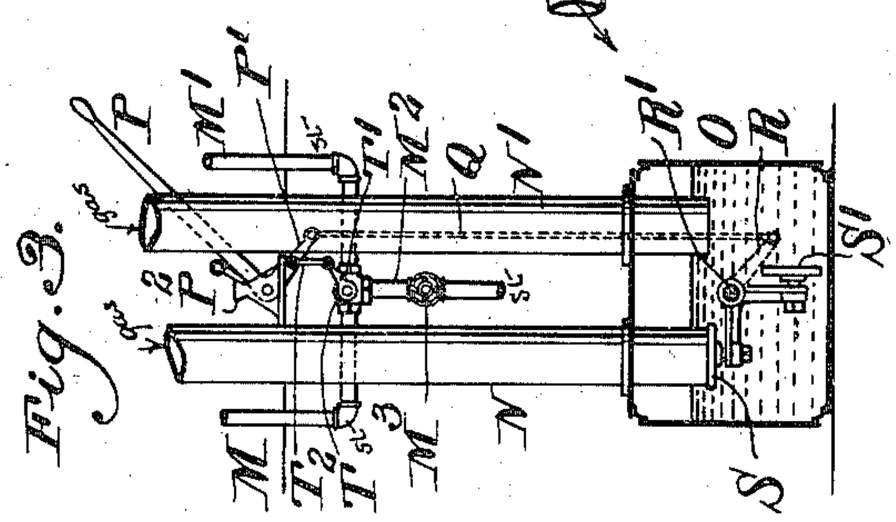


Fig. 4.

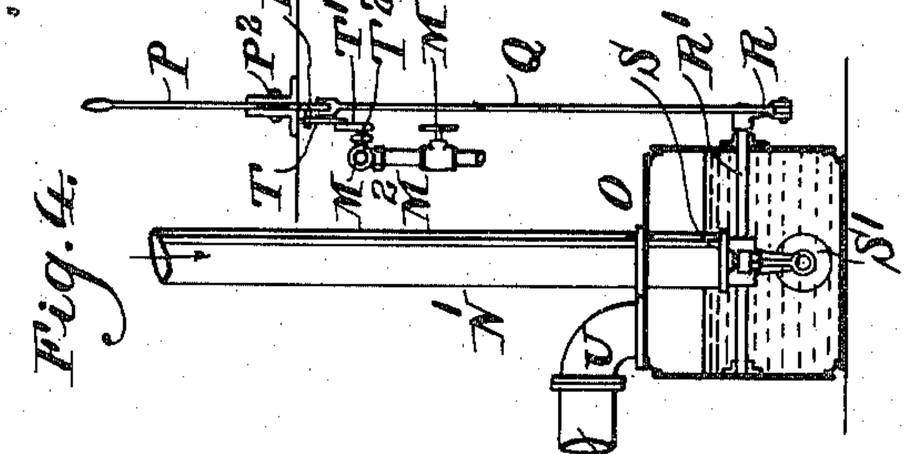
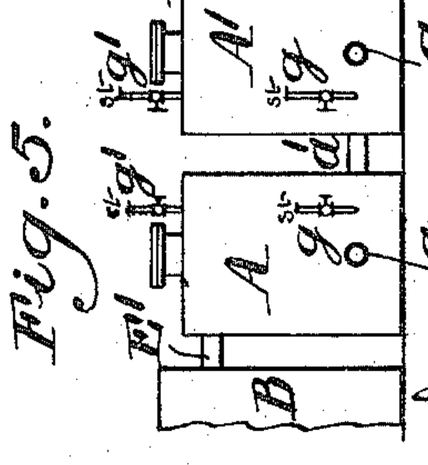


Fig. 5.



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UNITED STATES PATENT OFFICE.

ARTHUR GRAHAM GLASGOW AND ALEXANDER CROMBIE HUMPHREYS, OF NEW YORK, N. Y.

METHOD OF AND APPARATUS FOR CARBURETING WATER-GAS.

SPECIFICATION forming part of Letters Patent No. 581,909, dated May 4, 1897.

Application filed August 6, 1895. Serial No. 558,391. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR GRAHAM GLASGOW and ALEXANDER CROMBIE HUMPHREYS, citizens of the United States, and residents of the city of New York, county of New York, and State of New York, (said GLASGOW temporarily residing in London, England,) have invented certain new and useful Improvements in Methods of and Apparatus for Carbureting Water-Gas, of which the following specification is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

Our invention relates to the manufacture of carbureted water-gas, and has for its object a more perfect utilization of the heat generated in the stages of the process known as "blowing-up the generator"—namely, that stage which consists in forcing air into the fuel-bed contained in the generator for the purpose of raising its temperature to a sufficient heat for the proper decomposition of steam.

In approved modern practice the potential heat or a portion thereof of the gases passing off from the generator during the blowing-up operation is stored by secondary combustion of these gases in regenerative chambers, which chambers are afterward utilized for vaporizing oil during the time when water-gas is issuing from the generator and for converting the oil-vapors into fixed gases. In some apparatus these regenerative chambers are utilized for superheating the steam which is forced into the generator as well as for fixing the gases.

We have ascertained that in the manufacture of carbureted water-gas the blast-gases as they leave the regenerative chambers used for carbureting and fixing the gas have still sufficient sensible and potential heat to impart a high temperature to the air used in the blowing-up operation, and that this heat can be utilized to pronounced advantage by the methods hereinafter described, and of which an essential feature is the provision of two independent or supplemental regenerative chambers connected with the chambers used for carbureting and fixing the gas in such a way that the blast-gases after leaving the fixing chamber or chambers will traverse and impart heat to the said independent chambers, the independent chambers, however, forming no part of the water-gas conduit and being connected with the air-blast apparatus and the generator in such a way that the air used in blowing up the generator-fire will traverse and be heated in the independent regenerative chambers, preferably passing from the said independent chambers through the fixing and carbureting chambers to the generator, this being rendered practicable by reason of the fact that the temperature of the air is so high that it will not tend to rob the fixing and carbureting chambers of an injurious amount of heat, as would be the case if it were passed directly to them without preheating.

Our invention in detail and the apparatus adapted for carrying it into effect will best be understood as described in connection with the drawings, in which the apparatus is illustrated, and in which—

Figure 1 is a plan view of our new apparatus; Fig. 2, a sectional elevation thereof, the parts being represented as spread out into a plane; Fig. 3, a front view of a valve arrangement which we have devised for the convenient reversal of the steam and opening and closing of the proper water-gas-delivery pipes. Fig. 4 is a side elevation of the said valve arrangement, and Fig. 5 a view illustrating a modification in the arrangement of the apparatus.

A is the generator, which, as shown in Figs. 1 and 2, is provided with gas-take-off pipes E E′, leading from the top and bottom of the generator to a commom delivery-pipe E^2 and provided with valves F and F′, by which either branch can be closed at will. The gas-take-off pipes are duplicated, one pipe E^2 in the construction shown leading to the carbureting-chamber B, while the other leads to the carbureting-chamber B′. Each of the said carbureting-chambers is connected with a fixing-chamber, (indicated at C and C′,) connection being made by a conduit, such as K or K′. Of course any usual construction of carbureting and fixing chamber can be employed.

D and D′ indicate the supplemental or in-

dependent regenerative chambers, which, as shown, connect with the fixing-chambers C and C′ through pipes L and L′, *l l* indicating valves in said conduits, by which they can be closed at will, though the presence of such valves is not essential, as will be explained hereinafter.

G and G′ indicate steam-pipes, by which saturated steam can be introduced either to the bottom or top of the generator.

H and H′ indicate oil-supply pipes leading into the carbureters B and B′.

I I′ I² indicate connections from the air-blast (not shown) to the various regenerative chambers, the air being admitted therethrough where secondary combustion in such chambers is desired. Obviously these blast conduit branches may be led off from the main conduit at any point, and therefore the air delivered through them may, if desired, be preheated in the independent chambers D and D′.

J J′ indicate the air-blast conduits leading to each of the chambers D and D′. As shown, these pipes enter the base of the chambers, but it may be advantageous under certain circumstances to distribute the air at various points in the regenerative chambers D and D′, so as to prevent the cooling down of one part of said chambers to too great a degree.

M and M′ indicate the two branches of the steam-supply pipe which lead into the two sets of regenerative chambers, and which, as shown, enter the heads of the fixing-chambers C and C′, at which points it is good practice to introduce the steam for the purpose of superheating it before it enters the generator. The steam-pipes, however, may be introduced into the chambers D and D′, for instance, at the points indicated in dotted lines at *m* and *m′*, in which case the valve *l* can safely be dispensed with.

N and N′ are the gas-take-off pipes, leading from the fixing-chambers C and C′ to a common receptacle O, which, as shown, is a seal-box, U being the gas-conduit leading therefrom.

S and S′ are valves adapted to close the ends of the pipes N and N′ and, as shown, secured to the ends of levers pivoted at R′, the lever-arm R being provided by which the levers carrying the valves are actuated and their valves brought into operation, one pipe being closed and the other pipe being opened, necessarily, by the same motion. The lever R is actuated through a rod Q by means of a lever P P′, pivoted at P², the working arm P′ of the lever being connected by a link T with a lever T′, which in turn is connected with a cock or valve T², by which steam coming from the source of supply through a pipe M² is turned either into the pipe M or the pipe M′, and, obviously, by this arrangement the reversal of the steam always takes place simultaneously with the opening of the gas-delivery pipe corresponding to the position of the steam-cock.

V and V′ indicate take-off conduits for blast-gases leading from the base of the chambers D and D′.

In Fig. 5 we have illustrated two generators (marked A and A′) connected by a conduit *a′* at their bases and with the carbureting-chambers B and B′ by means of the pipes E′ E′. At *g* and *g′* we have indicated pipes for saturated steam leading into each of these generators, and in this figure, as well as Fig. 2, we have indicated at *a* a cold-blast conduit leading to the base of the generators.

The apparatus having been brought to a proper temperature throughout in any convenient way—as, for instance, by passing blast-gases first through the regenerative chambers on one side and then through those on the other side—the operation of manufacturing gas will be carried on as follows: First, assuming that the chambers on the left-hand side of Fig. 2 are those most highly heated air will be forced into the chamber D through the conduit J. Passing through the said chamber it will enter the chamber C by means of the pipe L, thence pass through the conduit K and chamber B, and thence through conduit E² either to the top of the generator through pipe E′ or to the bottom of the generator through pipe E, as may be desired. In case the air enters the top of the generator he valve F′ in the pipe through which it enters is of course opened and the corresponding valve F closed, while in the other set of take-off pipes the valve F is open and the valve F′ closed, so that the air will pass down through the fuel in the generator, and thence through pipes E and E² at the right-hand side into the chamber B′. Of course by reversing the valves F and F′ the course of the air will be upward through the fire and the delivery will be through the pipes E′ and E² at the right-hand side. The blast-gases will pass through the chamber B′, thence through conduit K′ to the chamber C′, thence through conduit L′ to the chamber D′, from which they escape through the take-off conduit V′. Secondary combustion in each of the chambers through which the blast-gases are passing is provided for by introducing air through the pipes I, I′, and I². The blast of air is then cut off and steam introduced into the head of the chamber C through the pipe M or into the chamber D, as through the pipe *m*, in case no valve *l* is provided in the pipe L. The steam sweeping through the chambers C and B becomes superheated and enters the generator as superheated steam. The water-gas formed in the generator by forcing the steam through the heated fuel then passes through the chamber B′, into which oil is also forced, and the mixed gases then pass to and are fixed in the chamber C′, from which they issue through the pipe N′ and into the seal-box O, the valves S and S′ being in the position indicated in Fig. 3. From the box O the gas is passed through pipe U to any convenient storage-tank. At the end of the gas-making run we

prefer to reverse the steam by moving the lever P so as to cut off the steam from pipe M and admit it in the pipe M', this same motion closing the pipe N' and opening the pipe N. The steam then sweeps backward through the chambers C' and B' to the generator and through it into the chambers B and C and then through the pipe N to the seal-box and delivery-pipe. This reversal of the gas, which of course takes place after the oil is cut off at the point H', sweeps the rich gas out of the chambers C' and B' and forces a certain quantity of lean gas into and through the chambers B and C, no oil being introduced at H at this time, and a layer of steam intervening between the lean gas in the chamber C and the air in the chamber D in case steam is introduced at *m*, while of course the use of a valve *l* makes an absolute cut-off and prevents possibility of an explosive mixture.

When the right-hand side of the apparatus has been filled with steam and the left-hand side with lean gas, the steam is cut off by an independent valve, such as indicated at M^3, and which must be employed at any rate, so it will be seen that the reversal of the steam-valve controlled by the lever P P' is to be made only once for each change of direction. Air is next introduced into the independent chamber D' through conduit J' and passed through the chambers C' and B' to the generator, the products of combustion then passing through and being employed to heat the chambers B, C, and D. Then steam is introduced through pipes M' or *m'*, superheated in chambers C' and B', and passes through the generator, the water-gas then passing through and being carbureted and fixed in the chambers B and C, from the last of which it passes through the pipe N to the seal-box. After this run the steam is again reversed by the lever P P', the apparatus swept out, and then again the air is introduced through the chamber D.

We have described in detail the above method of operation because it shows clearly that our apparatus is entirely practicable and can be operated without danger of the formation of explosive mixtures of gas and air. The sequence of operations can be varied in ways which will be apparent to all skilled in the art, and it will also be understood that by providing an independent blast, as *a*, and steam-conduits, as G and G', we have in view particularly the proper trimming and balance of the temperatures which sometimes render the use of these appliances advisable.

It will be apparent that by passing the air directly from the independent chamber D and D' to the generator the main benefits of our invention would still be obtained. We prefer to utilize the three regenerative chambers as the conduits for the air on its way to the generator, because the air is heated thereby to a higher degree and will not absorb so much of the heat as to interfere with the proper functions of the carbureting and fixing chambers. This is true also as to the steam which, obviously, having been admitted as through pipes *m* and *m'* to the chambers D and D', could pass directly to the generator, but as with regard to the air we prefer the construction shown, where the apparatus is doubled, as indicated in the drawings. In another application filed by us July 10, 1895, Serial No. 555,489, we have shown and described a specific apparatus in which the air and steam are not passed through the carbureting and fixing chambers.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The combination with a water-gas generator of two sets of carbureting and fixing chambers, a water-gas take-off leading from each of said sets, a supplemental regenerative chamber filled with refractory material also connected to each of said sets, blast-gas take-offs leading from each supplemental chamber, air-blast conduits leading into each of the supplemental chambers, steam-conduits leading to the generator, and valves arranged as described for reversing and alternating the passage of air, blast-gases, and water-gas through the apparatus.

2. The combination with a water-gas generator of two sets of carbureting and fixing chambers, a water-gas take-off leading from each of said sets, a supplemental regenerative chamber filled with refractory material also connected to each of said sets, blast-gas take-offs leading from each supplemental chamber, air-blast conduits leading into each of the supplemental chambers, steam-conduits leading into a member of each connected set of carbureting and fixing chambers, and valves arranged as described for reversing and alternating the passage of air, steam, blast-gases and water-gas through the apparatus.

3. The combination with a water-gas generator of two sets of carbureting and fixing chambers, a water-gas take-off leading from each of said sets, a supplemental regenerative chamber filled with refractory material also connected to each of said sets, blast-gas take-offs leading from each supplemental chamber, air-blast conduits leading into each of the supplemental chambers, steam-conduits leading into a member of each connected set of carbureting and fixing chambers, and valves arranged as described for reversing and alternating the passage of air, steam, blast-gases and water-gas through the apparatus.

4. The combination of a water-gas generator with two sets of carbureting and fixing chambers, gas-conduits as N N' leading from each of said sets to a common receptacle, steam-conduits as M M' leading into each set of said chambers, a double valve as S S' arranged to alternately close and open the conduits N N', a cock or valve T^2 adapted to alternately open and close the conduits M M'

to a source of steam-supply and a valve-actuating device as lever P arranged to simultaneously actuate the valves S S′ and T² and so as to at the same time reverse the steam-current, open the gas-conduit in proper relation thereto, and close the other gas-conduit.

5. The method of making carbureted water-gas which consists in forcing air through a preheated regenerative chamber adapted to store heat and supplemental to the chambers used for carbureting and fixing the water-gas and thence into the generator, then drawing off the products of combustion through a set of carbureting and fixing chambers and another supplemental preheated regenerative chamber and using its actual and potential heat to heat said chambers, then cutting off the air-blast and forcing steam into the generator, drawing off the water-gas through one of the chambers adapted for carbureting and fixing, and forcing oil therein to carburet said gas, then cutting off the oil and steam and forcing air through the second supplemental preheated regenerative chamber to the generator drawing off the products of combustion through the second set of chambers adapted for carbureting and fixing gas and thence through the first-mentioned supplemental regenerative chamber, and thus continuing alternating the air-blast and the course of the water-gas, and in all cases drawing off the carbureted gas before it reaches the supplemental regenerative chambers in which air is heated.

6. The method of making carbureted water-gas which consists in forcing air through a preheated regenerative chamber adapted to store heat and independent of the carbureting-chambers, and thence through a preheated regenerative chamber or chambers adapted for carbureting and fixing gas into the generator, drawing off the products of combustion through a similar set of regenerative chambers and utilizing the actual and potential heat thereof to heat said chambers, then cutting off the air-blast and forcing steam into the generator, then drawing off the water-gas through the portion of the other set of chambers adapted for carbureting and fixing and injecting oil therein to carburet the gas, then cutting off the steam and forcing air through the second set of chambers to the generator drawing off the products of combustion through the first set, and thus continuing alternating the air-blast and in all cases drawing off carbureted gas before it reaches the chamber into which air is first introduced.

7. The method of making carbureted water-gas which consists in forcing air through a preheated regenerative chamber, adapted to store heat and independent of the carbureting chambers, and thence through a preheated regenerative chamber or chambers adapted for carbureting and fixing gas into the generator, drawing off the products of combustion through a similar set of regenerative chambers and utilizing the actual and potential heat thereof to heat said chambers, then cutting off the air-blast and forcing steam through one set of chambers into the generator, then drawing off the water-gas through the portion of the other set of chambers adapted for carbureting and fixing and injecting oil therein to carburet the gas, then cutting off the steam and forcing air through the second set of chambers to the generator drawing off the products of combustion through the first set and thus continuing alternating the air-blast and steam and in all cases drawing off carbureted gas before it reaches the chamber into which air is first introduced.

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