2 Sheets--Sheet 1.

F. H. EICHBAUM.

Gas-Apparatus.

No. 168,006. Patented Sept. 21, 1875.

Fig. 1.

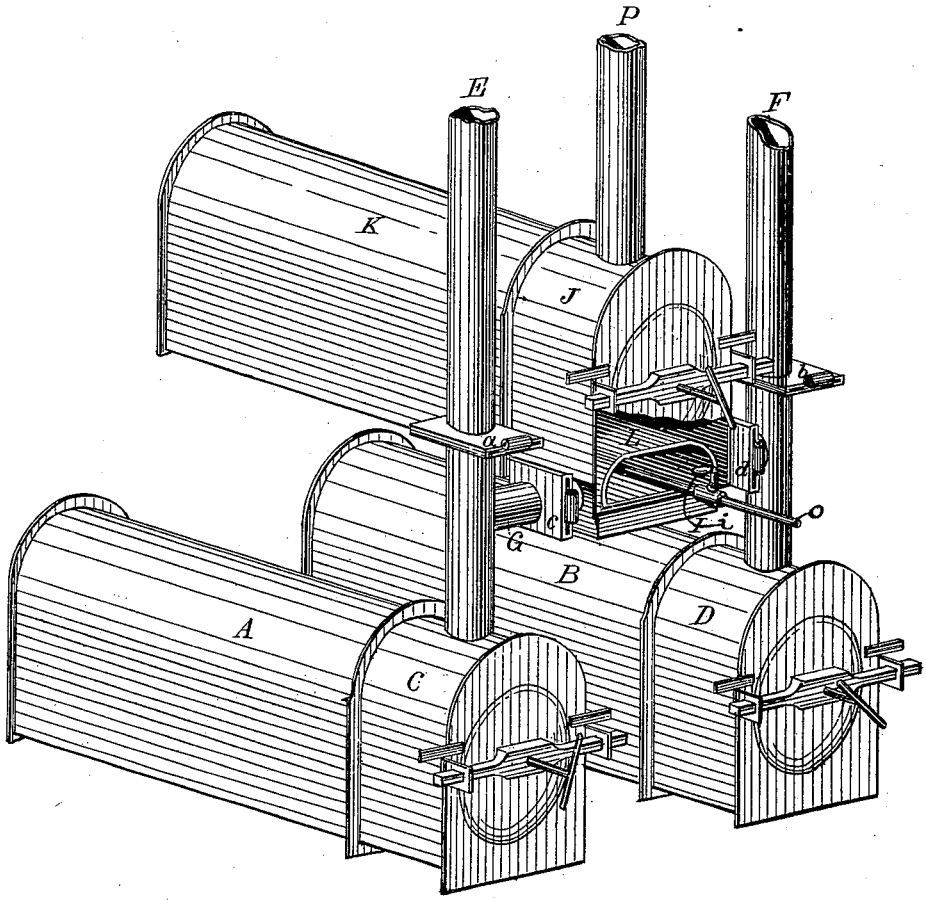


Fig. 4.

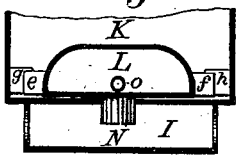
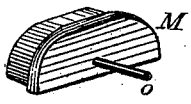


Fig. 5.



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Gas-Apparatus.

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Fig. 2.

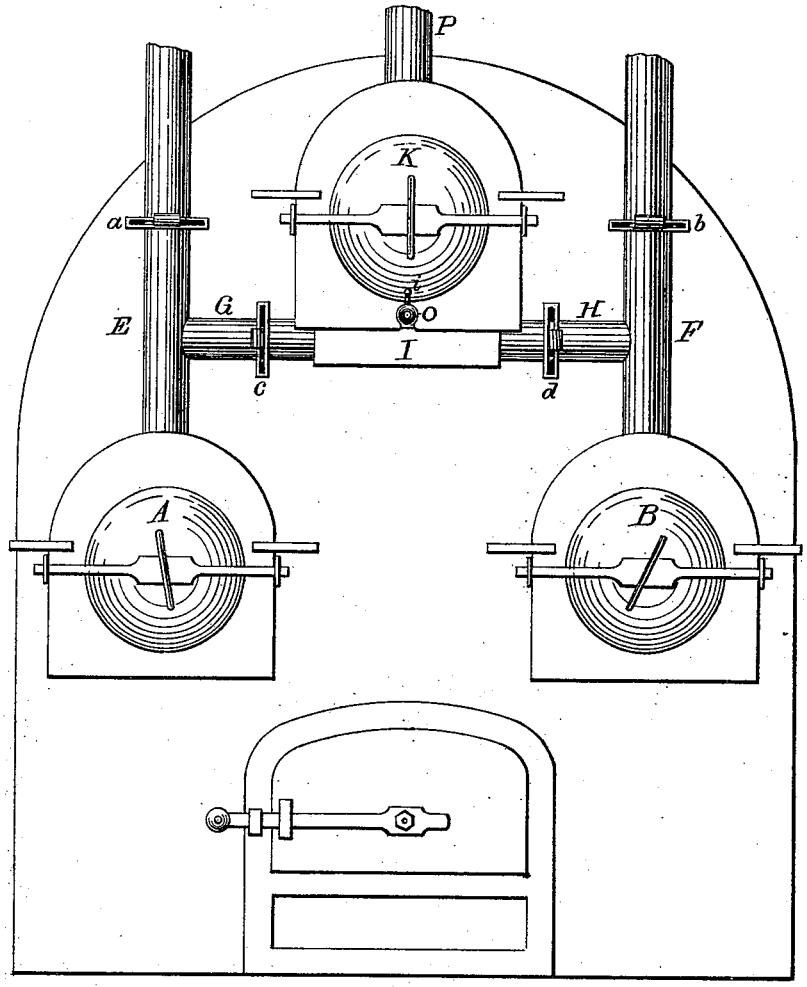
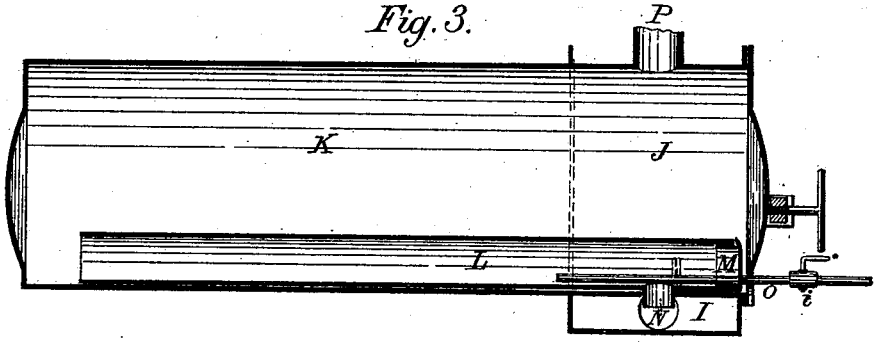


Fig. 3.



Attest:
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UNITED STATES PATENT OFFICE.

FREDERICK H. EICHBAUM, OF DETROIT, MICHIGAN, ASSIGNOR OF TWO THIRDS HIS RIGHT TO WILLIAM W. HORTON, J. T. SALTER, J. H. SHELDON, AND JAMES AIKEN, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN GAS APPARATUS.

Specification forming part of Letters Patent No. **168,006**, dated September 21, 1875; application filed January 13, 1875.

CASE A.

To all whom it may concern:

Be it known that I, FREDERICK H. EICHBAUM, of Detroit, in the county of Wayne and State of Michigan, have invented a new and Improved Apparatus and Processes for the Manufacture of Illuminating-Gas; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The object I have in view is the manufacture of a better and cheaper illuminating-gas by a combination of the gases evolved by the destructive distillation of non-resinous woods and of hydrocarbons, the whole producing a permanent or fixed gas of sufficient candle-power.

The novelty of my invention consists in a peculiar mixing-retort composed of an outer and inner retort, the latter having a pipe which passes through the bottom of the former; also, in combining a retort having certain lugs with another retort having certain stops; also, in combining a certain chamber, secured to the under side of the outer end of the inclosed retorts, with its proper retort, having a pipe entering such chamber and the inclosing retort, all as more particularly hereinafter described and explained. It also consists in some novelties of construction, and in the various operative combinations of the apparatus, as more particularly hereinafter set forth.

In order that those skilled in the art may be able to use my process, and make and use my apparatus, I proceed to describe the same, making reference to the drawings, in which—

Figure 1 is an elevation, in perspective, of my apparatus; Fig. 2, a front view of the same; Fig. 3, a vertical central section of the double retort; Fig. 4, a separate view, showing the front of the inner retort, and the mode of securing it; Fig. 5, a separate view of the stopper to the inner retort.

Similar letters denote corresponding parts in each figure.

In the manufacture of wood-gas for illuminating purposes in this country, it is found that few, or perhaps only one, variety of wood—the long-leaved pine—will produce a gas of sufficient candle-power to meet the public requirements. Experiments have, however, been made frequently and for several years in the manufacture of illuminating-gas from the various non-resinous woods most abundant in the several portions of the country where such experiments have been made, and have resulted in the production of an illuminating-gas which, of itself, was found to be insufficient in candle-power for commercial requirements, and various plans have been adopted to enrich such gases, so as to bring them up to the required standard.

It has been found, however, that in the manufacture of gas by the destructive distillation of wood, such distillation produces, by molecular changes and chemical unions, a considerable quantity of tarry fluid, which contains tar, acetic acid, and wood-alcohol, which, in the ordinary apparatus, is not only put to no beneficial use, but represents a certain amount of waste of gas. It is one of the results of my process and apparatus that these products shall all be converted into illuminating-gas.

I have found by experiment, however, that these non-resinous woods referred to, although distilled exhaustively, as explained, are yet incapable of producing gas of sufficient candle-power, and require enriching by hydrocarbon gases.

One method which I have adopted for this purpose, and for which I have made application for Letters Patent, covers the infusion or impregnation of wood with a sufficient quantity of hydrocarbons, so that such woods, when subjected to destructive distillation, will evolve illuminating-gas of precisely the candle-power required. In speaking of this wood, thus prepared, in this specification, I shall describe it as treated wood. I have found, however, by experiment, that the non-resinous woods are capable of receiving so large an infusion or impregnation of hydrocarbons that, subject to a destructive distillation, they evolve an illuminating-gas of a higher candle-power

than is required, and to that degree need dilution. This dilution, I have found, can best be made by the addition or combination of a sufficient portion of the gas evolved from the destructive distillation of untreated wood.

I have found, moreover, that an excellent illuminating-gas may be made by the destructive distillation of the untreated woods of the non-resinous sorts referred to, to which, in the act of distillation, hydrocarbons are added in sufficient quantities, either in the same retort in which the wood is being distilled, or by distilling the hydrocarbons in a separate retort, and combining the two gases in a retort connected with and common to both.

I have discovered, in addition, that I can produce a cheap and excellent illuminating-gas by the destructive distillation of untreated wood and treated wood in the same retort, or by the distillation of the treated and untreated woods in separate retorts, with or without a connecting or common third retort.

To perform the processes described, I employ the apparatus which is now described.

A and B are retorts, preferably alike, and made of the semi-cylindrical form shown, properly set and adjusted, so that sufficient heat may be applied, and each having a mouth or projection marked, respectively, C and D. Each of the mouths has the usual covering-piece secured in place by the ordinary means.

From the top centers of the mouths C and D spring stand-pipes E and F, which lead up into the hydraulic main in the usual manner, and the escape through them of the products of distillation is regulated by slide-valves *a* and *b*.

Below these last-named valves the pipes E and F are tapped by branch pipes G and H, which terminate, respectively, in a chamber, I, preferably rectangular in form, which is situated directly under the mouth J of the retort K.

The branch pipes G and H have also slide-valves *c* and *d*, for the purpose of cutting off or permitting the flow of gases from the retorts A and B into the chamber I.

The retort K before mentioned is preferably of the same form and construction as the retorts A and B, and is set and adapted for being heated in any usual or convenient manner.

This retort, however, incloses a smaller retort, L, of a form quite similar to the retort K, which retort L rests upon its flat bottom upon the bottom of the retort K, and extends from the front of the same to a point near its rear end, where there is a space between the open rear end of the retort L and the inner rear end of the retort K. The front of the retort L is closed by a removable stopper, M, which fits closely into said retort. This retort is also removable, both for the purpose of cleaning it conveniently and for cleaning the retort K, and has upon its bottom near the front a pipe, N, which fits into a corresponding opening in the top of the chamber I, which is securely fastened to the under part of the mouth-piece of the retort K, and serves as a communication between said chamber and the front end of the retort, and also serves, in some degree, to hold said retort in a proper horizontal position within the retort L. As, however, it would not sufficiently or safely accomplish this purpose, there are placed upon the sides of the retort L certain lugs *e f*, which rest against other lugs or stops *g h* secured to the sides of the mouth of the retort K, so that when the door or cover of the retort K is luted, and pressed strongly against the stopper of the retort L, the lugs and stops before named serve to prevent the retort last named from being forced out of place.

A pipe, O, is tapped through the stopper before named, and terminates in the interior of the retort L, and is connected in any suitable way with any vessel or receiver containing liquid hydrocarbons, which, by gravity or pressure, are forced through said pipe into said retort, the flow being regulated by a cock or valve, *i*.

A stand-pipe, P, springing from the top of the mouth of the retort K, and connecting also with the hydraulic main, completes the enumeration and description of the several parts of my apparatus.

It will be here observed that, although I prefer the arrangement of three retorts, as described, I do not wish to confine myself to that number, as it may readily be seen that, for certain purposes and processes to which I have referred, a smaller or greater number may be used conveniently.

It being understood that the apparatus is properly heated and ready for use, and that I wish to obtain illuminating-gas of a certain candle-power from the destructive distillation of treated woods, which have been impregnated with just the required quantity of hydrocarbons to evolve an illuminating-gas of the candle-power described, I charge the retort A or the retort B, or both of them with such treated wood, and close the valves *a* or *b*, or both, and open the valves *c* or *d*, or both.

The gas evolved by the destructive distillation of the treated woods passes up the stand-pipes E F, through the branch pipes G H, into the chamber I, into the retort L, along the length of said retort, then back the length of the retort K, and into the stand-pipe P, at which point it has wholly become a permanent or fixed gas of the precise candle-power desired. It is understood, however, that if only one of the retorts A or B is used, that the valve must be closed to the branch pipe of the retort which is not used.

If I wish to use treated wood, which alone would make an illuminating-gas of too high candle-power, I place the treated wood in the back of the retorts A or B, or both, and the process is the same as that just described, with the same result. Although I put the treated wood at the back of the retort as a

better mode, inasmuch as it forces the gases from the hydrocarbons to pass over the gases from the untreated wood and travel a greater distance, yet a very good result may be attained by mixing the treated and untreated woods indiscriminately in the retort or retorts.

It will be found a very convenient method in use, to charge the retort A with treated wood, and the retort B with untreated wood, or conversely, when the same process will be performed, and the same result effected.

Should I desire to make my gas from untreated wood and from hydrocarbons, the process is as follows, viz: I charge the retorts A or B, or both, with untreated woods, opening the valves in the stand-pipes and closing the valves in the branch pipes. When the distillation begins evolving gases freely, I close the valves in the stand-pipes and open the valves in the branch pipes, at the same time opening the valve or cock *i'* in the pipe O, which permits a flow of fluid hydrocarbon into the retort L. The gases from the retort A or B pass over the hydrocarbons in the retort L, and unite chemically with the hydrocarbon-gas in the retort L, and pass through such retort, and back through the retort K, and become thereby a permanent or fixed gas of the desired candle-power. Or I may charge solid hydrocarbons with untreated wood in the retorts A or B, or both, and the before-described processes follow, with the same result. Or the solid hydrocarbons can be charged into the retort L with the same result, the same process being followed.

It will be readily understood that, with my arrangement of the four retorts A, B, K, and L, and with the materials named—to wit, treated woods, untreated woods, solid hydrocarbons, and fluid hydrocarbons—I may change the details of the process to a much greater extent than described without varying the spirit or scope of my invention.

In the foregoing description, where I have spoken of treated and of untreated woods, I do not wish to confine myself to wood proper, as any vegetable material may be used in the same way, for the same purpose, and with the same results.

The particular advantages which result from my apparatus and the processes connected with it, are as follows: The elements composing the tarry matters usually evolved and wasted in the destructive distillation of woods are utilized in the form of illuminating-gas. The quantity and quality of the gas to be evolved from the materials used can be determined beforehand with exactness, as it is a matter of demonstration by weight of the material. The wood distilled produces a gas which serves as a vehicle to carry the richer gases of the hydrocarbons without waste, and the combination of the two under the same temperature produces a permanent and fixed gas. Some hydrocarbons, as coal-tar, the residuum of petroleums, and crude petroleum, cannot be used to advantage in any other sort of apparatus.

The apparatus described may be used with any description of hydrocarbons, and is capable of a vast variety of uses, as before explained.

The yield of charcoal is greatly increased, and the value of the same is enhanced by reason of the greater density and purity of the same.

By these processes and this apparatus the cost of producing illuminating-gas is largely diminished, while the result is a uniform permanent gas of precisely the candle-power desired.

Having thus described my processes and the apparatus used in connection with them, what I claim as new, and my invention, is—

1. The mixing-retort described, composed of the outer retort K and the inner removable retort L, having a pipe, N, which passes through a proper opening in the bottom of the retort K, substantially as described and shown.

2. In combination, the retort L, having lugs *e f*, with retort K, having stops *g h*, substantially as and for the purpose described.

3. In combination, the chamber I, the retort L, having pipe N, and the retort K, all constructed and arranged substantially as described.

This specification signed and witnessed this 12th day of January, 1875.

FREDERICK H. EICHBAUM.

Witnesses:

J. H. SHELDON,

CHARLES THURMAN.