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W. H. ADAMS & F. POWELL.

APPARATUS FOR THE MANUFACTURE OF ILLUMINATING GAS.

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Fig. 1

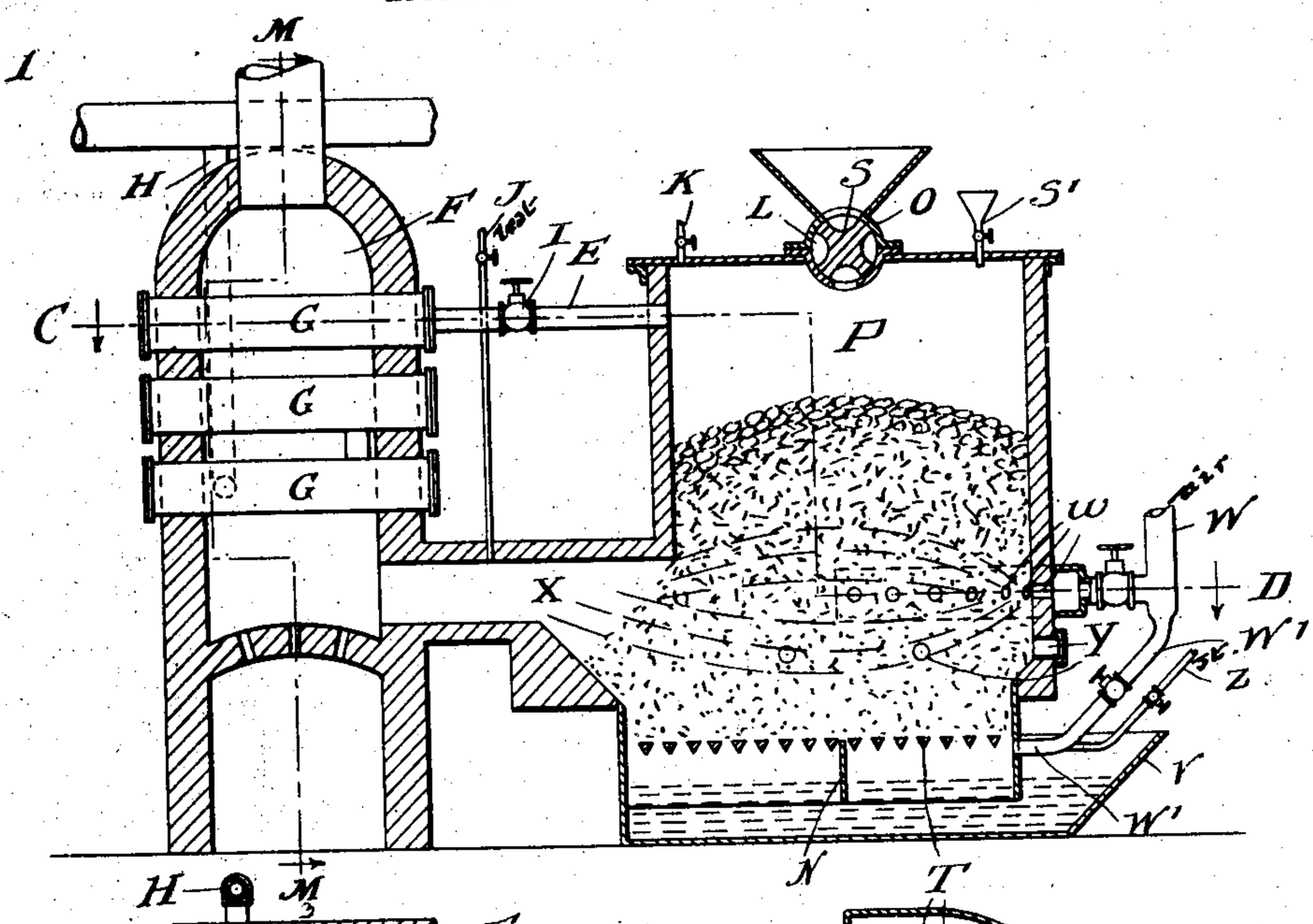


Fig. 2

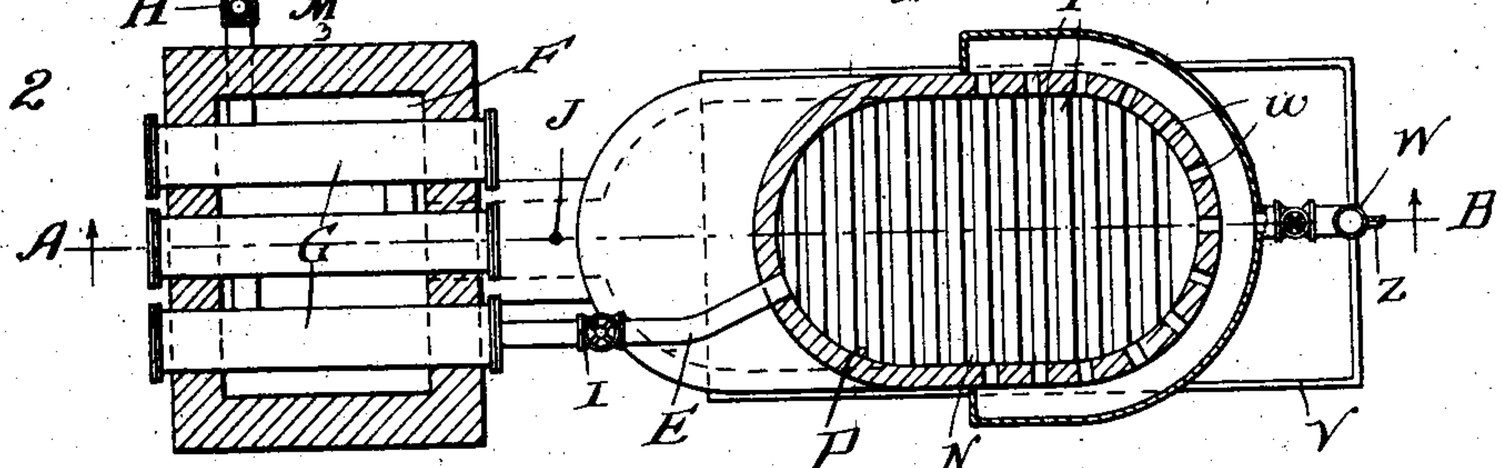
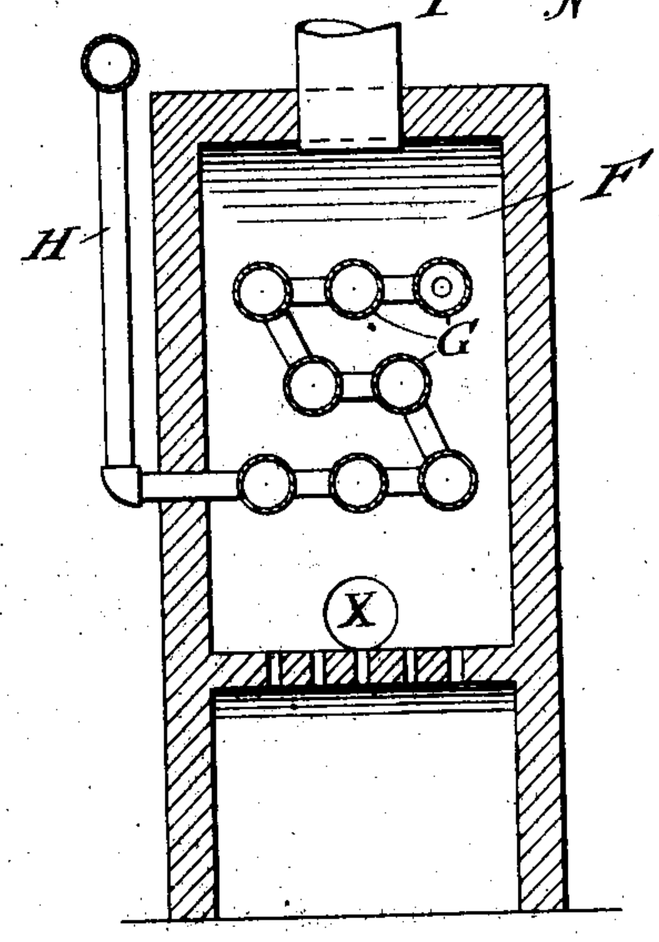


Fig. 3



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE MANUFACTURE OF ILLUMINATING-GAS.

No. 834,239. Specification of Letters Patent. Patented Oct. 30, 1906.

Application filed July 16, 1904. Serial No. 216,800.

To all whom it may concern:

Be it known that we, WILLIAM H. ADAMS and FREDERICK POWELL, citizens of the United States, residing in Portland, in the county of Multnomah and State of Oregon, have invented a new and useful Improvement in Apparatus for the Manufacture of Illuminating-Gas, of which the following is a specification.

The modern type of apparatus used for the generation of what is known as "coal-gas" consists, essentially, of a fire-brick furnace into which are built several fire-clay retorts. Around these retorts a very hot fire is kept burning. The retorts are filled with bituminous coal and are hermetically sealed during the period of firing, except as to one outlet for the escape of the gas distilled from the coal. The best class of fire-resisting materials must be used for these retorts, and the wear and tear on them is excessive, because they are subject to great changes of temperature between the time of charging them with coal and the time of the highest heating, when the last distillates are driven off. The varying changes of temperature within the retort result in the formation of tars and watery products, (approximately one to two gallons per thousand feet of gas manufactured.) There is also a considerable percentage of gas wasted in leaks and during changes of the parts while feeding coal and removing coke, so that the process has always been an uncertain and expensive one, and notwithstanding its superiority as an illuminant has been superseded to a large extent by the cheaper so-called "water-gas."

Our invention is intended to supply a less expensive and generally useful type of apparatus that will consume any class of fuel which contains sufficient volatile hydrocarbon, preferably the culm coals, peat, sawdust, lignites, cannel and bituminous coals, as well as crude oil, asphaltum, &c., for the generation of illuminating-gas. We accomplish the distillation of the gas-producing elements and make them into fixed gas in an apparatus the operation of which is continuous and simple. The operation of the apparatus being practically continuous, we avoid the destructive changes in temperature to which the old-style retorts are subject and avoid also the loss of gas and the loss of time in emptying and recharging them. We make none of the usual by-products of the gas process except a small amount of fixed carbon deposited on the inside of the retorts in the form of a pure coke. A portion of this coke may be used in the lowest and hottest tier of retorts for the purpose of finally decomposing any water-vapor into water-gas and carbonic acid (if any) into carbon-monoxid.

Referring to the drawings, Figure 1 is a vertical section on the line A B of Fig. 2, and Fig. 2 is a horizontal section on the line C D of Fig. 1. Fig. 3 is a vertical section on line M M of Fig. 1.

The chamber P of the generator is preferably of elliptical shape and is elongated at the base just above the grate T, so as to form an increased area at the zone of combustion. In this manner we insure an additional mass of fuel in this zone, which we find desirable to thoroughly decompose the products of combustion.

The fuel is admitted to the chamber of the generator preferably by the feed device S, the operation of which will be understood. It consists, essentially, of a cylindrical casing O with openings at the top and bottom. Inside of this casing and fitting it closely is a cylinder in which are pockets L, which fill with fuel when they are under the upper opening and discharge when they come to the lower opening in the casing. This cylinder is made to revolve by suitable gearings. It thus introduces fuel into the generator, while preventing the escape of gas, except the small amount unavoidably filling the pockets from which the fuel has discharged itself.

S′ represents a valved feeder through which liquid hydrocarbons may be admitted to the generator for enriching the gas.

A water-seal ash-pan is shown at V, and W is an air-pipe with ports *w*, through which the air passes to the fuel.

X is an outlet-pipe for producer-gas only, and, as will be seen, it is in the same horizontal plane practically as the inlet W.

W′ is an additional air-inlet for supplying

air through that portion of the grate immediately below the ports *w*.

N is a vertical diaphragm placed transversely across the bottom of the generator below the grate and extending downward into the water in the ash-pan. This diaphragm limits the area of the grate through which the air and steam are applied by the inlet W'. The air and steam admitted through the portion of the grate described pass at first upward and then horizontally toward the outlet X in the same manner as the air from the side inlets W.

Z represents a steam-inlet entering the air-pipe W' at a point close to the generator, and Y represents poke-holes.

E is a pipe leading from the top and interior part of the generator through the walls and the shell of the generator into the chamber F, where it is connected to one of a series of communicating retorts G. Through this pipe E all the gas which forms in the top of generator P and which is substantially free from air or products of combustion is driven by the pressure of the generator into the retorts G and there split up into fixed gases by the heat created by combustion of producer-gas in chamber F.

I is a valve regulating the flow through the pipe E. The fixed gas made in retorts G is then passed through pipe H to scrubbers and purifiers in the usual manner.

J and K are small pipes with suitable tips forming gas-jets connected, respectively, with the outlet X for producer-gas and the top of the generator for illuminating-gas. Small flames kept burning at these jets form indicators which show at all times the quality of gases leaving the generator.

Our practice in making illuminating-gas with the described apparatus is as follows: The generator P is first filled to a sufficient height above the grate with wood to act as kindling. On top of this is added sufficient fuel of any character to bring the level somewhat above the outlet X. The fire is lighted through the poke-holes and increased by a gentle blast from a blower (not shown in the drawings) or by natural draft through the air-inlets *w* and *w'*. All openings in the top of the generator are then closed substantially air-tight. The fire quickly spreads across the lower portion of the generator, igniting the fuel up to the top of the outlet X, as shown by the dotted lines radiating from *w* and from the portion of the grate supplied by *w'*. As soon as this is accomplished a regular feed of fuel is begun through the feeder S, the blast is increased, and thereafter a steady output of gas can be maintained.

The form of the generator, the points at which the blast is applied, and the position of the outlet X are such that the combustion produced by the blast is limited substantially to the zone indicated by the dotted lines and extending from the grate up to the plane of the top of the outlet X. The combustion carried on in this zone results in the generation of producer-gas, which is removed through the outlet X and is burned in the chamber F, as described below. It will be seen at once that this limitation of the combustion to the space between the grate and the top of the outlet X divides the space within the generator into two separate and substantially distinct zones, the lower of which we have described as the zone wherein combustion takes place. The upper zone is the zone of distillation.

The fuel in the zone of distillation lying immediately upon the fuel which is in a state of combustion is heated and subjected to the same action as the coal in the retort of the gas-bench. Its volatile constituents are driven off in the form of gas, tar, and water vapor. These products of distillation (identical with those formed in the retort of the gas-bench) are removed as fast as generated through the outlet E and constitute, when properly purified, illuminating-gas.

It is obvious that a regulation of the volume of gas removed through the pipe E is required to avoid, on the one hand, an outflow in excess of the quantity produced by distillation which would result in the entrance of some of the producer-gas from the combustion zone into the upper portion of the generator and, on the other hand, an insufficient outlet for these distillation products which would cause some of the rich illuminating-gas to be forced downward into the zone of combustion, thereby enriching the producer-gas escaping through the outlet X at the expense of a portion of the illuminating-gas.

To enable the operator to properly regulate the flow through the outlet E, the two jets of gas are kept burning, one taking producer-gas from the outlet X, the other from the top of the generator. Any loss of illuminating-gas is at once indicated by the color of the flame of producer-gas, and any contamination of the illuminating-gas by the producer-gas is at once indicated by the weakening of the other flame. It would seem at first glance that the regulation of the outlet E in order to properly operate the apparatus would require the greatest watchfulness on the part of the operator and great skill to detect the first indication of the presence of producer-gas in the illuminating-gas. In actual operation, however, this is very simple. So long as the flame of illuminating-gas shows the necessary quality of gas for the purpose required—viz., illumination—the flow is allowed to continue through the outlet E. When the quality of the gas goes below a certain determined standard apparent to the eye, the outlet is reduced by partially closing the valve I until the flame again shows the required quality, or by the addi-

tion of volatile hydrocarbons in the form of crude petroleum by the feeder S′ or by slightly increasing the speed of the feed of fuel by the feeder S the required quality of gas is restored.

It is obvious that fuels poor in volatile hydrocarbons will make but a small quantity of distilled or illuminating gas. To such fuels it is possible in our apparatus to add fuels rich in volatile hydrocarbons, such as crude petroleum, asphalt, &c., introduced either separately through the feeder S′ or mixed with the solid fuel and fed with it, thus increasing the product of illuminating-gas. A practically uniform feed of fuel through the mechanical feeder S and a periodical shaking of the grate-bars makes the operation continuous and always under easy control of the operator.

The gas distilled from the fresh fuel in the zone of distillation, identical with that obtained from fuel of the same character when heated in the closed retorts of the gas-bench, contains or is accompanied by watery vapors and tars and consists partly of hydrocarbons condensible at ordinary temperatures into tarry compounds. If passed at once to scrubbing-towers, these condensable hydrocarbons as well as the heavier tars and the water-vapor would be at once removed; but by passing them while still hot through red-hot retorts the distillation of these compounds is completed, converting them into permanent or fixed gases. These retorts are kept at a constant high temperature by the combustion of the producer-gas generated in the lower zone of the apparatus. This constant temperature insures a long life to these retorts. These are set in a brick combustion-chamber with ends exposed and closed by removable cover, so that the removal of the deposited carbon is facilitated. The particular form of retort shown is only one of a number of forms that may be used for the purpose described.

As a precaution against the passage of any water-vapor through the retorts or any carbonic acid contained in any producer-gas that may get into the upper part of the generator and pass over with the illuminating-gas one or two of the last retorts in the series may be filled with the broken pieces of carbon or coke removed from the surface of the retort. This becomes incandescent and by its action in this condition on the water-vapor and carbonic acid they are decomposed into hydrogen and carbon monoxid. After passing through the retorts the gas is passed through scrubbers and purifiers in the usual manner, but with much smaller loss, in the form of tar and condensable hydrocarbons than in the case of the old retort process.

The waste heat from the retort-chamber is used for making steam for operating the machinery of the plant—viz., the feeder blower, and any conveying or elevating machinery required. There will be an excess of the producer-gas above what is required to heat the retorts. Thus a by-product is created which may be used for heating, power, and other purposes and considerable revenue be derived thereby.

It will readily be understood by one skilled in the art of making illuminating-gas that our process in a generator of the form described constitutes a continuous distillation process equivalent in results to a continuous retort process, that any class of fuel may be used for purposes of combustion in the lower zone, and that any of the distillates of petroleum, rich hydrocarbons, cannel coals, or fat bituminous coals can be used to furnish the desired illuminants. The combustion of the fixed carbon elements of the fuel in the lower zone—the zone of combustion—supplies the heat whereby the volatile constituents are expelled from the fuel in the upper or zone of distillation immediately above, and these crude products of distillation are finally fixed and the distillation of the tars is completed in the retorts heated by the producer-gas made in the lower zone of the generator. At the same time the water-vapor of the fuel instead of being condensed is converted into water-gas by passage through the hot retorts.

Between the purifiers and the gas-holder an "exhauster" is introduced, as in common practice, to draw the gas from the retorts through the scrubbers and purifiers and force it into the holder. This keeps up the flow of gas through the pipe E and the valve I.

We claim—

1. The generator for manufacturing illuminating-gas having its air-inlet and an outlet for the products of combustion so located as to produce a horizontal zone of combustion in the lower part of the fuel, said generator also having an outlet above the fuel-level for the removal separately of the products of distillation, and a retort exteriorly heated by the gas from the zone of combustion and into which retort said products of distillation are conducted.

2. The horizontal generator for manufacturing illuminating-gas having means for feeding the fuel at the top, such means being normally adapted to exclude the air, an exit for the products of distillation above the top of the fuel, air-supplying means and an exit for the products of combustion at opposite sides of the generator and at the same level below the top of the fuel, a grate supporting the fuel, an ash-pan, and means for normally sealing the ash-pan against the entrance of air.

3. The apparatus for generating illuminating-gas comprising a generator adapted to maintain a horizontal zone of combustion in the lower portion and a zone of distillation in the upper portion of the fuel, and having one

exit for the products of combustion and another exit for the products of distillation, and a retort connected to the last-mentioned exit and serving to convert the products of distillation into fixed gases.

4. The apparatus for generating illuminating-gas comprising a generator adapted to maintain a horizontal zone of combustion in the lower portion and a zone of distillation in the upper portion of the fuel, and having one exit for the products of combustion and another exit for the products of distillation, and a retort connected to the last-mentioned exit and serving to convert the products of distillation into fixed gases, said retort being heated by the products of combustion from the first-mentioned exit.

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