No. 827,075.

PATENTED JULY 31, 1906.

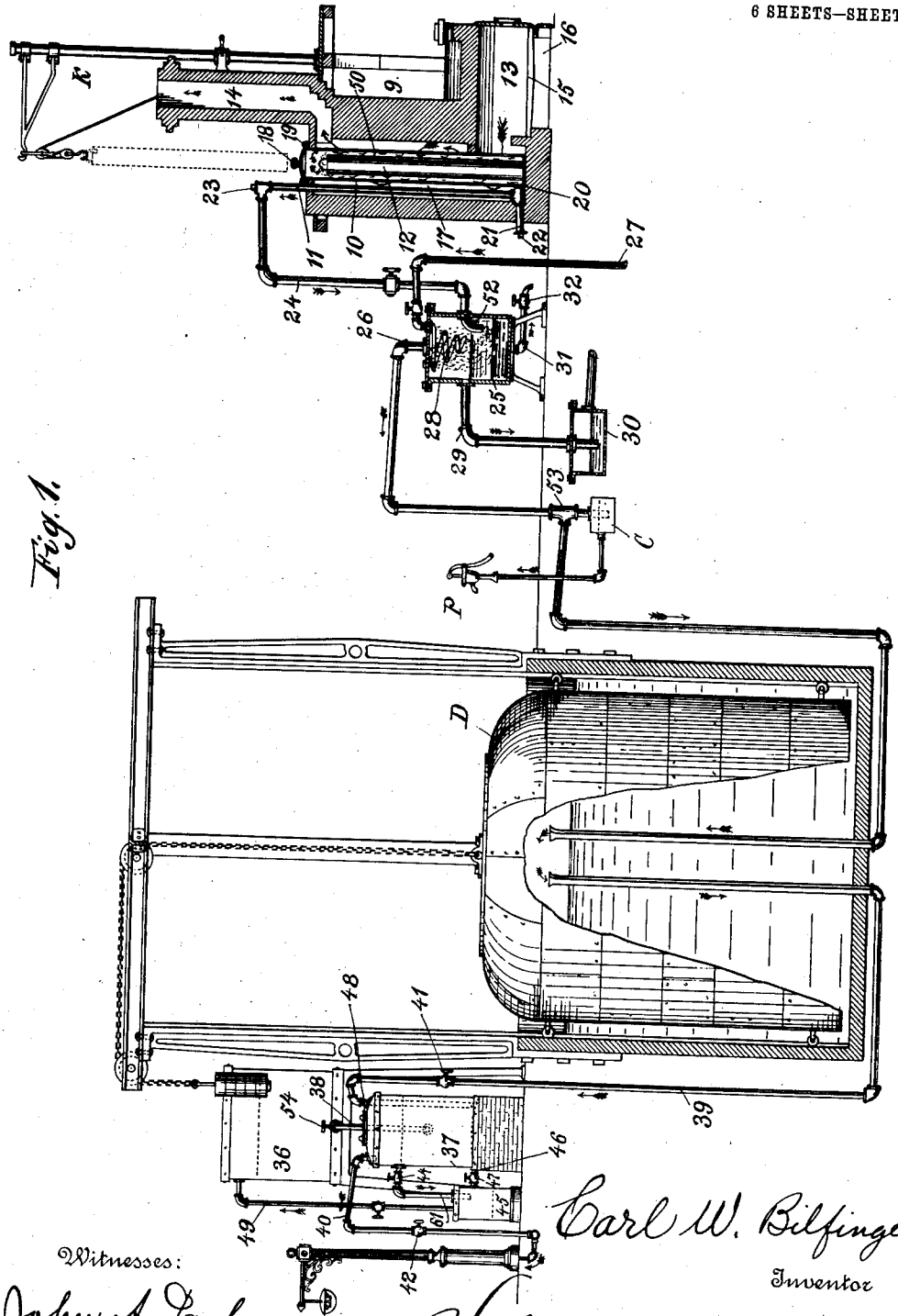
C. W. BILFINGER.

APPARATUS FOR THE MANUFACTURE OF ILLUMINATING GAS.

APPLICATION FILED JUNE 22, 1904.

6 SHEETS—SHEET 1.

Fig. 1.



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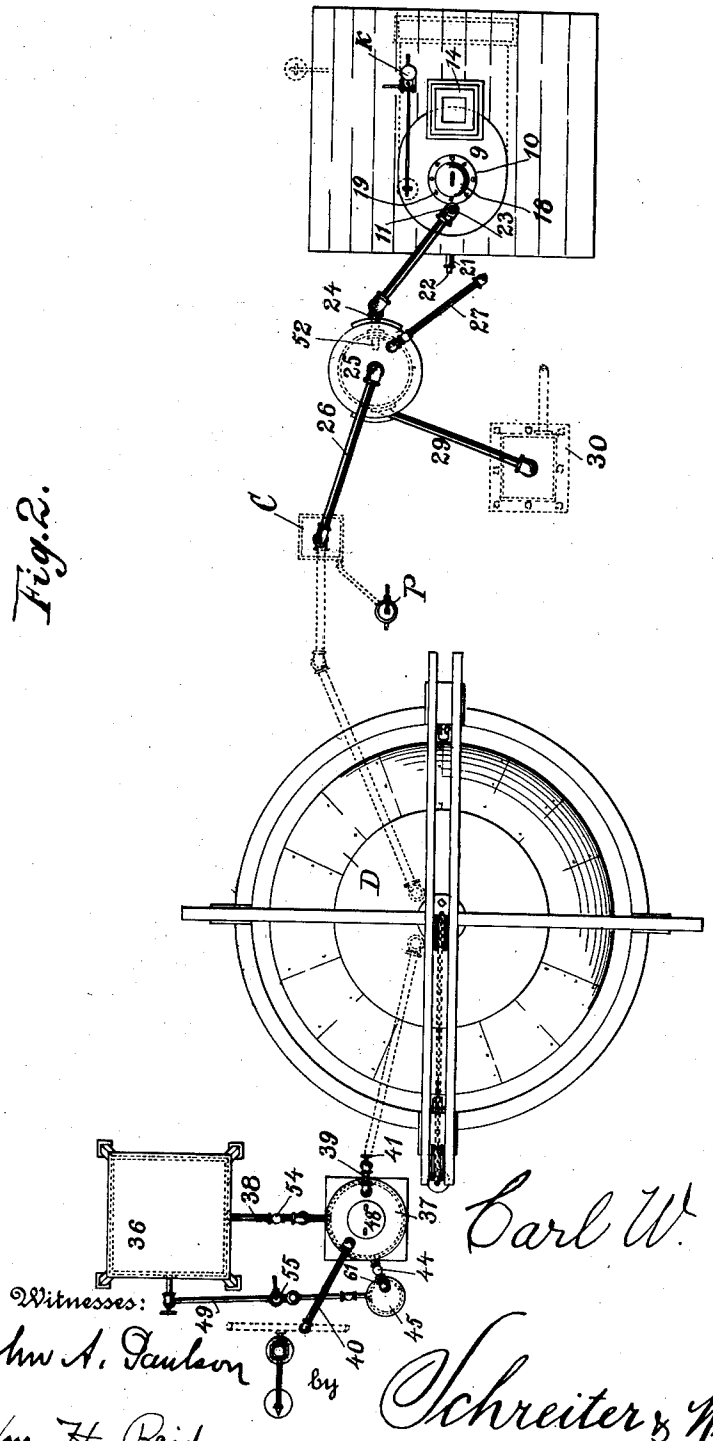
6 SHEETS—SHEET 2.

Fig. 2.



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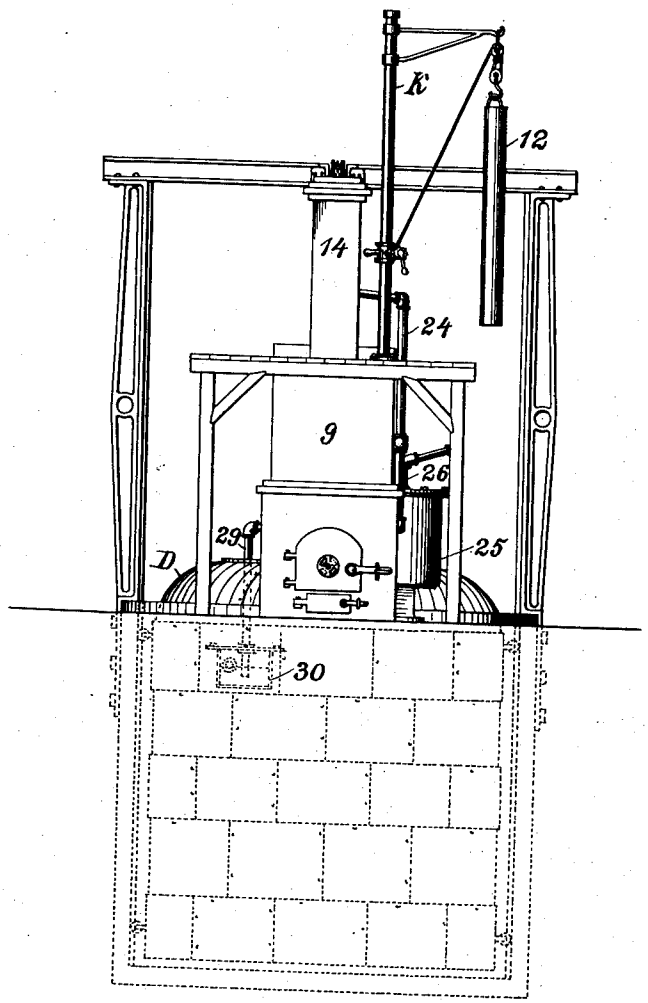
6 SHEETS—SHEET 3.

Fig. 3.



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6 SHEETS—SHEET 4.

Fig. 4.

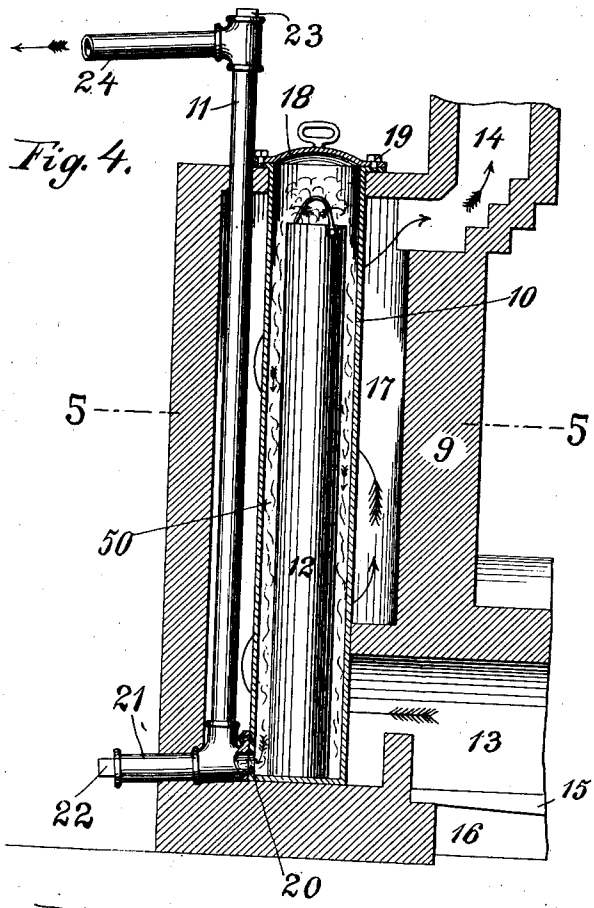
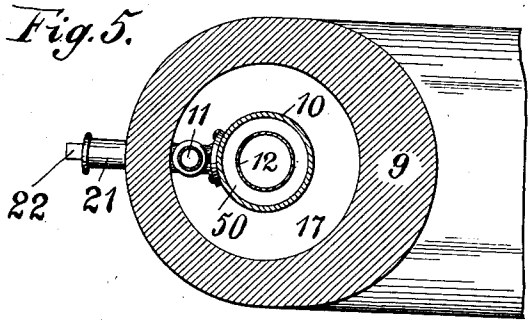


Fig. 5.



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6 SHEETS—SHEET 5.

Fig. 6.

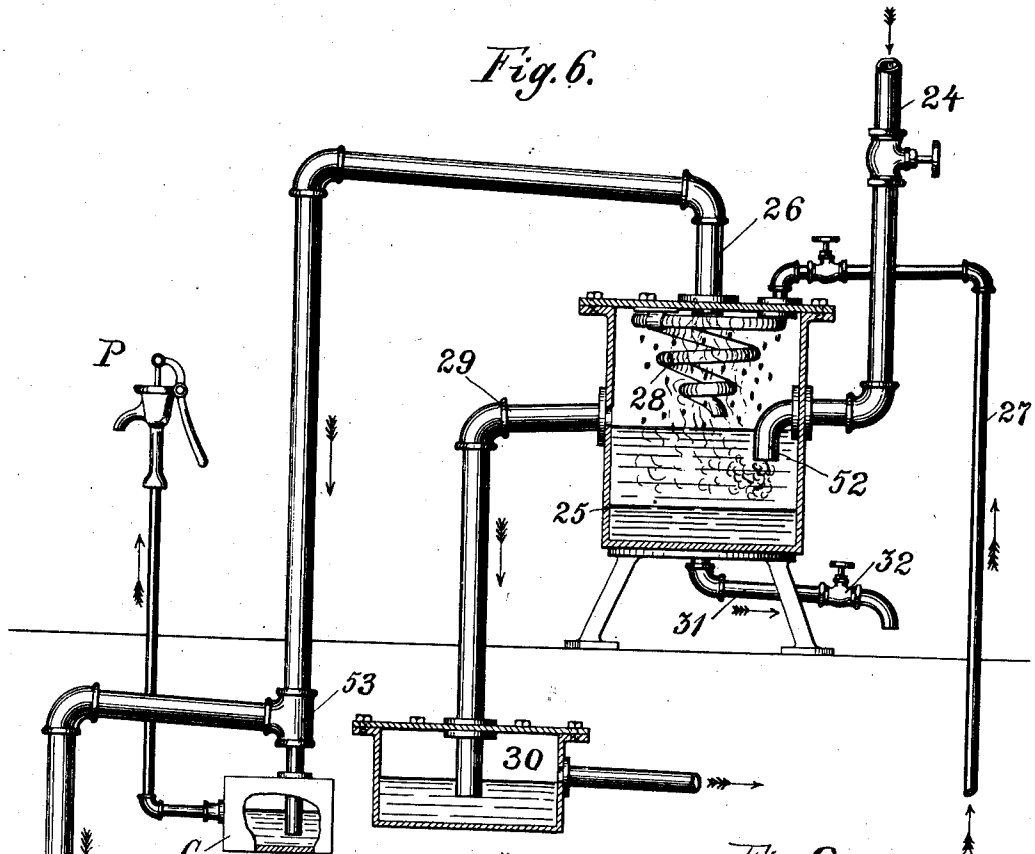


Fig. 7.

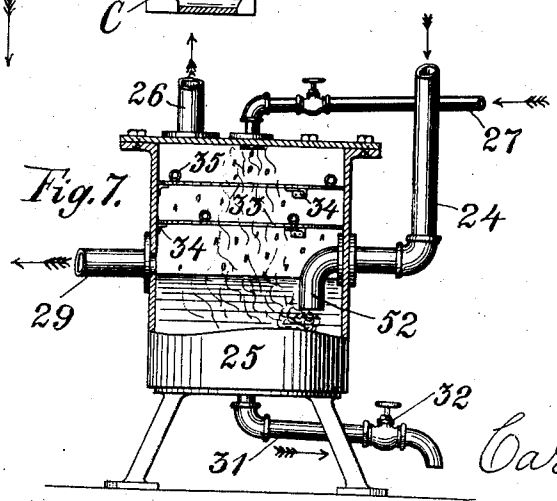
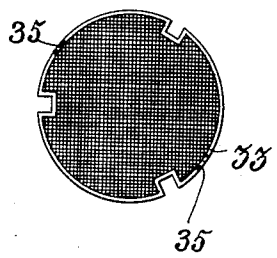


Fig. 8.



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No. 827,075. PATENTED JULY 31, 1906.

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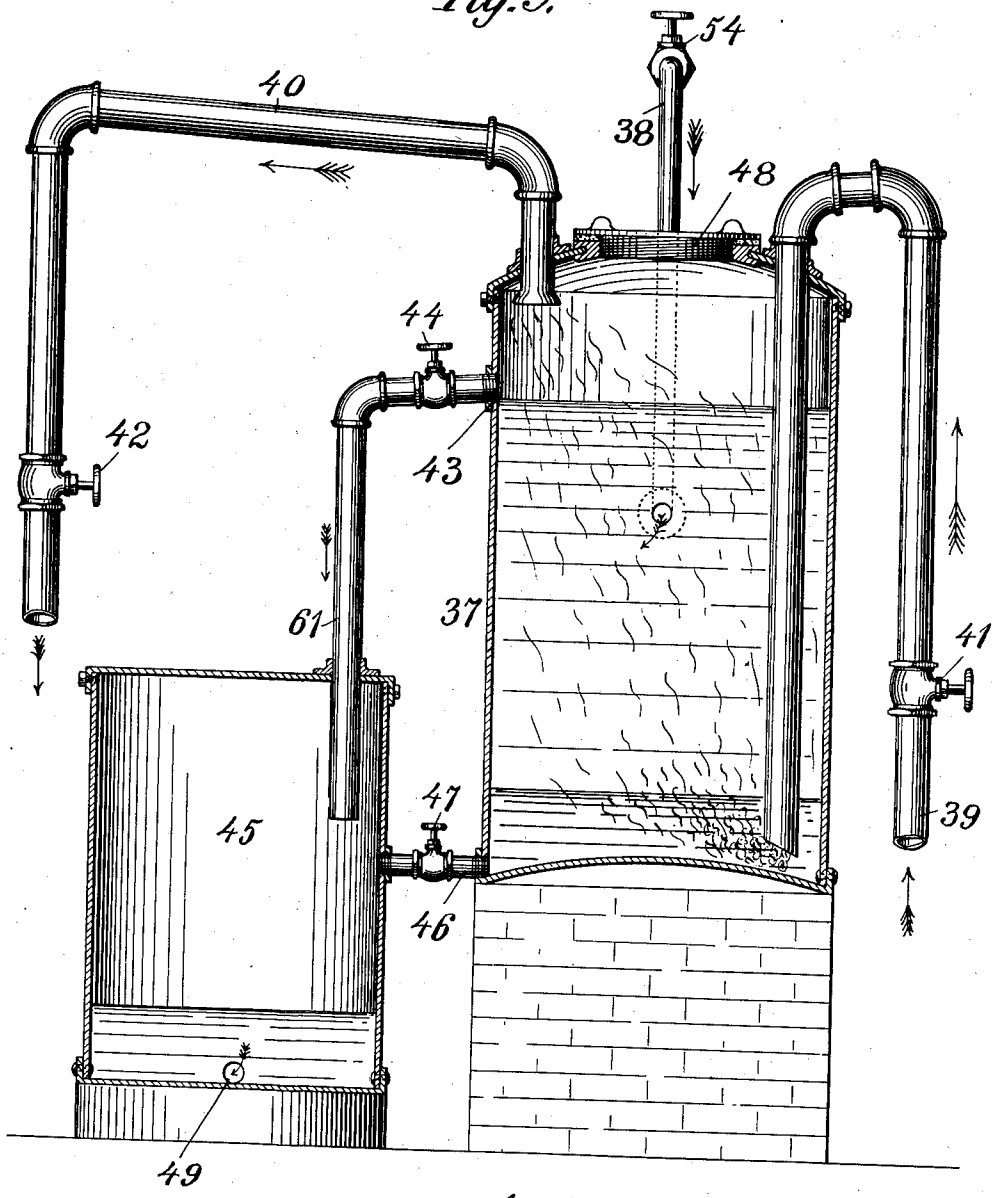
APPARATUS FOR THE MANUFACTURE OF ILLUMINATING GAS.

APPLICATION FILED JUNE 22, 1904.

6 SHEETS—SHEET 6.

Fig. 9.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE MANUFACTURE OF ILLUMINATING-GAS.

No. 827,075. Specification of Letters Patent. Patented July 31, 1906.

Application filed June 22, 1904. Serial No. 213,678.

To all whom it may concern:

Be it known that I, CARL W. BILFINGER, residing in Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Apparatus for the Manufacture of Illuminating-Gas, of which the following is a specification, reference being had to the accompanying drawings, illustrating the apparatus constructed according to my invention.

This invention relates to apparatus for producing illuminating-gas by distilling carbonaceous substances, preferably what is generally known in the southern pine belt as "lightwood;" and it consists of the hereinafter-described improved construction of such apparatus.

Heretofore illuminating-gas has been produced as one of the by-products of destructive distillation of wood in retorts, the object of such destructive distillation being to recover the pine-oils contained in the carbonaceous material.

The object of this invention is to produce gas as the main product, to economically utilize for that purpose all volatile ingredients of the raw material that are capable of being converted into fixed gases, and to produce gas of good illuminating quality of material which is poorer in fatty or oily ingredients, and consequently not economically suitable for manufacture of pine-oils and the like; and to that end my improved apparatus comprises an oven and retort for distilling the carbonaceous material and in combination therewith means for reheating the volatile products of the distillation, whereby the vapors of oily ingredients produced by the distillation in such state that they would be condensed in the conduits and reservoirs into fixed gases, thus effecting the utilization in the manufacture of the gas of those oily ingredients of the carbonaceous materials that give it the requisite illuminating capacity, rendering it suitable for use as illuminating-gas.

My invention comprises also means for eliminating from the thus produced gas all carbonic acid and other aciduous ingredients which affect detrimentally its illuminating quality and for enriching the gas thus produced by combining with it naphthalene under conditions resulting in permanent and safe absorbing of this ingredient by the illuminating-gas.

In the above-mentioned drawings, Figure 1 is an elevation partly-sectional view of an apparatus constructed according to my invention. Fig. 2 is a plan view, and Fig. 3 an end elevation thereof. Fig. 4 is a longitudinal vertical sectional view, partly elevation, of that part of the apparatus where the crude gas is produced. Fig. 5 is a cross-sectional view thereof on line 5 5 indicated in Fig. 4. Fig. 6 is an elevation, on an enlarged scale, of that part of the apparatus where the crude gas is treated to separate the condensable from the uncondensable ingredients thereof and to eliminate from it carbonic acid and other aciduous impurities. Fig. 7 is a sectional view, partly elevation, of a modified construction of the condenser and purifier. Fig. 8 is a detail plan view of one of the distributing-sieves used in the condenser and purifier. Fig. 9 is a sectional view, partly elevation, of that part of the apparatus where the gas produced is treated to effect the combination of naphthalene therewith.

The arrangement of the several parts of the apparatus, as shown in Figs. 1 and 2, is to my understanding the most convenient for the operation of such a plant; but excepting the successive co-location of the several parts the exact arrangement or plan shown in the drawings is not essential.

The generator (shown in an enlarged view in Fig. 4) comprises the oven 9, preferably built of brick, a cylindrical retort 10, and the gas-conduit 11 set therein, the pot or cartridge 12, set in the retort, the fire-box 13, chimney 14, flues, and other auxiliaries.

The oven comprises fire-box 13, with a grate 15, ash-pit 16, and a chamber 17, wherein the retort 10 and the regenerating-conduit 11 are permanently set up. The retort 10 is preferably an iron vessel cylindrical in shape, with a proportionately small diameter.

The retort is open on its top end and provided with a lid 18 for hermetically sealing it during the process of distillation. This lid is secured to the retort by bolts 19 or by other suitable means. At the bottom end of the retort an aperture 20 is provided, with which the regenerating-conduit 11 connects by means of pipe 21. Pipe 21 is extended be-

yond the wall of the oven and is closed, preferably by a plug 22, screwed in its end. This pipe is smaller and inclined in a direction away from the retort to facilitate the outflow of liquids resulting from the condensation of some of the ingredients of the product of distillation. This pipe 21 may be used for injecting live steam into the gas-generating apparatus and serves also to introduce implements for removing from the bottom of the retort such tarry substances and smudge as may accumulate therein. For this latter purpose the upper end of regenerating-conduit 11 is closed by a similar plug 23. Chamber 17 may contain one or more of such retorts. If more retorts are used, each is to be provided with a separate regenerating-conduit 11, which are then joined into one conduit some distance above the top of the retort. For each retort there is provided an iron pot or cartridge 12. This is a cylindrical drum of considerably smaller diameter than the retort and also shorter, is open on the top, and provided with a bail or other suitable means for attaching it to the hook of a derrick K, provided for better manipulating it when setting it in the retort and lifting it out again when the distillation is completed. Conduit 11 is carried upward from pipe 21 and along the retort within the chamber 17 of the oven and for some distance above the top of the oven, where it is joined to conduit 24, conveying the product of distillation (the crude gas) to the condenser and purifier.

The object of the described arrangement of the cartridge within the retorts and of the regenerating-conduit 11 within the chamber of the oven is to effect a reheating or regenerating process and to subject the crude product of distillation to a higher degree of heat than the raw material is required to be subjected to to produce it. By this arrangement the decomposition of such ingredients of the raw material that would result in producing gases of low illuminating capacity and containing a large percentage of carbonic acid and other aciduous impurities is obviated, and the vapors of ingredients that are rich in substances producing high illuminating capacity are converted most effectively and permanently into fixed gases.

As shown by the arrows in Fig. 4 of the drawings, the product of distillation escapes at the open top of the cartridge 12 and is then drawn downwardly through the space between the cartridge and the retort toward the aperture connecting with the regenerating-conduit 11 and then through this conduit upwardly again toward the top of the oven. During this entire period vapory and gaseous product of distillation is acted upon by the heat of the combustion-gases passing through the chamber to the chimney-flue, being directly in contact with the heated shell of the retort 10 and the regenerating-conduit 11, while the raw material from which this product of distillation was obtained is, so to say, insulated from the direct action of the combustion-gases, subjected only to such heat as penetrates to the cartridge 12 through the vapors and gases surrounding it in the interior of the retort. By this means I obtain, primarily, only such ingredients of the distilled material as are converted into vapors and gases at a lower temperature and are consequently free from substances producing gases of low illuminating quality, and at the same time I am enabled to subject the product of distillation to just such a degree of heat as is required to convert its vaporous ingredients into fixed gases and to effect this by merely regulating the furnace-fire accordingly. The result of this arrangement is a gas rich in illuminating ingredients, nearly free from all carbonic acid and other such impurities, and the obtaining of this most desirable and essential result by the simple means of so proportioning the furnace and regulating the fire to produce such heat as is required to convert the condensable products of distillation into fixed gases.

The regenerated product of distillation flows through conduit 24 into the purifier and condenser. (Shown in enlarged view in Fig. 6.) This part of my improved apparatus comprises a closed tank 25, into which the conduit 24 enters some distance below the top of the tank. The product of distillation is led in by means of the elbow 52, set in the interior of the tank and connecting with the conduit 24 beneath the level of the liquid in the tank. The gas-outlet pipe 26 connects with the tank through an aperture in the lid.

The purifying and condensing medium is conducted into the tank through pipe 27, entering through the lid of the tank and connecting there with a perforated coil 28, supported within the tank by suitable lugs affixed to the lid of the tank. The overflow-outlet pipe 29 connects with the tank at some distance from the bottom thereof and conveys the overflow into a closed culvert 30, from where it is permitted to escape at a level above the end of the outlet-pipe 29. This arrangement provides a liquid seal for the outlet-pipe. Another outlet 31 is provided in the bottom of the tank to discharge from it such heavy products of condensation as accumulate on the bottom, being of greater specific gravity than the liquid used for condensing and purifying the crude gas. This outlet-pipe 31 is provided with a stop-cock 32, that serves to close it except when the accumulated heavy products are being discharged.

The purifying and condensing medium may be ordinary water; but it is preferable to use hydrate of lime, which more effectively and rapidly eliminates from the crude gas carbonic acid and other aciduous impurities.

The perforated coil 28 is provided to more rapidly disseminate the purifying and condensing medium and to produce a larger surface of and a more intimate contact with the gas. In place of a coil one, two, or more sieves 33 may be used, arranged as shown in Fig. 7 of the drawings. These sieves 33 may be constructed of wire or of perforated sheet metal. They are supported within the tank on brackets 34 and are provided with eyelets or lugs 35 for handling them by means of hooks. If such sieves are to be used, the aperture for the inlet of the purifying medium is preferably located in the center of the lid. This arrangement (shown in Fig. 7) has the advantage over the perforated coil in that the latter is liable to clogging of the small discharge-apertures for the purifying medium by particles of impurities that may be contained in the hydrate of lime or in other reagents which may be used for the purpose. From the purifier and condenser apparatus the gas is conducted through pipe 26 to the reservoir D. Pipe 26 is preferably bent to form elbows, as shown in the drawings, so disposed that the first horizontal run thereof is inclined toward the purifying apparatus and the second toward the closed receptacle C, wherewith the vertical run of the pipe communicates by branch 53. This arrangement is not essential. It is, however, convenient and desirable in that it prevents the accumulation in the conduits of any liquids. Such liquids as accumulate in the closed receptacle C are withdrawn from time to time by using pump P. This pump is also used for withdrawing all condensation from the conduits when steam is used in the generator, as stated above.

The gas discharged into the reservoir D is ready for use and will be found of sufficient illuminating capacity for ordinary purposes. When gas of higher illuminating capacity is required, the apparatus illustrated on an enlarged scale in Fig. 9 is employed. It comprises a tank 36, (shown in Fig. 2,) a tank 37, connected with tank 36 by conduit 38, a gas-inlet conduit 39, a gas-outlet conduit 40, and the auxiliary devices referred to farther on. The substance employed in the apparatus for increasing the illuminating capacity of the gas is naphthalene, which I use dissolved in naphtha, making approximatly a fifty-per-cent. solution thereof. This solution is filled in tank 36 and is admitted through conduit 38 into tank 37. Conduit 38 enters tank 37 approximately about the middle of its height and is provided with a stop-cock 54 to regulate the flow as required.

The gas-inlet conduit 39, connecting with the gas-holder D, enters tank 37 through its top and extends downward near its bottom, while the gas-outlet conduit 40 extends only a short distance into the space above the liquid in the tank. The gas-inlet conduit is provided with a valve 41 and the gas-outlet conduit with valve 42 for stopping and starting and for regulating the flow of the gas through the apparatus. An outlet-aperture 43 for the liquid in the tank is provided at a level to leave a clear space above the liquid for the gas rising through the naphthalene solution. The outflow-aperture 43 is connected by pipe 61, provided with stop-cock 44, with a closed tank or culvert 45 placed below the tank 37 and connected with it also by an outlet-pipe 46, set closely to the bottom of the tank 37. This pipe 46 is provided with stop-cock 47 and serves for drawing off the solution from the tank 37 when the operation is completed or when the tank is required to be cleaned. For this latter purpose a manhole is provided in the top of tank 37, closed by lid 48, tightly fitted thereon, and secured in position by a screw-threaded flange or by other suitable means.

The reservoir 45 is connected by pipe 49 with a pump 55, discharging into tank 36. This overflowing liquid is a weak solution of naphtahlene in gasolene, and by adding from time to time a proportionate quantity of naphthalene into the tank 36 the apparatus may be used continuously for a long period. The gas passing from the apparatus through the pipe 40 is discharged into conduits conveying it to the places where it is used.

The manufacture of illuminating-gas is carried on in this apparatus as follows: The wood or other carbonaceous material from which the gas is to be produced is filled into the cartridge 12 and the cartridge is set into the retort approximately concentrically therewith. Then the lid 18 is secured in its place upon the retort by bolts 19. Better results from distillation are obtained if the retort and regenerating-conduit 11 are heated to approximately 650° Fahrenheit before the cartridge is inserted therein. The gases and vapors emanating from the charge of material flow from the open top end of the cartridge and are drawn downwardly through the space 50 toward the aperture 20 in the bottom of the retort and then through the regenerating-conduit 11. During this entire travel the gases and vapors are exposed to a higher degree of heat than the raw material from which they were extracted, whereby the vapors of most of the lighter oils are converted into fixed gases. This crude gas is discharged into the hydrate of lime, (or other purifying and condensing medium,) where the heavier vapors not converted into fixed gases condense. The fixed gas rises and escapes into the space above the level of the liquid. While thus passing upward the gas is met by the spray of a fresh supply of hydrate of lime dripping from the apertures of the coil 28. This absorbs all carbonic acid and assists in the condensation of any vapors that may yet be contained therein. The purified gas es-

capes through conduit 26 into the reservoir where it is kept for use. This apparatus serves also as controller for the regulation of fire in the furnace. If the overflow-discharge from the purifier and condenser contain oils whose vapors may be converted into fixed gas, this is an indication that the heat maintained in the oven is not sufficient, and, again, if the heavy ingredient in the purifier and condenser appears to contain carbonized matter that is an indication that a too high heat is maintained in the oven. These discharges should be examined after starting the apparatus from time to time and also at intervals during the continuation of the process; but it is not necessary to make them very frequently, except if different kinds of materials are used.

The apparatus for enhancing the illuminating capacity of the gas is set in operation only when the gas is being consumed. To that end the valve 54 of the naphthalene-inlet pipe is opened and the tank 37 is filled with the solution to the level of the outflow-pipe 43. Then valve 41 of the gas-inlet pipe is opened. The pressure upon the gas in the reservoir D forces the gas into the tank 37, the gas escaping from the open end of the gas-outlet pipe at the bottom of the tank. The passing of the gas through the naphthalene keeps the solution agitated, so that it will not settle. The gas is at the same time distributed in small quantities, and thus brought in contact with the naphthalene under the most favorable conditions for absorbing it. During this process the inflow of naphthalene is regulated according to the quantity of gas passing through the apparatus. This is done by properly setting valve 54, regulating the inflow.

What I claim is—

1. Apparatus for producing illuminating-gas from carbonaceous materials having, in combination, a heat-flue supplied with heat through a lateral opening therein; a vertical cylindrical retort within said flue and resting upon the bottom thereof; a gas-conduit within said flue, communicating with said retort at its lower extremity by a pipe, an outlet communicating with said pipe, its end being normally closed by means of a plug; a lid for the retort whereby the same may be closed; a cylindrical cartridge, designed to contain the carbonaceous material, said cartridge being closed at its lower and open at its upper extremity, and being of such diameter as to be received endwise into said retort, and when therein to rest upon the bottom thereof and to have its outer surface spaced at some distance from the inner surface of said retort, and to communicate directly through its open end with the interior of said retort; a bail at the upper extremity of said cartridge adapted to coöperate with a hook depending from a derrick positioned above said retort; said flue, retort and cartridge being so associated that the cartridge is at no time subjected to any material heat except such as is communicated to it through the space intervening between said cartridge and the enveloping retort, the lateral surface only of said retort being at any time subjected to material heat.

2. Apparatus for producing illuminating-gas from carbonaceous material having, in combination, a heat-flue having a lateral opening therein; means for supplying heat to said flue through said lateral opening; a vertical cylindrical retort within said flue and resting upon the bottom thereof; a gas-conduit within said flue communicating with said retort at its lower end by a pipe; an outlet communicating with said pipe, its end being normally closed by a plug; a lid for the retort whereby the same may be closed; a cylindrical cartridge, containing the carbonaceous material and constituting the carrier therefor, said cartridge being closed at its lower and open at its upper extremity, and being constructed so as to be received endwise into said retort; said cartridge, when in said retort, resting upon the bottom thereof and having its outer surface spaced at some distance from the inner surface of the retort; said cartridge, when in said retort, communicating directly through its open end with the interior of said retort, so that gases issuing from the open end of the cartridge will enter directly the space intervening between the cartridge and retort and pass down through said space and out from the retort by way of the communication leading to the gas-conduit; a bail at the upper extremity of the cartridge to facilitate handling the same in its capacity of carrier for the carbonaceous material; said flue, retort and cartridge being so associated that the cartridge is at no time subjected to any material heat except such as is communicated to it through the space intervening between the cartridge and the enveloping retort, and through the gases contained in said space, the lateral surface only of said retort being subjected to material heat.

3. Apparatus for producing illuminating-gas from carbonaceous material having, in combination, a heat-flue, means for supplying said flue with heat; a vertical cylindrical retort within said flue and resting upon the bottom thereof; a gas-conduit within said flue communicating with said retort at its lower end; an outlet communicating with said retort and conduit, its end being normally closed; a lid for the retort; a cartridge containing the carbonaceous material and constituting the carrier therefor, said cartridge being closed at its lower end and open at its upper end, and being constructed so as to be received endwise into said retort and to be readily removable therefrom; said cartridge,

when in said retort, having its outer surface spaced at some distance from the inner surface of the retort; said cartridge, when in said retort, communicating directly through its open end with the interior of said retort so that gases issuing from the open end of the cartridge will immediately enter the space intervening between the cartridge and retort; said flue, retort and cartridge being so associated that the cartridge is at no time subjected to any material heat except such as is communicated to it through the space intervening between said cartridge and the enveloping retort and through the gases contained in said space.

4. Apparatus for producing illuminating-gas from carbonaceous material having, in combination, a heat-flue, means for supplying said flue with heat; a retort within said flue and resting upon the bottom thereof; a gas-conduit within said flue communicating with said retort; an outlet communicating with said retort and conduit, its end being normally closed; means for closing the retort; a cartridge containing the carbonaceous material and constituting the carrier therefor, said cartridge being closed at one end and open at the other, and being constructed so as to be received into said retort and when therein to have its outer surface spaced at some distance from the inner surface of the retort; said cartridge, when in the retort, communicating directly through its open end with the interior of said retort so that gases issuing from the open end of the cartridge will immediately enter the space intervening between the cartridge and retort; said flue, retort and cartridge being so associated that the cartridge is at no time subjected to any material heat except such as is communicated to it through the space intervening between the cartridge and the enveloping retort and through the gases contained in said space.

5. Apparatus for producing illuminating-gas from carbonaceous material having, in combination, a heat-flue, means for supplying said flue with heat; a retort within said flue; a gas-conduit within said flue communicating with the retort; means for closing the retort; a cartridge containing the carbonaceous material and constituting the carrier therefor, said cartridge having an aperture therein, and being constructed so as to be received into the retort and positioned therein with its aperture remote from the point of communication between the retort and the conduit; said cartridge, when in the retort, having its outer surface spaced at some distance from the inner surface of the retort; said cartridge, when in the retort, communicating directly through its aperture with the interior of the retort so that gases issuing from said aperture will immediately enter the space intervening between the cartridge and retort and pass through said space to the remote point of communication between the retort and the conduit; said flue, retort and cartridge being so associated that the cartridge is at no time subjected to any material heat except such as is communicated to it through the space intervening between said cartridge and the enveloping retort and through the gases passing through said space.

6. Apparatus for producing illuminating-gas from carbonaceous material having, in combination, a retort; a gas-conduit communicating with said retort; means for heating said retort and conduit; means for closing the retort; a cartridge containing the carbonaceous material and constituting the carrier therefor, said cartridge being constructed so as to be received into said retort and when therein to have its outer surface spaced at some distance from the inner surface of the retort; said cartridge, when in the retort, communicating directly with the interior of the retort at a point remote from the point of communication between the retort and conduit, so that gases issuing from the cartridge will immediately enter the space intervening between the cartridge and retort and pass through said space and out of the retort by way of the conduit; the retort and cartridge being so associated that the cartridge is at no time subjected to any material heat except such as is communicated to it through the space intervening between the cartridge and the enveloping retort and through the gases passing through said space.

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