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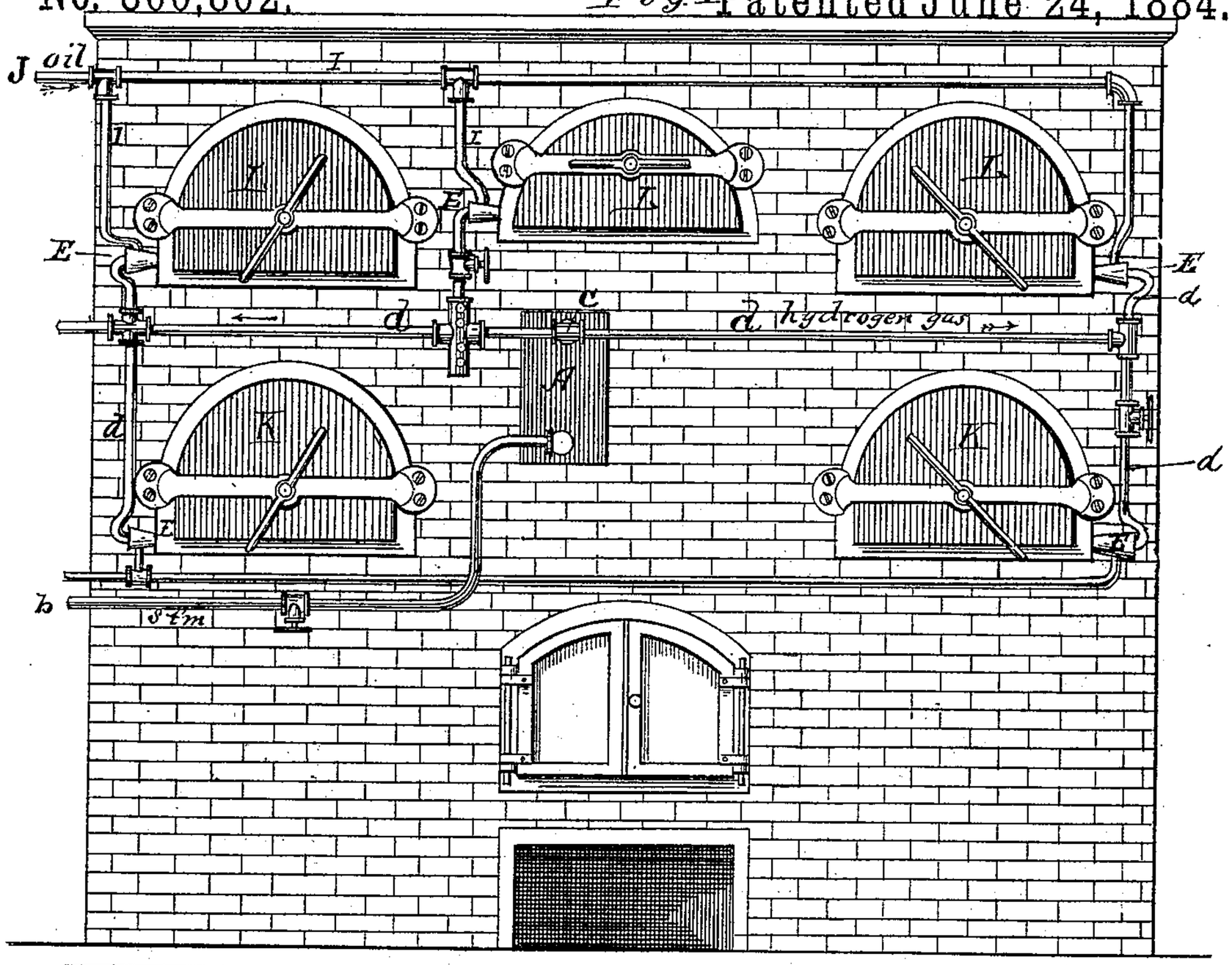
S. C. SALISBURY.

PROCESS OF AND APPARATUS FOR MANUFACTURING ILLUMINATING GAS.

No. 300,802. Patented June 24, 1884.

Fig. 1



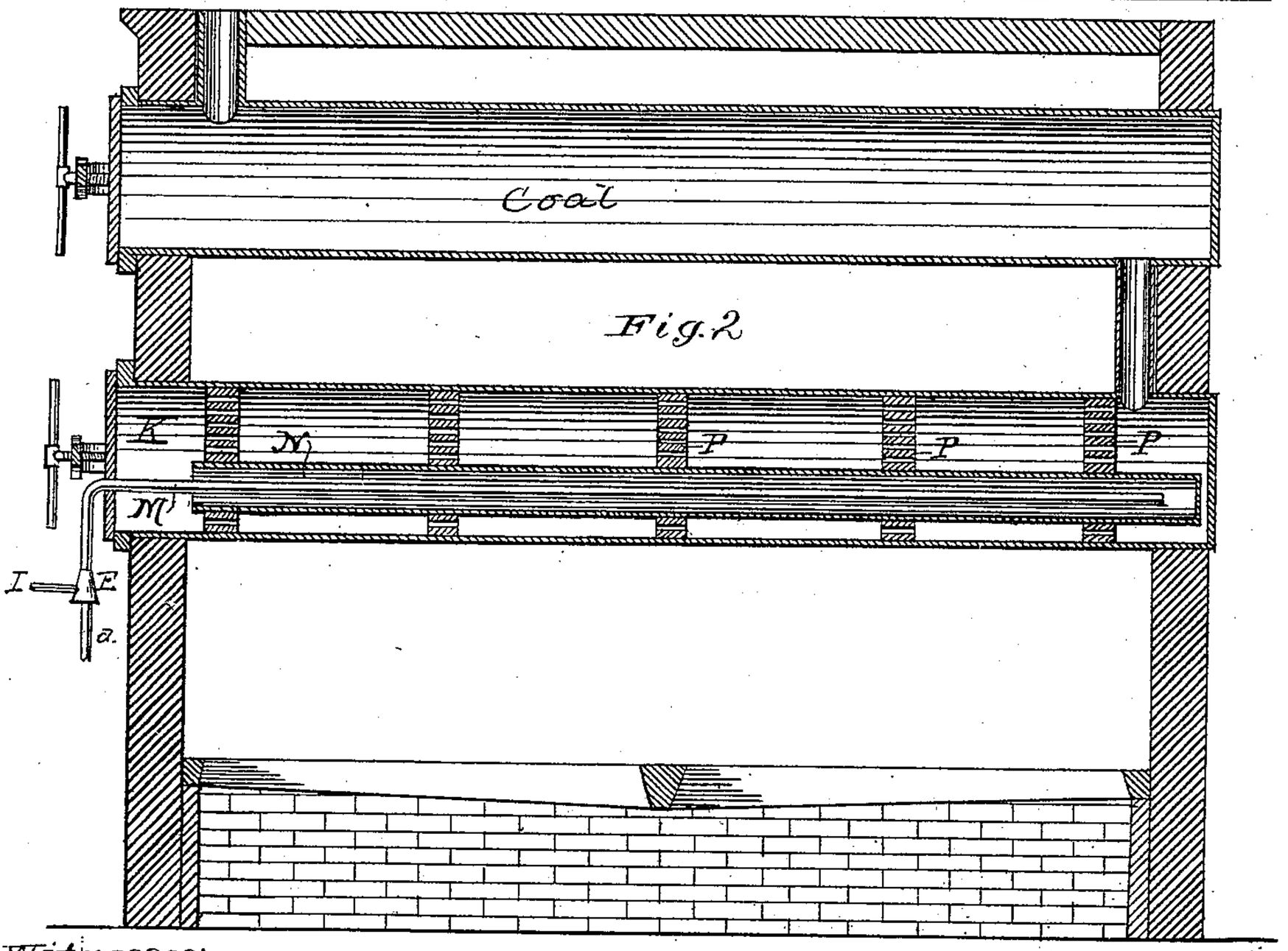


Fig. 2

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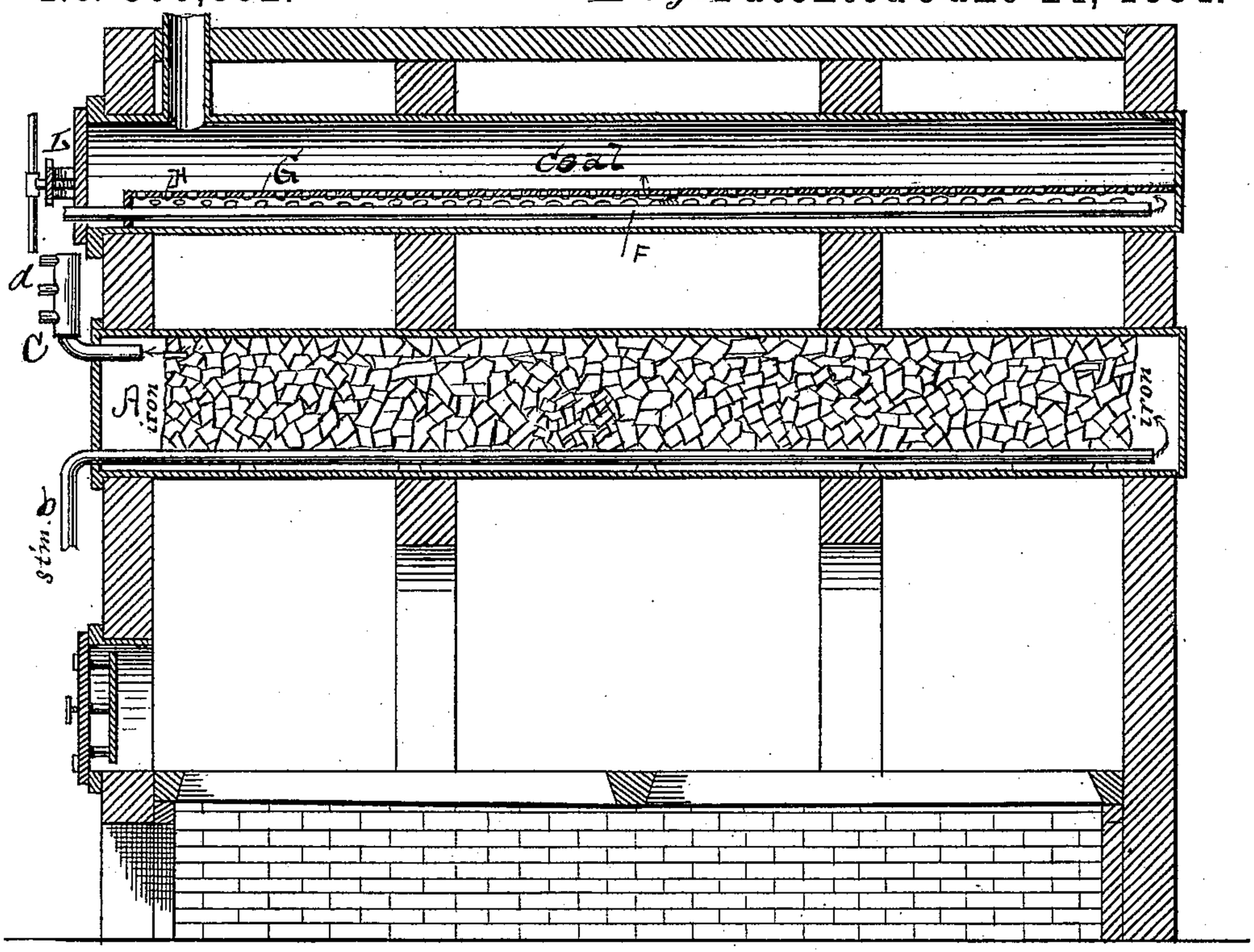
PROCESS OF AND APPARATUS FOR MANUFACTURING ILLUMINATING GAS.

No. 300,802. *Fig. 3* Patented June 24, 1884.



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SILAS C. SALISBURY, OF NEW YORK, ASSIGNOR TO LEVI P. ROSE, OF YONKERS, NEW YORK.

PROCESS OF AND APPARATUS FOR MANUFACTURING ILLUMINATING-GAS.

SPECIFICATION forming part of Letters Patent No. 300,802, dated June 24, 1884.

Application filed December 6, 1883. (No model.)

To all whom it may concern:

Be it known that I, SILAS C. SALISBURY, of the city, county, and State of New York, have invented new and useful Improvements in Processes of and Apparatus for Manufacturing Illuminating-Gas, of which the following is a specification.

The object of this invention is to utilize a much larger proportion of the coal than can be done by the ordinary process of making coal-gas, as well as to utilize and make into gas a large proportion of the waste by-products, called "coal-tar," and also during process of manufacture up to a full twenty-five candle-power that will not smoke in burning through, say, a four-foot burner.

In the manufacture of the ordinary coal-gas it is customary to charge each retort, when at a cherry-red heat, with about three hundred pounds of bituminous coal, and then close the retort. During the first hour a very rich gas passes off, and with it comes a large amount of oily matter, which condenses in process of washing and passes to what is termed "tar." During the second, third, and fourth hours a much less amount of gas is made, and very much reduced in its richness or candle-power, but becomes mixed in the holder, and so mixed produces a gas of about fifteen candles, and all attempts made to enrich this coal-gas by using a richer coal, called "cannel coal," is done at greatly increased cost and reduction of the size of the burner, or else a smoky gas is obtained, and it is a well-known fact that by this process a large proportion of the gaseous product contained in the coal remains in the coke and gas-tar, &c. My process aims first to prevent the production of so much coal-tar and to enrich the poorer qualities named, and abstract a much larger proportion of the gaseous matter from the coals, leaving much less coke and coal-tar, and increasing the capacity of a bench of coal-retorts from twenty to sixty thousand cubic feet each twenty-four hours, increasing its illuminating qualities fully twenty-five per cent., and yet reducing the actual cost of the gas thus produced fully thirty per cent. below the actual cost of the ordinary process of manufacturing coal-gas.

In order to prove that my theory and process are based on scientific and correct principles, I have proved the same to be as described in actual practice, producing results named, and in order that others may be able to construct and alter present coal-gas works to my plans and mode of making gas, I will now fully describe such alteration and additions to present coal-gas works as will enable gas-engineers and their assistants to make such alterations as will produce such quality of gas as herein named.

Figure 1 is a front elevation of a bench of retorts. Fig. 2 is a longitudinal vertical section showing a modification in arrangement. Fig. 3 is a longitudinal vertical central section.

I place an iron retort, A, of about six inches diameter, over, say, the side above the second retort, as shown, in a bench of five retorts. This iron retort extends through the brick-work of the bench containing the five clay retorts, having bearings the entire length to prevent sagging or bending when at a white heat, and projecting outside of each end of the brick-work, on which I place caps screwed or otherwise. On the front cap I have an inlet-pipe, *b*, and outlet-pipe *c*, of two-inch bore. To the inlet *b*, I attach a two-inch pipe, extending same to within two inches of the rear end of said main pipe, leaving it open at this end. I then charge this main retort A with iron turning and pieces of pig iron, or fill same with, say, three-quarter-inch iron pipes, leaving a space at each end of two inches. I then screw on caps, connect the inlet-pipe with a two-inch steam pipe and valve leading to the dome of steam-boiler. I attach to the outlet-pipe C a two-inch branch pipe, *d*, above the front of the bench of retorts in most suitable place. To this branch pipe I attach, say, three-quarter-inch pipe with valve, and which leads to and is attached to an injector, E, say, to the main tube of same, which injector is attached—that is, the delivery end—to a pipe, F, say, of one-inch diameter. This pipe F is placed, say, inside of a three-inch pipe, G, both running full length of the inner part of one or more of the clay retorts, say L. The rear end of the pipe G has a cap or plug, and the pipe F is open at rear end and discharges its con-

tents, say, within two inches of the rear end of the pipe G, so that whatever kind of gas is discharged through the pipe F returns through the pipe G. Now, this three-inch pipe G is perforated with, say, one-eighth of an inch holes, H, say, a distance of three inches apart, of two rows, on sides for the gas to escape among the coals; or I may dispense with the outer three-inch pipe, G, if found unnecessary. Now, to the outer shell of the injector I attach oil-pipes I, with suitable valves, which oil-pipes lead to the main branch pipe J, which supplies liquid hydrocarbon, preferably already highly heated. Now, when the retorts L are heated up to the required temperature for making coal-gas, they are charged with, say, three hundred pounds bituminous coal. Lids are then fastened on. Steam is admitted at once from the boiler through the inlet-pipe *b*. During its passage to the rear end of the iron retort A it (the steam) becomes highly superheated. By the time it is discharged at the rear end, and on its return through the densely-packed iron or pipes, which are at a cherry-red heat, it becomes decomposed, and a large proportion of the oxygen contained in the steam being absorbed by the iron, the remaining gas, as it is delivered out of the outlet-pipe in front into the branch pipe *c*, is heated to, say, 1,000°. I now start the injector E and deliver through pipes F in retorts, say L, this highly-heated gas, which diffuses itself through the coal and takes up the richer gases, reduces the same to a required quality of fixed gas, and prevents escape of the oily substance forming tar, and during the first hour of this process all of the very richest of the products of the coal will have been mixed with that hydrogen gas and form a very rich carbureted-hydrogen gas. After the first hour I admit a small quantity of the hot liquid hydrocarbon to each of the injectors with the hydrocarbon gas, and the injectors mix the two—hydrogen and oil—thoroughly, and force the same through pipes F and G on the inside of these gas-retorts—say L, and deliver the same gas-vapor through and among the hot coals, causing it to enrich the gas escaping from the coals to the quality required, and I continue to enrich this vapor-gas with the liquid hydrocarbon until the end of six hours, and in such manner as will continually produce a full twenty-five-candle-power gas. The coals, being porous, absorb the richer portions of the hydrocarbon vapors and gradually prepare the same to mix and perfect and then unite with the remaining gases contained in the coal, and at the end of six hours the coal removed will be found to have parted with most of its gaseous products, and the coke left, only about half of its usual bulk and weight, will fully supply the amount of fuel required to heat the number of benches of retorts required to make gas needed. By this process—say the first hour using the very hot hydrogen gas or gases of decomposed steam — which causes a very rapid decomposition of the coal, liberates its gases quickly, and uniting same with the gases derived from the decomposed steam, forming a very rich hydrocarbon gas, and, as the coal has been deprived of its richer oily gases, thus enriching the hydrogen or liberated gases from the decomposed steam, with the hot liquid hydrocarbons in gradual increased proportions in full accordance with the diminished richness of the gases derived from the coal, so as to keep up the standard quality of twenty-five-candle-power gas to the end of six hours. It will then be found fully one-third more gas has been obtained from the coal than usual, but with a diminished quantity of tar and coke, &c., and a much richer quality of gas from a poorer quality in gas-holder, and in every respect far superior to what is known as "water-gases," which are known to contain thirty to forty per cent. of carbonic oxides. This process being very simple and easily understood, and the attachments easily and cheaply made, existing coal-gas works can be altered very quickly, and can be replaced or detached so that in case of oil giving out, or from any cause it becomes too expensive to use the liquid hydrocarbons, they could use the first-named gases with coal for purposes named, and discontinue same after the very richer gases have been utilized as named; or, if the hydrocarbon liquids cannot be obtained to enrich the poorer gases, they may be enriched at intervals of two hours with a small quantity of cannel coal, shale, or rosin, and then continue the use of hydrogen and decomposed gases derived from steam, which will at once utilize the same and produce fully as rich a gas as formerly named, which gas so produced from cannel coals or rosin will not smoke in burning through large burners, as would be the case without the aid and uses of gases named, and the increased cost of such cannel coal or rosin used for enriching will be fully compensated for by increased quantity of gas and its uniformity of quality and the utilization of the usual waste by-products. I can modify this arrangement in case of erecting new benches of retorts. In such cases I would only use coal in the three upper retorts, L, and connect the two lower retorts, K, on each side with the two upper retorts directly over the same at the back end, as in Fig. 2, and in that case fill up much of the space of the two lower retorts with hollow brick tiles and deliver into the front end of these two lower retorts through an inch pipe, M, and return to front end through a three-inch pipe, N, a rich vapor-gas, which would be perfected by contact with the heated surfaces of the perforated tiles P, and pass out of the rear end up into the upper retorts, and then combine with the coal-gas as made, and in this case I would only charge up the upper two retorts every six hours. The effect of this arrangement would be to use a less amount of coal and less coal-gas and an increased quantity of vapor

oil-gas in combination, and this would be valuable when coal was dear and poor and liquid hydrocarbon cheap. In practice, I have found this to be most perfect and economical, and producing sufficient fuel of coke to heat up the retorts, and at the same time utilizing all of the coal, making very little tar, and I have also found it to utilize all of the richer products of the vapor of liquid hydrocarbons and preventing any waste products—such as free carbon, &c.; and, again, I find that gas made by each of these modes will not condense at very low temperature.

Having fully described the mechanical and chemical means of accomplishing my results and process of manufacturing illuminating-gas from coal and other gases named,

I claim—

1. The retort K, connected at one end, with the coal-retort above it, and provided with the pipes M N and the perforated tile partitions P, for preparing hydrogen gas and passing it into and through a charge of distilling-coal, as set forth.

2. The process of making illuminating-gas, which consists in delivering hydrogen gas or the liberated gases of decomposed steam in among the red-hot gas-coals within the retort during the early stages of its decomposition, thereby reducing the coal-gas to a standard quality and preventing its condensation into tar, and afterward introducing a light hydrocarbon vapor regulated in quality and gradually increasing the quantity of said hydrocarbon as the richness of the coal-gas diminishes, whereby a predetermined standard of gas is uniformly produced from the beginning to the end of the charge.

3. The process of manufacturing illuminating-gas from coal, which consists in introducing under pressure, first, hydrogen gas or the liberated gases from decomposed steam, and afterward, such hydrogen gas accompanied by hydrocarbon vapors, increasing in quantity of hydrocarbon as the richness of the coal diminishes, whereby said introduced gases are forced into and through the mass of coal in the retort, and the extraction and union of the gases are facilitated.

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