E. R. HOPKINS.

Manufacture of Illuminating Gas.

No. 145,655. Patented Dec. 16, 1873.

Fig 1.

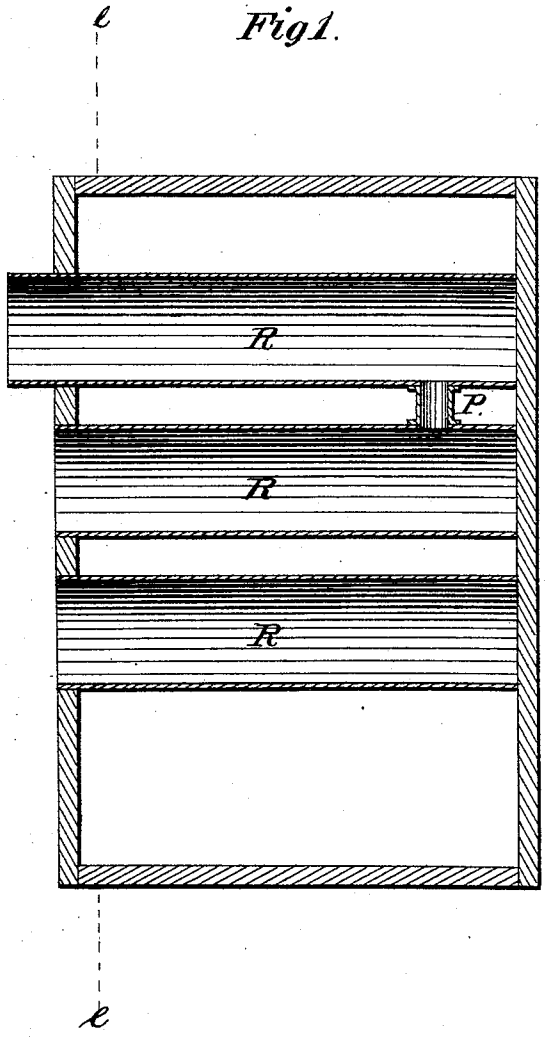
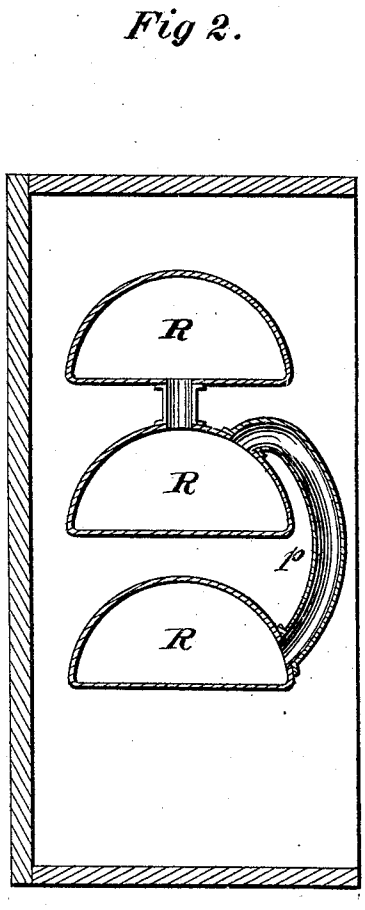


Fig 2.



Witnesses.

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IMPROVEMENT IN THE MANUFACTURE OF ILLUMINATING-GAS.

Specification forming part of Letters Patent No. **145,655**, dated December 16, 1873; application filed November 11, 1873.

To all whom it may concern:

Be it known that I, EDWARD R. HOPKINS, of the city of Newark and State of New Jersey, have discovered a new and useful Method of Making Illuminating-Gas, of which the following is a clear and exact description, which will enable those skilled in gas manufacture to apply the same:

In the methods now employed, the coal from which gas is manufactured is subjected to distillation in a closed retort, from which the eliminated gases escape directly to the hydraulic main through pipes fitted to the mouth-pieces of the retorts. Ordinarily, six retorts, each having a separate stand-pipe connecting with the hydraulic main, are set in one bench, in such a manner as to receive the heat of one furnace, and with this arrangement of separate retorts about nine thousand cubic feet of fourteen-candle gas are made from one ton of two thousand two hundred and forty pounds of coking-coal.

Whatever be the temperature of distillation, much of the carbon which is eliminated from the coal is deposited on the crown, sides, and bottom of the retort, and in the period of from three to five weeks this deposit so far closes up the retort as to render further use impracticable without resort to some method for its removal. The adhesion of this carbon to the retort is hardly less than the cohesive strength of the material of which the retort is made, and its removal is accompanied by much expense, great injury to the retort, the loss of the heat of the retort and bench, a suspension of the use of the bench for two or three days, and a depreciation of the quality and quantity of gas made from the coal distilled during the first three or four days after resumption. So great are these various items of loss that even in the largest and best-managed works this deposit of carbon adds nearly, or quite, twenty per cent. to the cost of gas manufacture; but let us examine this deposit a little more closely. The material is nearly pure carbon—the chemical element which gives gas its illuminating power. Can it be economized after removal from the retort, and thus be made to repay a portion of the loss it has occasioned? Experience says not; for, while it may be burned as fuel, the carbon cannot be made to combine in illuminating-gas. Beside this carbon deposit there are other waste products in the usual method—the ammoniacal and tarry parts. It was the analysis of these which first suggested the question of greater economy in gas manufacture. They contain some carbon and much hydrogen. These were in solid combination in the coal, and from it they were eliminated by heat. Now, reasoning that, if there be a decomposition at any temperature, and a recomposition immediately follow, the compound so formed should be permanent through that temperature, and, consequently, no deposit should take place, and that which does take place in the retort is due to avoidable causes. What are those causes? Imperfect combination is shown by the carbon deposit in the retort and the ammoniacal condensation out of it, these two containing the two elements of pure illuminating-gas.

In the investigation which led me out of the difficulty, I kept in view the well-known conditions, mixture, contact, and temperature by which chemical action may be induced even between elements of weak affinities. In the study I soon found that the close and direct connection between the retort and the hydraulic main enables the eliminated gases to escape from the high temperature of the retort before they become thoroughly mixed, and, consequently, before the conditions for full recombination at the eliminating temperature have been fulfilled. This discovery suggested the fact as embracing the explanation of the deposit, for, without mixture at the temperature of elimination, chemical combination cannot take place, and, hence, a deposit must result.

Now, bearing in mind that the mixture to be secured is that of hydrogen, the lightest of known gases, with carbon compounds, which are the heavier as they contain the more carbon, we see that the relative specific gravities must retard the process so long as the flow of the gases is in one horizontal direction; but, if the flow be made to change in a vertical direction through one hundred and eighty or

more degrees, the heavy and light gases will be forced through each other, and their elements brought in contact for chemical combination. To effect this, in the simplest manner, I join the ordinary clay retort to another placed immediately above it by a short pipe, whose whole length is inside of the bench, and therefore exposed to the full heat of the furnace, and this second retort to a third in the same manner, and all in such a way that the gas eliminated in the first retort, in passing to the pipe connecting with the hydraulic main, is forced to traverse both of the other retorts and in opposite directions.

With such a combination it is obvious that gases eliminated in the first retort are thoroughly mixed before they have passed through the second and third retorts, and reached the stand-pipe where their temperature becomes reduced below that required for combination. The gases from the first retort, rising into the second through the highly-heated pipe, strike the crown of the second retort and are thence curved or deflected down, producing curls in the gases rising from the coal in this retort, and thereby securing their mixture before they leave this retort. The same mechanical action is secured in the third retort, with this difference, that the volume of the gases rising into it being double a correspondingly greater disturbance is produced, and the mixing of the gases there eliminated is perfected in the retort.

It will be seen that this arrangement of retorts differs from the usual way in the suppression of stand-pipes between the first and second retorts, respectively, and the hydraulic main, the employment of a short vertical pipe between the first and second retorts, and one between the second and third, so that the gas passes from one retort into another placed directly over it until it leaves the highest and last of the series, through the stand-pipe which connects with the hydraulic main.

The three retorts are simultaneously but unequally charged with coal, and always so that the gas shall pass from a lighter-charged into a heavier-charged retort. I deem the placing of the retorts which compose a set so that they are one above another, instead of side and side, and the charging so that the gas must pass from a lighter-charged retort into a heavier-charged retort, as of the utmost importance; for, with these two conditions complied with, there is no need of other connecting-pipes between the retorts themselves, or between either of them and the hydraulic main; there is no carbon deposit in the connecting-pipes, the stand-pipe, or in the retorts themselves; and the volatile products eliminated from the coal are more fully economized in the production of permanent illuminating-gas than when the retorts are set side and side, or they are charged so that the gas passes from a heavier-charged into a lighter-charged retort.

When the conditions I have named are satisfied the advantages of the method are as follows: First, A greater volume of illuminating-gas is obtained from any given quantity of coal; second, a better quality of illuminating-gas is obtained from coal of any given quality; third, there is no appreciable deposit of carbon in the retort; fourth, the carbon and hydrogen, which are waste and hurtful products in the usual method, are economized with a saving of expense in manufacture, and are made to contribute largely to the quality and volume of the gas; fifth, there being no deposit of carbon in the retorts, they may be used continuously for an indefinite period of time, and always with the full charge of coal, which is possible with the old method only during the first few days of the use of the retorts; sixth, while the method gives a better quality of gas, more cubic feet per ton, and permits the distillation of more tons in a given number of benches in a given time, a less number of benches are required to supply any given demand; and, hence, the method secures a saving both in construction and subsequent repairs of the works, and in all other elements of expense of gas manufacture.

The comparative results, as regards quality and quantity of gas from each ton of common gas-coal are as follows:

Old method: Quantity, 9,500; quality, 14-candle.

New method: Quantity, 12,000; quality, 20-candle.

A comparison of the products of the feet by the candle-power in the two cases shows that the new method gives nearly twice the illuminating-power from one ton of coal.

I am aware that the advantages may be obtained from separate retorts so long as the same means be employed to mix the gases while held under the high heat of elimination; and this may be done by the attachment of a stand-pipe which shall change its direction vertically through one hundred and eighty or more degrees while still within the bench, where it will have the same temperature of the retort.

In the sheet of drawings which accompanies this specification, Figure 1 is a longitudinal section through the crowns of three retorts, R R R, showing the pipe connection P between the second and third; and Fig. 2 is a cross-section on *l l* of Fig. 1, showing the connection *p* between the first and second retorts.

I do not claim anything when the retorts of the series are set side and side and the charging is done so that the gas passes from a heavier into a lighter charged retort, my invention being limited to retorts which are placed so that those of a set are essentially one above another.

My invention and process of charging the retorts does not allow of any alternating of the retorts as regards heavy and light charges, and I desire to limit myself to always placing the largest charge of coal in that one retort of

the series which alone is connected with the hydraulic main.

I claim—

1. Three or more retorts, R, arranged one above another, and connecting by means of vertical connecting pipes or tubes, the highest of the series alone being provided with a stand-pipe, as and for the purposes set forth.

2. The process, as herein described, of charging a set of connecting retorts with unequal charges of coal, so that the gas shall pass from a lighter-charged retort into a heavier-charged retort placed above it.

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Witnesses:
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