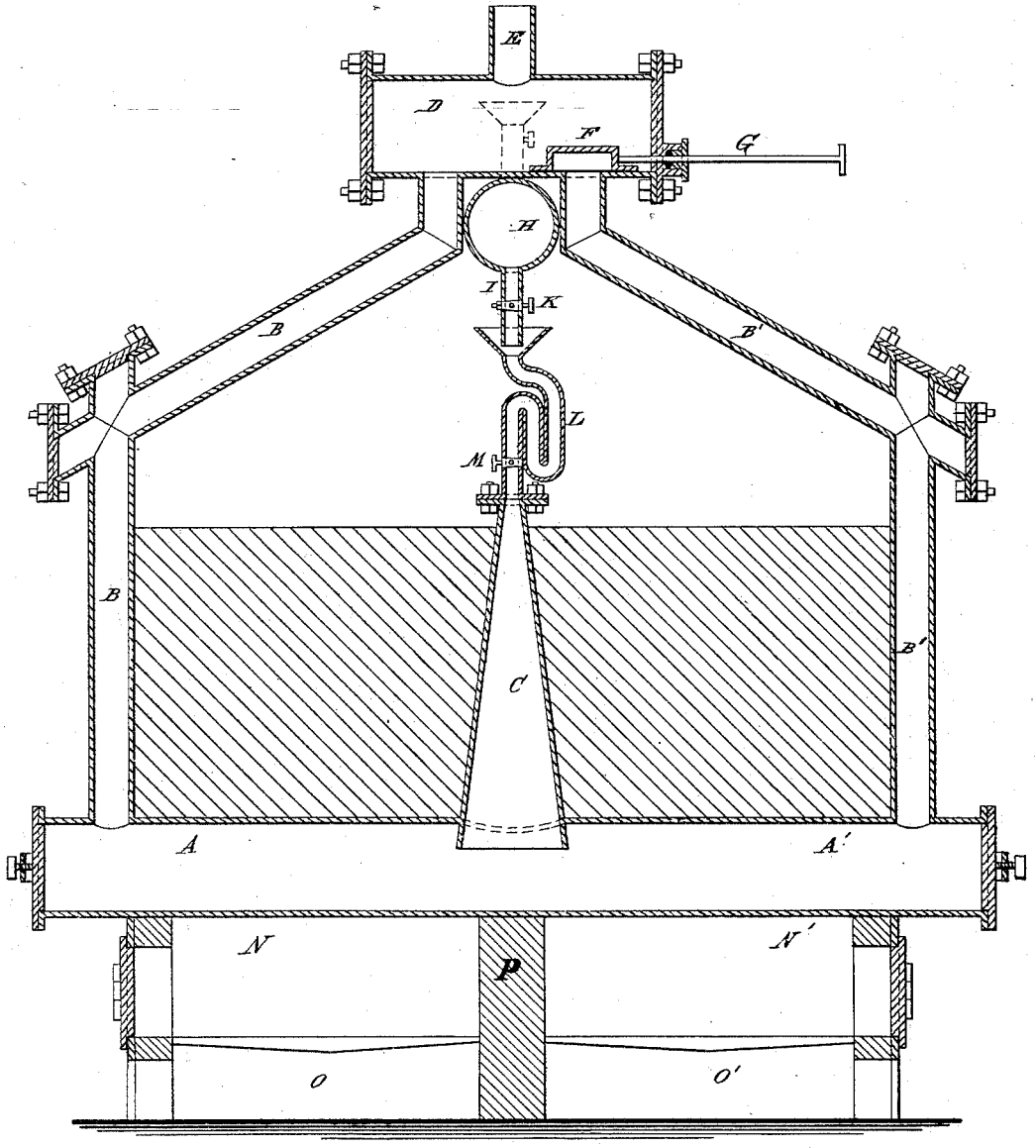
H. W. ADAMS.

Process and Apparatus for the Manufacture of Illuminating Gas from Coal and Oil.

No. 197,077. **Patented Nov. 13, 1877.**



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IMPROVEMENT IN PROCESSES AND APPARATUS FOR THE MANUFACTURE OF ILLUMINATING-GAS FROM COAL AND OIL.

Specification forming part of Letters Patent No. **197,077**, dated November 13, 1877; application filed September 18, 1877.

To all whom it may concern:

Be it known that I, HENRY W. ADAMS, of the city and county of Philadelphia, and State of Pennsylvania, have invented an Improved Process and Apparatus for the Manufacture of Illuminating-Gas from Coal and Oil, of which the following is a specification:

The object of my invention is to distill gas-coal so as to make no tar and ammoniacal liquor, as is now done, but to decompose these hitherto waste products into gas, and to do this either alone or in conjunction with oil or fluid oleaginous matter, in the same apparatus, for the purpose of increasing the quantity and improving the quality of the coal-gas.

The retorts now in common use are open at one end and closed at the other. The exit-pipe, for the escape of the gas from the retort, is placed on its upper side, near its open end. When the charge of gas-coal is put in, the retort is usually at a cherry-red heat, while the coal is cold. The first effect is that the coal is heated up to the steam-making temperature, which causes a distillation of the water or moisture in the coal. As the heat is not sufficient to decompose it into oxygen and hydrogen gases, it escapes by the outlet-pipe, and passes over into the coolers and mains and condenses. When the heat is sufficient, some nitrogen unites with the hydrogen and forms ammonia, which is dissolved in the water, and ammoniacal liquor is thus formed.

When the coal becomes hot enough to distill off its bitumen, but not hot enough to decompose it to permanent gas, this vapor of gas-tar passes directly out of the retort through the aforesaid exit-pipe, and is condensed in the coolers and mains.

This process of making ammoniacal liquor and tar goes on until the coal in the retort is raised to a red-hot heat, when the volatile matter in it is decomposed and converted into several fixed gases, which, when purified, are stored together in gasometers for illuminating purposes.

Each of the aforesaid secondary products, namely, the ammoniacal liquor and tar, amounts to several gallons per ton of coal distilled. The ammoniacal liquor, consisting mostly of water, is capable of being decomposed and converted into a large volume of hydrogen gas, poor in illuminating quality; and the tar, the richest product of carbonaceous matter yielded by the coal, is capable of being decomposed and converted into a gas excessively rich in carbon, and possessing a very high degree of illuminating power.

When the former poor gas and the latter rich gas are made in the same retort and at the same time, they mix and mingle in a nascent state, and unite, to some extent at least; and the said mixed and united volumes make a very large quantity of gas of very excellent quality.

One prime object of my invention, therefore, is to locate the coal to be distilled in the distilling apparatus, so that the first moisture and vapor of tar which start out of the said coal at too low a heat to be decomposed shall be compelled to pass over and through a considerable body of red-hot coal, coke, or other decomposing surfaces, and for a considerable distance, before they reach the exit-pipe, and thus be converted entirely into fixed gas. This I most effectually do by the means hereinafter described.

Another object of my invention is to take advantage of the red-hot surfaces of the coals undergoing destructive distillation in the apparatus to decompose petroleum, oil, or other fluid and gas-yielding material, to increase the quantity and improve the quality of the coal-gas.

During the latter part of the period of distillation, the gas from the coal undergoing destructive distillation grows poorer in carbon and richer in hydrogen, and consequently its illuminating power is gradually diminished. By supplying a small graduated stream of petroleum or oil, or other suitable material, to the red-hot coal as it approximates gradually toward the condition of coke, and even after it reaches that state, a most excellent quality of gas of high illuminating power, is generated in the same retort, and by means of the same heat and apparatus, and at the same time, with no additional trouble or cost except that incurred for the crude petroleum, which is now very cheap. By this conjunctive distillation of coal, petroleum, and other fluid gas-

yielding matters, and the decomposition of their mingled vapors into fixed gas, a very much larger production of gas of better quality may be obtained at a comparatively reduced cost.

Having stated the objects of my invention, I will now show how these objects may be realized.

The drawing which accompanies this specification, and which is made a part of it, shows a vertical section of my coal and oil gas apparatus.

The letters represent its different parts.

The letters A and A′ show a double or through retort, charged with gas-yielding coal. This retort is of the usual shape, resembling, in cross-section, the letter D. It is about twelve feet long, more or less, or double the usual length, more or less, and of the ordinary width and depth. The doors at each end and the outlets for the gas to escape are the same as those now in use. It is set in the common method. The letter C represents a neck, cast or fitted on its upper surface, and at a point equidistant from its two ends. It is somewhat in the shape of an inverted funnel. It descends for a little distance into the retort, so that when the retort is charged with coal and is heated to a cherry-red heat the petroleum or other fluid matter which falls down through the neck C may be compelled to ascend in vapor through the surrounding and superincumbent coal, now red hot, and be more completely decomposed to fixed gas. The letters B and B′ represent the two exit-pipes, rising from the top surface of the retort A and A′ and at each end of it. These two pipes unite with and terminate in the chest D. This is a cast-iron box, about three feet long, one foot wide, and one foot deep, more or less, and has an exit-pipe, E, and a slide-valve, F, having the stem G attached to operate it. Letter H shows the end of a horizontal main, for holding petroleum or other fluid gas-yielding matter to be fed into C. This main may be a long pipe, in large gas-works, supported by piers resting on the brick-work of the benches containing the retort. The chests or boxes D may sit upon it, like saddles, and be supported by it. I shows a pipe inserted into the under side of H, with a cock, K, in it for feeding a graduated stream of petroleum or other matter into the neck C. L shows the bent conduit-pipe, the lower end of which enters C, and the upper end is attached to a funnel. This pipe is provided with a stop-cock, M. The bend in this pipe is for the purpose of storing in it a column of petroleum or other liquid matter to prevent the escape of gas from the neck C.

N N′ show the furnaces for heating the retort A A′. O O′ are the ash-pits. P is a pier in the middle of the furnaces, on the top of which the retort rests. The neck C is bricked into the furnaces, and only the small upper end rises above the bricks. The lower end of this neck should be at least one foot in diameter, to prevent its stopping up with accumulated carbon. It may taper up to a diameter of four inches, more or less.

Benches of three or five of these double or through retorts may be set together, in the usual way of setting gas-retorts. They are fired in the same way.

Having described the construction of my coal and oil gas apparatus, I will now show the method of operating it.

In the first place, the fires are kindled in the furnaces N N′. The retort A A′ is heated up to a cherry-red heat. The end of the retort shown at A may, in the first instance, be charged with coke before the fires are kindled, and no charge be put into the end indicated by A′, so that the coke in A may be red hot by the time the whole retort becomes heated up to the gas-making temperature. Then the end A′ is charged with gas-yielding coal. The slide-valve F is drawn by the stem G, working in a gas-tight stuffing-box, over the mouth of the exit-pipe B′. The moisture and tar which first start off from the coal in A′ pass along over and through the red-hot coke in A, and are perfectly decomposed and converted into fixed gas, which passes up the exit-pipe B, into the chest D, and out of the pipe E to the hydraulic main, coolers, purifiers, and gasometer.

In such works as may be constructed to make oil-gas in conjunction with coal-gas, an example of which is shown in the drawing, the cock K in the pipe I is now opened, so as to let a small stream of petroleum or other suitable gas-yielding material fall into the funnel and pipe L. The cock M is opened. When the the bend in this pipe is full the fluid will overflow and descend into the neck C, and fall onto the red-hot coke in the retort below it, and be raised to vapor. This vapor will pass into and through and over the red-hot coke in A, and be decomposed and converted into gas, and mix with the coal-gas and pass on with it to the gasometer.

It will be seen that the vapors generated from the oleaginous matters fed into the neck C never pass over a fresh charge of coal, but always travel in the opposite direction over the red-hot and partially-distilled coal. It is therefore practicable to feed petroleum, gas-tar, oil, melted rosin, or other suitable gas-yielding material into the neck C at all times during the destructive distillation of coal in the retort; but it is obvious that the feed of this fluid matter may be gradually increased from the beginning of the third hour to the end of the sixth hour, inasmuch as the quantity and quality of the gas from the coal in that end of the retort through which the oil-vapors are traveling are constantly diminishing. Hence at the end of the period of distillation, whether that be six or eight hours, more or less, the maximum rate of feed will have been reached. Then, when a fresh charge of coal is introduced into the retort, and the course of the gas is

reversed, the supply of this liquid matter to the neck C is considerably diminished, inasmuch as the partially-distilled coal in the hot end of the retort is itself now yielding a large supply of good gas, and is employed in decomposing the aqueous and tar-charged vapors distilled from the fresh and imperfectly-heated charge in the opposite end.

I do not limit myself to this precise method. The temperature of the retort and the time the charge has been undergoing distillation will be the proper guides to the engineer to enable him to regulate the quantity of fluid matter to be fed into the neck C.

This process is continued for three hours, more or less. Then the charge of coal in the end of the retort indicated by A′ will be red hot and partially distilled, and in a suitable condition to become, in its turn, a decomposer of the aqueous vapor and tar from a fresh charge of coal in A. Consequently at this point the cocks K and M are shut. The valve F is pushed by the stem G over the mouth of the exit-pipe B. The mouth of the exit-pipe B′ is now uncovered. The direction of the gas is by this means changed. It will pass, in this instance, from A to A′, and up B′ into D and E, and on, as before. The charge of coke is now drawn from the end of the retort indicated by A, and a fresh charge of gas-coal is introduced in its place.

In small works, or where only a small amount of gas is wanted, as in factories, churches, private residences, and other similar buildings, and only one or a limited number of retorts is needed, one end of my double or reciprocating retort may be charged first with coke or other suitable non-gas-yielding material, and heated red hot, as aforesaid, and then the bituminous coal may be introduced into the other end of the said retort. In this case the aqueous and tarry vapors which are distilled from the said coal before it gets red hot will pass over and through the said red-hot coke or other material, and be decomposed to good gas; but as soon as the coal becomes red hot and begins to make good gas the valve which shuts the connection between it and the hydraulic main should be so moved as to uncover the stand-pipe connected with the end of the retort containing the coal, or both ends, at pleasure, and allow the good gas from the said coal to escape directly to the hydraulic main, without undergoing decomposition by passing through the opposite red-hot charge. Petroleum or other fluid gas-yielding matter may be fed into the middle of such a retort thus charged, and be decomposed to good gas, conjunctively with the destructive distillation of said bituminous coal.

This method of charging my double or reciprocating retort may be followed continuously, if so desired. In such cases, one end of the said retort is kept constantly charged with non-gas-yielding substances and the other end with bituminous coal, and the aqueous and tarry vapors from the coal before it becomes heated to the gas-yielding temperature are decomposed to good gas in the opposite end until the said coal becomes red hot, which is in from one to two hours after it is introduced into the retort. At this period petroleum or other fluid matter may or may not be fed into the middle of the retort, but both ends of the retort should now be opened, if oil or petroleum be fed in; but if not, the coke end is shut, in order to let the gas escape from both ends at the same time, or from one, if no oil is used, to avoid its decomposition, as aforesaid.

Everything being arranged as before mentioned, the process goes on as in the first instance, only the direction of the gas is changed. The cocks K and M are again opened. The neck C being in the middle of the retort A and A′, the petroleum or any other fluid substance falls into the middle of the same, and always has to travel over the red-hot end of the charge whichever way the gas may be traveling. At the end of the next three hours the charge in A′ is drawn and a fresh one put in, and the valve F is drawn over the mouth of the exit-pipe B′, and the direction of the gas is thus reversed. All the other operations before mentioned are at the same time performed.

Thus it will be seen that each charge of coal is distilled six hours, and each end is charged three hours apart. By this means scarcely no ammoniacal liquor nor tar will be made, and the production of good gas from the same quantity of coal will be fully doubled; besides a very large amount of gas of excellent quality, and at small expense, will be produced from the petroleum or other suitable matters.

I do not limit myself to the period of six hours for distilling each charge. Any desired length of time may be adopted.

It will be seen that the slide-valve F may uncover both stand-pipes B and B′ at the same time by allowing it to remain between the mouths of these pipes. In such a position the gas from the retort would flow equally from each end without passing through its entire length. This would be a great advantage, especially when coal alone is distilled in the retort A A′, because, after the undecomposed vapors of a fresh charge have been gasified by passing over the hot end of the charge contained in the opposite end of the retort, the good gas, subsequently generated from this now red-hot coal, would be further decomposed and damaged by contact with the red-hot charge in the other end of the retort. It is better, therefore, to move the slide-valve F between the mouths of the exit-pipes B B′ in the chest D. The rich gas from the fresh charge, now red hot, will thus escape directly from the end of the retort in which it is made without suffering further degeneration by heat. The same thing is true, to a considerable extent, when petroleum or other liquid matter is fed

into the neck C, although the gasification of the oleaginous matter tends to cool the hot end of the retort, and thus protect the good gas coming from the charge in the opposite end.

I consider it, therefore, a great advantage in having the ready means in my slide-valve F of either reversing the gas in the retort A A′, and causing it to travel through the entire length of it either way, as is necessary when a fresh charge is introduced, or of uncovering both exit-pipes B B′ and allowing the gas to escape from both ends of the retort at the same time.

Having described the nature and operation of my invention, what I claim is—

1. The through or double retort A A′, in combination with the exit-pipes B B′, the chest D, the exit-pipe E, and the slide-valve F, having rod G, constructed and operated substantially in the manner and for the purposes hereinbefore set forth.

2. The neck C, in combination with the through or double retort A A′, having stand-pipes B B′, constructed and operated substantially in the manner and for the purposes shown and described.

3. In combination with the retorts, the chest D, the exit-pipes B B′ entering it, and slide-valve F, having rod G, constructed and operated substantially in the manner and for the purposes hereinbefore shown and described.

4. The petroleum-reservoir H, having pipe I, provided with stop-cock K, in combination with conduit-pipe L, having stop-cock M, and the enlarged neck C of the through or double retort A A′, having stand-pipes B B′, the neck C entering the retort centrally, substantially in the manner and for the purposes described.

5. The process of producing illuminating-gas, which consists in passing the gases and vapors distilled from a fresh charge of coal through a bed of hot coke, partially-distilled coal of an earlier charge, and, after the fresh charge has been partially distilled, admitting oil, petroleum, or other similar substance to or near the middle of the retort containing such charges, and passing the vapors from the oil and other similar material, together with the gas and vapors from the coal, through the hot coke or partially-distilled coal of an earlier charge, for producing a fixed gas.

6. The process of producing illuminating-gas, which consists in passing the aqueous and tar-charged vapors distilled from a fresh charge of coal through another charge of red-hot coke or partially-distilled coal, until the said vapors are exhausted and the charge from which they proceed becomes red hot and begins to yield good fixed gas, and then changing the course of the said gas and passing it directly out of the retort to the hydraulic main without further contact with the heated surfaces of the secondary charge.

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Witnesses:

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