

UNITED STATES PATENT OFFICE.

HENRY W. ADAMS, OF NEW YORK, N. Y.

IMPROVEMENT IN PROCESSES FOR MAKING ILLUMINATING-GAS.

Specification forming part of Letters Patent No. 9,175, dated August 10, 1852.

To all whom it may concern:

Be it known that I, HENRY W. ADAMS, of the city, county, and State of New York, have invented a new and Improved Process of Manufacturing Illuminating-Gas; and I do hereby declare the following to be a full and exact description of the same—that is to say:

The experience of gas-engineers everywhere concurs hitherto in the following general results, to wit: that one ton of coal of two thousand two hundred and forty pounds of ordinary quality for gas-making will produce nine thousand two hundred cubic feet of illuminating-gas when purified on a distillation of four hours, and eleven thousand one hundred and twenty cubic feet on a distillation of six hours, and about one hundred and ninety pounds of coal-tar; that hitherto the coal-tar has not been converted into illuminating-gas, but sold at low rates, in limited quantities, for painting iron or like unimportant uses, though it is the essence of light, containing alliole, benzole, and many other volatile oils, and is capable of being converted into gas at the rate of twelve cubic feet per pound, of specific gravity .96; that whether the distillation of the coal be conducted through four or six hours there is a diminution of both the quantity and quality of gas produced in each successive hour compared with that of the preceding hour; that in the case of a four hours' distillation the specific gravity of the gas produced sustains an average of .421 of atmospheric gravity taken as unity, and in the case of a six hours' distillation the specific gravity of the gas produced sustains an average of .359 compared with the same standard; that the following tables will illustrate the preceding and other results, in detail, of the common experience hitherto had in this department of manufacture, assuming the distillation of the charge of one hundred and twelve pounds of coal to be for six hours:

Hours of distillation.	Feet per hour.	Consumption per hour in a jet with flame four inches high.	Specific gravity.	Distance of shadow in inches.	Illuminating-power compared with mold-candles.
First hour.....	150	1.15	.534	70	2.72
Second hour.....	120	1.1	.495	75	2.36
Third hour.....	95	1.2	.344	75	2.36
Fourth hour.....	95	1.5	.311	80	2.08
Fifth hour.....	80	1.7	.270	85	1.81
Sixth hour.....	16	2.9	.200	100	Not one.
Total six hours..	556	9.55	2.154	485	11.33
Divide by 6 and the average is.....	92.3	1.5916	.359	80.8 $\frac{1}{2}$	1.8 $\frac{1}{2}$

Supposing the distillation to be for four hours, with the same charge of one hundred and twelve pounds of coal, the result is as follows:

Hours of distillation.	Feet per hour.	Consumption per hour in a jet with flame four inches high.	Specific gravity.	Distance of shadow in inches.	Illuminating-power compared with mold-candles.
First hour.....	150	1.15	.534	70	2.72
Second hour.....	120	1.1	.495	75	2.36
Third hour.....	95	1.2	.344	75	2.36
Fourth hour.....	95	1.5	.311	80	2.08
Total four hours.	460	4.95	1.684	300	9.52
Divide by 4 and the average is.....	115	1.2375	.421	75	2.38

Thus showing the value of a four-hour charge over a six-hour charge, and of nine thousand two hundred cubic feet of gas, the product of two thousand two hundred and forty pounds of coal distilled four hours, over eleven thousand one hundred and twenty cubic feet of gas, the product of the same quantity of coal distilled six hours; or that under the process hitherto practiced, in proportion as the period of the distillation is reduced, the richer and more dense and comparatively greater in quantity is the gas produced, and less of it in quantity is required to produce a given amount of light; and it has also been ascertained in practice that any burner with a superior gas will consume only about half the quantity it will consume with common gas.

The distinguishing results of the improved process of manufacture which I have invented consist in maintaining the products of the distillation to an approximate sameness in quantity, density, and illuminating quality during all the successive hours of distillation, whether these are limited to four or extended through six hours, and thereby also saving in time and in the consumption of fuel, inasmuch as my process employs only the same amount of heat as without it is necessarily employed in the distillation of each charge by the process hitherto known and practiced. The saving of time here alluded to involves not only the advantage of producing an enlarged quantity of gas within a given time to meet the exigencies of consumers, but involves also a proportionate saving of labor, fuel, wear, and depreciation of the apparatus employed. It is, moreover, a well-known result, deduced from long experience, that the heating power of hydrogen gas is very much greater than that of carbureted hydrogen, and that in proportion

as gas is poor in carbon its heating and destructive action upon the retorts increases, and hence in the hitherto-practiced process of manufacture, in which the gas of each charge deteriorates proportionally in the amount of its carbon through each succeeding hour of the charge, it constantly approaches to the nature and condition of hydrogen and carbonic oxide, and its damaging power upon the retorts is in like ratio augmented.

By my process the quality as well as the quantity of the gas being maintained throughout the duration of the charge the destructive action upon the retorts occasioned by the absence of carbureted hydrogen is avoided, and the cooling agency of the gasification of rich bituminous and carbonaceous fluid matter fed into them is preserved to the very last moment of distillation, thereby effecting a saving of much importance to every gas establishment.

My improved process calls for no material alteration in the ordinary construction or form of gas-works commonly employed for the distillation of coal-gas beyond that of combining the reservoir, the tube, the stop-cock, and siphon that are used in the well-known process of distilling gas from oil or rosin or other bituminous or carbonaceous substances with the furnace of the ordinary coal-retorts, and for the same purpose of regulating the delivery of a needful supply of either of those substances, as may be desired, into the coal-retorts beneath while the process of coal-distillation is in progress. The form of the reservoir or vessel so employed, as also the retorts and their adjustment to the furnace and to the other apparatus, which I prefer is that invented or described by the late Professor Daniell, F. R. S., in Dr. Ure's Dictionary of Arts and Sciences, the reservoir having a wire-gauze screen or perforated diaphragm, and the retort, near its exit-pipe, a dividing plate or wall rising nearly to its upper side to prevent the deposits of coal and other substances under distillation from falling or flowing into the exit-pipe, which is made to start from the under side of the retort to prevent the return of the condensed tar or bituminous matter, which has once passed in vapor from the retort; but I do not mean to confine my process to any particular form of retort, or of furnace, or of feeding apparatus, or of combination of apparatus beyond the essentials of such an arrangement therein as will enable the operator to feed into the retort at pleasure in any desired quantities or mixtures at or during any stages of the process of coal-distillation within the retort oil, coal-tar, resin, or other bituminous or carbonaceous substances which may be provided for distillation.

The distinguishing characteristic of my improvement in the process of manufacturing illuminating-gas from any mixture of said substances consists in supplying and distilling them conjunctively in respect to time with coal in the same retort, and by the same heat and in any desired quantities, by means of the arrange-

ment of apparatus above described, or by any apparatus equivalent to the same, and for the purposes of effecting the advantages in respect to increased quantity, richer quality, and saving of labor, and the preservation of the apparatus, hereinbefore enumerated. In said process, the coal in the retorts, which are charged in the customary manner, (with the retorts first heated to a cherry-red, as usual,) being measurably deprived of its richest gas, and approximating to a conversion into coke before the tar, oil, resin, or other auxiliary substance is commenced to be fed into the retorts in a fluid state, affords a large and incandescent surface to such substances and acts as a most suitable decomposing agent thereto, reducing it to vapor and then to gas, which at once mixes or unites with the gas that is simultaneously being distilled from the coal. The former gas, uniting in this manner its superior richness and density with the latter gas, which is of steadily-diminishing richness and density, effects a medium standard of highly-illuminating gas, and proportionately more valuable than the ordinary coal-gas hitherto manufactured, as the quantity distilled from the auxiliary substances so manufactured with the coal-gas is more valuable than a like quantity of such coal-gas.

Resin or asphaltum or any bituminous or carbonaceous substance may be beneficially employed for melting in and feeding from the reservoir to the retort charged with coal. Coal-tar aided by a gentle heat forms a good solvent of these substances.

I do not claim the invention of mixing coal-gas with resin-gas, or of manufacturing to a limited extent the two gases simultaneously in the same retort, for it has been and may yet be practiced at some works to mix unmelted resin with coal before or at the time of charging the retorts therewith, and distilling the two substances together, by which the additional quantity of gas which the greater productiveness of the resin so used over coal supplies is obtained, as is also the improved quality of the resin-gas to mix with the gas of the coal, and this from the distillation of a single charge; but the advantage of this process is of only limited extent, because the absence of an incandescent state of the coal in the retort to facilitate the decomposition of the resin (the converse of which is effected in my process) and the absence of large heated surfaces for the rapid decomposition of the resin causes a large production of the vapor from the resin to pass from the retort, to be deposited with the tar of the coal instead of being converted into illuminating-gas. Moreover, the decomposition of the resin thus mixed with the coal and deposited in the retort at the commencement of the charge is ordinarily completed within the first hour of the distillation of the common charge, and thereafter ceases to increase either the quantity or to furnish any compensating aid to the thenceforward deteriorating quality of the gas from the remaining charge of coal, the converse of which is again the case in my improved process.

To illustrate and describe my improvement with its advantages yet further, it may be remarked as the result of general observation that in the ordinary process of distilling coal-gas, the coal gives off about two-tenths of its gas during its first hour, and this is much the richest of the product of the coal in carbon; therefore the best gas for illuminating purposes. During the next three hours about five-tenths of the whole gas of the charge is extracted. During the fifth hour about one-tenth is extracted, and during the sixth hour about one-thirtieth. After the distillation of the first hour the illuminating quality of the gas diminishes during each succeeding hour toward the non-luminous hydrogen and carbonic-oxide gases, which, when delivered into the gas-holder and united with the first and best quality generated during the first hour, dilute the latter very largely and depreciate the whole product to an intermediate value. Hence, and also because the coal within the retort has become suitably incandescent to act advantageously as decomposing surfaces, my process directs, at the close of the first hour of distillation of each charge of coal, to commence feeding from the reservoir the coal-tar, oil, resin, or other convertible substance into the retort moderately, and from that time forward to the close of the distillation of the coal the feed should be gradually increased to correspond with the diminished productiveness of the coal-charge in both quantity and quality of its illuminating-gas, by which process the manufacture of gas within the retort is kept uniform with that of the first hour in both quantity and quality during each hour of the series allotted for distillation of the coal-charge, be it four, six, or eight hours, and this without any addition of fuel or of labor beyond the supply of the liquid from the reservoir and the fuel for the ordinary charge of coal. By this equality of generated carbon during each hour of the process of distillation of the charge the gradual cooling of the retorts during the latter portion of the distillation, as heretofore practiced, is rendered unnecessary, and the damaging effects upon the retorts of the presence within the retorts of a large quantity of non-luminous gases is remedied and avoided. The feed being shut off at the end of the process, the charge of the retort may be withdrawn in a few minutes and the retorts recharged, and the manufacture continued with comparatively slight interruption, loss of time, or loss of heat or variation in the quality of the gas produced.

The coal-tar derived from the coal and thus used, by being fed from the reservoir into the retort at any desired stage of distillation of coal, is converted into gas at the average rate of two thousand two hundred and eighty cubic feet of the richest quality of gas to each ton of two thousand two hundred and forty pounds of coal distilled, making by my process that number of cubic feet of clear gain of gas to each ton of coal distilled over the products of that quantity of coal distilled in the modes

hitherto practiced and used. The gain also in the quality of the tar-gas over coal-gas is by my process as two hundred and seventy-two is to one hundred.

By recurring to the tables already given above it will be seen that a process which admits of a distillation of the coal-charge during six hours instead of four hours will yield eleven thousand one hundred and twenty cubic feet of gas to the ton of two thousand two hundred and forty pounds of coal, instead of only nine thousand two hundred feet, a gain in quantity of one thousand nine hundred and twenty feet, and yet that in consequence of the diluted quality of this gained quantity the aggregate is of less illuminating power than the smaller quantity; but by my process the continuance of the distillation of the coal-charge for the period of six hours is rendered practicable, securing the gain of the above-named increased production of one thousand nine hundred and twenty cubic feet of gas per ton of coal, and securing the further gain of the above-named two thousand two hundred and eighty cubic feet of gas from the tar of each ton of coal, making an aggregate gain of four thousand two hundred cubic feet of gas from each ton of coal distilled. Nor is the average quality of the aggregate thus produced from six hours' distillation diluted in this process to the quality of the aggregate produced from four hours' distillation, as hitherto practiced, as the mean of the last-named aggregate will be in specific gravity 0.421, while that of the former aggregate will be 0.519, nearly equal throughout the mass to the density of the gas of the first hour's distillation of coal; but I wish to be understood as not confining my gain in the quantity of gas that is capable of being manufactured by my said process during a charge of either four or six hours to the coal-tar produced from the charge of coal and to its distillation into gas; but that additional quantities of coal-tar or of resin or of oil or of other bituminous or carbonaceous substances may also be fed into the retort for distillation conjunctively with the coal, in the manner described, as occasion or interest may require, to produce a correspondingly-increased quantity of gas during each charge.

What I claim as my invention, and desire to secure by Letters Patent, is—

The process of manufacturing illuminating-gas, substantially as herein set forth—viz., the process of feeding into heated retorts charged with bituminous coal either oil, coal-tar, resin, asphaltum, or any other bituminous or carbonaceous substances, separately or mixed and reduced to a fluid state, and decomposing the same in the same retort and by the use of the same heat, in conjunction with the distillation of the coal, in the manner and for the purposes substantially as herein described.

HENRY W. ADAMS.

Witnesses:

FRANCIS O. J. SMITH,
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