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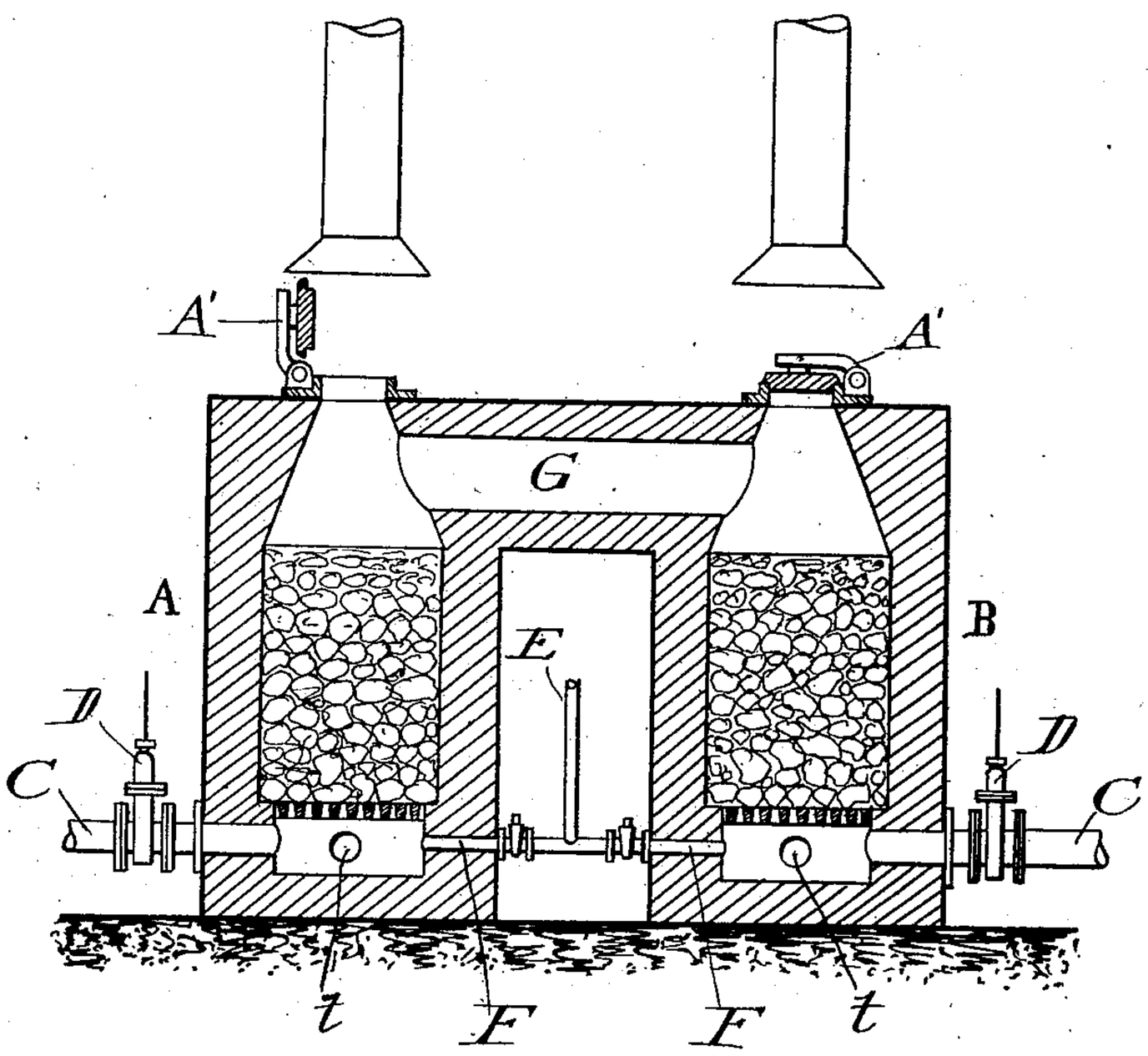
E. FLEISCHER.

PROCESS OF MAKING WATER GAS.

(Application filed Aug. 2, 1901.)

(No Model.)



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PROCESS OF MAKING WATER-GAS.

SPECIFICATION forming part of Letters Patent No. 701,556, dated June 3, 1902.

Application filed August 2, 1901. Serial No. 70,646. (No specimens.)

To all whom it may concern:

Be it known that I, EMIL FLEISCHER, doctor of philosophy, chemist, residing at Thiergartenstrasse 32, Dresden-Strehlen, in the Kingdom of Saxony, Germany, have invented new and useful Improvements in the Manufacture of Gas, of which the following is a specification.

The present invention relates to the manufacture of water-gas.

The object of the process is twofold.

First. To produce a so-called "three-quarter water-gas," being a mixed gas gifted with greater heating power than the existing and well-known kinds of mixed gases. The three-quarter water-gas is composed of twenty-five per cent. of nitrogen and seventy-five per cent. of combustible gases, (CO, H, CH_4, and the like,) thereby essentially differing from the ordinary mixed gas, known as "Dowson" gas, which contains fifty per cent. of nitrogen and more.

Second. To produce the gas not only, as in the case of said Dowson gas, from coke or anthracite, but also from ordinary coal or bituminous fuel.

The essential features of the process may be described as follows: A layer less than two meters high of the combustible material in an incandescent state is first subjected to a strong blast of air. As set forth in Dellwik's patent, No. 636,899, the blast is to be so operated as to cause carbonic-acid gas to preponderate in the escaping gases over the oxid of carbon. After this fresh fuel is thrown in the flue-valve is closed and the gas-valve opened. By considerably reducing the section of the twyer-openings and slowing down the blast engine or device a quantity of air, suitably diminished against the volume previously injected, is next blown in and, in the nature of things, mostly burned to oxid of carbon. The "generator-gas" thus produced is conveyed to the gas-holder. To distinguish it from the first or preliminary blowing period, to be briefly designated henceforth as the "primary" blast, the second blowing period will be shortly called the "secondary" blast in what follows. However, since it is intended to produce likewise water-gas for the purpose of mixing it with the generator-gas steam is sent through the layer of incandescent material either before or after the secondary blast. As soon as the decomposition of the steam is perceived to decrease, owing to the cooling down of the layer of fuel, the run is finished and another run started by going back to the primary blast.

In order to turn the heating capacity in the fuel to the utmost account and to cause the resulting three-quarter water-gas to contain no more than twenty-five per cent. of nitrogen, it is indispensable that the quantity of air introduced in the secondary period be smaller than that injected in the primary or preliminary part of the run. The air injected in the secondary period may be reduced, in fact, to one-half the former quantity, and in no case should exceed three-fifths of the volume of water-gas. This applies more especially when the primary blast is made to generate carbonic acid according to Dellwik's patent, No. 636,899, where the carbon burned to oxid of carbon in the primary as well as in the secondary blast periods, and equal quantities of air used on both occasions, sixty-seven per cent. only of the heating capacity in the fuel could at the utmost be made available in the formation of the mixed gas. In that case the resulting gas instead of containing only twenty-five per cent. of nitrogen will contain nearly forty per cent., and, indeed, be but little better than Dowson gas, which shows fifty per cent. of the prejudicial ingredient. On the other hand, if the same quantity of air is equally injected in the primary and secondary blasts and CO_2 produced on both occasions the utilization of the heating capacity in the fuel is easily carried up to ninety per cent., owing to the increased decomposition of steam. Still the mixed gas resulting from the process is found to contain no less than thirty-one per cent. of nitrogen. Only of the proportion of the quantities of air used in the primary and secondary blasts is fixed at about two to one, the utilization of the heat reaches its maximum figure of 90.7 per cent. and a mixed gas is obtained showing but 23.1 per cent. of nitrogen and justifying, therefore, the name of "three-quarter water-gas." Accordingly in the present process a third period is added to the two customary periods of

the kindling and the steaming blasts. A useful gas being likewise produced in this additional period, there are consequently two gasing stages under the present method. The object of this insertion of another gasing stage is, in the first place, to prolong the time for the distillation of the coal—a process specially favored by blowing for more carbonic acid than carbonic oxid under the German patent, No. 115,666—and, secondly, to further promote distillation by starting it with a low supply of heat through arranging the additional gasing period to follow after the steaming period. Supposing both the secondary or gas blast period and the steaming period to last fifteen minutes each, the coal will be effectually coked during four times fifteen or sixty minutes by the passing water and generator gases before it is burned to carbonic acid in the subsequent primary blast.

Although it is quite possible to produce three-quarter water-gas from coal by means of a single generator, provided that the two blast periods are carried out in the manner and under the conditions described, yet when using coal it is more rational to make use of twin generators. A twin arrangement of this kind, as shown in the accompanying drawing, consists of two independent generators A and B, each provided with all the necessary air and steam conduits, gas and flue or escape valves, and communicating with each other only by a passage G, arranged above the layers of fuel. In now describing the method of carrying out the present process one of the twin generators will be called A and the other B.

Let it be assumed that both generators are charged with a layer one to two meters deep of incandescent coal. First a strong blast is started in A, with the twyer fully open, which will produce CO_2. While keeping up the blast the quantity of air introduced into A is gaged by some suitable means—say by registering the number of strokes of the blast engine or device. The gases issuing from A are either allowed to pass away as waste through the opened escape-valve A′ or are made use of for the purpose of preheating water or superheating steam. At the conclusion of the primary or kindling blast period the air-blast slide of A is closed, the blast is stopped, and a layer of fresh coal introduced in A, while the escape-valves A′ of both generators are closed and the gas-valve D, which is connected with the ash-pit of A and which closes the passage of the gas through the pipes C to the gas-meter, is opened. During the secondary or gas-blast period now following (the object of which is the production of CO) the air may be introduced either directly to A or through B. It is, however, preferable to pass the blast into the body which has not yet received the preliminary blast. Accordingly the blast is turned on through B, the quantity of air thus introduced being less than (preferably only half) the quantity introduced into A during the previous blast. In order to be able to mete out that quantity with some measure of exactness, the blast is introduced much more slowly than in the previous blast period, (at about one-eighth of the speed,) while the slide in the twyer *t* is so far closed as to cause in the blast-conduits the same pressure as during the previous primary blast. During this time the number of strokes of the blast-engine are again counted and when their number reaches one-half of the number obtained in the primary blast the blast is stopped. In this manner half the quantity of air which had been introduced in A during the primary-blast period is slowly driven through the secondary or gas-blast period. The generator-gas thus obtained passes through B, crosses over at the top into A, where it greatly assists in the combustion or coking of the charge of fresh coal, descends through A, (in the course of which the tarry-vapors of the coal on coming in contact with the hotter coke layers, through which they have to pass, are decomposed,) until it arrives in the ash-pit of A, from which it passes through the gas-valve D and pipe C into the scrubber and gasometer. The proper quantity of air having thus been introduced, the gas-blast period is brought to an end by stopping the blast-engine and fully closing the blast slide or valve. Steam as hot as possible (preferably superheated) is now admitted from below through the pipes E F to B, which passes along the same way as did the air before, and in doing so again powerfully contributes toward the driving out of any gas evolved from the coal in chamber A. By thus introducing steam water-gas is generated, such generation depending on the consumption of heat accumulated in the fuel. The cessation of such generation of water-gas marks the conclusion of the whole process, after which the operations which characterize the various period or phases (primary or kindling blast, secondary or gas blast, introduction of steam) are repeated in the same order, with this difference, however, that it is now B on which the primary blast is turned. It will be clear that the fresh coal with which A had been charged will twice be subjected to the process of distillation—viz., when hot generator-gas and, again, when the steam or water-gas are passing through it upward from below—whereby an even more energetic reaction is secured than was the case in the preceding phase. In this manner four long periods for distilling the coal are obtained before it is finally consumed in the blast-producing CO_2, for which reason the new process is eminently adapted for the employment of coal.

In the case of more or less gaseous coal the various operations of the process will follow each other and be carried out in the manner described—*i. e.*, they will be marked by an independent and separate injection of steam. In the case of coal poor in gas the steam is

admitted simultaneously with the gas-blast. In the latter case it is advisable to admit the steam not from below the grate, but from above the layer of fuel into that particular generator which happens to be in the gas-blast period, so that the hot generator-gas may help to heat the steam, after which both pass over into the other generator.

It is possible to vary the sequence of the different phases or periods forming the complete process or cycle, and also the moment at which the generators are charged with fresh fuel—*i. e.*, before, during, or after the gas-blast period—whereby the time allowed for the distillation of the coal may be conveniently prolonged or reduced to the quantity of gas in the coal. It is even feasible to divide the primary-blast phase, since it may be advisable to use, for instance, the strong blast, for a short time before introducing steam and again before the gas-blast; but whatever variation may be found expedient according to the quality of the coal employed, still the characteristic feature of this process remains unalterable under any circumstances—viz., that there are always at least two distinct blast periods required—whereas all other processes for the production of mixed gas like Dowson make use of only a single continuous blast. Apart from their different import the two blast periods at least required under the present method are, moreover, characterized by quantitative diversity as regards the volumes of air needed, since it is not rational to consume more air in the production of CO than in the production of CO_2. Finally, it should be observed that these several blast periods have to be maintained even when they do not follow each other immediately, but are separated by the injection of steam. Then, again, the treatment in a twin generator is peculiar as regards the ways and directions which the gases are made to follow during the several periods. With reference to the product itself the three-quarter water-gas may be claimed as a perfectly new description of mixed gas not previously obtained by anybody else. Up to the present time no mixed gas has been produced in a generator which contains appreciably less than fifty per cent. of nitrogen. While a cubic meter of Dowson's gas, according to Fisher, contains only thirteen hundred and sixty calories, a cubic meter of the three-quarter water-gas contains a combustion-heat of more than three thousand calories, thereby well dividing the fields on which the one or the other should be employed. Finally, it may be observed that when the object of the gas-blast (without steam injection) is only to obtain generator-gas, this may be employed for the production of the necessary quantity of steam as well as for driving, by means of a gas-motor, the blast apparatus. In this manner a gas is obtained which contains even less nitrogen in proportion, while the heat obtained from the coal is decreased by barely a few per cent. turned to account in the production of steam and motor power.

The principal characteristic of this process will be found under all circumstances in the employment of several blast periods instead of only one.

Now what I claim, and desire to secure by Letters Patent, is the following:

1. In the process of making water-gas from bituminous fuel by blowing up the fuel to high temperature and passing steam through it, the improvement which consists in passing through the generator after the charging of a fresh quantity of fuel a quantity of air less than that used for blowing up the fuel and at rate slower than that used for blowing up and slow enough to generate producer-gas.

2. In the process of making water-gas from bituminous fuel by blowing up the fuel to high temperature and passing steam through it, the improvement which consists in passing through the generator after the charging of a fresh quantity of fuel and before the passing of steam, a quantity of air less than that used for blowing up the fuel and at rate slower than that used for blowing up and adapted to generate producer-gas.

3. The process of making water-gas from bituminous fuel in twin generators, which consists in blowing up one generator and charging fresh fuel into it, blowing through the other generator a quantity of air less than necessary to blow it up and at a rate slower than that used for blowing up, passing the escaping gases through the said first generator, admitting steam into the second generator and passing the escaping gases through the first generator, blowing up the second generator, blowing air slowly and in small quantity through the first generator, as described, and passing steam through the first generator and afterward through the second one, substantially as described.

4. A process for the production of water-gas from mineral coal or the like consisting in the blowing up of the fuel in any ordinary way causing thereby a high temperature throughout the fuel, charging coal into the generator, generating producer-gas by blowing in slowly a quantity of air less than that used for blowing up the fuel and passing steam through the fuel.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMIL FLEISCHER.

Witnesses:
JULIUS HARTMAN,
CASIMIR EIGENSATZ.