A. JABS.

GAS PRODUCER.

APPLICATION FILED JULY 16, 1908.

944,332. Patented Dec. 28, 1909.

Fig. 1.

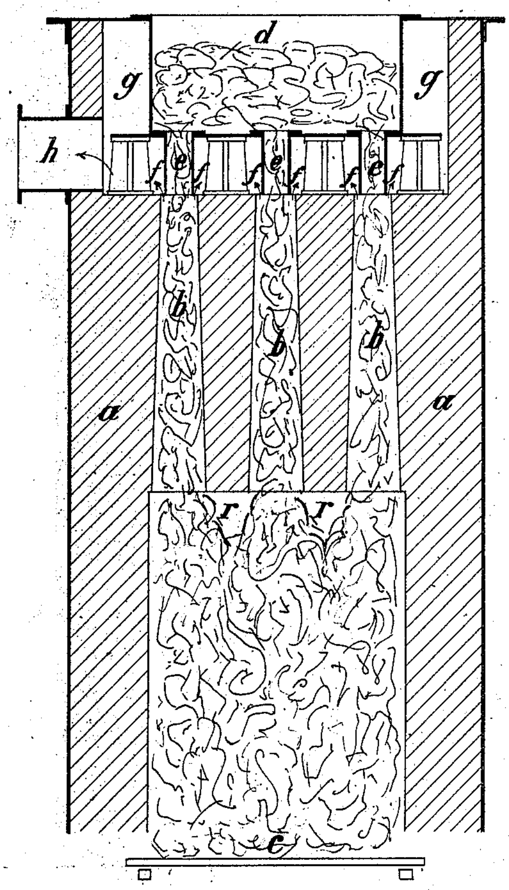


Fig. 4.

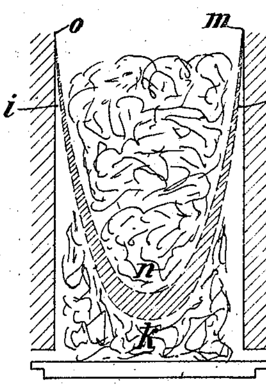


Fig. 5.

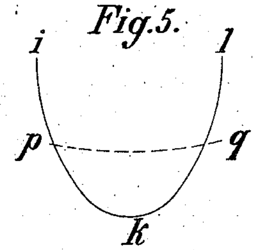


Fig. 6.

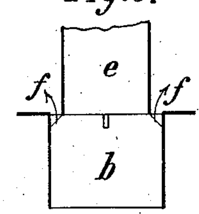


Fig. 2.

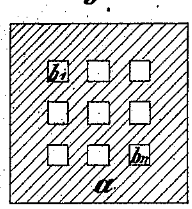


Fig. 3.

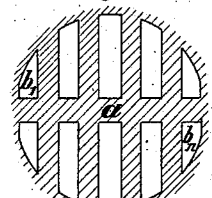
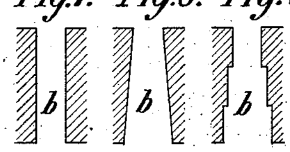


Fig. 7. *Fig. 8.* *Fig. 9.*



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UNITED STATES PATENT OFFICE.

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GAS-PRODUCER.

944,332. Specification of Letters Patent. **Patented Dec. 28, 1909.**

Application filed July 16, 1908. Serial No. 443,809.

To all whom it may concern:

Be it known that I, Asmus Jabs, engineer, a citizen of the German Empire, residing at 7 Alpenstrasse, Zurich, Switzerland, have invented certain new and useful Improvements in or Relating to Gas-Producers, of which the following is a specification.

The distillation of caking coals in gas producers offers great practical difficulties which it has not been hitherto possible to overcome in a simple manner.

A regular working of the gas producer can be obtained when expensive coal in pieces is used, but not when using coal in small pieces or the so-called "pit coal", that is to say coal coming direct from the pit. For treating caking coals shaft gas producers are chiefly used, this method being exclusively referred to hereinafter. During the descent of the charge of a shaft generator, the friction of the mass of coal and coke against the fixed wall of the shaft, brings about a loosening of the fuel, the descent of which along the wall of the shaft is delayed by friction, so that the mass in the center advances with a greater speed, while at the circumference it lags behind and, therefore, between the wall and the coal and coke there is produced a loosening of the material, owing to which large gaps are formed which offer free passage to the gases and smaller resistance to movement, so that the gases naturally follow the same when rising through the generator. Owing to this increase of the passage openings at the circumference of the shaft, large unbroken quantities of gas escape in a very short time, the carbonic acid of the said gases being reduced only at the outside of the gas currents at the point of contact with the incandescent masses, while in the interior of the widened gas flues it remains unaltered. The same incomplete reduction is also caused by the temperature of the generator walls which is outwardly reduced by the heat radiation. This is proved by examining samples of gas taken on their escape from the fuel at the walls of the generator, when it will be found that they contain always more carbonic acid than at the places which are at a greater distance from the shaft walls, while sometimes they contain even free oxygen. In a shaft gas producer, using caking coal, the influence of the walls is found to be still greater. The combustion products produced above the grate from the fuel already distilled, the coke, rise chiefly along the walls, distil the coals to a still greater extent at that point and convert them into coke. The coke thus produced does not offer any difficulties to the subsequent gasification. That portion of the combustion gases which is striving to pass through the remainder of the mass of coal heats the limit layer between the coke and the coal to perhaps 4–500° C. and partly distils it. At that temperature, the coals become inflated and their volume increases. The whole of the limit layer then forms under the pressure of the charge, a solid mass which is practically impermeable to the combustion gases. In that way, further distillation of the center or core of the coals by direct transmission of heat from the combustion products ceases. The distillation can then be effected only by the heat which is transmitted to the mass of coals by conductivity. This takes place in a very slow manner as proved by the results of distillation of coals in coke furnaces and retort furnaces of gas works.

In the drawing Figure 4 shows at the sectional surfaces *i k l m n o* the cross-section of the mass of coal which is fritted together, it is further distilled starting at *i k l*, while the limit *m n o* moves still farther upward. As the coke below is being burned, the whole mass descends. In regular working the zone *i k l m n o* retains its position in the generator. The coals in the core have a low temperature which sometimes scarcely reaches 200° C.

It will be seen from the foregoing that in a gas producer for caking coals, nearly all the products of distillation rise along the walls, so that the temperature at those points will rise very quickly. On looking into such a generator, there will be seen along the wall a very narrow red hot annular zone, the rest of the cross-section is quite dark.

The distillation of non-caking coals in a shaft generator does not offer any special difficulties, as proved by the manifold use of anthracite and coke generators for producing power gas for explosion engines.

As shown in Fig. 5, the two zones *i k l* and *m n o* coincide here, that is to say, the combustion gases can also rise in the center of the gas producer and distil the coals in the core as well. The temperature zone *i k l* for the caking coals passes into the flat zone *p q* when anthracite and coke are used. The injurious influence of the generator wall on the descending charge does not then have as much importance as in the case of caking coal.

It follows from the foregoing that it would be easy to distil the coals in question if it were possible to convert them into coke or poor coals before the fuel passes into the gas producer proper, or if the caking were prevented as far as possible. Both methods have been tried with more or less success.

The present invention is based on the principle illustrated in Figs. 1–3 of the accompanying drawing in accordance with which the fuel is supplied to the gasifying chamber, that is to say, to the gas producer proper, already distilled to such an extent that its caking together should be already impossible, this being the equivalent of supplying material similar to gas coke to the gasifying chamber. To that end, for distilling the coals, that is to say, for converting them into coke, the upper part of the generator is divided into vertical or inclined partial shafts which can be placed in the gasifying chambers (Figs. 1–3 and 7–9).

The heat required for the distillation, is supplied by the generator gases leaving the gasifying chamber, by direct transmission of heat to the coals. As in the case of caking coals, according to the preceding explanation, the combustion gases rise only along the walls, and the distillation of the core of the coals is mostly effected by the heat supplied by conductivity to the mass of coals, that is to say slowly, the cross-sections of the partial shafts are calculated in such manner that the thickness of the cake of coals in cross-section is only a moderate one (under normal conditions 20—30 cms.), in order that the core of the contents of the retort should be, if possible distilled in a few hours.

A gas producer according to this invention is diagrammatically illustrated in the accompanying drawing, in which—

Fig. 1 is a longitudinal section through a rectangular generator, Fig. 2 a cross-section through the partial shafts on a reduced scale, Fig. 3 a cross-section through the partial shafts for a round generator, Figs. 4 and 5 are diagrams illustrating the process and Figs. 6–9 detail views.

In the construction shown in Fig. 1, the gas producer *a* is provided with nine partial shafts *b* above the distilling or combustion chamber *c*. The partial shafts *b* are connected to the charging chamber *d* by filling conduits *e* (Fig. 6) around which slots *f* are left, for the escape of the gases into the conduit *g* provided outside with branches *h* of which only one is shown in the drawing.

As shown in section in Fig. 3, in the case of round or cylindrical apparatus, the partial shafts *b* can have any desired shape, such for instance, as rectangular. In Fig. 7 the cross-section is of the same shape, in Fig. 8 it is gradually widened at the bottom and in Fig. 9 it is provided with off-sets. The generator gases forming the products of the distillation of coke, escape from the chamber *c* with a temperature of about 7–800° C. In becoming uniformly distributed along the single partial shafts *b* (1^n) and rising in the same along the walls, they give off their heat to the contents and to the walls of the partial shafts, and owing to their small cross-section previously distil the coals to such an extent that the volatile ingredients of the same are mostly extracted at this point. Even if there should still remain in the fuel when it comes out from the partial shafts *b*, 5–10% of the volatile ingredients, of which the coals originally contained 30%, the said coke-like coal would be easy to distil in the generator and there would be no longer any fritting together. Whether the partial shafts could be made of the same cross-section from top to bottom, or whether they are to be made with a narrower or wider cross-section at the bottom, depends chiefly on the properties of the coals to be distilled at the distillation temperature, for instance for coals which become inflated the cross-section should be increased at the bottom, in order to insure a uniform descent of the charge.

The fuel converted into coke, will leave the partial shafts in more or less large pieces, according to the conditions of temperature and pressure. When passing from the partial shafts *b* into the generator *c*, the cakes of coke are loosened by the sudden increase of cross-section and partly fall to pieces. Below the partial shafts are produced hollow chambers or spaces *r* which are favorable to a uniform distribution of gas throughout the partial shafts.

The partial shafts can be made and mounted in the same way as gas retorts, or, as shown in the drawings, built of shaped bricks or ordinary fire-proof bricks. The latter have the advantage that, owing to their large mass, the walls form a large heat accumulator and consequently exercise a favorable influence on the regular working of the gas producer. In certain conditions it may be advisable to perforate the intermediate walls of the partial shafts at single points, in order to produce an equalization of pressure for the gases, which may be useful in certain cases.

It is already well known to suspend partial shafts in the upper part of the generator, or to place them on the gasifying chamber of the generator, but none of the existing constructions has the same object and gives the same result as the construction according to this invention. In well known gas producers, the fuels are not heated directly but indirectly by the retort walls from outside, consequently in view of the small heating surface and small heat conducting qualities of the thick fire-proof walls only a small quantity of heat, in the case of iron walls not so little, is transmitted to the outer surface of the fuel in the retorts, but the whole inner core of the fuel is heated from the outside inwardly only as permitted by its bad heat-conducting property, and therefore, the distillation in the retorts is small in accordance with the small temperature there.

The arrangement of partial shafts in the upper part of the generator for solid fuels, as described in the present specification, has on the contrary, another object and a new result, namely that the heating gases are conducted into and through the partial shafts and brought in them into direct contact with the fuel, the latter offering them a correspondingly greater heating surface, owing to its division and owing to its being in pieces. To that end, the escaping gases are drawn off not at the lower end, but at the upper end of the partial shafts (Figs. 1–6), openings *f*, that is to say, through the partial shafts *b*. The heating gases rising in the partial shafts, give off the greater portion of their heat to the fuel as useful heat and heat and distil the latter to a considerable extent, carrying away its products of distillation and while rising in opposite direction to the descending fuel, continuing to give a steadily increasing quantity of useful heat and being cooled more and more so that their original temperature can be reduced to about 100° C., while in the case of indirect heating of the partial shafts, the gases leave the generator with an average temperature of 650°.

The well known widening of the shafts at the bottom (Figs. 8 and 9) which in certain cases may be advantageous in the apparatus according to this invention, facilitates the admission and the distribution of the gases in the lower portions of the shafts, and causes the gases with the highest temperature to remain for a longer time in contact with the fuel, the speed of movement of which in proportion to the narrowing of the cross-section is always increasing upwardly, unlike that which is the case in those constructions in which only the air passing through and surrounding the fuel, passes into the retorts to become there more or less compressed and to bring about only very inefficient movements of the heat.

What I claim is:—

1. In a shaft generator for producing gas from caking coal the combination of a lower combustion chamber *c*, a plurality of superimposed partial shafts *b*, a charging chamber *d* superimposed upon the partial shafts *b* and gas conduits *f* surrounding the upper ends of the partial shafts *b*, which conduits *f* are closed toward the charging chamber *d* and open to a gas collecting branch *h*.

2. In a shaft generator for producing gas from caking coal the combination of a lower combustion chamber *c*, a plurality of superimposed partial shafts *b*, a charging member *d* superimposed upon the partial shafts *b* and gas conduits *f* surrounding the upper ends of the partial shafts *b*, which conduits *f* are closed toward the charging chamber *d* and open to a gas collecting branch *h*, the sections of said partial shafts *b* increasing in diameter from the top to the bottom.

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

ASMUS JABS.

Witnesses:
JACOB BRUNNER,
KURT GRIMM.