No. 794,037. PATENTED JULY 4, 1905.

W. NACKEN.

GAS GENERATOR.

APPLICATION FILED OCT. 26, 1903.

2 SHEETS—SHEET 1.

Fig. 2.

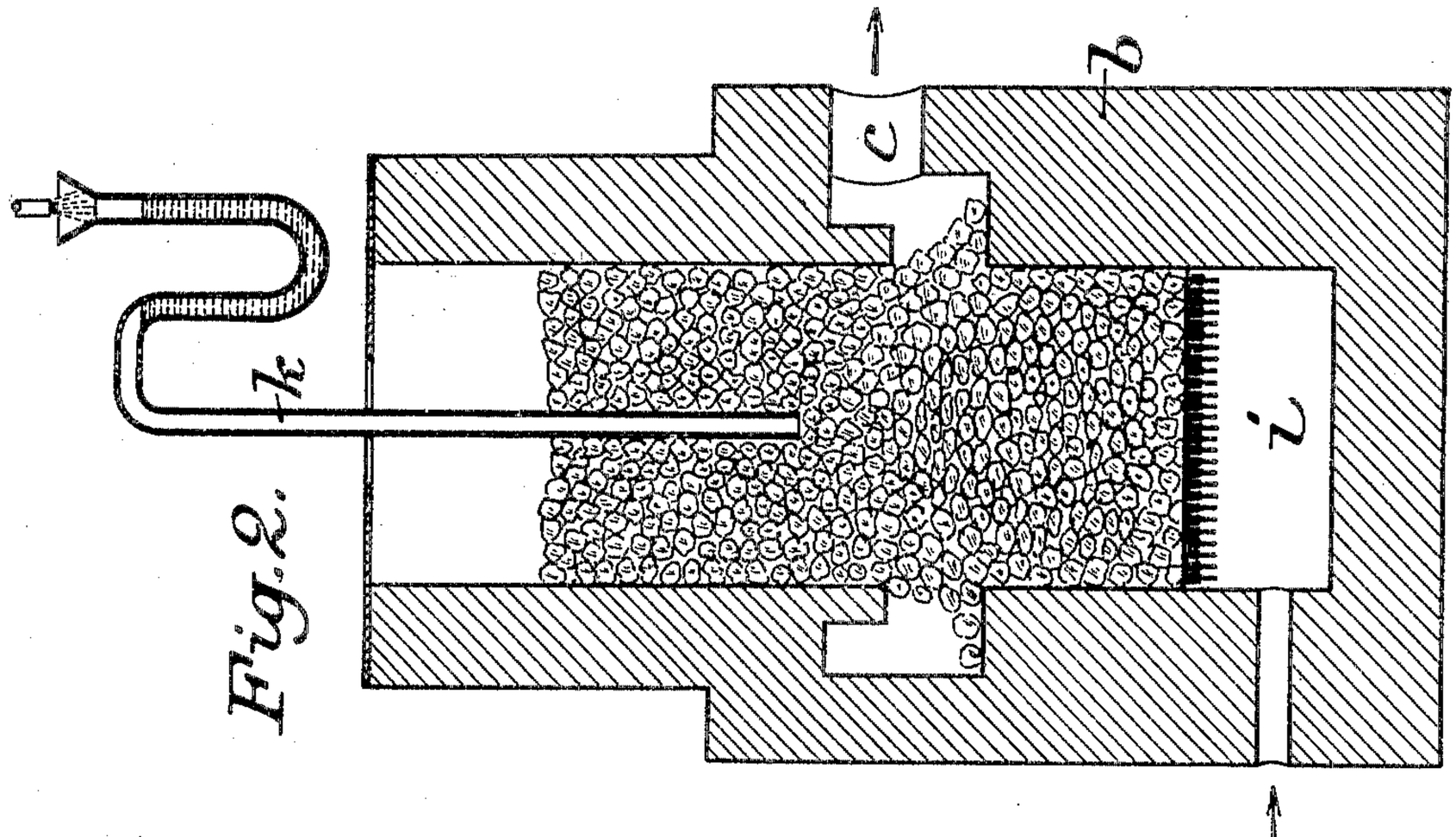
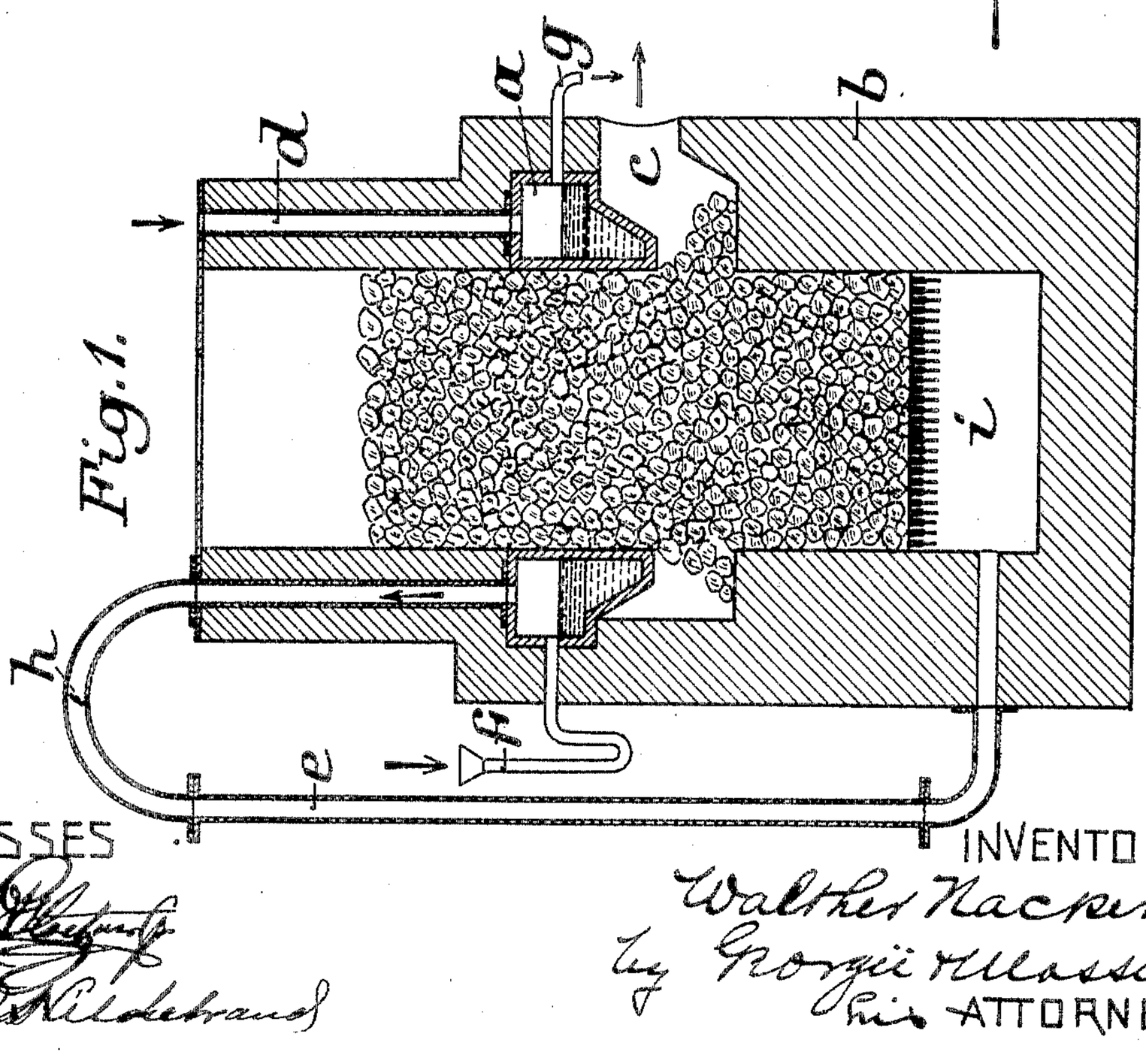


Fig. 1.



WITNESSES

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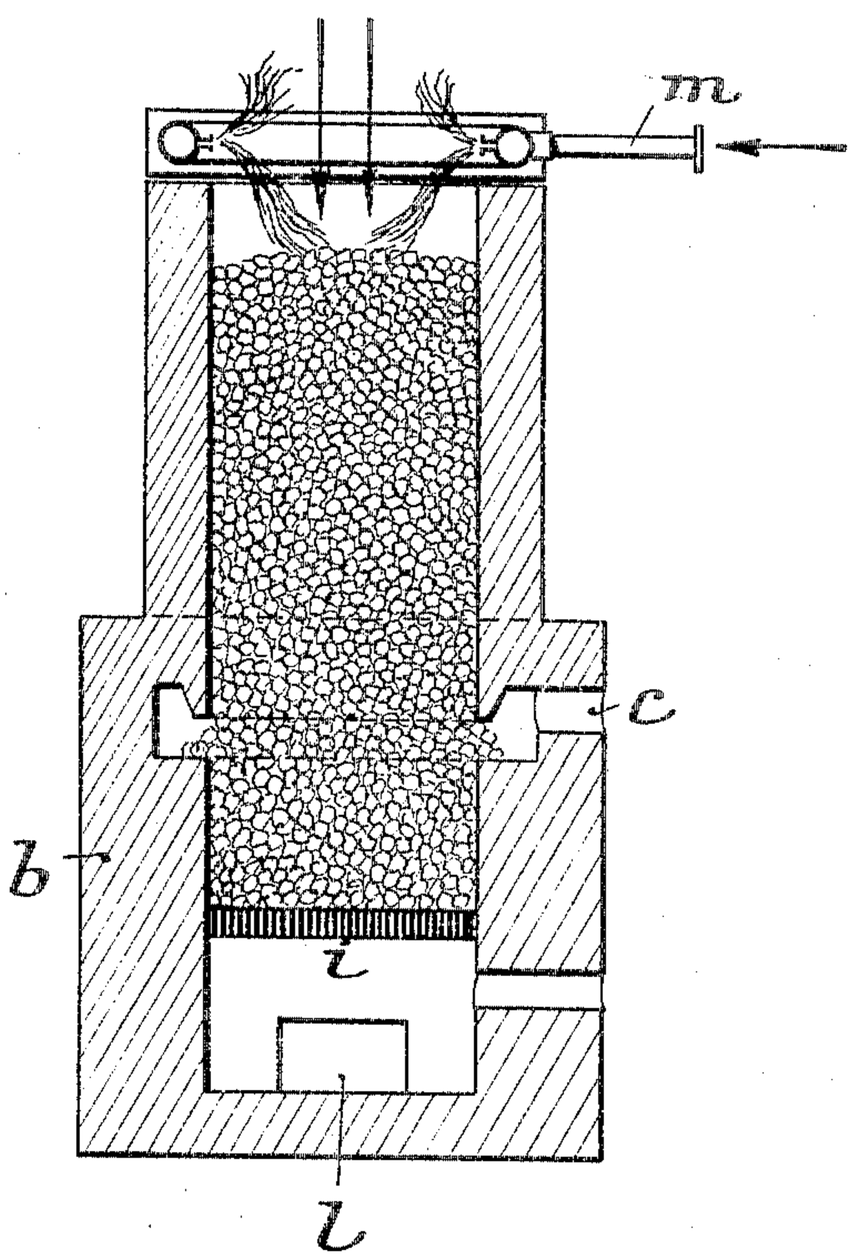
Fig. 3.



WITNESSES

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No. 794,037. Patented July 4, 1905.

UNITED STATES PATENT OFFICE.

WALTHER NACKEN, OF MÜLHEIM-ON-THE-RHINE, GERMANY.

GAS-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 794,037, dated July 4, 1905.

Application filed October 26, 1903. Serial No. 178,566.

To all whom it may concern:

Be it known that I, WALTHER NACKEN, engineer, a subject of the German Emperor, residing at 15 Buchheimerstrasse, Mülheim-on-the-Rhine, Germany, have invented certain new and useful Improvements in Gas-Generators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to gas-generators, its object being to provide a suction-generator which may be charged with bituminous or other gas containing coal or fuel and which at the same time will furnish a gas free from hydrocarbons and tars—that is to say, a gas which will burn with a non-luminous flame and which therefore will serve for heating purposes.

For this purpose the gas-generator embodying my invention consists of a fuel-receptacle which is open at the top and provided with a grate at the bottom and with an intermediate discharge for the generated gas. By this construction the gases for supporting the combustion, such as air or a mixture of steam and air, are brought into contact with the upper as well as with the lower end of the fuel-column and are forced or drawn into the interior of the said column, so that the gases produced are all carried off from the interior of the said fuel-column. The operation of the gas-generator thus arranged is as follows: In view of the suction or exhaustion of the gases from the generator by means of any form of exhaust-pump or suction device the pressure in the interior of the fuel-column is reduced and air or a mixture of air and steam is drawn into the incandescent-fuel column from the top and the bottom of the said column and in passing through the incandescent fuel is converted into generator-gas. The fuel, which is added at the top from time to time, is heated by the glowing coal upon which it rests, the first effect being that the volatile distillation products are given off from the newly-charged fuel, whereupon it gradually attains incandescence and then also takes part in the gasification. The products of distillation are then directly mixed with the air or air and steam sucked in from the top, and the mixture is then directly carried through the incandescent-fuel column. The first effect of this is that the liquid hydrocarbons are changed to gaseous hydrocarbons, whereupon the latter are decomposed into their elements, hydrogen and carbon, the latter being thrown out as soot. The decomposition of the hydrocarbons depends upon the height of the upper fuel-column—that is to say, that portion of the fuel-column which lies between the upper end of the generator and the gas-discharge.

The lower portion of the generator—that is to say, the portion between the grate and the intermediate gas-discharge—serves exclusively for the complete gasification of the coke formed in the upper part of the generator. Hence this lower part corresponds to a coke-generator having the usual draft from below upward, and its height must be so determined that the air passing through it will have a full opportunity to completely combine with the carbon, so as to form generator-gas. Experiments have shown that when the lower part of the generator has the proper height to be operative it is preferable to make the height of the upper part of said generator greater than the height of said lower part.

It is an essential feature of this invention that the upper part of the generator is open and freely accessible and also that the lower end of the fuel-column is supported so as to leave a space below the same to give free access to the gas for supporting combustion, or, in other words, that it is held above the ground by the grate. By leaving the upper part of the fuel-receptacle open the coal may be observed at all times without disturbing the operation and also the coal may be poked and raked and prevented from caking by suitable instruments at any time. It should be noted in this connection that in generators with downward combustion, as in the upper portion of the generator under my invention, it is of the utmost importance for a perfect operation that the upper layer of coal may be observed at all times in order to be able to maintain the zone at which combustion begins

at the same height constantly, which is done in the present case by timely addition of fuel and by a proper distribution of the supply of air to the top and bottom. It is, moreover, of importance that the upper layer of coal can be observed at all times in order to prevent an uneven combustion, which can be prevented in time by proper distribution of the fuel in charging. It is also of importance in view of the slag-forming fuel employed for gasification that the formation of larger connected masses of slag or clinkers is prevented by frequently thrusting suitable implements down into the fuel-column. The construction of the generator as above stated makes it possible to frequently and even uninterruptedly poke the coal down to the slots or openings in the grate and to scrape the slag away from all parts of the walls of the generator without interrupting the operation and in particular without changing the mixing proportions of the air or air and steam mixture flowing into the generator.

Of the accompanying drawings, Figure 1 is a vertical section through a gas-generator arranged according to my present invention, and Figs. 2 and 3 are similar views of modifications embodying my invention.

Referring to Fig. 1, the upright fuel-receptacle *b* is always open at top and has at bottom a fire-grate that is accessible from the top opening of the chamber. The gases are drawn off through a suitably-formed channel *c*, arranged at the proper point relatively to the height of the fuel-column, which is in a state of incandescence in its entire height. The fuel introduced at top is heated by the incandescent layer below and is first subject to distillation by such heat in becoming gradually incandescent and is then further gasified by the air admitted at the top of the generator and passing through the incandescent layer of fuel. The residue consisting of incandescent coke then gradually descends into the lower part of the producer, where in coming into contact with the air entering through the grate it is finally completely gasified, with exception of the ash which drops into the ash-pit *i*, which is removed from time to time through the opening *l*, formed in said ash-pit. The products of distillation disengaged in the upper part of the body of fuel in being made by the draft at *c* to descend through the upper incandescent layers of fuel will before reaching the channel *c* have become decomposed into non-condensable gases, possibly with separation of solid carbon, and pass away through channel *c*, together with producer-gases formed in the upper and lower parts of the fuel. The air entering through the fire-grate is advantageously moistened, for which purpose there is provided above the discharge-channel an annular water-evaporating chamber *a*, in which a body of water is maintained at a temperature slightly below 100° centigrade. The evaporating-chamber *a* is built into the brickwork of the producer in such a manner that the bottom thereof forms the top of the annular discharge-channel *c* for the gases and the inner side thereof a portion of the producer-chamber. By this arrangement of the evaporation-chamber on the one hand the excess of heat of the fuel at the discharging zone not being utilized by the process is usefully employed in generating the required steam and on the other hand the downward projecting upper edge of the brickwork channel *c* is made of a material that is less liable to be damaged by heat than brickwork. The chamber *a* is made to communicate with the atmosphere through one or more pipes *d* and with the ash-pit *i* through the pipe *e*. The reduction of pressure effected in the producer-chamber by the suction in the discharge-channel *c* is transmitted through ash-pit *i* and pipe *e* to the interior of chamber *a*, causing air to be drawn in through pipes *d*, which air in passing over the surface of the heated water takes up vapor or steam therefrom and then passes with the same through pipe *e* into the ash-pit *i*, and thence upward through the incandescent column of fuel, where it is converted into producer-gas. The water in chamber *a* is maintained at a constant level by supplying continuously water through the pipe *f*, while the excess runs off through the overflow-pipe *g*, the supply being made sufficient to maintain the temperature of the water in the chamber below boiling-point. For regulating the amount of air passing into the ash-pit the pipe *e* may be provided with a regulating device, such as the damper *h*, which is operated by hand.

The lower part of the producer serves only for the complete gasification of the coke produced in the upper part. It is therefore like an ordinary coke gas-producer with the usual upward draft, and its height is only determined by the necessity for allowing the entering air to combine perfectly with the carbon to form producer-gas before passing away. While with ordinary coke-gas producers this minimum height is frequently exceeded in order to previously heat the upper fuel by the hot gases, and thus to utilize their heat more perfectly, such an increase of height has no object in the present mode of operating, as the fuel enters the decomposing process already in an incandescent state. Any such increase in height would only uselessly increase the cost and the space occupied by the producer, the detaching of clinkers from above would be more difficult, and the loss of heat through radiation would be increased. Thus it will be seen that the lower part of the producer has its practically determined height the same as the upper part, and it has been proved that for the production of the required gas according to this invention the upper part must be larger than the lower part.

The non-luminous gas produced according to this invention is more uniform in its composition than the luminous gas taken off from the higher layers of the producer in the usual manner, as the zones where the decomposition of the tar and the gasification of the hydrocarbons take place overlap each other, and the producer cannot be practically so worked as to maintain a constant height of the fuel. If, therefore, this height sinks somewhat, the place where the gases are drawn off approaches somewhat nearer to the surface of the fuel and more undecomposed tars will remain in the gas. If, on the other hand, the height of the fuel rises above the normal level, the discharge-opening for the gases will be farther away from the surface of the fuel and more gaseous hydrocarbons will be decomposed. Below the zone in which all the hydrocarbons have been decomposed into their elements the gases cannot be subject to any further change. According to this invention, therefore, they are withdrawn at a point sufficiently below this zone to insure that their composition will not be affected by any variations in the total height of the body of fuel in the producer that may occur in the practical working.

The heating-gas, burning with a non-luminous flame obtained by the above means, is not only more uniform in its composition, but also, on account of the complete decomposition of all the tars, it is very much purer than the luminous gas prepared in the known manner. It has a lower heating capacity than the latter and is on this account particularly suitable for working internal-combustion motors, but less so for producing high temperatures, and unless carbureted it is of course not suitable for illuminating purposes.

When gasifying certain kinds of fuel, it may be of advantage to add steam also to the air entering at top, as shown in Fig. 3. In this figure *m* represents the pipe for introducing the steam.

For utilizing the soot that is contained in the gases in the producer itself the large amount of free heat contained in the lower layers of the upper part of the fuel can be utilized for converting into steam water introduced at the point where the soot is separated, or steam may be directly so introduced. Fig. 2 shows the arrangement of a pipe *k* for this purpose, which descends through the upper body of fuel to the point where the carbon separates from the gas and which is supplied with water through a siphon bend at top, as shown. The result of such steam-supply will be the production of water-gas mainly if not entirely from the separated soot, as this offers very much more extended surfaces than the lumps of coke, and owing to its being in a nascent state it is much more disposed to enter into reaction.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a gas-generator a fuel-receptacle open at the top and provided with a grate at the bottom, and means for admitting air below said grate in combination with an intermediate gas-discharge and means for causing the intermediate layers of the fuel to convert water into steam and bringing the steam so formed into contact with the fuel at the soot-forming point.

2. In a gas-generator a fuel-receptacle open at the top and provided with a grate at the bottom, and means for admitting air below said grate in combination with an intermediate gas-discharge and means for converting water into steam at an intermediate point of the fuel-receptacle, and for introducing said steam into the fuel.

In testimony whereof I have affixed my signature to this specification in the presence of two witnesses.

WALTHER NACKEN.

Witnesses:

GUSTAV ELSNER,

WILHELM RÜPPERS.