

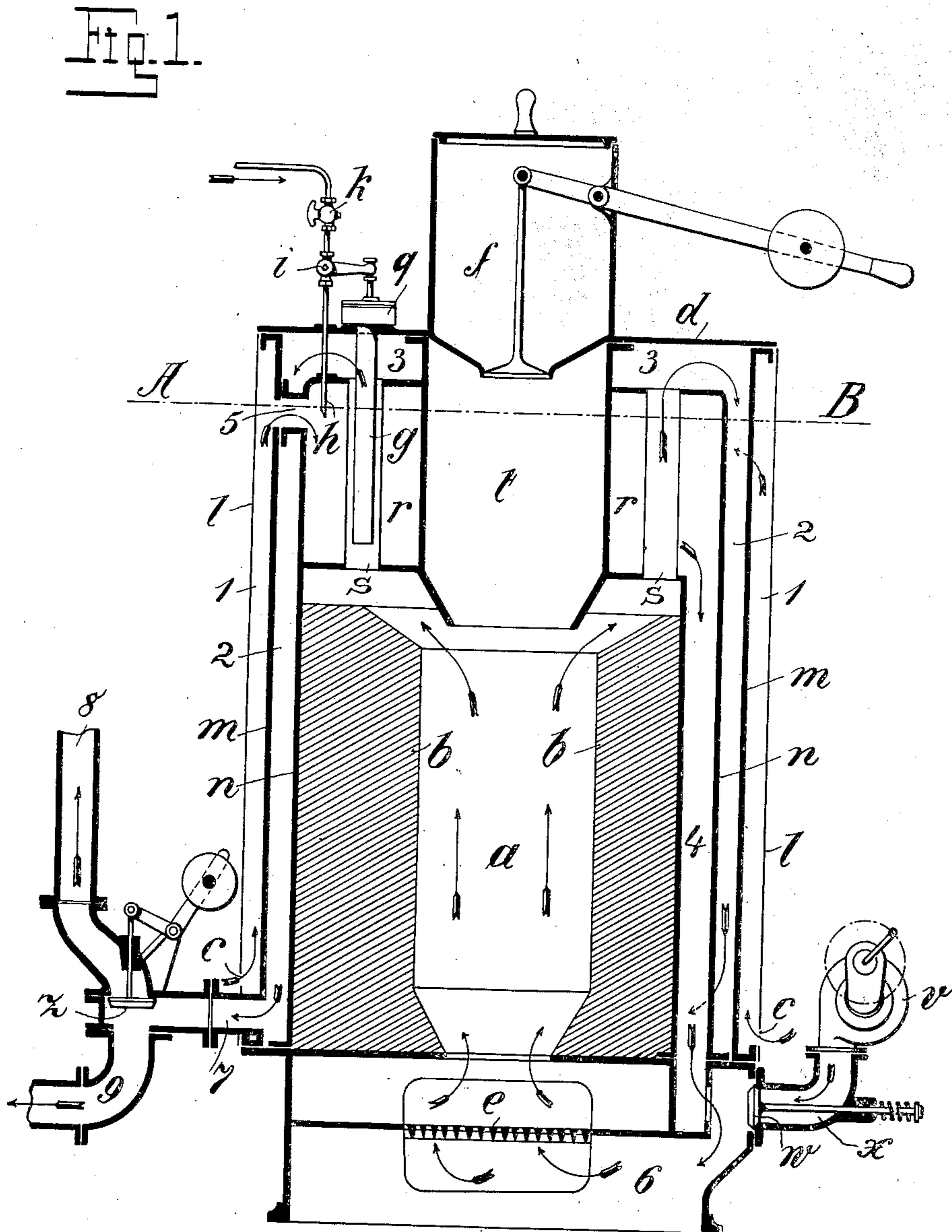
No. 829,919.

PATENTED AUG. 28, 1906.

L. HERTZOG.  
APPARATUS FOR PRODUCING POWER GAS.

APPLICATION FILED SEPT. 10, 1904.

2 SHEETS—SHEET 1.



Witnesses.  
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2 SHEETS—SHEET 2.

Fig. 2.

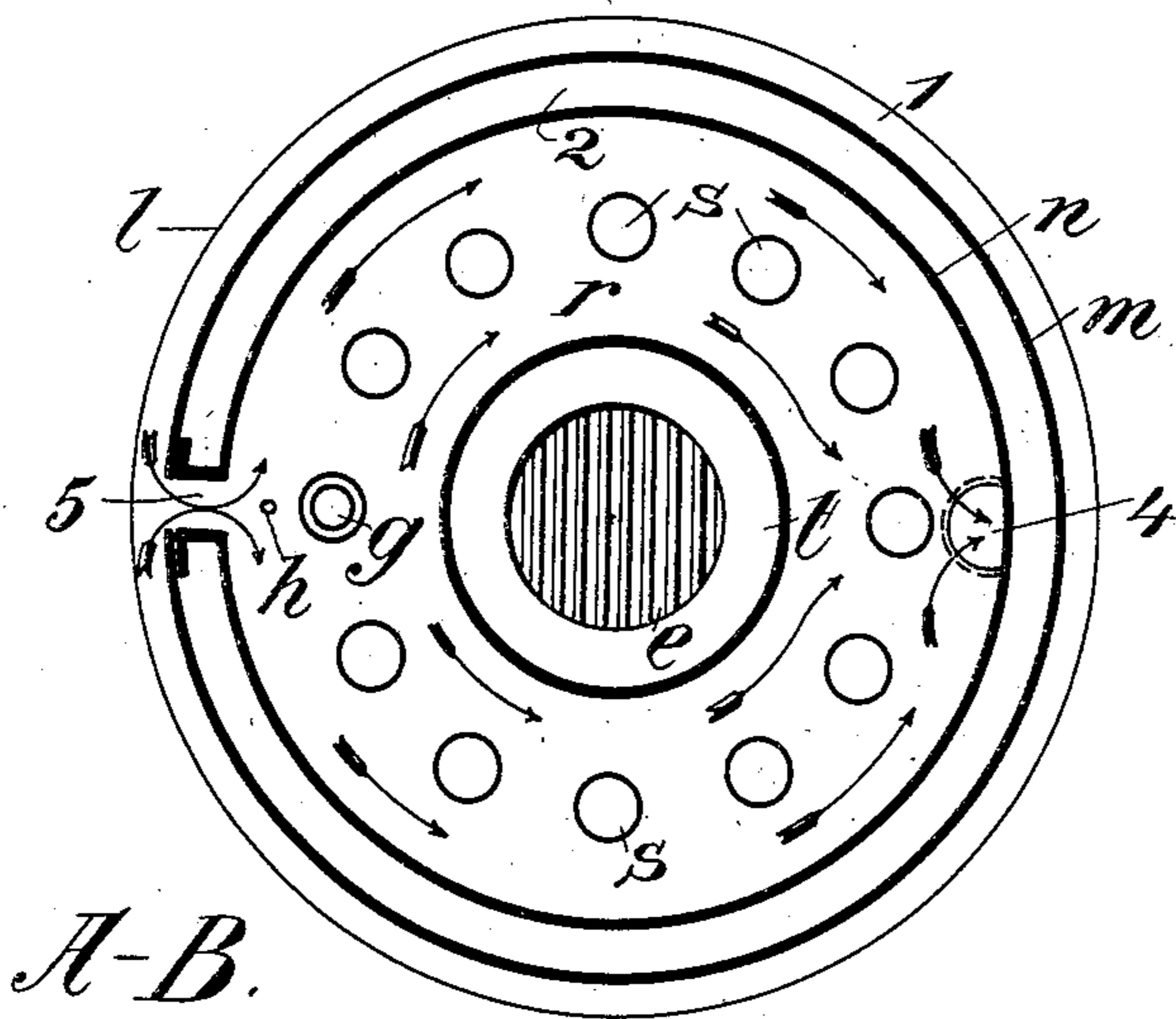


Fig. 3.

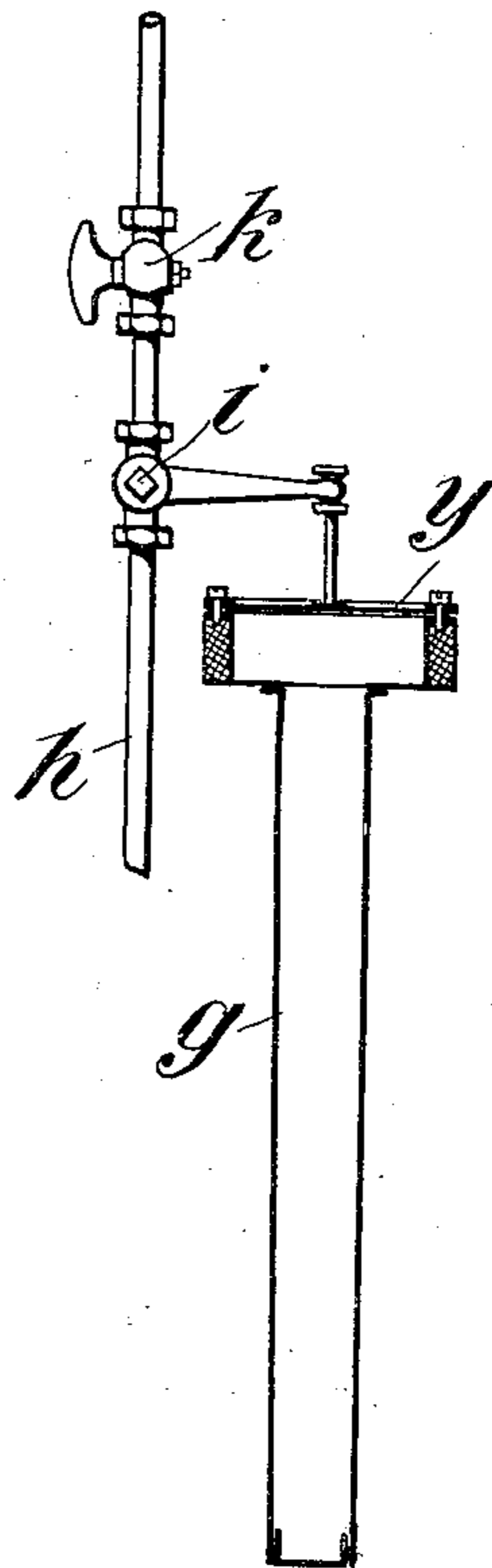
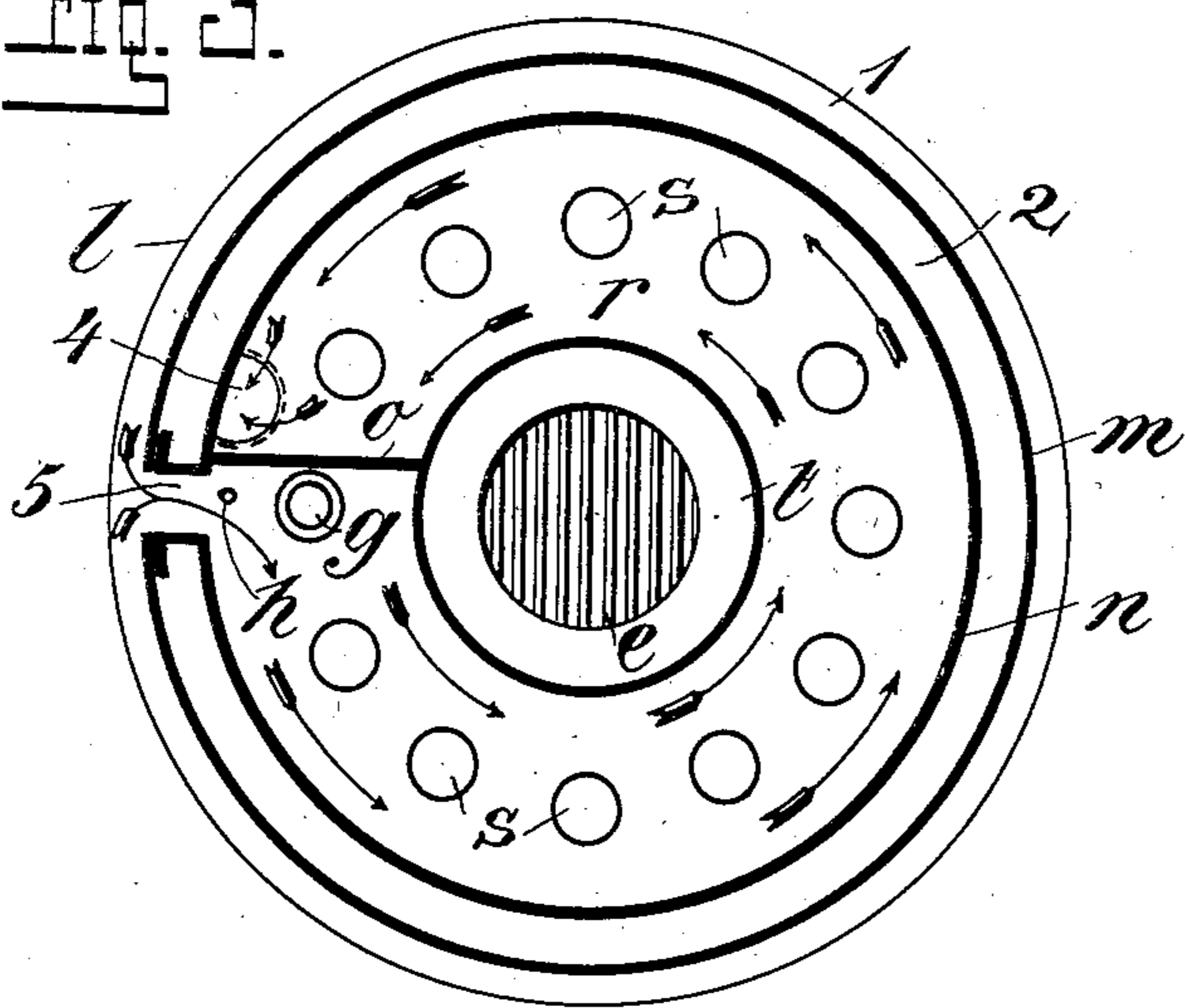


Fig. 4.

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# UNITED STATES PATENT OFFICE.

LUDWIG HERTZOG, OF BERLIN-SÜDENDE, GERMANY, ASSIGNOR TO THE FIRM OF ADOLPH SAURER, OF ARBON, SWITZERLAND.

## APPARATUS FOR PRODUCING POWER-GAS.

No. 829,919.

Specification of Letters Patent.

Patented Aug. 28, 1906.

Application filed September 10, 1904. Serial No. 224,044.

*To all whom it may concern:*

Be it known that I, LUDWIG HERTZOG, a citizen of the Confederacy of Switzerland, residing at Berlin-Südende, Potsdamerstrasse 11, German Empire, have invented new and useful Improvements in and Connected with Apparatus for Producing Power-Gas, of which the following is a specification.

This invention relates to the production of power-gas and to apparatuses thereto of that class provided with a gas-generator and a steam-boiler combined therewith, a mixture of steam and hot air being conducted through the grate and the burning combustible in order to be decomposed and a power-gas generated composed mainly of carbonic oxid, hydrogen, and nitrogen.

The object of the invention is to obtain a gas containing as much hydrogen as possible. To this end the heat of the gases coming from the generator, in addition to being used for the generation of steam, is used to heat the generator—i. e., their superfluous heat is bound as much as possible in the generator itself before they leave the same and the radiation of heat through the walls of the generator prevented as far as possible. Furthermore, the heat of the said gases coming from the generator is received by the air for combustion introduced into the generator, and thus utilized for a preparatory heating of this air, and in this way the heat in question is constantly brought back and made use of again.

A further object is to make the generators of suction-gas less unsafe or more exact in their functions than they are at present, so that a machine driven by such a generator-gas will be nearly as reliable in its working as a steam-engine or a gas-engine working with illuminating-gas. This was not possible hitherto, as the mixtures of gases lack that constant uniformity in their composition which is necessary for a perfectly regular driving of engines. The cause of this lies in the fact that it was hitherto not possible to precisely regulate the amount of hydrogen in the gaseous mixture and in the impossibility of keeping together or binding in a uniform manner the heat required for and developed in the process of generating gas. In consequence of keeping

together as much as possible and using again the heat set free in the generator it is possible to drive a greater quantity of steam through the coals, the result of which is that the gas generated after this invention contains far more hydrogen than obtained by former processes. Through the exact regulation of the water-supply a greater safety and regularity in the generation of gas and in the working of the engines driven by this gas is also obtained, so that they will be able to compete with those engines on which the highest demands are made regarding exactness in their functions. With this invention the combustible is worked out or utilized in a higher degree, whereby a greater efficiency of an apparatus of the same size is attained, which is a further technical success. This new mode of utilizing the heat can of course find its application also in the generation of pressure-gas for cupola-furnaces or, in general, everywhere where gases are formed by the contact of atmospheric or saturated air or of pure oxygen with red-hot solid combustibles. The cross-section of the shaft holding the combustible may be of any shape and the shaft itself be arranged horizontally or vertically.

These objects are accomplished in the manner and by the means hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section; Fig. 2, a ground plan, section A B; Fig. 3, a ground plan, section A B, of a modified form; Fig. 4, a section through the water-regulating device drawn on a larger scale.

The combustible to be gasified is received by the shaft *a*, lined with a fireproof material *b*. On top of this shaft is arranged a tubular vaporizing-chamber *r*, with a supply-funnel *t* built into it. Around the jacket *n*, inclosing the fireproof material *b*, are arranged two hollow cylinders *m* and *l*, with spaces 1 and 2 between them. A cover-plate *d*, provided with a feeding-funnel *f* having a double closure, serves to shut off the shaft *a* and the two spaces 1 and 2 on top from each other and against the outer air, so that the space 1 stands in no communication with space 2 nor with the shaft *a* and that shaft *a* and space 2, though closed against the outer air, stand in communication with each other

through the heating-tubes *s* and the spaces 3 left free between the upper wall of the vaporizing-chamber and the cover *d*.

The interior of the vaporizing-chamber *r* stands in communication on the one side through the channel 5 with the space 1, into which the air enters through holes *c*, distributed over the surface of the cylinder or mantle *l*, and on the other side through channel 4 with space 6 under the grate *e*. From space 2 a channel 7 leads to the two-way valve *z*, from which branch off two conduits, of which the first, 8, leads into the open air and the second, 9, to the purifiers and to the places of consumption. Into one of the tubes *s* of the vaporizing-chamber *r* is placed a reservoir *g*, preferably filled with air and in its enlarged part *q* closed by a membrane *y*; *h* is the tube for injecting the water, *i* the self-regulating water-cock, and *k* a tap or cock adjusted by hand for regulating the supply of water. (Compare also Fig. 4.)

Opposite the opening at the lower end of the channel 4, provided with a valve-seat, is arranged a socket *x*, provided with a double-seat valve *w* over an opening in the wall of the foot of the generator to carry a fan *v*. Through the valve *w*, which is subjected to the action of a spring and controlling two openings, the way is temporarily cut off to the mixture of steam and air under the grate, and when the fan does not work the channel *x* leading thereto is closed as a rule, so that if the whole apparatus is working normally no air can enter the same from the fan.

Mode of acting: To start the apparatus, a fire of quickly-burning materials (wood-shavings, paper, wood, or charcoal) is lighted upon the grate *e*, whereupon gradually the combustible material (anthracite, coke, brown coal, tar, even watery coal) to be gasified is fed to it through the feeding-funnel *f* and the supply-funnel *t*. By blowing with the fan *v* the apparatus can be started more rapidly. Hereby the double-seat valve *w* is so fixed that it closes the opening in the lower end of the channel 4, so that no part of the wind generated can enter through channel 4 into the vaporizing-chamber *r*, &c.; but all the air moved by the fan must pass through the grate *e* and the combustible in the shaft *a*. During this time the two-way valve *z* is in such a position that it closes the conduit 9, so that all the smoke is compelled to escape into the open air through the chimney 8. Also the cock *k* in the water-conduit is closed. The ascending hot gases give off during this start a great part of their heat to the vaporizing-chamber *r* and to the two cylinders *m* and *n*. Through the heat of these gases the air in the reservoir *g* of the apparatus for regulating the water-supply is heated at the same time, in consequence of which it expands and acts on the membrane *y*, whose motion is thereupon transmitted by

a lever upon the cock *i*, so that the latter opens more or less, according to the expansion of the air in the reservoir *g*—that is to say, according to the heat in the generator and the gases drawing off—in consequence of which more or less water of a constant pressure can enter the vaporizing-chamber *r* through the tube *h*. As soon as the formation of the inflammable gas commences after the combustible material in the shaft *a* has become sufficiently hot the two-way valve *z* and the double-seat valve *w* are turned into the positions shown in the drawings, while at the same time the fan is stopped, so that the channel 4 communicates with the ash-receptacle 6. This space, however, is shut off against the fan *v*, therefore also against the outer air, and that, further, the chimney-flue is closed off and the space 2 in communication with the conduit 9. At the same time the water-cock *k* is also opened. The apparatus is now ready for the regular working. If the generator is to supply the gas for driving a motor, the latter can now be started. Through the suction caused by the motor the air necessary for the generation of gas in this case is sucked up into the vaporizing-chamber through the openings *c*, space 1, and channel 5. The air receives hereby a preparatory heating on the hot wall of the cylinder *m*. In the vaporizing-chamber *r* the water regulated by the cock *i* is dropping through the tube *h*. It evaporates at once, and at each stroke of the piston it is mixed with the hot air and superheated. The mixture is now conducted through the channel 4 into the ash-room and from there through the grate *e* and the red-hot mass of combustible in the shaft *a* in order to be decomposed. Through this process is generated the so-called "Dowson gas," generator suction or power gas, composed mainly of carbonic oxid, ( $\text{CO}$ ), hydrogen, ( $\text{H}$ ), and nitrogen, ( $\text{N}$ ). The gas now passes through the heating-tubes *s*, the spaces 3 and 2, the channel 7, and through the conduit 9 to the purifiers and from there to the place of consumption. On their way through *s*, 3, and 2 the gases give off a great part of their heat to the vaporizing-chamber *r* and the walls of the cylinders *n* and *m*. That part of the heat of the gases which is not absorbed by the vaporizing-chamber *r* and the mantle *m*—that is to say, the part still left in the gases after the generation of steam, preparatory heating of the air, and overheating of the mixture of steam and air—is used to heat the generator by insulating and giving off the heat to the same. It is in consequence of this possible to send a much greater quantity of steam through the red-hot mass of coal without cooling the latter, as the heat restored to the generator and the mass of coals is able to decompose. The temperature in the generator, and, as a con-

sequence, also the composition of the gas, remain constantly the same as the volume of air in the reservoir *g* varies already at the slightest change of temperature, so that proportionately more or less water is conveyed to the vaporizing-chamber *r*.

In order to obtain a larger heating-surface, so as to better absorb and give off the heat, the two cylinders *m* and *n*, as well as the vaporizing-chamber *r* and the heating-tubes *s*, if required, may have ribbed or corrugated surfaces. If the channel 4 is arranged as shown in Fig. 2, the mixture of steam and air is conveyed in equal halves right and left around the supply-funnel *t* and collects again shortly before leaving through channel 4. Instead of this arrangement the construction may, according to requirements and circumstances, be as shown in Fig. 3. By this arrangement of channel 4 in connection with a rib *o* the whole mixture is forced before entering the channel 4 to pass along all the heating-tubes *s*.

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

1. In an apparatus of the class described, the combination of a shaft receiving the combustible material, of an evaporator arranged on top of said shaft of the generator having tubes and a fuel-supply funnel built into it, of a water-tube of said evaporator provided with a self-regulating cock, of two hollow cylinders with spaces between them, surrounding the evaporator and shaft, of channel connecting the evaporator and the space

under the grate and means to make heated air enter the evaporator, substantially as described.

2. In an apparatus for producing power-gas, comprising a shaft constructed to receive the combustible material, an evaporator arranged on top of said shaft; the combination of two hollow cylinders with spaces between them, surrounding the evaporator and shaft, the inner space having an outlet and being connected with the space above the upper wall of the evaporator and its tubes, to form a passage for the generated hot gases to said outlet and the outer space communicating by a channel with the evaporator to form a passage for the heated air to enter the evaporator, substantially as and for the purpose set forth.

3. In an apparatus for producing power-gas comprising an evaporator arranged on top of the shaft of a generator, the tubes of said evaporator communicating with the space under the grate, a fan, a passage therefrom to the space under the grate the combination of a double-seat valve controlling the channel conducting the mixture of steam and air from the evaporator under the grate and the said fan-passage, substantially as shown, for the purpose specified.

In witness whereof I have hereunto set my hand in presence of two witnesses.

LUDWIG HERTZOG.

Witnesses:

MARY FALCONER,  
CARL KAUFMANN.